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INDIAN MINERALS YEARBOOK 2023

- GENERAL REVIEWS
- METALS AND ALLOYS
- MINERAL REVIEWS

INDIAN BUREAU OF MINES

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INDIAN MINERALS YEARBOOK 2023

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PREFACE

Indian Minerals Yearbook–2023 (IMYB–2023) is the 62^{nd} Edition in its series and is an amalgamation of three major components – General Reviews, Reviews on Metals & Alloys and Mineral Reviews. The 'General Reviews' comprise topics that encompass country-wide & macro-level information on minerals. Attempts have been made to comprehensively depict the Indian Mineral Industry and its contribution to the National Economy, along with concise portrayal of Policy & Legislation, Research & Development and Exploration & Development that have relevance to the year 2022-23. Besides, an extensive chapter on State Reviews elaborately delves into the Mineral-wealth Status, Production and Industry of each of the States/UTs of the country. Topics on Prices, Production, Foreign Trade, Mineral-Based Industries and Status of Mineral Concessions in India, form part of the Reviews contained in the General Reviews.

The second part of the book comprises Reviews on Metals & Alloys. The Reviews primarily focus on important metalliferous minerals, metals and alloys produced in the country and comprehensively cover details of the country's ferrous, non-ferrous, strategic and precious metals and their related metallurgical industries. Each of the 19 Reviews provides valuable insights on resource/reserve positions, usage, consumption, R & D, trade, world scenario and future outlook of the metalliferous minerals, metals/alloys.

The concluding part of the book comprises 'Mineral Reviews' and contains 26 Reviews of important minerals produced in the country which are arranged in an alphabetical sequence. Each Review provides valuable insights on resource/reserve positions; production, stock & prices, mining, marketing & transport; usage & specifications; trade policy; world review; foreign trade; and future outlook of the minerals. The data coverage of this Edition, i.e., IMYB–2023 pertains to the year 2022-23.

It has been our continuous endeavour to improve upon the coverage and the content of the Yearbook and to present the entire spectrum of Minerals and Metals Sector to the maximum extent possible. Every update and nuances specific to Mineral Sector in terms of policy changes/guidelines issued/laws enacted and amendments made to them are carefully monitored and incorporated at the relevant chapters. The National Mineral Policy, 2019 which was introduced with an aim to ensure transparency, better regulation and enforcement, balanced social economic growth as well as sustainable mining practices have been assimilated into the content under relevant topics. Besides, legislative changes for Mines and Minerals Sector effected to make the Sector growth-oriented and vibrant have been assigned special focus.

Indian Minerals Yearbook is a flagship title of Indian Bureau of Mines and its publication & release is the outcome of collective & coordinated efforts of the Bureau's Mineral Economics Division and Mining & Mineral Statistics Division. In preparation of the Edition, materials & inputs were resourced from the reports of various Divisions of IBM. Various survey reports/annual reports, technical journals, periodicals of various organisations, including the affirmative responses received from the Mineral Industry on statutory and non-statutory basis have also been referred and inputs from related websites too were drawn and incorporated wherever necessary to impart a sense of holism to the information covered under this Title.

The Bureau is indebted to Central and State Government Departments, Public Sector Undertakings, Public and Private Companies and Research Organisations, Mineral-Based Industries & Associations concerned with mines, minerals and mineral-based industries for their support & cooperation in lending and sharing information. It is firmly believed that the present Edition of Indian Minerals Yearbook, i.e., IMYB–2023 is in the lines of its predecessors and will serve the interest of all its referring/reading clientele who in the past have reposed such unshakable faith in the authenticity of the data/information published in the Series.

Nagpur
Date: January, 2025

P.N. Sharma
Controller General (I/c)
Indian Bureau of Mines

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EXPLANATORY NOTES AND SOURCES

The statistics presented in this publication are in metric units and the prices quoted are in the Indian currency unless otherwise stated.

The stage of measurement of quantity is normally the mine output which refers to the form in which the minerals are extracted. It also includes the usual processing operations done at the mine site to render the ore marketable. Exceptions to the above definition are gold and silver for which the metal output is considered, and for copper, lead & zinc, the concentrates.

The value of the mineral is reckoned in terms of the Ex-Mine Price which represents the sale value of the mineral at the mine site. The value of production of minerals is calculated by multiplying in each case the quantity of production and pit's mouth value per unit as furnished by the mine owners in the returns under MCDR 1988 in all cases except captive mines where the value is calculated on the basis of the cost of production. In case of fuel minerals, the production value figures in respect of coal & lignite are supplied by the Office of the Coal Controller, Kolkata, on annual basis. Regarding petroleum and natural gas (utilised), value published by the National Accounts Division, Central Statistical Office, is used. Value of sulphur produced as by-product from fertilizer plants and oil refineries is not included in the value of mineral production. The value of non-ferrous metals is furnished by the respective units. The export valuation is on the basis of free on board (f.o.b.) inclusive of export duty, wherever such duty is levied. The basis of valuation of imports is the cost, insurance and freight (c.i.f.) value.

Break-ups may not add to total in some tables due to rounding-off.

Sources

The statistical data presented in this publication have been taken from a large number of sources as listed below:

Minerals other than fuels,

atomic minerals and

'minor minerals'

The basic data relating to major minerals except coal, petroleum and natural gas are collected by IBM under Rule 45 of the MCDR, 1988 framed under the Mines and Minerals (Development and Regulation) Act, 1957. These Rules cover all the States and Union Territories of the Indian Union and apply to all minerals except i) petroleum and natural gas, ii) coal, lignite and sand for stowing, iii) minor minerals, and iv) any mineral declared as prescribed substance by Atomic Energy Act, 1962. Data on sulphur are collected from fertilizer plants and oil refineries. .

Ilmenite, rutile, monazite, rare earths and zircon

Indian Rare Earths Ltd; Kerala Minerals and Metals Ltd; Department of Atomic Energy, Mumbai, and Private Sector producers and processors.

Fossil fuel

a) Coal and lignite	Coal Controller, Kolkata and the Coal Directory of India.
b) Crude oil and natural gas	i) Economics and Statistics Division of the Ministry of Petroleum & Natural Gas, Government of India, New Delhi, and ii) Indian Petroleum & Natural Gas Statistics, Ministry of Petroleum & Natural Gas, Government of India. iii) Basic Statistics on Petroleum & Natural Gas, Ministry of Petroleum & Natural Gas, Government of India. iv) National Accounts Division, Central Statistical Office, Ministry of Statistics and Programme Implementation, Government of India

Minor minerals

Respective State Governments. 'Minor minerals' are defined in Clause (e) of Section 3 of the Mines and Minerals (Development and Regulation) Act, 1957. The current list of 'minor minerals' includes minerals, such as, building stones, gravel, ordinary earth, ordinary clay, ordinary sand other than sand used for prescribed purposes (i.e. used for other than refractory, ceramics, metallurgical, stowing in coal mines and optical purposes, and in manufacture of silvicrete cement, sodium silicate, pottery and glass), boulder, shingle, chalcedony or impure quartz pebbles (used for ball mill purposes or filling for boreholes or for decorative purposes in buildings), limeshell, kankar, and limestone used in kilns for manufacture of lime used as building material, murrum, brick earth, fuller's earth, bentonite, road metal, rehmatti, slate and shale used for building material, stones used for household utensils, marble, quartzite and sandstone when used for

purpose of building or for making road metals and household utensils and saltpetre. In addition to the minerals already declared, 31 more minerals have been declared minor minerals vide Notification S.O 423(E), dated 10th February, 2015, namely, (i) Agate, (ii) Ball Clay, (iii) Barytes, (iv) Calcareous Sand, (v) Calcite, (vi) Chalk, (vii) China clay, (viii) Clay (Others), (ix) Corundum, (x) Diaspore, (xi) Dolomite, (xii) Dunite or Pyroxenite, (xiii) Felsite, (xiv) Felspar, (xv) Fireclay, (xvi) Fuschite Quartzite, (xvii) Gypsum, (xviii) Jasper, (xix) Kaolin, (xx) Laterite, (xxi) Limekankar, (xxii) Mica, (xxiii) Ochre, (xxiv) Pyrophyllite, (xxv) Quartz, (xxvi) Quartzite, (xxvii) Sand (Others), (xxviii) Shale, (xxix) Silica Sand, (xxx) Slate and (xxxi) Steatite or Talc or Soapstone.

Trade statistics

Monthly Statistics of the Foreign Trade of India, issued by the DGCI&S, Kolkata

Prices

a) Minerals	i)	Principal producers and exporters
	ii)	Coal Controller, Kolkata
	iii)	Industrial Minerals (UK)
	iv)	Basic Statistics on Indian Petroleum & Natural Gas, Ministry of Petroleum & Natural Gas, Government of India.
	v)	DGCI&S, Kolkata (Import Value)
b) Metals	i)	Producers and exporters
	ii)	Reserve Bank of India Bulletin
	iii)	World Metal Statistics (WBMS)
	iv)	London Metal Exchange (Website)
	v)	Minerals & Metals Review (Monthly/Yearly)
World information & statistics	i)	Mineral Commodity Summaries (USGS)
	ii)	World Mineral Production (BGS)
	iii)	Minerals Yearbook (USGS)
	iv)	World Metal Statistics (WBMS)
	v)	Mineral Industry Surveys (USGS)
	vi)	Canadian Minerals Yearbook

Minerals Consumption — Data obtained on statutory and non-statutory basis from industrial units consuming minerals/ores. Data have also been obtained in some cases from Central Government Ministries. The consumption indicated relates to the number of reporting units in the organised sector only. Estimated consumption data is based on statistical norms in vogue.

from National — Reserves/resources of minerals in India have been taken from National Mineral Inventory prepared by IBM as per UNFC system. The source of information for the world resources of minerals is given against each mineral.

Port facilities — Annual Report of the Ministry of Shipping, Indian Ports Association, Major and Minor Port Authorities and exporters of minerals.

Research and Development — IBM's Ore Processing Laboratory, National Laboratories under the Council of Scientific & Industrial Research, and Ore Dressing Division of BARC and R&D laboratories in the Public/Private Sector.

Besides, Annual Reports of various Ministries of Government of India, Annual Reports, Brochures and Websites of Public Sector undertakings and private companies, Bulletins concerned with minerals and mineral-based industries, etc. were also referred.

Information /Data Liability Disclaimer

The reviews as presented in the Indian Minerals Yearbook are the product of the concerted efforts of in-house authors. In preparation of manuscripts, the authors resourced data/information from various sources, such as, published information on the internet, various publications, Annual reports etc. Major chunks of information have actually been collated internally from the different Divisions of Indian Bureau of Mines which regularly and routinely are in the cycle of gathering data /information through correspondences.

All these sourced information/data that get included in the General/Mineral Reviews are subjected to analyses, interpretations and sometimes extrapolations in the case of paucity of data.There have been instances when the data have been used 'as it is' hence it is recommeneded that the readers apply discretion in discerning the data for their further utilisation for general or scientific purposes.

Indian Bureau of Mines while processing of the sourced data/information undertakes its best efforts to ensure accuracy and to verify that the data published have been selected on the basis of thorough scientific judgement. However, IBM would make no warranties to that effect, and shall not be liable for any consequent damage that may result from errors or omissions in the database contained there in.

ABBREVIATIONS

The abbreviations and symbols/units used in the Publication are as follows:

AMD	Atomic Minerals Directorate for Exploration and Research
APMDC	Andhra Pradesh Mineral Development Corp. Ltd
BALCO	Bharat Aluminium Company Ltd
BARC	Bhabha Atomic Research Centre
BGML	Bharat Gold Mines Limited
BGS	British Geological Survey, UK
BIS	Bureau of Indian Standards
BISAG	Bhaskaracharya Institute of Space Applications & Geo-Informatics
BOT	Build, Operate, Transfer
BSMDC	Bihar State Mineral Development Corp. Ltd
CAPEXIL	Chemical and Allied Export Promotion Council
CBM	Coal Bed Methane
CCI	Cement Corporation of India Ltd
c.i.f.	Cost, Insurance and Freight
CMDC	Chhattisgarh Mineral Development Corporation
CMPDI	Central Mine Planning & Design Institute
CSO	Central Statistical Office
DAE	Department of Atomic Energy
DES	Directorate of Economics & Statistics
DGCI&S	Director General of Commercial Intelligence and Statistics
DGH	Directorate General of Hydrocarbons
DGM	Directorate of Geology and Mining
DGPS	Differential Global Positioning System
DMG	Directorate of Mining and Geology
DMF	District Mineral Foundation
EEZ	Exclusive Economic Zone
EU	European Union
FDI	Foreign Direct Investment
FIMI	Federation of Indian Mineral Industries
f.o.b.	free on board
f.o.b.t.	free on board trimmed
f.o.r.	free on rail
GMDC	Gujarat Mineral Development Corp. Ltd
GSI	Geological Survey of India
GVA	Gross Value Added
HCL	Hindustan Copper Ltd
HGML	Hutti Gold Mines Co. Ltd
Hindalco	Hindalco Industries Ltd
HZL	Hindustan Zinc Ltd
IBM	Indian Bureau of Mines
IMMT	Institute of Minerals & Materials Technology (Formerly RRL, Bhubaneswar)
IREL	Indian Rare Earths Ltd
ISRO	Indian Space Research Organisation
JPC	Joint Plant Committee
JV	Joint Venture
KCC	Khetri Copper Complex
KMML	Kerala Minerals & Metals Ltd
LAPL	Large Area Prospecting Licence
LME	London Metal Exchange
MALCO	Madras Aluminium Company Ltd
M(A)R	The Mineral (Auction) Rules
MCDR	Mineral Conservation and Development Rules
M(EMC)R	The Minerals (Evidence of Mineral Contents) Rules
MCR	Mineral Concession Rules
MECL	Mineral Exploration Corporation Ltd
ML	Mining Lease
MMDR Act	Mines & Minerals (Development & Regulation) Act
MMTC	Minerals and Metals Trading Corp. Ltd
MoEFCC	Ministry of Environment, Forest and Climate Change
MoU	Memorandum of Understanding
MSS	Mining Surveillance System
MTS	Mining Tenement System
MSTC	Metal Scrap Trade Corp. Ltd
NA	Not Available
NAS	Not Available Separately
NALCO	National Aluminium Co. Ltd
NCMT	National Centre of Mineral Targeting
ND	Not Determined
NELP	New Exploration Licensing Policy
NES	Not Elsewhere Stated
NFL	National Fertilizers Ltd
NLC	Neyveli Lignite Corporation Ltd
NMDC	National Mineral Development Corp. Ltd
NMET	National Mineral Exploration Trust
NMEP	National Mineral Exploration Policy
NMI	National Mineral Inventory
NML	National Metallurgical Laboratory
NRSC	National Remote Sensing Centre
NTPC	National Thermal Power Corp. Ltd
NQ	Not Quoted
N/v	Near Village/s
OIL	Oil India Ltd
OMC	Orissa Mining Corporation Ltd
ONGC	Oil and Natural Gas Corporation Ltd

PMKKKY	Pradhan Mantri Khanij Kshetra Kalyan Yojana	TSL	Tata Steel Ltd (formerly Tata Iron and Steel Co. Ltd)
PL	Prospecting Licence	TW	Territorial Waters
PPP	Public Private Partnership	UAE	United Arab Emirates
RP	Reconnaissance Permit	UK	United Kingdom
RRL	Regional Research Laboratory	UNFC	United Nations Framework Classification
RSMML	Rajasthan State Mines and Minerals Ltd	USA	United States of America
SAIL	Steel Authority of India Ltd	USGS	United States Geological Survey
SBICAP	SBI Capital Markets Limited	UT	Union Territory
SCCL	Singareni Collieries Company Ltd	VE	Visual Estimate
SDF	Sustainable Development Framework	VISL	Visvesvaraya Iron & Steel Ltd
SEZ	Special Economic Zone	w.e.f.	with effect from
SMC	Sikkim Mining Corporation Ltd	(e)	Estimated
STD	Standard (Code of UNFC)	(P)	Provisional
TAMIN	Tamil Nadu Minerals Ltd	(R)	Revised
TAMRA	Transparency, Auction Monitoring and Resource Augmentation	(U)	Under reference
TERI	The Energy and Resources Institute	--	Nil
tpd	tonnes per day	++	Negligible
tpy	tonnes per year		

Units

cm	centimetre	t	tonne
m	metre	'000	tonnes thousand tonnes
mm	millimetre	lkm	line kilometre
cu m	cubic metre	ct	carat
'000 cu m	thousand cubic metres	g	gram
m cu m	million cubic metres	kg	kilogram
sq m	square metre	₹	Indian rupees
km	kilometre	₹ '000	thousand rupees
ha	hectare	kWh	kilowatt-hour
sq km	square kilometre	s	second

Conversion Table

Troy oz	31.1035 g	cwt	112 lb
kg	2.2046 lb	foot	0.3048 m
tonne	Metric ton of 2,204.6 lb	Crore	Ten million
ton	Long ton of 2,240 lb	Lakh	Hundred thousand

Classification of Reserves/Resources of Various Minerals as per United Nations Framework Classification (UNFC) System

The classification of reserves/ resources of various minerals based on UNFC system were first prepared by IBM as on 1.4.2000 and later, as on 1.4.2005. Reserves/resources are furnished mineralwise in State Reviews and gradewise and statewise in Mineral Reviews. Quinquennially updated resources for 43 minerals as on 1.4.2010 and for 70 minerals as on 1.4.2015 have been included in this Edition of Indian Minerals Yearbook in State Reviews and Mineral Reviews. The process for updating the National Mineral Inventory as on 1.4.2020 for 46 minerals is currently in progress. The amendment to Mineral Conservation & Development Rules,1988 vide Gazette Notification No.185 dated 17.4.2003 makes it statutory for all non-coal major mineral mine-owners to report their reserves data as per UNFC and for Mining Lease applications to submit mining plans accordingly. Detailed guidelines, definitions, etc. concerning UNFC were issued by IBM on 3 June 2003 and published in the edition of Mineral Conservation & Development Rules, 1988.

The UNFC consists of a three-dimensional system with the following three axes : Geological Assessment, Feasibility Assessment and Economic Viability. The process of geological assessment is generally conducted in stages of increasing details. The typical successive stages of geological investigation, i.e., reconnaissance, prospecting, general exploration and detailed exploration, generate resource data with a clearly defined degree of geological assurance.

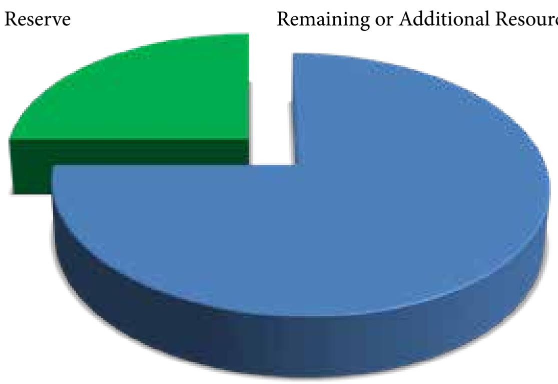
These four stages are, therefore, used as geological assessment categories in the classification. Feasibility assessment studies form an essential part of the process of assessing a mining project. The typical successive stages of feasibility assessment, i.e., geological study as initial stage followed by prefeasibility study and feasibility study/mining report are well-defined. The degree of economic viability (economic or sub-economic) is assessed in the course of prefeasibility and feasibility studies. A prefeasibility study provides a preliminary assessment with a lower level of accuracy as compared to that of a feasibility study which assess the economic viability in detail.

It is a three-digit-code-based system, the economic viability axis representing the first digit, the feasibility axis, the second digit and the geologic axis, the third digit. The three categories of economic viability have codes 1, 2 and 3 in decreasing order. Similarly, the three categories of feasibility study have also codes 1, 2 and 3 while the four stages of geological assessment are represented by 4 codes, i.e., 1 (detailed exploration), 2 (general exploration), 3 (prospecting) and 4 (reconnaissance). Thus, the highest category of resources under UNFC system will have the code (111) and lowest category, the code (334). The various terms used in this classification and their definitions in brief are as follows:

Total Mineral Resources

Reserve plus Additional or Remaining Resource comprise the Total Resource, or Total Resource minus Reserve gives the Remaining Resource.

Total Resources



Diagramatic Representation of Reserve and Resource

A. Mineral Reserve

Economically mineable part of measured and/or indicated mineral resource.

(i) **Proved Mineral Reserves (111)**
Economically mineable part of Measured Mineral Resource.

(ii) Probable Mineral Reserves (121 & 122)

Economically mineable part of indicated or in some cases, a measured mineral resource.

B. Mineral Resource

A Mineral Resource (Remaining or Additional Resource) is the balance of the Total Mineral Resources that have not been identified as Mineral Reserve.

(i) Measured Mineral Resource (331)

That part of mineral resource for which tonnage, density, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence, i.e., based on detailed exploration.

(ii) Indicated Mineral Resource (332)

Tonnage, density, shape, physical characteristics grade and mineral content can be estimated with reasonable level of confidence based on exploration, sampling and testing information, location of borehole, pits etc.

(iii) Inferred Mineral Resource (333)

Tonnage, grade and mineral content can be estimated with low level of confidence inferred from geological evidence.

(iv) Reconnaissance Mineral Resource (334)

Estimates based on regional geological studies and mapping, airborne and indirect methods, preliminary field inspections as well as geological inference and extrapolation.

(v) Prefeasibility Mineral Resource (221 and 222)

That part of an indicated and in some circumstances measured mineral resource that has been shown by prefeasibility study as not economically mineable or can become economically viable subject to changes in technological, economic, environmental and/or other relevant conditions.

(vi) Feasibility Mineral Resource (211)

That part of measured mineral resource, which after feasibility study has been found to be economically not mineable.

Definition of Uneconomic Occurrence

Materials of estimated quantity, that are too low in grade or for other reasons are not considered potentially economic. Thus, Uneconomic Occurrence is not part of a mineral resource. If quantity and quality are considered worthy of reporting, it should be recognised that an Uneconomic Occurrence cannot be exploited without major technological and/or economic changes, which are not currently available.

Mineral Occurrence

A mineral occurrence is an indication of mineralisation that is worthy of further investigation. The term mineral occurrence does not imply any measure of volume/tonnage or grade/quality and is thus not part of a mineral resource

General Reviews

1. Indian Mineral Industry & National Economy

The optimistic growth forecasts stem from a number of positives like the rebound of private consumption that provided a fillip to production activity, higher Capital Expenditure (Capex), near universal vaccination coverage enabling people to spend on contact-based services, such as restaurants, hotels, shopping malls and cinemas, as well as the return of migrant workers to cities to work in construction sites leading to a significant decline in housing market inventory, the strengthening of the balance sheets of the Corporates, a well-capitalised Public Sector banks ready to increase the credit supply and the credit growth to the Micro, Small, and Medium Enterprises (MSME) sector to name the major ones.

Growth is expected to be brisk in FY24 as a vigorous credit disbursal, and capital investment cycle is expected to unfold in India with the strengthening of the balance sheets of the Corporate and Banking sectors. Further support to economic growth will come from the expansion of public digital platforms and path-breaking measures, such as, PM Gati-Shakti, the National Logistics Policy, and the Production-Linked Incentive schemes to boost manufacturing output.

According to Survey, India's economic growth in FY23 has been principally led by private consumption and capital formation and they have helped generate employment as seen in the declining urban unemployment rate and in the faster net registration in Employee Provident Fund. Moreover, World's second-largest vaccination drive involving more than 2 billion doses also served to lift consumer sentiments that may prolong the rebound in consumption. Still, private capex soon needs to take up the leadership role to put job creation on a fast track.

The Survey further reflects that the credit growth to the Micro, Small and Medium Enterprises (MSME) sector has been remarkably high, over 30.6 per cent, on average during Jan-Nov 2022, supported by the extended Emergency Credit Linked Guarantee Scheme (ECLGS) of the Union government. It adds that the recovery of MSMEs is proceeding apace, as is evident in the amounts of Goods and Services Tax (GST) they pay, while the Emergency Credit Linked Guarantee Scheme (ECGLS) is easing their debt servicing concerns. Apart from this, increase in the overall bank credit has also been influenced by the shift in borrower's funding choices from volatile bond markets, where yields have increased, and external commercial borrowings, where interest and hedging costs have increased, towards banks. If inflation declines in FY24 and if real cost of credit does not rise, then credit growth is likely to be brisk in FY24. The Capital Expenditure (Capex) of the central government, which increased by 63.4 per cent in the first eight months of FY23, was another growth driver of the Indian economy in the current year, crowding in the private Capex since the January-March quarter of 2022. On current trend, it appears that the full year's capital expenditure budget will be met. A sustained increase in private Capex is also imminent with the strengthening of the balance sheets of the Corporates and the consequent increase in credit financing it has been able to generate. Dwelling on halt in construction activities during the Pandemic, the Survey underscores that vaccinations have facilitated the return of migrant workers to cities to work in construction sites as the rebound in consumption spilled over into the housing market. This is evident in the housing market witnessing a significant decline in inventory overhang to 33 months in Q3 of FY23 from 42 months last year.

Promoting the Private Sector as a co-partner in the development, the Survey notes that a fundamental principle behind the government's policy in the post 2014 period has been the engagement with the Private Sector as a partner in the development process. The New Public Sector Enterprise Policy for Aatmanirbhar Bharat has thus been introduced to realise higher efficiency gains by minimising the presence of the government in the PSEs to only a few strategic sectors. Significant initiatives have been introduced under Aatmanirbhar Bharat and Make in India programmes to enhance India's manufacturing capabilities and exports across the industries. The National Logistics Policy (2022) has been launched to create an overarching logistics ecosystem for lowering the cost of logistics and bringing it to par with other developed countries. Liberalisation of FDI policy has resulted in a visible structural shift in the gross FDI flows to India during the last decade. Opening the strategic sectors, such as, defence, mining and space, for the Private Sector has enhanced the business opportunities in the economy. Reforms to address the structural challenges faced by MSMEs have also been a vital part of the industrial policy in recent year.

India's Merchandise Trade

India achieved an all-time high annual merchandise export of US$ 422 billion in FY'22. Merchandise export was US$ 332 billion over April-December 2022 against US$ 305 billion during the period April-December 2021. Significant strides in exports were registered in drugs and pharmaceuticals, electronic goods and organic and inorganic chemicals sector in FY'22. India maintained its dominance in world services trade FY'22. India's services export stood at US$ 254.5 billion in FY'22 recording a growth of 23.5 % over FY'21 and registered a growth 32.7% in April-September 2022 over the same period of previous year. The combined value of goods and services export in April-December 2022 are estimated to be US$ 568.6 billion, showing a growth of 16% compared to April-December 2021.

Exports

India's exports showed resilience during FY'23 on the back of record levels of export in FY'22. Various export promotion measures were initiated to nurture the inherent comparative advantage of Indian exports. Petroleum products, gems & jewellery, organic & inorganic chemicals, drugs & pharmaceuticals were among the leading export items. However, the slowdown in Indian exports is inevitable in a slowing global economy, characterised by slowing global trade. The Survey adds that recognising the key role exports play in improving the resilience of the external sector, from a medium to long-term perspective; various export promotion measures are being considered/implemented. These measures would nurture the inherent comparative advantage that Indian exports embody.

The Economic Survey mentioned that National Logistics Policy would ease the domestic frictions to encourage Indian exports by reducing the cost of internal logistics. It also says that the latest Free Trade Agreements, such as, with UAE and Australia, would address the external frictions by creating opportunities for exports at concessional tariffs and non-tariff barriers. Thus, the whole ecosystem would evolve in an export-friendly manner over time. Significant initiatives have been introduced under Aatmanirbhar Bharat and Make in India programmes to enhance India's manufacturing capabilities and exports across the industries. The National Logistics Policy (2022) has been launched to create an overarching logistics ecosystem for lowering the cost of logistics and bringing it to par with other developed countries. Reforms to address the structural challenges faced by MSMEs have also been a vital part of the industrial policy in recent years. Efforts are underway to promote international trade settlement in Indian Rupees. Once these initiatives gain traction, dependence on foreign currency would potentially reduce, making the economy less vulnerable to external shocks.

Value of Exports of Ores and Minerals for the period 2020-21 to 2022-23 by Principal Minerals is given in Table–1. The total value stood at ₹ 2,42,32,63,731 as on 2022-23 which is ~6 % less than the previous year.

Table- 1: Value of Exports of Ores & Minerals (including Re-export) for the period 2020-21 to 2022-23 (By Principal Minerals)

Ores & Minerals	2020-21		2021-22		2022-23		% change in 2022-23 over 2021-22
	Value in ₹ '000	% share in total value	Value in ₹ '000	% share in total value	Value in ₹ '000	% share in total value	
All Minerals	**1966539540**	**100**	**2578629646**	**100**	**2423263731**	**100**	**-6.03**
Diamond	1258209200	63.98	1893641728	73.44	1837280521	75.82	-2.98
Iron Ore	362556021	18.44	241480427	9.36	144299670	5.95	-40.24
Granite	113279766	5.76	126460352	4.9	125512876	5.18	-0.75
Alumina	28280781	1.44	47334417	1.84	64237704	2.65	35.71
Sulphur (exc. Sublimed Precipitated and colloidal)	4328627	0.22	21010532	0.81	33267617	1.37	58.34
Salt (Other Than Common Salt)	10571743	0.54	13393717	0.52	24294751	1	81.39
Building and Monumental Stones	24200968	1.23	24912268	0.97	20638218	0.85	-17.16
Precious and Semi-precious Stones (cut And Uncut):total	23463605	1.19	50616826	1.96	20516238	0.85	-59.47
Emerald (cut and Uncut)	5316603	0.27	10808861	0.42	17096852	0.71	58.17
Barytes	6261470	0.32	11075666	0.43	16613885	0.69	50
Coke	4771075	0.24	41017403	1.59	15566657	0.64	-62.05
Coal (ex - Lignite)	5736794	0.29	11233701	0.44	15001652	0.62	33.54
Marble	10082272	0.51	11352007	0.44	11941092	0.49	5.19
Quartz and Quartzite	6213690	0.32	7559270	0.29	9221459	0.38	21.99
Titanium Ores and Conc.	5348323	0.27	6155343	0.24	7288953	0.3	18.42
Bentonite	5215656	0.27	5850483	0.23	6607488	0.27	12.94
Sandstone	11220825	0.57	11282294	0.44	5822370	0.24	-48.39
Steatite	4364076	0.22	5201974	0.2	5626721	0.23	8.17
Mica	5733785	0.29	6594832	0.26	5557843	0.23	-15.72
Felspar (natural)	3931135	0.2	4194510	0.16	4292153	0.18	2.33
Ball Clay	410109	0.02	664037	0.03	3779211	0.16	469.13
Kaolin	1610489	0.08	2398327	0.09	3440275	0.14	43.44
Limestone	42939083	2.18	4551537	0.18	3124865	0.13	-31.34
Slate	2453970	0.12	2733090	0.11	2505184	0.1	-8.34
Copper Ores and Conc.	7689376	0.39	3964549	0.15	2435371	0.1	-38.57
Garnet (abrasive)	1265586	0.06	1433741	0.06	1903765	0.08	32.78
Chromite	71979	0	89710	0	904154	0.04	907.86
Borax	414601	0.02	656472	0.03	818305	0.03	24.65
Gypsum	723888	0.04	765738	0.03	574560	0.02	-24.97
Garnet (Cut and uncut)	280824	0.01	378455	0.01	484011	0.02	27.89
Bauxite	951442	0.05	1005256	0.04	479019	0.02	-52.35
Wollastonite	311809	0.02	282266	0.01	365656	0.02	29.54
Other Minerals	8329969	0.42	8529857	0.33	11764635	0.49	37.92

P: Provisional
Source: DGCIS Kolkata

MINING INDUSTRY

The history of mineral extraction in India dates back to the days of the Harappan civilization. The wide availability of the minerals provides a base for the growth and development of the Mining Sector in India. Minerals are precious natural resources that serve as essential raw materials for fundamental industries, so the growth of the Mining Industry is essential for the overall industrial development of a nation. India produces as many as 95 minerals, which includes 4 fuel, 10 metallic, 23 non-metallic, 3 atomic and 55 minor minerals (including building and other materials). The vast resources of numerous metallic and non-metallic minerals that India is endowed with serve as a foundation for the expansion and advancement of the nation's Mining Industry. The industry has the potential to significantly impact GDP growth, foreign exchange earnings, and give end-use industries like building, infrastructure, automotive, and electricity, among others, a competitive edge by obtaining essential raw materials at reasonable rates. Rise in infrastructure development and automotive production are driving growth. Power and Cement industries are also aiding growth for the sector. Demand for Iron and Steel is set to continue given the strong growth expectations for the Residential and Commercial Building Industry.

Index of Mineral Production

The index of mineral production (excluding atomic and minor minerals) (with base year 2011-12=100) for 2022-23 at 119.9 displayed an increase of 5.8 % as compared to the previous year. (Table-2).

Table-2: Index of Mineral Production, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Base year 2011-12=100)

Year	Index of mineral production (1000)	Coal & lignite (306.854)	Crude petroleum & natural gas (444.318)	Metallic minerals (230.004)	Non-metallic minerals (18.824)
2020-21	101	131.4	70.7	117.7	117.4
2021-22	113.3	143.5	74.4	146.8	130.1
2022-23(p)	119.9	163.6	74.1	148.6	137.7

Note: Figures in parentheses indicate the weight attached to respective groups.

Table –3: Sector-wise Production & Value of MCDR Minerals (2021-22 and 2022-23)

Mineral	Unit	2021-22						2022-23					
		Production			Value (₹ '000)			Production			Value (₹ '000)		
		Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
Bauxite	t	11066108	11427941	22494049	15371528	9912641	25284169	12850798.17	10993538.58	23844336.75	11990686.71	15381035.14	27371721.85
Chromite	t	1163755	2621870	3785625	18780640	29188527	47969167	2514116.269	1043173.01	3557289.279	32526590.62	14106824.54	46633415.15
Copper Conc.	t	115313	0	115313	11024312	0	11024312	0	112745.109	112745.109	0	11438.44491	11438.44491
Copper Ore	t	3569632	0	3569632	0	0	0	0	3326337	3326337	0	0	0
Gold	kg	1395	12	1407	6704750	56268	6761018	21.60719	1411.414	1433.02119	119.63894	7535.030743	7654.669683
Gold Ore	t	470456	4538	474994	0	0	0	39837	593677	633514	0	0	0
Iron Ore	'000t	99809	154290	254099	476516054	531748554	1008264608	151168.0435	107144.4081	258312.4516	430078258.5	403923464.5	834001723
Manganese Ore	t	1238812	1453596	2692408	13502028	8565798	22067826	1517678.889	1309285.473	2826964.362	8861178.729	13961398.88	22822577.61
Silver	kg	143	647013	647156	11503	42115418	42126921	713620	148.093	713768.093	43805.0756	9.2987	43814.3743
Tin Conc.	kg	24812	1489	26301	30523	2096	32619	549.3	44898.8	45448.1	0.7611	51.0567	51.8178
Zinc Conc.	t	0	1594085	1594085	0	78727814	78727814	1670207.761	0	1670207.761	92306.37919	0	92306.37919
Apatite	t	0	0	0	0	0	0						
Asbestos	t	0	0	0	0	0	0						
Diamond	ct	266	0	266	18051	0	18051	388		388	61473		61473
Emerald	ct	0	0	0	0	0	0						
Flint Stone	t	0	0	0	0	0	0						
Fluorite (graded)	t	1237	0	1237	9430	0	9430	145	1010.13	1155.13	43.5	6180.007929	6223.507929
Garnet (abrasive)	t	0	8182	8182	0	24660	24660	9859	0	9859	36217.10968	0	36217.10968
Graphite	t	36214	26674	62888	52872	69275	122147	40573.249	54216	94789.249	113917.1866	66234.60288	180151.7895
Iolite	kg	0	27	27	0	191	191						
Kyanite	t	4245	5075	9320	8183	9084	17267	360	2405.16	2765.16	644.4	4675.104	5319.504
Lead & Zinc Ore	t	0	16338564	16338564	0	0	0	16744080	0	16744080	0	0	0
Lead Conc.	t	0	368040	368040	0	22025747	22025747	376665.871	0	376665.871	24761.9298	0	24761.9298
Limeshell	t	0	100	100	0	231	231	250	0	250	655.9	0	655.9
Limestone	'000t	11322	380712	392034	5004406	97018216	102022622	385501.2816	20142.31945	405643.601	103007163.6	8214860.321	111222023.9
Magnesite	t	61324	52173	113497	288988	265784	554772	47063	60461.99	107524.99	250573.4993	252013.4485	502586.9478
Marl	t	0	1853481	1853481	0	326498	326498	1461667.87	0	1461667.87	316761.8602	0	316761.8602
Moulding Sand	t	0	17583	17583	0	5256	5256	17259.795	0	17259.795	5373.35758	0	5373.35758
Phosphorite	t	1295429	99530	1394959	6554512	93558	6648070	99870	1878580.25	1978450.25	93877.8	12260739.98	12354617.78

Table- 3 (Concld.)

Mineral	Unit	2021-22						2022-23					
		Production			Value (₹ '000)			Production			Value (₹ '000)		
		Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private	Total
Salt (rock)	t	286	0	286	712	0	712	0	1001.951	1001.951	0	4848.511026	4848.511026
Selenite	t	646	70	716	872	30	902	0	327.37	327.37	0	441.9495	441.9495
Siliceous Earth	t	0	33898	33898	0	22837	22837	32069.54	0	32069.54	17360.3854	0	17360.3854
Sillimanite	t	0	3432	3432	0	8283	8283	1437	0	1437	3756.888	0	3756.888
Sulphur	t	880858	0	880858	0	0	0						
Vermiculite	t	690	2370	3060	2284	1481	3765	2303	0	2303	1610.15	0	1610.15
Wollastonite	t	0	108335	108335	0	149156	149156	110793	0	110793	151761.448	0	151761.448

Reporting Mines

Reporting mine is defined as "A mine reporting production or reporting 'nil' production during a year but engaged in developmental work; such as, overburden removal, underground driving, winzing, sinking work, exploration by pitting, trenching or drilling as evident from the MCDR returns".

Indian Mining Industry is characterised by a large number of small operational mines. The number of mines which reported mineral production (excluding atomic, fuel, and minor minerals) in India was 1,319 in 2021-22 as against 1,375 during 2020-21. Out of 1,319 reporting mines, most of the mines reported are in Madhya Pradesh followed by Gujarat, Karnataka, Odisha, Chhattisgarh, Andhra Pradesh, Rajasthan, Tamil Nadu, Maharashtra, Jharkhand and Telangana.

Working mines

Sector	2019-20	2020-21	2021-22
All Minerals	**1385**	**1375**	**1319**
Metallic Minerals	602	608	545
Non - Metallic Minerals	783	767	774

Role of Public Sector

The Public Sector has played important role in the overall mineral production in 2022-23. The entire production of Copper Ore & Conc., among metallic mineral and diamond, salt (rock) and selenite in respect of non-metallic minerals was reported from the Public Sector. By and large, the entire production of gold, tin conc., fluorite, kyanite and phosphorite came from Private Sector during 2022-23. (Table-3)

Gross Value Added from Mining & Quarrying Sector

The Ministry of Statistics & Programme Implementation has released the provisional estimates of national income, revising the base year from 2004-05 to 2011-12 in the year 2015. The industry-wise estimates are now presented as Gross Value Added (GVA) at basic prices. Certain changes have been made in this series including for Mining & Quarrying industry. During 2022-23 Mining and Quarrying industry accounted for about 2.4% of the GVA at current prices. The GVA at current and constant prices for the period from 2020-21 to 2022-23 is furnished in Tables –4 & 5.

Table – 4 : Gross Value Added at Basic Price, 2020-21 to 2022-23

(At Current Prices) (31.05.2023)

(Value in ₹ crore)

Industry	2020-21 (2nd RE)	2021-22 (1st RE)	2022-23 (PE)	% Change in 2022-23 over the previous years
GVA (All)	**18188780**	**21438883**	**24742871**	**15.4**
Mining & Quarrying	316268	429364	583535	35.9

Source: NSO *RE: Revised Estimates* *PE: Provisional Estimates*

Table – 5 : Gross Value Added at Basic Price, 2020-21 to 2022-23

(At 2011-12 Prices) (31.05.2023)

(Value in ₹ crore)

Industry	2020-21 (2nd RE)	2021-22 (1st RE)	2022-23 (PE)	% Change in 2022-23 over the previous years
GVA (All)	**12681482**	**13798025**	**14764840**	**7.0**
Mining & Quarrying	289905	310415	324708	4.6

Source: NSO *RE: Revised Estimates* *PE: Provisional Estimates*

Employment

The average daily employment of labour engaged in Mining Sector (excluding fuel minerals, atomic and minor minerals) was 1,09,304 in 2021-22. Out of this, 36,080 or 33 % were in Public Sector and 73,224 or 67 % in Private Sector. Metallic minerals accounted for 80 % and non-metallic minerals 20 % of the total labour force during the year.

POLICY

National Mineral Policy, 2019 has been approved by the Union Cabinet on 28.02.2019. National Mineral Policy, 2019 replaced the extant National Mineral Policy, 2008 ("NMP 2008"). The impetus to review NMP 2008 came about by way of a direction from the Supreme Court vide its judgment dated 02.08.2017 in Writ Petition (Civil) No. 114/2014 titled Common Cause vs. Union of India & Others.

Objective of NMP-2019

The aim of National Mineral Policy 2019 is to have a more effective, meaningful and implementable policy that brings in further transparency, better regulation and enforcement, balanced social and economic growth as well as sustainable mining practices.

The National Mineral Policy, 2019, includes provisions which aim to boost the Mining Sector, such as,

- Introduction of Right of First Refusal for RP/PL holders,
- Encouraging the Private Sector to take up exploration,
- Auctioning of virgin areas for composite RP cum PL-cum-ML on revenue share basis,
- Encouragement of merger and acquisition of mining entities,
- Transfer of mining leases and creation of dedicated mineral corridors to boost Private Sector mining areas,
- Proposes to grant status of industry to mining
- Activity to boost financing of mining for Private Sector and for acquisitions of mineral assets in other countries by Private Sector,
- Proposes to auction mineral blocks with pre-embedded clearances to give fillip to auction process, propose to make efforts to harmonise taxes, levies & royalty with world benchmarks to help Private Sector.

The NMP-2019 will ensure more effective regulation. It will lead to sustainable Mining Sector development in future while addressing the issues of project-affected persons especially those residing in tribal areas.

Amendments during 2022-23

► *The Mineral Conservation and Development (Amendment) Rules, 2022 were notified on 11.04.2022 for allowing reporting of the data of Iron Ore from 45% to below 51% Fe and below 45% (for Magnetite).*

► The Reimbursement of Exploration Expenditure Rules, 2022 were notified on 03.06.2022 for reimbursement of exploration expenditure of the concession holders whose rights have lapsed under Section 10A(2)(b) of the MMDR Act, 1957.

Star Ratings of Mines

Ministry of Mines, in its endeavour for taking up exhaustive and universal implementation of the Sustainable Development Framework (SDF) in mining, has evolved a system of Star Rating of Mines. The Ministry of Mines instituted the Sustainable Development Framework (SDF) for taking up mining activity, encompassing inclusive growth, without adversely affecting the social, economic and environmental well-being, at present and also in future generation. It has been instituted as a two-tier system providing self-evaluation templates to be filled in by the mine operator followed by validation through Indian Bureau of Mines.

The evaluation templates for Star Rating was notified vide Notification dated 23.05.2016 for major minerals. Based on the performance of the mining lease, 1 to 5 star rating would be awarded. The prospect of getting higher Star Rating is expected to drive miners to quickly adopt sustainable mining practices. In recently notified Mineral Conservation & Development Rule, 2017, Star Rating for mines has been included as statutory provision for achieving of minimum 3 stars. A web enabled online system for evaluation of measures has been developed and launched on 18th August, 2016 as a vital step for ensuring compliance of environmental protection and social responsibility by the Mining Sector. A template for star rating of minor minerals is also being prepared.

During 2021-22, 1034 mines have filed online star rating templates for the assessment years 2020-21 under Rule 35 of MCDR, 2017. After validation process, Forty mines securing five Star rating for the reporting year 2020-21 have been felicitated by the Hon'ble Minister of Mines in the 6th Mining Conclave held at New Delhi on 12.7.2022.

For the performance year 2021-22, 1181 lessees have filed SDF templates and 76 mines have got five - star rating. Star rated mines were felicitated at the hands of Hon'ble Union Minister of Parliamentary Affairs, Coal & Mines during the 75th Foundation Day ceremony of IBM on 1.3.2023.

LEGISLATIVE FRAMEWORK

The details of Legislative Framework are provided in the Review on "Mineral Policy and Legislation" under "General Review".

Auction of Mineral Blocks

As per information available on website of Ministry of Mines as on 26.11.2024, a total of 441 mineral blocks have been auctioned successfully across 14 States. Central Government auctioned 24 blocks as per recent auction rules which enabled Central Government to auction blocks of critical minerals.

List of Successful auction since 2015, updated as on 26.11.2024

State	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Andhra Pradesh	-	1	2	2	-	-	4	11	3	2	25
Bihar	-	-	-	-	-	-	-	-	-	1	1
Chhattisgarh	3	-	2	-	-	2	2	20	6		35
Gujarat	-	-	3	-	-	4	3	2	6	7	25
Jharkhand	2	1	1	3	-	-	-	-	3		10
Karnataka	-	7	-	7	4	1	8	11	6	1	45
Madhya Pradesh	-	1	-	5	2	5	4	29	22	14	82
Maharashtra	-	-	2	1	10	-	9	6	10	2	40
Odisha	1	2	2	-	25*	1	9*	10			48
Rajasthan	-	3	2	1	2	-	7	8	31	32	86
Tamil Nadu	-	-	-	-	-	-	-				0
Telangana	-	-	-	-	-	-	-			2	2
Uttar Pradesh	-	-	-	-	-	-	-	4	3		7
Goa	-	-	-	-	-	-	-	4	5	2	11
Central Government	-	-	-	-	-	-	-	-	-	24	24
Total	**6**	**15**	**14**	**19**	**43***	**13**	**46***	**105**	**95**	**87**	**441**

Measures taken to Control Illegal Mining

Illegal mining means any reconnaissance or prospecting or mining operation undertaken by any person or a company in any area without holding a reconnaissance permit or a prospecting licence or, as the case may be, a mining lease as required under Sub-section (1) of Section 4 of the MMDR Act. Section 23C of Mines and Minerals (Development and Regulation) Act 1957, empowers the State governments to frame rules to prevent illegal mining and the State Government may by notification in the official gazette, make such rules for preventing illegal mining, transportation and storage of minerals and for the purposes connected therewith in the State.

There is a three-pronged strategy for prevention of illegal mining viz. constitution of task force by the State Government at State and District Level, framing of rules under Section 23C of the MMDR Act, 1957 and furnishing of quarterly returns on illegal mining for review to the Central Government. The details of States who have constituted task force at State level, framed Rules under Section 23C of the MMDR Act, 1957 and have furnished quarterly returns on illegal mining to IBM are as follows: – Twenty-two State Governments have constituted the task force. The function of the task force is to review the action taken by member departments for checking the illegal mining activities in their respective jurisdiction. Twenty-one State Governments have framed the rules under Section 23C of MM (D&R) Act, 1957 to curb illegal mining.

The State Government submits quarterly returns on prevention of illegal mining to IBM. These returns contain details, such as, number of cases detected and action taken thereon etc. IBM on receipt of the returns from the various State Governments, consolidates the information and sends it to the Ministry at the end of each quarter. The Mineral Conservation and Development Rules, 2017 (MCDR) provides measures to ensure systematic & scientific mining. Rule 45 of the MCDR provides for the mining companies to submit periodic reports on the extraction and disposal of the mined material. Rule 45 of MCDR also facilitates end-to-end national-scale accounting of all minerals produced in the country from the pit head to its end-use, reducing the scope for illegal mining, royalty evasion, etc. The amended Rule 45 now makes it mandatory for all miners, traders, stockist, exporters and end users of minerals to register and report on the production, trade and utilisation of minerals to the State Government (s) and Indian Bureau of Mines.

Space Technology for Checking Illegal Mining

Indian Bureau of Mines (IBM) has entered into an MoU with National Remote Sensing Centre (NRSC), for a pilot project "Sudoor Drishti" to demonstrate the feasibility of using High Resolution Satellite Imagery and Digital Elevation Model (DEM) in monitoring mining activities / changes over selected group of mines.

Application of Drone Technology in Mining

Furthering the efforts to utilise new technology, the Ministry of Mines has explored the applicability of the Unmanned Aerial Vehicles (UAV) Technology or commonly referred to as 'UAVs' for the mining sector. The UAV-based remote sensing is an emerging technology, increasingly used in agriculture, environmental, geology, mining, town planning and forestry applications and other applications. UAVs, typically operate at lower altitudes than manned aircraft and are also able to provide unique data with regard to spatial resolution angle of view. Compared to manned fixed-wing aircraft, typically used in aerial remote sensing, UAVs can provide lower ground sample distances (GSD) or higher spatial resolutions on the ground. After a successful pilot project during 2020-21 to ascertain the efficacy of using Unmanned Aerial Vehicles (UAV) to monitor the mining activities in the country, necessary amendments were made in the Mineral Conservation and Development Rules 2017 to include submission of digital images to IBM. The MCDR, 2017 vide Rule 34A now mandates the mineral concession holders to submit digital aerial images to IBM on an annual basis. The digital images to be submitted to IBM will be based on drone (UAV) survey of the mines having production capacities of more than 1 million tonne or lease area of 50 hectares or more based on the Standard Operating Procedure laid down by IBM. For other mines the lessee will be required to submit satellite images based on the SOP laid down by IBM.

During 2022-23, IBM finalised SOP for carrying out drone survey as per the provisions of Rule 34A of MCDR, 2017. A register of receipt of drone/ satellite data submitted by the lessees under Rule 34A of MCDR 2017 is being maintained at IBM. As on March, 2023 as many as 754 mining leases data was received. The Gazette Notification dated 14.02.2023 has been published for submission of Digital Aerial Images to the State Governments while submitting the data to IBM under Rule 34 A of MCDR 2017. As a part of Drone Application implementation, so far a cumulative of 124 officers of IBM Regional Offices and Headquarters have been imparted training on the Basics of GIS and Processing of Drone Survey data.

IBM successfully organised a Workshop-cum-Training Programme on 'Digital Aerial Data Submission' on 13.01.2023 at its Headquarters in Nagpur. Workshop received overwhelming response from the Mining Industry and about 203 participants from across the country participated. IBM officers in their exhaustive presentations explained the various shortcomings observed in the data being submitted to IBM.

Mining Surveillance System (MSS)

The Project on Mining Surveillance System (MSS) was undertaken by Indian Bureau of Mines, Ministry of Mines, and BISAG (Bhaskaracharya Institute for Space Applications and Geoinformatics) of Ministry of Electronics and Information Technology (MEITY) to develop a system for detection of incidence of illegal mining by use of space technology and Surveillance of area up to 500 m outside the lease boundary to check instances of illegal mining. The deterrence effect of 'Eyes watching from the Sky' would be extremely useful in curbing instances of illegal mining. In the fourth phase in 2022-23, 61 preliminary triggers were generated for major minerals and uploaded on the portal for further transmission to the State Governments. After field verification in respect of 24 triggers for major minerals, unauthorized mining in seven cases of major minerals have been confirmed by the State Governments.

District Mineral Foundation / Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY)

District Mineral Foundation (DMF) established by contributions from the mining companies, came into force specially for addressing the long-time grievance of the neglected civil society consisting of people affected by mining activities. Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) scheme formulated for the welfare and development of the mining affected areas and people under DMF was also launched. The details of Fund collection till August, 2024 as per Ministry of Mines website is as follows:

DMFT collection	Amount in ₹ crore
Amount collected in respect of Coal & Lignite	37,154.78
Amount collected in respect of Major Minerals (Other than Coal & Lignite)	50,439.72
Amount collected in respect of Minor Minerals	11,505.82
Total amount collected under DMF	**99,100.77**

Mining Tenement System (MTS)

Mining Tenement system (MTS) is a flagship project of Indian Bureau of Mines and it's a unique online based application. With MTS, IBM envisions digitising its internal processes of the core modules which in turn can induct a workflow-based system to increase the efficiency and transparency in its charter of functions. As part of this project, IBM also envisions conducting enhancements, wherever applicable. MTS system is being developed through National Informatics Centre (NIC). Returns and Registration modules of Mining Tenement System (MTS) have been successfully put online from 1st May 2022 onwards accommodating the submitted returns for the month of April 2022 onwards. Registration, Returns and Mining Plan Modules were launched in 6th Mining Conclave on 12.7.2022. DPR in respect of the other modules is in progress and they will become operational in phased manner. The system will digitise most of the activities in a transparent manner with facility of quick retrieval of data.

Implementation of ame nded Rule 45 of Mineral Conservation and Development Rules (MCDR) 1988/2017: Rule 45 of MCDR, 1988/2017 has made it mandatory for all mining lease holders, for any person, or company engaged in trading or storage or end use or export of minerals mined in the country to register online with IBM to keep accounts of mineral flow. Up to March, 2023, registration position for major minerals plus 31 minor minerals was– total 8,084 Miners, 5,354 units of end users, 10,305 traders, 2,889 stockists and 1,580 exporters have registered with IBM.

Indian Bureau of Mines (IBM)

IBM plays the role of National Repository of mineral data through maintaining a data bank of mines and minerals by developing advanced IT-based Mineral Information System. IBM also carries out mining research project on need-based aspects of mining; and conducts mineral beneficiation studies, including mineralogical testing and chemical analysis; and preparation of mineral maps. Indian Bureau of Mines (IBM), as a facilitator to the Mineral Industry, performs multifarious functions, such as, providing technical consultancy services for conducting feasibility studies, environment impact assessments, environment management plans, etc. as a storehouse of data. A Remote Sensing Centre has been set up at IBM in 2018. Multi-mineral leasehold maps are updated on ARC-GIS platform. All the maps viz. lease boundaries, Geological layer and toposheet layer have been integrated for the States of Goa and Maharashtra.

The activity of updation of Multi mineral Lease hold Maps on GIS platform has been completed in March 2022. Creation of geodatabase in respect of 21 States and one UT viz. Goa, Andhra Pradesh, Kerala, Rajasthan, Madhya Pradesh, Gujarat, Chattisgarh, Telangana, Tamil Nadu, Odisha, Jharkhand, Maharashtra, Karnataka, Bihar, Haryana, Himachal Pradesh, Assam, Meghalaya, Manipur, Uttarakhand & West Bengal states and Jammu & Kashmir (UT) were completed. The geological layer has been imported from the GSI Bhukosh for all the states and integrated with corresponding GIS database. Plotting of boundaries of 3,890 major mineral mining leases has been completed and is available on a geospatial platform. Attachment of mine data in respect of the leases has also been accomplished.

FOREIGN TRADE

As per the World Trade Statistical Review 2023, India's ranking amongst the leading exporters in the world merchandise trade improved from 30 in 2004 to 18 in 2022 with a share of 1.80%. Similarly, India's ranking amongst the leading importer in world merchandise trade was 9 in 2022 as compared to 23 in 2004 with a share of 2.8 per cent. In terms of importing Fuels and Mining products, India's share stood at 5.7% in 2022 when compared to 4% in 2010 2.8%, 2.4% during 2005 & 2000 respectively.

EXPORTS

Ores & Minerals

During the year 2022-23, the value of exports (including re-exports) of ores and minerals was ₹ 2,42,326 crore. The export value which had increased from ₹ 1,96,654 crore in 2020-21 to ₹ 2,57,863 crore in 2021-22, decreased to ₹ 2,42,326 crore in 2022-23. The value of mineral exports showed a decrease of 6.03% in 2022-23 as compared to that in the previous year.

Diamond continued to be the largest constituent item with a share of 75.82% in the total value of mineral exports in 2022-23. Next in order of share was iron ore with contribution of 5.95% followed by granite 5.18%, alumina 2.65% and sulphur (exc. sublimed srecipitated and colloidal) 1.37%.

Metals & Alloys

The value of exports (including re-exports) of metals & alloys stood at ₹ 2,85,908 crore in the year 2022-23. The export value which had increased from ₹ 2,07,222 crore in 2020-21 to ₹ 3,47,457 crore in 2021-22, decreased to ₹ 2,85,908 crore in 2022-23. The value of metal exports showed a decrease of 17.71% in 2022-23 as compared to the previous year.

In terms of value of exports, Iron & Steel has the largest share of 53.60%, followed by Aluminum Alloys Incl. Scrap 24.81%, Ferroalloys 9.43% and Copper & Alloys (Incl. brass & bronze) 3.80%.

IMPORTS

Ores & Minerals:

During the year 2022-23, the value of imports (including re-imports) of ores and minerals was ₹ 21,63,599 crore. The import value which had increased from ₹ 7,91,320 crore in 2020-21 to ₹ 15,51,380 crore in 2021-22, increased to ₹ 21,63,599 crore in 2022-23. The value of mineral imports showed an increase of 39.46% in 2022-23 as compared to that in the previous year.

Petroleum (crude) continued to be the largest constituent item with a share of 60.21 % in the total value of mineral imports in 2022-23. Next in order of share was Coal (Except Lignite) with the contribution of 17.73 % followed Diamond by 9.60% and Natural Gas 6.34%.

Metals & Alloys

The value of imports (including re-imports) of metals & alloys stood at ₹ 6,68,213 crore in the year 2022-23. The import value which had increased from ₹ 4,35,611 crore in 2020-21 to ₹ 6,26,927 crore in 2021-22, increased to ₹ 6,68,213 crore in 2022-23. The value of metal imports showed an increase of 6.59% in 2022-23 as compared to the previous year.

In terms of value of imports, Gold (Non-monetary & monetary : total) has the largest share of 41.97%, Iron & steel 25.47%, Copper & Alloys (Incl. Brass & Bronze) 9.08%, Aluminum and Alloys Incl. Scrap 8.42% and Silver 6.32%.

VALUE ADDED EXPORT TRADE

India's foreign trade includes exports of minerals, both in the raw form and semi-processed & processed forms like mineral-based primary manufactured products. India's share in export of Iron & Steel stood at 3.0% valuing about 19 billion dollars. World merchandise exports during 2022 as per World Trade Statistical Review - 2023, India's share stood at US$ 4,53,481 million while imports stood at US$ 7,23,348 million.

INFRASTRUCTURE

In order to achieve the GDP of $5 trillion by 2024-25, India needs to spend about $1.4 trillion on infrastructure. During FYs 2008-17, India invested about US$1.1 trillion on infrastructure. However, the challenge is to step up infrastructure investment substantially. Keeping this objective in view, National Infrastructure Pipeline (NIP) was launched with projected infrastructure investment of around ₹ 111 lakh crore (US$ 1.5 trillions) during FY 2020-2025 to provide world-class infrastructure across the country, and improve the quality of life for all citizens. It also envisages to improve project preparation and attract investment, both domestic and foreign in infrastructure. NIP was launched with 6,835 projects, which has expanded to over 9,000 projects covering 34 infrastructure subsectors. During the fiscals 2020 to 2025, sectors such as energy (24%), roads (19%), urban (16%), and railways (13%) amount to around 70% of the projected capital expenditure in infrastructure in India. NIP has involved all the stakeholders for a coordinated approach to infrastructure creation in India to boost short-term as well as the potential GDP growth. NITI Aayog has developed the 'National Monetisation Pipeline (NMP Volumes 1&2)' in consultation with infrastructure line ministries. Asset monetisation, entails a limited period license/ lease of an asset, owned by the government or a public authority, to a Private Sector entity for an upfront or periodic consideration. The Private Sector entity is expected to operate and maintain the asset based on the terms of the contract/concession, generating returns through higher operating efficiencies and enhanced user experience. Funds, so received by the public authority, are reinvested in new infrastructure, or deployed for other public purposes. Such contracts include provision for transfer of asset back to the authority at the end of the period. A robust asset pipeline has been prepared to provide a comprehensive view to investors and developers of the investment avenues in infrastructure. The pipeline includes selection of derisked and brownfield assets with stable revenue generation profile (or long rights) which will make for an attractive investment option. Total indicative value of NMP for core assets of the Central Government has been estimated at ₹ 6.0 lakh crore over 4-year period (5.4% of total infrastructure investment envisaged under NIP).

Coal

The country witnessed the highest ever coal production in the Year 2022-23. The all-India coal production in the year 2022-23 was 893.19 million tonnes (MT) (Provisional) in comparison to 778.21 MT in the year 2021-22 with a growth of about 14.77%.

With transformative measures taken by Ministry of Coal under 'Atmanirbhar Bharat' initiative, domestic raw coking coal production is likely to reach 140 MT by 2030, CIL has planned to increase raw coking coal production from existing mines up to 26 MT and identified ten new mines with PRC of about 22 MT by FY 2025. Also, CIL has offered eight discontinued coking coal mines on a innovative model of revenue sharing to the Private Sector with a PRC of 2 MT. LOA issued for 6 nos, out of which, Agreement has been signed for 3 nos.

To further enhance raw coking coal production, the Ministry of Coal has auctioned 16 coking coal blocks to the Private Sector with a PRC of 25 MT during the last two years. Most of these blocks are expected to start production by 2025. The Ministry has also identified four coking coal blocks and the Central Mine Planning and Design Institute (CMPDI) also will finalise GR for 4 to 6 new coking coal blocks. These blocks may be offered in subsequent rounds of auction for Private Sector to further step up domestic raw coking coal supply in the country.

Electricity

Electricity is the essential for powering economic activity and is the crux in the functioning of all modern technologies. The Power Sector has witnessed substantial transformation from both the demand and supply side. As per Central Electricity Authority website, the total installed capacity of power stations in India as on 31.03.2023 stood at 4,16,059 MW.

The Overall generation (Including generation from grid connected renewable sources) in the country has increased from 1,110.458 BU during 2014-15 to 1,173.603 BU during the year 2015-16, 1,241.689 BU during 2016-17, 1,308.146 BU during 2017-18, 1,376.095 BU during 2018-19, 1,389.121 BU during 2019-20, 1,381.855 BU during 2020-21, 1,491.859 BU during 2021-22 and 1,624.465 BU during 2022-23.

Transport

RAILWAYS

Indian Railways (IR) with over 68,000 route km is the third largest network in the world under single management. Indian Railways has registered record revenue figures of ₹ 2.40 lakh crore for Financial Year 2022-23. This is nearly ₹ 49,000 crore more than the previous year, reflecting 25% growth. During this financial year 2022-23, Freight revenue too has leapfrogged to ₹ 1.62 lakh crore, a growth of nearly 15% on previous year. Indian Railways' passenger revenues have registered an all-time high growth of 61% to reach ₹ 63,300 crore. Buoyancy in revenues and tight expenditure management have helped in achieving an Operating Ratio of 98.14%, well within the RE target. After meeting all revenue expenditure, Railways generated ₹ 3,200 Crore for Capital investment from its internal resources (₹ 700 crore for DRF, ₹ 1,000 crore for DF and ₹ 1,516.72 crore for RRSK)

CIVIL AVIATION

India is one of the fastest growing markets for civil aviation in the world. It is expected to become the third largest overall (including domestic and international traffic) by the year FY25. During 2022-23, a total of 136.02 million passengers travelled in Indian Scheduled domestic Services. 6,98,000 MT freight was carried during 2022-23 as per Civil aviation Statistics handbook – 2022-23.

PORTS AND SHIPPING

Maritime Sector in India has been the backbone of country's trade. To harness 7,517 km coastline and 14,500 km potentially navigable waterways, Government has embarked upon ambitious 'Sagarmala programme' which aims at port led development of the country. There are 802 projects worth ₹ 5.40 lakh crore for implementation of Sagarmala programme by 2035. The Major Ports in the country have an installed capacity of 1,597.59 MTPA and handled traffic of 720.05 MT during 2021-22. During Apr-Dec. 2022, a total of 576.63 million tonnes of cargo were shipped by India. This included 175.08 MT of POL, 29.70 MT of Iron ore and 140. 72 MT of Coal. While increasing the capacity of major ports, Ministry of Shipping has been striving to improve the operational efficiencies through mechanisation, digitisation and process simplification. As a result, key efficiency parameters have improved considerably.

ROADS

The capacity of National Highways in terms of handling traffic (passenger and goods) needs to keep pace with economic growth. India has the second largest road network in the world of about 63.32 lakh km. The National Highways have a total length of 1,44,955 km, which in totality serve as the arterial network of the country. The development of National Highways is the responsibility of the Government of India. The Government of India had launched major initiatives to upgrade and strengthen National Highways through various phases of the National Highways Development Project (NHDP) and is taking the initiative forward through the umbrella program of Bharatmala Pariyojana Phase-I and other schemes and projects.

In order to provide a boost to infrastructure development and enable it to overcome the impact of COVID-19 pandemic, the Ministry has placed target of 14,300 km for award, which is highest ever and 12,200 km for construction for the FY year 2022-23. Overall road projects exceeding 65,000 km in length, costing more than ₹ 11 lakh crore, are in progress, of which work in respect of projects of more than 39,000 km length has been completed and in balance length of more than 26,000 km works are in progress. NHs of 5,774 km length have been constructed during the first nine months of FY 2022-23.

Total Budgetary allocation for the year 2022-23 has been increased by 51.81% from ₹ 1,31,149 crore in 2021-22 to ₹ 1,99,108 crore in 2022-23. Further, RE outlay has been enhanced by 8.7% over the BE outlay for the year 2022-23. Toll Collection of ₹ 15,958.13 crore was achieved till Nov., 2022 as per annual report of MoRTH – 2023.

PERFORMANCE OF SELECTED MINERAL-BASED INDUSTRIES

India continued to be wholly or largely self-sufficient in minerals which constitute primary mineral raw materials that are supplied to industries, such as, iron & steel, aluminium, cement, various types of refractories, china clay-based ceramics, glass, etc. India is self-sufficient or near to self-sufficient in bauxite, chromite, iron ore and limestone. India is deficient in kyanite, magnesite, manganese ore, rock phosphate, sillimanite, etc. which were imported to meet the demand for either blending with locally available mineral raw materials and/or for manufacturing special qualities of mineral-based products. To meet the increasing demand of uncut diamonds, emerald and other precious &

semi-precious stones by the domestic Cutting and Polishing Industry, India is dependent on imports of raw uncut stones for their value-added reexports. Degree of Self-sufficiency in Principal Minerals for 2022-23 (P) is furnished in Table– 6

Table–6: Degree of Self-sufficiency in Principal Minerals, 2022-23(P)

Sl. No.	Commodity	Apparent Demand* ('000 tonnes)	Supply/Domestic Supply ('000 tonnes)	Order of self-sufficiency (%)
1	Bauxite	27261	23843	87
2	Chromite	3637	3560	98
3	Iron ore	238478	257856	100
4	Kyanite	4	2.765	72
5	Limestone	433720	406155	94
6	Magnesite	605	108	18
7	Manganese ore	7467	2827	38
8	Rock phosphate (including apatite)	11069	1978	18

Figures rounded off *P: Provisional.*
Source: MCDR Returns for production data and DGCI&S for export & import data.
Note: a) Minor minerals have not been included due to non-availability of production for the year 2022-23.
b) Even in cases where almost entire domestic demand is satisfied by domestic supplies, some quantities of certain special quality/types of minerals and metals are imported to meet the requirement in certain specific end-uses.
: Apparent demand (production+ import-export)

Cement

- Indian cement industry is second largest in the world with installed cement capacity of 600 million tonnes and production of 391 million tonnes of cement in 2022-23. Presently, the cement production data is collected by DPIIT through Cement Information System (CIS) portal. However, some plants are not providing data regularly.
- Cement production data is used by Government for policy decisions and for calculating the index of industrial production
- The cement production data is used by office of Economic Advisor, DPIIT to calculate the Index of Eight Core Industries in which weightage of Cement production is 5.37%.

Petroleum Oil And Refineries, Natural Gas Etc.

- Crude oil production during March 2023 was 2,454.14 TMT, which is 15.57% lower than target for the month and 2.85% lower than the production of March 2022. Cumulative crude oil production during April-March, 2022-23 was 29,178.56 TMT, which is 8.41% lower than target for the period and 1.73% lower than production during corresponding period of last year respectively.
- Cumulative crude processed during April-March 2022-23 was 2,55,233.05 TMT, which is 1.27% and 5.60% higher than target for the period and production during corresponding period of last year respectively.
- Production of Petroleum Products: Cumulative production during April-March, 2022-23 was 2,66,539.30 TMT, which is 1.86% and 4.81% higher than target set for the period and production during corresponding period of last year respectively.
- Cumulative natural gas production during April-March 2022-23 was 34,450.27 MMSCM, which is 6.34% lower when compared with target for the period but 1.25% higher than production during corresponding period of last year.

2. Mineral Policy & Legislation

POLICY

1. National Mineral Policy, 2019

National Mineral Policy, 2019 was approved by the Union Cabinet on 28th February, 2019.

Objective

The aim of National Mineral Policy, 2019 is to have a more effective, meaningful and implementable policy that brings in further transparency, better regulation and enforcement, balanced social and economic growth as well as sustainable mining practices.

Details

The National Mineral Policy, 2019 includes provisions which will give boost to Mining Sector such as:

- Introduction of Right of First Refusal for RP/PL holders;
- Encouraging the Private Sector to take up exploration;
- Auctioning in virgin areas for composite RP-cum- PL-cum-ML on revenue share basis;
- Encouragement of merger and acquisition of mining entities;
- Transfer of mining leases and creation of dedicated mineral corridors to boost Private Sector mining areas;
- Proposes to grant status of industry to mining activity to boost financing of mining for Private Sector and for acquisitions of mineral assets in other countries by Private Sector;
- Proposes to auction mineral blocks with pre embedded clearances to give fillip to auction process; and
- Proposes to make efforts to harmonise taxes, levies & royalty with world benchmarks to help Private Sector.

LEGISLATION

Notifications

Important Notifications notified/issued during the period under review are furnished below:

Ministry of Mines:-

1. Ministry of Mines, Notification, S.O. 1493(E).—

In pursuance of Sub-Rule (4) of Rule 10 of the Official Language (Use for official purposes of the Union) Rules, 1976 (as amended, 1987) the Central Government hereby notifies the following office of Geological Survey of India, an attached office of the Ministry of Mines, more than 80% Staff whereof have acquired working knowledge of Hindi:

Geological Survey of India, Remote Sensing & Aerial Surveys, Bengaluru

Source: The Gazette of India, Extraordinary, No. 1424 Part II, Section 3-Sub section (ii), dated 20.03.2024.

2. Ministry of Mines, Notification, G.S.R. 106(E).—

In exercise of the powers conferred by section 11B of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957), the Central Government hereby makes the following rules further to amend the Atomic Minerals Concession Rules, 2016, namely:—

1. Short title and commencement.—

(1) These rules may be called the Atomic Minerals Concession (Amendment) Rules, 2024.

(2) They shall come into force on the date of their publication in the Official Gazette.

2.In the Atomic Minerals Concession Rules, 2016, in Schedule A, in the Table, items 1, 2, 4, 7, 8 and 11 and the entries relating thereto shall be omitted.

Source: The Gazette of India, Extraordinary, No. 97 Part II, Section 3-Sub section (i), dated 14.02.2024.

3. Ministry of Mines, Notification, G.S.R. 118(E).—

In exercise of the powers conferred by section 13 of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957), the Central Government hereby makes the following rules further to amend the Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016, namely:—

1. Short title and commencement.—

(1) These rules may be called the Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession (Second Amendment) Rules, 2024.

(2) They shall come into force on the date of their publication in the Official Gazette.

2.In the Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016, in rule 45, —

(i) for sub-rule (3), the following sub-rule shall be substituted, namely:—

"(3) The Indian Bureau of Mines shall publish average sale price of Tungsten Trioxide (WO_3) in Indian Rupees on the basis of prices published by the United States Geological Survey or other reputed publications for Tungsten concentrate for the latest available calendar year by multiplying such price of Tungsten concentrate with the following, namely:—

(i) average reference rate of Reserve Bank of India for the said calendar year, and

(ii) the conversion factor of 1.54.";

(iii) after sub-rule (6), the following sub-rules shall be inserted, namely:—

"(7) The Indian Bureau of Mines shall publish average sale price of Cadmium, Gallium, Indium, Rhenium, Selenium, Tellurium and Titanium in Indian Rupees on the basis of prices published by the United States Geological Survey or other reputed publications for the Cadmium metal, Gallium metal, Indium metal, Rhenium metal pellets, Selenium powder, Tellurium metal and Titanium sponge metal, as the case may be, for the latest available calendar year by multiplying such price with average reference rate of Reserve Bank of India for the said calendar year.

(8)The Indian Bureau of Mines shall publish average sale price of Beryllium in Indian Rupees on the basis of prices published by the United States Geological Survey or other reputed publications for the Beryllium-copper master alloy for the latest available calendar year by multiplying such price with the following, namely:—

(i) average reference rate of Reserve Bank of India for the said calendar year, and

(ii) the conversion factor of 25.

(9)The Indian Bureau of Mines shall publish average sale price of Tantalum in Indian Rupees on the basis of prices published by the United States Geological Survey or other reputed publications for Tantalite for the latest available calendar year by multiplying such price with the following, namely:—

(i) average reference rate of Reserve Bank of India for the said calendar year, and

(ii) the conversion factor of 1.22.

(10)The Indian Bureau of Mines shall publish average sale price of Vanadium Pentoxide in Indian Rupees on the basis of prices published by the United States Geological Survey or other reputed publications for the Vanadium Pentoxide for the latest available calendar year by multiplying such price of Vanadium Pentoxide with average reference rate of Reserve Bank of India for the said calendar year.".

Source: The Gazette of India, Extraordinary, No. 107, Part II, Section 3-Sub section (i), dated 20.02.2024.

4. Ministry of Mines, Notification, S.O. 1359(E).—

In exercise of the powers conferred by the second proviso to sub-section (1) of section 4 of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957), the Central Government hereby notifies the M/s. MECON Limited, a Central Public Sector Enterprise under the control of the Ministry of Steel, for the purposes of the said proviso subject to the condition that the said Public Sector Enterprise shall make available the data generated by it, in respect of the prospecting operations undertaken by it, to the concerned State Government.

2.This notification shall come into force on the date of its publication in the Official Gazette.

Source: The Gazette of India, Extraordinary, No. 1293, Part II, Section 3-Sub section (ii), dated 14.03.2024.

5. Ministry of Mines, Notification, G.S.R. 152(E).—

In exercise of the powers conferred by sub-section (3) of section 9 of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957), the Central Government hereby makes the following further amendments in the

Second Schedule to the said Act, namely:—

2.In the Second Schedule to the Mines and Minerals (Development and Regulation) Act, 1957,—

(i) after item 4 and the entries relating thereto, the following item and entries shall be inserted, namely:—

"4A.	Beryllium	Two per cent. of the average sale price of Beryllium metal chargeable on the Beryllium metal contained in the ore produced.";

(ii) in item 5, for the words, "Ilmenite, Rutile and Zircon", the words "Ilmenite and Rutile occurring in Beach Sand Minerals found in teri or beach sands" shall be substituted.

(iii) for item 6 and the entries relating thereto, the following item and entries shall be substituted, namely:—

"6.	Cadmium: Primary	Four per cent. of the average sale price of Cadmium metal chargeable on the Cadmium metal contained in the ore produced
	By-product	Two per cent. of the average sale price of Cadmium metal chargeable on the by-product Cadmium metal contained in the ore produced.";

(iv) after item 10 and the entries relating thereto, the following item and entries shall be inserted, namely

"10A.	Cobalt: Primary	Four per cent. of the average sale price of Cobalt metal chargeable on the Cobalt metal contained in the ore produced.
	By-product	Two per cent. of the average sale price of Cobalt metal chargeable on the by-product Cobalt metal contained in the ore produced.";

(v) after item 19 and the entries relating thereto, the following item and entries shall be inserted, namely:—

"19A.	Gallium: Primary	Four per cent. of the average sale price of Gallium metal chargeable on the Gallium metal contained in the ore produced.
	By-product	Two per cent. of the average sale price of Gallium metal chargeable on the by-product Gallium metal contained in the ore produced.";

(vi) after item 23 and the entries relating thereto, the following item and entries shall be inserted, namely:—

"23A.	Indium	Two per cent. of the average sale price of Indium metal chargeable on the Indium metal contained in the ore produced.";

(vii) after item 38A and the entries relating thereto, the following item and entries shall be inserted, namely:—

"38B.	Rhenium	Two per cent. of the average sale price of Rhenium metal chargeable on the Rhenium metal contained in the ore produced.";

(viii) after item 41 and the entries relating thereto, the following item and entries shall be inserted, namely:—

"41A.	Selenium: Primary	Four per cent. of the average sale price of Selenium metal chargeable on the Selenium metal contained in the ore produced.
	By-product	Two per cent. of the average sale price of Selenium metal chargeable on the by-product Selenium metal contained in the ore produced.";

(ix) after item 47 and the entries relating thereto, the following item and entries shall be inserted, namely:—

"47A.	Selenium: Primary	Four per cent. of the average sale price of Tantalum metal chargeable on the Tantalum metal contained in the ore produced
	By-product	Two per cent. of the average sale price of Tantalum metal chargeable on the by-product Tantalum metal contained in the ore produced
47B.	Tellurium:	Two per cent. of the average sale price of Tellurium metal chargeable on the Tellurium metal contained in the ore produced.";

(x) after item 48 and the entries relating thereto, the following items and entries shall be inserted, namely:—

"48A.	Titanium (produced from ores other than Brown Ilmenite (Leucoxene), Ilmenite and Rutile occurring in Beach Sand Minerals found in teri or beach sands):	
	(i) Primary	Four per cent. of the average sale price of Titanium metal chargeable on the Titanium metal contained in the ore produced.
	(ii) By-product	Two per cent. of the average sale price of Titanium metal chargeable on the by-product Titanium metal contained in the ore produced.";

"49.	Tungsten:	Three per cent. of the average sale price of Tungsten Trioxide (WO_3) on contained WO_3 per tonne of ore on pro rata basis";

(xi) for item 49 and the entries relating thereto, the following item and entries shall be substituted, namely:—

(xii) for item 51 and the entries relating thereto, the following item and entries shall be substituted, namely:—

"51	Vanadium:	
	Primary	Four per cent. of the average sale price of Vanadium Pentoxide on contained V_2O_5 per tonne of ore on pro rata basis.
	By-product	Two per cent. of the average sale price of Vanadium Pentoxide on contained V_2O_5 per tonne of ore on pro rata basis.";

(xiii) after item 54 and the entries relating thereto, the following items and entries shall be inserted, namely:—

"54A.	Zircon:	Two per cent. of average sale price on ad valorem basis.".

Source: The Gazette of India, Extraordinary, No. 140, Part II, Section 3-Sub section (i), dated 01.03.2024

6. Ministry of Mines, Notification, G.S.R. 51(E).—

In exercise of the powers conferred by section 18 of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957), the Central Government hereby makes the following rules further to amend the Mineral Conservation and Development Rules, 2017, namely:—

1. Short title and commencement.— (1) These rules may

be called the Mineral Conservation and Development (Amendment) Rules, 2024.

(2) They shall come into force on the date of their publication in the Official Gazette.

2.In the Mineral Conservation and Development Rules, 2017 (hereinafter referred to as the said rules), in rule 4,—

(i)for sub-rule (1), the following sub-rule shall be substituted, namely:—

"(1) Every holder of a reconnaissance permit or prospecting licence or the preferred bidder selected for grant of composite licence or exploration licence, shall submit to the Controller General or the authorised officer a scheme of reconnaissance or prospecting or both, as the case may be, within a period of ninety days from the date of execution of the permit or licence or issuance of letter of intent, indicating the manner in which he proposes to carry out the reconnaissance or prospecting operations or both in the area covered under the permit or licence.";

(ii)in sub-rule (2), in the opening para, after the words "reconnaissance or prospecting", the words "or both" shall be inserted.

3.In the said rules, in rule 5,—

(i)in sub-rule (1), —

(a) after the words "reconnaissance or prospecting", the words "or both" shall be inserted;

(b) after the words "composite licence", the words "or exploration licence" shall be inserted;

(ii)in sub-rule (2), after the words "composite licence", the words "or exploration licence" shall be inserted;

(iii)after sub-rule (2), the following sub-rule shall be inserted, namely:—

"(3) In case of exploration licence, a modified scheme of reconnaissance or prospecting or both shall be submitted to the Controller General or the authorised officer after three years from the date of execution of the licence, indicating the manner in which the licencee proposes to continue the reconnaissance and prospecting operations in the area retained under the licence under sub-section (11) of section 10BA.".

4.In the said rules, in rules 6 and 7, after the words "composite licence", the words "or exploration licence" shall respectively be inserted.

5.In the said rules, in rule 8,—

(i) in sub-rule (1), after the words "composite licence", the words "or exploration licence" shall be inserted;

(ii) in sub-rule (2),—

(a) after the words "composite licence", the words "or exploration licence" shall be inserted;

(b) after the words "prospecting operations", occurring at both the places, the words "reconnaissance or prospecting operations" shall be substituted.

6.In the said rules, in rule 9,—

(i) in the marginal heading, after the words "composite licence", the words "or exploration licence" shall be inserted;

(ii) for sub-rule (1), the following sub-rules shall be substituted, namely:—

"(1) Every holder of a reconnaissance permit or prospecting licence or composite licence or exploration licence shall submit to the Regional Controller or the authorised officer in this behalf, as the case may be, and to the State Government, a half-yearly report along with Form B of the Schedule-I as under, namely:—

(i) report of the operations undertaken from 1st January to 30th June or part period thereof to reach by 15th August of each year; and

(ii) report of operations undertaken from 1st July to 31st December or part period thereof to reach by 15th February of each year.

(1A) The exploration licencee shall, within three months of the completion of the operations for which licence has been granted, or from the date of expiry of the exploration licence, whichever is earlier, submit geological report to the State Government and to the Controller General or the authorised officer of the Indian Bureau of Mines, as the case may be, explaining the result of the reconnaissance and prospecting operations in the form of a geological report prepared under rule 5 of the Minerals (Evidence of Mineral Contents) Rules, 2015; identifying the area suitable for grant of a mining lease.";

(iii)for sub-rule (3), the following sub-rule shall be substituted, namely:—

"(3) Every agency authorised under the second proviso to sub-section (1) of section 4 shall submit to the State Government and the authorised officer a half-yearly report along with Form B of the Schedule-I as per the stipulated period provided in sub-rule (1).".

7. In the said rules, after rule 9, the following rule shall be inserted, namely:—

"9A. Restriction on disclosure of information, scheme and reports.— The holder of exploration licence shall not in any manner disclose the information, scheme and reports prepared under these rules or any other geological information related to reconnaissance or prospecting operations to any person other than the Government or authority specified in these rules or any other rules made under the Act, without prior approval of the Central Government.".

8. In the said rules, in rule 11, in sub-rule (4), the following proviso shall be inserted, namely:—

"Provided that if the mining or mineral processing operations in a mine is discontinued for a period exceeding two hundred and seventy days before the expiry of a period of five years for which the mining plan was approved on the last occasion; and the holder of the mining lease has submitted prescribed notice to the authorised officer and the State Government under rule 28, the holder shall not be required to submit mining plan for review during the period of such temporary discontinuation, but shall submit the mining plan for review and obtain approval of the competent authority on the same before reopening of the mine.".

9.In the said rules, in rules 12, 46, 47, 48, 50, 52, 53, 54, 55, 56, 59 and 64, after the words "composite licence", wherever they occur, the words "or exploration licence" shall be inserted.

10.In the said rules, in rule 35, in sub-rule (2), after the first proviso, the following shall be inserted, namely:—

"Provided that if the mining or mineral processing operations in a mine is discontinued for a period exceeding one hundred and eighty days during the previous financial year; and the holder of the mining lease has submitted prescribed notice to the authorized officer and the State Government under rule 28, the holder shall not be required to submit the report and images for the said previous financial year.".

11.In the said rules, in rules 36, 37, 41, 42 and 44, after the words "composite licence", wherever they occur, the words ", exploration licence" shall be inserted.

12.In the said rules, in rule 40, after the words "prospecting licence", the words ", composite licence, exploration licence" shall be inserted.

13.In the said rules, in rule 56, in sub-rule (1), for the words "prospecting", the words "reconnaissance or prospecting" shall be substituted.

14.In the said rules, in Schedule I,—

(i) in Form-A, Form-B, Form-H, Form-I, Form-J, Form-K and Form-N, after the words "composite licence", wherever they occur, the words "or exploration licence" shall be inserted;

(ii) in Form-A, Form-B, Form-H and Form-I, for the words, "Mineral Conservation Development Rules, 2016", the words and figures, "Mineral Conservation Development Rules, 2017" shall be substituted;

(iii)in Form-B, under the heading "IMPORTANT INSTRUCTIONS FOR FILLING THE FORM", for the first instruction, the following instruction shall be substituted, namely:—

"• This Form, duly filled in must reach the concerned authorities within the period specified in rules 9(1), 9(2) or 9(4), as the case may be.";

(iv)in Form-H, in entry 11, in clause (ii), after the words and symbol "Prospecting Licence/" the words and symbol "Composite licence/exploration licence" shall be inserted.

15.In the said rules, for Schedule II and Schedule III, the following shall be substituted, namely:—

SCHEDULE-II

[see rule 45(7A)]

AMOUNT TO BE PAID IN CASE OF VIOLATION UNDER RULE 45

Item	Amount (in ₹)	Explanation
1	2	3
Non-submission or incomplete/ wrong/false information in monthly returns in Form F1, F2, F3; by the due date	In case of leases having leased area up to 25 hectare and having per annum approved production capacity up to 2 lakh tonnes, ₹5,000/- per day after due date of submission of return as specified in the Rule till rectification of violation. For all other cases, ₹10,000/- per day after due date of submission of return as specified in the Rule till rectification of violation.	In case of referred back returns by Indian Bureau of Mines for incorporating necessary corrections, to be undertaken by the lease holder, and if corrected within the allotted time limit and accepted thereafter by the Indian Bureau of Mines, no amount will be payable for the intervening period for such corrections. Failure to rectify in such cases will attract the payment as specified.;
Non-submission or incomplete/ wrong/ false information in annual returns in Form G1, G2, G3; by the due date	In case of leases having leased area up to 25 hectare and having per annum approved production capacity up to 2 lakh tonnes, ₹ 5,000/- per day after due date of submission of return as specified in the Rule till rectification of violation. For all other cases, ₹10,000/- per day after due date of submission of return as specified in the Rule till rectification of violation.	
Non-submission or incomplete/ wrong/false information in monthly returns in Form L; by the due date	₹5,000/- per day after due date of submission of return as prescribed in the Rule till rectification of violation.	
Non-submission or incomplete/ wrong/false information in annual returns in Form M; by the due date	₹5,000/- per day after due date of submission of return as prescribed in the Rule till rectification of violation.	

SCHEDULE-III

[see rule 62(2)]

Rules whose contravention shall be punishable with fine

Rule No.	Marginal heading of the Rule	Amount of Fine for leases having leased area up to 25 hectare and having per annum approvedproduction capacity up to 2 lakh tonnes (in ₹)	Amount of Fine for the cases other than those covered in column (3)(in ₹)
1	2	3	4
Sub-rule (4) of rule 11	Mining operations under mining lease	1,000/- per day, subject to maximum 5,00,000/-	2,000/- per day, subject to maximum 5,00,000/-
12	Prospecting and mining operations	1,00,000/-	5,00,000/-
18	Beneficiation studies to be carried out	1,00,000/-	5,00,000/-
19	Machinery and plant	1,00,000/-	5,00,000/-
20	Notice for opening of mine	1,00,000/-	5,00,000/-
23	Submission of progressive mine closure plan	1,00,000/-	5,00,000/-
28	Notice of temporary discontinuance of work in mines and obligations of lease holders	1,00,000/-	5,00,000/-
29	Intimation of reopening of a mine	1,00,000/-	5,00,000/-
46	Notice of certain appointments	1,000/- per day, subject to maximum 1,00,000	2,000/- per day, subject to maximum 1,00,000/-
51	Notice of amalgamation of mining lease	1,000/- per day after due date as prescribed in the Rule, subject to maximum 1,00,000/-	2,000/- per day after due date as prescribed in the Rule, subject to maximum 1,00,000/-
55	Employment of geologists and mining engineers	1,00,000/-	5,00,000/-".

Source: The Gazette of India, Extraordinary, No. 45, Part II, Section 3-Sub-section (i), dated 21.01.2024

7. Ministry of Mines, Notification, S.O. 4796(E).—In exercise of the powers conferred by sub-sections (1) and (2) of section 16 read with section 17 and sub-section (3) of section 25 of the Bureau of Indian Standards Act, 2016 (11 of 2016), the Central Government is of the opinion that it is necessary so to do in the public interest and after consulting the Bureau of Indian Standards, hereby makes the following Order to amend the Copper (Quality Control) Order, 2023, namely: -

1. Short title and commencement – (1) This Order may be called the Copper (Quality Control) Amendment Order, 2023.

(2) It shall come into force on the date of its publication in the Official Gazette.

2.In the Copper (Quality Control) Order, 2023, in paragraph 1, for sub-paragraph (2), the following sub- paragraph shall be substituted, namely: -

"(2) This Order shall come into force with effect from 01.06.2024."

Source: The Gazette of India, Extra ordinary, No. 4598, Part II, Section 3-Sub section (ii), dated 03.11.2023

8. Ministry of Mines, Notification, S.O. 5091(E).— In exercise of the powers conferred by sub-sections (1) and (2) of section 16 read with section 17 and sub-section (3) of section 25 of the Bureau of Indian Standards Act, 2016 (11 of 2016), the Central Government is of the opinion that it is necessary so to do in the public interest and after consulting the Bureau of Indian Standards, hereby makes the following Order to amend the Nickel (Quality Control) Order, 2023, namely: -

1. Short title and commencement – (1) This Order may be called the Nickel (Quality Control) Amendment Order, 2023.

(2) It shall come into force on the date of its publication in the Official Gazette.

2.In the Nickel (Quality Control) Order, 2023, in paragraph 1, for sub-paragraph (2), the following sub- paragraph shall be substituted, namely: -

"(2) This Order shall come into force with effect from 01.06.2024."

Source: The Gazette of India, Extraordinary, No. 4874, Part II, Section 3-Sub-section (ii), dated 30.11.2023

9. Ministry of Mines, Notification, S.O. 5090(E).—In exercise of the powers conferred by sub-sections (1) and (2) of section 16 read with section 17 and sub-section (3) of section 25 of the Bureau of Indian Standards Act, 2016 (11 of 2016), the Central Government is of the opinion that it is necessary so to do in the public interest and after consulting the Bureau of Indian Standards, hereby makes the following Order to amend the Aluminium and Aluminium Alloys (Quality Control) Order, 2023, namely: -

1. Short title and commencement – (1) This Order may be called the Aluminium and Aluminium Alloys (Quality Control) Amendment Order, 2023.

(2) It shall come into force on the date of its publication in the Official Gazette.

2.In the Aluminium and Aluminium Alloys (Quality Control) Order, 2023, in paragraph 1, for sub-paragraph (2), the following sub-paragraph shall be substituted, namely: -

"(2) This Order shall come into force with effect from 01.06.2024."

Source: The Gazette of India, Extra ordinary, No. 4873, Part II, Section 3-Sub section (ii), dated 30.11.2023.

10. Ministry of Mines, Notification G.S.R. 48(E).— In exercise of the powers conferred under the second proviso to sub-section (1) of section 4 of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) and consequent upon accreditation provided by the National Accreditation Board for Education and Training of the Quality Council of India (QCI-NABET), the Central Government hereby notifies the following agencies as specified in the guidelines for notification of accredited private exploration agencies issued by the Government of India in the Ministry of Mines vide order no. M.VI-16/15/2021-Mines VI, dated the 12th August, 2021 (hereafter referred to as the said guidelines):

Serial Number	Exploration Agency	Category of Exploration Agency
1	M/s GEMS Project Pvt Ltd.	A
2	M/s Ramgad Minerals and Mining Limited	A
3	M/s Kundan Concentrates Private Limited	A
4	M/s PRB Infraprojects Private Limited	A

2.The agencies shall carry out prospecting operations in compliance with the conditions specified in the said guidelines.

3.This notification shall come into force on the date of its publication in the Official Gazette and shall remain valid for a period of three years from the date of notification or till expiry or termination of the accreditation granted, whichever is earlier.

Source: The Gazette of India, Extra ordinary, No. 42, Part II, Section 3-Sub section (i), dated 19.01.2024.

11.Ministry of Mines, Notification S.O. 5411(E).— In exercise of the powers conferred by sub-section (1) of section 8 of the Offshore Areas Mineral (Development and Regulation) Act, 2002 (17 of 2003), the Central Government hereby reserves the area to the extent of 10,277.10 hectares (102.77 sq. km) with the coordinates of the boundary points specified in the Table below in Arabian Sea off the coast of Daman for the purposes of the Central Government for grant of composite licence by the administering authority to the Jawaharlal Nehru Port Authority (an autonomous body under the Ministry of Ports, Shipping and Waterways) under sub-section (3) of section 8 of the said Act for exploration and production of sand for reclamation for the proposed development of greenfield port at Vadhavan in the District Palghar, Maharashtra.

Boundary Point Name (1)	Degree, Minute, Second (2)	
	Latitude	Longitude
A	20°20'0.6"N	72°15'0.72"E
B	20°23'0.6"N	72°15'0.72"E
C	20°23'0.6"N	72°16'0.84"E
D	20°24'0.36"N	72°16'0.84"E
E	20°24'0.36"N	72°17'0.96"E
F	20°26'0.6"N	72°17'0.96"E
G	20°26'0.6"N	72°18'0.72"E
H	20°27'0.36"N	72°18'0.72"E
I	20°27'0.36"N	72°19'0.84"E
J	20°28'0.12"N	72°19'0.84"E
K	20°28'0.12"N	72°22'0.84"E
L	20°25'0.48"N	72°22'0.84"E
M	20°25'0.48"N	72°21'0.72"E
N	20°24'0.36"N	72°21'0.72"E
O	20°24'0.36"N	72°20'0.96"E

Boundary Point Name (1)	Degree, Minute, Second (2)	
	Latitude	Longitude
P	20°22'0.48"N	72°20'0.96"E
Q	20°22'0.48"N	72°19'0.84"E
R	20°21'0.36"N	72°19'0.84"E
S	20°21'0.36"N	72°18'0.72"E
T	20°20'0.6"N	72°18'0.72"E

Source: The Gazette of India, Extraordinary, No. 5181, Part II, Section 3-Sub section (ii), dated 21.12.2023.

3. Status of Mineral Concession in India

As Under the Mines & Minerals (Development and Regulation) Act, 1957 and the Minerals (Other than Atomic and Hydrocarbons Energy Minerals) Concession Rules, 2016, the State Governments woul dgrant mineral concessions. A "mineral concession" means either a reconnaissance permit, prospecting licence, mining lease, composite licence or a combination of any of these and the expression "concession" shall be construed accordingly.

A "reconnaissance permit" (for the holder of a reconnaissance permit which was granted prior to January 12, 2015) means a permit granted for the purpose of undertaking reconnaissance operations. Reconnaissance Operations means any operations undertaken for preliminary prospecting of a mineral through regional, aerial, geophysical or geochemical surveys and geological mapping, but does not include pitting, trenching, drilling (except drilling of bore holes on a grid specified from time to time by the Central Government) or sub-surface excavation.

A "prospecting licence"(for the holder of a reconnaissance permit which was granted prior to January 12, 2015) means a licence granted for the purpose of undertaking prospecting operations. Prospecting Operations means any operations undertaken for the purpose of exploring, locating or proving mineral deposit.

A "composite licence" means the prospecting licence-cum-mining lease which is a two stage concession granted for the purpose of undertaking prospecting operations followed by mining operations in a seamless manner.

Also the State Governments are required to submit a copy of every mineral concession granted or renewed under the Act and rules made thereunder within two months of such grant or renewal to the Controller General, Indian Bureau of Mines and the Director General, Directorate General of Mines Safety under Rule 59 (1) of Minerals (Other than Atomic and Hydrocarbons Energy Minerals) Concession Rules, 2016. Additionally, the State Governments also have to submit a consolidated Annual Return of all mineral concessions granted or renewed under the Act and rules made thereunder to the Controller General, Indian Bureau of Mines, in such form as may be specified for the purpose and a copy shall also be supplied to the Director General, Directorate General of Mines Safety under Rule 59 (2) of Minerals (Other than Atomic and Hydrocarbons Energy Minerals) Concession Rules, 2016 not later than the 30th day of June following the year to which the return relates.

RECONNAISSANCE PERMITS, PROSPECTING LICENCES AND COMPOSITE LICENCES

No information from the State Governments/Union Territories is reported regarding grant of reconnaissance permit/ prospecting lincence/ composite licence for minerals (other than Atomic Minerals, Coal, Lignite, Petroleum, Natural Gas and Minor Minerals) during the period.

MINING LEASES

Section 3 (c) of the Mines & Minerals (Development & Regulation) Act 1957 defines "Mining Lease" (ML) is a lease granted for the purpose of undertaking mining operations and includes a sub-lease granted for such purpose. The Act defines "mining operations" as any operations undertaken for the purpose of winning any mineral.

The status of mining leases of 34 Metallic and Non-metallic minerals (excluding Atomic Minerals, Coal, Lignite, Petroleum, Natural Gas and Minor Minerals) as on 31.3.2023 (P) indicates that 3,007 mining leases were in force in the country in 22 States covering an area of 2,82,356.54 hectares.

The statewise summary of existing mining leases as on 31st March 2021, 2022 and 2023 is detailed in Table-1. The mineral-wise summary of existing mining leases as on 31.3.2023 (P) is furnished in Table-2. Sectorwise distribution of mining leases as on 31.3.2023 (P) is furnished in Table-3. Areawisedistribution of Leases (frequency in Hect.) as on 31.3.2023 (P) is furnished in Table-4.

The statewise break up of mining leases as on 31.3.2022 as reflected in Table-1 indicates that Madhya Pradesh was leading with 598 mining leases followed by Tamil Nadu (456), Gujarat (432), Andhra Pradesh (376), Karnataka (293), Chhattisgarh (158), Rajasthan (145), Maharashtra (113), Odisha (118), Jharkhand (100) and Telangana (79).

Of the total mining lease area covered by different States, Madhya Pradesh (14.59%),Odisha (12.77%), Rajasthan (12.40%), Karnataka (11.63 %), Gujarat (9.67 %), Chhattisgarh (9.03%), Andhra Pradesh (9.00%), Jharkhand (6.40%), Maharashtra (3.95%) and Telangana (3.70%). These Ten States accounted for about 93.13% of the total mining lease area granted and the remaining 6.87% was accounted for by the rest of the 11 states and 1 UT.

During 2022-23, mining leases in force were in both private and public Sectors which included Central and State Government Undertakings. Out of the total 3,077 mining leases in force in the country, 2,766 (91.98%) mining leases with an area of 2,06,590.78 hectares (73.16%) are in the Private Sector and the remaining 241 (8.01%) with an area of 75,765.76 hectares (26.83%) are in the Public Sector.

In the Metallic Minerals, Ferrous group of minerals includes iron ore, manganese ore, chromite, while the Non-ferrous group of minerals comprises bauxite, copper ore, lead & zinc ores, molybdenum, nickel, tin and the noble metals which include gold, silver and platinum group of metals. Mining Leases and Composite Licences granted through Auction during 2022-23 is given in Table-5.

Table-1 : Existing Mining Leases*as on 31st March 2021, 2022 and 2023 (P)

(By States)

State	as on 31.03.2021		as on 31.03.2022 (P)		as on 31.03.2023 (P)	
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)
India	**334**	**306398.76**	**3095**	**278008.94**	**3007**	**282356.54**
Andhra Pradesh	400	26743.81	379	25450.49	376	25411.77
Assam	7	889.5	7	889.5	7	889.5
Bihar	1	53.38	1	53.38	1	53.38
Chhattisgarh	181	25062.33	175	26210.55	158	25491.13
Goa	11	528.49	9	442.49	9	439.79
Gujarat	415	27535.8	440	26836.82	432	27300.96
Himachal Pradesh	42	2459.78	40	2448.58	40	2448.61
Haryana	4	46.85	4	46.85	4	46.85
Jammu & Kashmir**	37	2020.43***	37	2020.43***	38	2146.76
Jharkhand	122	19902.95	100	18068.24	100	18068.28
Karnataka	313	34984.36	298	33047.05	293	32830.72
Kerala	5	432.4	5	421.65	5	421.65
Meghalaya	21	789.34	21	789.34	23	1061.39
Madhya Pradesh	714	44342.37	613	37838.75	598	41196.77
Maharashtra	164	14540.58	130	12872.74	113	11149.17
Odisha	154	49587.23	117	33872.45	118	36066.91
Rajasthan	163	33561.83	168	34528.73	145	35007.52
Tamil Nadu	463	9170.16	459	9158.7	456	9097.96
Telangana	82	10485.4	80	10227.38	79	10442.61

Table- 1 (Concld.)

State	as on 31.03.2021		as on 31.03.2022 (P)		as on 31.03.2023 (P)	
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)
Uttar Pradesh	4	2960.19	4	2579.56	4	2579.55
Uttarakhand	7	191.79	7	191.79	7	191.79
West Bengal	1	13.47	1	13.47	1	13.47

** Excluding Atomic Minerals, Coal, Lignite, Petroleum and Natural Gas & Minor Minerals*
Source: Data received from various State Governments,
Respective State Government (DGMS/DMGS ete).
*** formed a new Union Territoty to be known as the Union Territory of Jammu & Kashmir vide Gazette Notification No. 53, New Delhi, the 9th August, 2019/Shravana 18, 1941 (Saka)*
**** Including mining lease in Ladakh U/T).*
Ladakh (U/T)
Note:- The data received from respective regional offices of IBM have also been taken in account wherever necessary.
(P): Provisional

Table-2 : Existing Mining Leases*

(By Minerals)

Sl. No.	Mineral	No. of Leases	Lease Area (ha)
1	Amethyst	2	5.83
2	Apatite	1	13.47
3	Bauxite	318	22334.73
4	Borax	1	159
5	Chromite	19	3293.08
6	Copper ore	9	3916.85
7	Diamond	2	275.96
8	Emerald	1	46.32
9	Epidote	1	4.05
10	Fluorite	10	489.86
11	Garnet	23	133.29
12	Gold	10	6934.46
13	Graphite	32	1314
14	Iolite	4	59.24
15	Iron ore	319	51817.41
16	Kyanite	14	223.81
17	Lead & zinc ore	11	7274.25
18	Limeshell	25	1072.15
19	Limestone	1815	165118.97
20	Magnesite	34	2303.79
21	Manganese ore	216	10535.84
22	Moulding sand	6	39.24
23	Perlite	1	144.88
24	Rock phosphate	7	1534.24
25	Rock salt	1	8.12
26	Sapphire	1	673.4
27	Semi-precious stones	16	251.88
28	Selenite	4	625.35
29	Siliceous earth	21	186.75
30	Sillimanite	2	33.34
31	Stibnite	1	40.47
32	Tin	15	319.17
33	Vermiculite	52	914.65
34	Wollastonite	13	258.69
	Total	**3007**	**282356.54**

** Excluding Atomic Minerals, Coal, Lignite, Petroleum and Natural Gas & Minor Minerals*
Source: Data received from various State Governments
Note:- The data received from respective regional offices of IBM have also been taken in account wherever necessary.
(P): Provisional

Table – 3 : Existing Mining Leases* as on 31.3.2023(P)

(By Sectors)

Sector	No. of Leases	Percent (%)	Area (ha)	Percent (%)
Total	**3007**	**100**	**282356.54**	**100**
Public	241	8.01	75765.76	26.83
Private	2766	91.98	206590.78	73.16

**Excluding Atomic Minerals, Coal, Lignite, Petroleum and Natural Gas & Minor Minerals*
Source: Data received from various State Governments

Table– 4 : Area Wise Status of Lease (Frequency In Hect.) (Other than Atomic, Hydro Carbons Energy & Minor Minerals)

as on 31.3.2023 (P)

(All India)

Frequency In (ha)	No. of Leases	Lease Area (ha)
0 to 2	368	477.95
>2 to 5	809	3135.74
>5 to 10	353	2594.36
>10 to 20	319	4661.15
>20 to 50	388	12680.12
>50 to 100	231	16707.48
>100 to 200	182	26016.43
>200 to 500	197	64146.87
Above 500	160	151936.44
Total	**3007**	**282356.54**

Source:- Respective State Government (DGMS/DMGS ete).
Note:- The data received from respective regional offices of IBM have also been taken in account wherever necessary.

Table – 5: Mining leases and composite licenses granted through auction during the year 2022-23.

S. No.	State	Name of the Block	Mineral	Date of auction	ML/CL	Area (In Ha)
1	Andhra Pradesh	Chinnabantupalli	Manganese	22.04.2022	ML	44.53
2	Andhra Pradesh	Nanda	Manganese	21.04.2022	CL	204
3	Andhra Pradesh	Mulagapadu	Manganese	21.04.2022	CL	402
4	Andhra Pradesh	Garikapeta	Manganese	21.04.2022	CL	460
5	Andhra Pradesh	Sivannadoraval	Manganese	21.04.2022	CL	420
6	Andhra Pradesh	Budharayavalasa	Manganese	22.04.2022	CL	638
7	Andhra Pradesh	Batuva	Manganese	22.04.2022	CL	243
8	Andhra Pradesh	Peddalingalavalasa	Manganese	22.04.2022	CL	472
9	Andhra Pradesh	Ramagiri North	Gold	31.10.2022	CL	N.A.
10	Andhra Pradesh	Ramagiri South	Gold	31.10.2022	CL	N.A.
11	Andhra Pradesh	Boksampalli South	Gold	31.10.2022	CL	N.A.
12	Chhattisgarh	Dallirajhara	Iron Ore	04.05.2022	ML	80
13	Chhattisgarh	Serangdag Block	Bauxite	06.05.2022	ML	93.85
14	Chhattisgarh	Kalwar Block	Iron Ore	06.05.2022	ML	23.72
15	Chhattisgarh	Kesada Eklama Chelikama	Iron Ore	10.05.2022	ML	755.039

Table- 5 (Cont.)

S. No.	State	Name of the Block	Mineral	Date of auction	ML/CL	Area (In Ha)
16	Chhattisgarh	Dondi Iron Ore Block	Iron Ore	01.08.2022	CL	25.26
17	Chhattisgarh	Thakurtola Iron Ore Block	Iron Ore	03.08.2022	CL	82.849
18	Chhattisgarh	Sapnadar Bauxite (A,B,C) Block	Bauxite	10.08.2022	ML	101.85
19	Chhattisgarh	Kandraja Bauxite Block	Bauxite	12.08.2022	ML	89.738
20	Chhattisgarh	Godhatola Iron Ore Block	Iron Ore	02.11.2022	CL	300
21	Chhattisgarh	Laladhurwa -Jognipali Limestone Block	Limestone	24.11.2022	ML	200.9
22	Chhattisgarh	Kelwardabri	Ni, Cr and associated PGE Minerals	22.12.2022	CL	N.A.
23	Chhattisgarh	Tendubhata	Iron Ore	23.12.2022	CL	N.A.
24	Chhattisgarh	Sandi, Rajnandgaon	Limestone	03.03.2023	ML	404
25	Chhattisgarh	Bhalukona – Jamnidih, Mahasamund	Ni, Cr and associated PGE Minerals	07.03.2023	CL	3000
26	Chhattisgarh	Damchua	Bauxite (M)	14.03.2023	CL	600
27	Chhattisgarh	North of Surbena- Khajri	Bauxite (M)	15.03.2023	CL	600
28	Chhattisgarh	Hahaladdi, North BastarKanker	Iron Ore	22.03.2023	CL	42.63
29	Chhattisgarh	Lohhater,North Bastar Kanker	Iron Ore	27.03.2023	CL	40
30	Chhattisgarh	Kennapara	Graphite	29.03.2023	CL	2400
31	Chhattisgarh	Murka Basera	Graphite	31.03.2023	CL	2400
32	Goa	Bicholim Mineral Blocks	Iron Ore	14.12.2022	ML	478.52
33	Goa	Sirigao-Mayem Mineral Block	Iron Ore	15.12.2022	ML	171.25
34	Goa	Monte De Sirigao Mineral Block	Iron Ore	16.12.2022	ML	95.67
35	Goa	Kalay Mineral Block	Iron Ore	21.12.2022	ML	179.18
36	Karnataka	ChittapurSw Limestone Block	Limestone	11.05.2022	CL	438
37	Karnataka	Satanur Limestone Block	Limestone	12.05.2022	CL	503.32
38	Karnataka	Sulhalli Limestone Block	Limestone	13.05.2022	CL	502.13
39	Karnataka	M/s Tiffin Barytes Asbestos & Paints Ltd, ML No 2293	Iron Ore	03.02.2022	ML	191.3
40	Karnataka	ML No. 2585 Thangavelu& Others	Iron Ore	01.09.2022	ML	60.92
41	Karnataka	M/s Ramgad Minerals & Mining (P) Ltd , ML. No. 2451	Iron Ore	01.09.2022	ML	24.04
42	Karnataka	Sri M Srinivasulu, ML.No. 2631	Iron Ore	02.09.2022	ML	75.14
43	Karnataka	Somanahalli Block	Iron Ore	20.03.2023	ML	190.13
44	Karnataka	Jaisinghpura South Block	Iron Ore	24.03.2023	ML	297.38
45	Karnataka	Vyasanakere Block	Iron Ore	28.03.2023	ML	405.4
46	Karnataka	Udagi	Limestone	30.03.2023	ML	646.34
47	Madhya Pradesh	Jam	Manganese	19.04.2022	CL	6.81
48	Madhya Pradesh	Pahari Narora-Tiloura-Tanaja Bansipur	Limestone	19.04.2022	ML	256.998

Table-5 (Cont.)

S. No.	State	Name of the Block	Mineral	Date of auction	ML/CL	Area (In Ha)
49	Madhya Pradesh	Pipariya Mal	Bauxite	19.04.2022	ML	273.215
50	Madhya Pradesh	Botejhari	Manganese	20.04.2022	CL	6.094
51	Madhya Pradesh	Dhaukan-Dhaurra-Urdaurra	Iron Ore	20.04.2022	ML	153.031
52	Madhya Pradesh	Pahari, Narora, Tiloura	Limestone	20.04.2022	ML	227.55
53	Madhya Pradesh	Baruyee	Bauxite	21.04.2022	ML	9.049
54	Madhya Pradesh	AtarharaParsokha	Limestone	21.04.2022	ML	349.172
55	Madhya Pradesh	Kubri	Bauxite and Limestone	22.04.2022	CL	12.44
56	Madhya Pradesh	Jamuwanikala	Bauxite	26.04.2022	CL	6.313
57	Madhya Pradesh	Bajna Iron Ore	Iron Ore	26.07.2022	ML	96
58	Madhya Pradesh	Khudawal Iron Ore and Manganese Ore	Iron Ore	26.07.2022	ML	11.02
59	Madhya Pradesh	Kachaldara Rock Phosphate	Rock Phosphate	27.07.2022	CL	19.36
60	Madhya Pradesh	RupakhedaPiplouda Rock Phosphate	Rock Phosphate	26.07.2022	CL	50
61	Madhya Pradesh	GhoraChitawara Limestone	Limestone	26.07.2022	CL	606
62	Madhya Pradesh	Bhatia Limestone Block	Limestone	03.01.2023	ML	23.86
63	Madhya Pradesh	SukhaSatpara	Limestone	03.01.2023	ML	216
64	Madhya Pradesh	Rewara	Limestone	03.01.2023	ML	23.9
65	Madhya Pradesh	GurharPahar	Gold	03.01.2023	ML	149.3
66	Madhya Pradesh	Khatamba	Rock Phosphate	03.01.2023	CL	-
67	Madhya Pradesh	NandiaLoharpura	Manganese	03.01.2023	CL	21.387
68	Madhya Pradesh	Netara	Graphite	04.01.2023	CL	960
69	Madhya Pradesh	Budbuda	Manganese	04.01.2023	CL	5.204
70	Madhya Pradesh	Panihar Iron Ore Block	Iron Ore	05.01.2023	CL	
71	Madhya Pradesh	Dhobitala Manganese Ore Block	Iron Ore	06.01.2023	CL	
72	Madhya Pradesh	NaganwatBadi, Jhabua	Manganese	16.03.2023	CL	4.91
73	Madhya Pradesh	Patehra REE & Graphite	Graphite	16.03.2023	CL	36.7
74	Madhya Pradesh	WarjiriDadar and Bear Hill, Balaghat	Bauxite (M)	17.03.2023	ML	117.15

Table- 5 (Concld.)

S. No.	State	Name of the Block	Mineral	Date of auction	ML/CL	Area (In Ha)
75	Madhya Pradesh	Kotpahar, Balaghat	Bauxite (M)	21.03.2023	ML	35.9
76	Maharshtra	Satarda	Iron Ore	01.04.2022	CL	1200
77	Maharshtra	Mauli	Iron Ore	06.04.2022	ML	24.26
78	Maharshtra	Lanjera-Futala block	Manganese	30.06.2022	CL	800
79	Maharshtra	Kondura block	Iron Ore	01.07.2022	CL	300
80	Maharshtra	Nanos block	Iron Ore	05.07.2022	CL	372
81	Maharshtra	Sasoli block	Iron Ore	06.07.2022	CL	2000
82	Odisha	Uskalabgu Block	Limestone	08.02.2023	ML	547.13
83	Odisha	Kutrumali Block	Bauxite	11.02.2023	ML	701.79
84	Odisha	Sijimali Block	Bauxite	09.02.2023	ML	1549
85	Odisha	Ballada Block	Bauxite	15.02.2023	ML	144.95
86	Odisha	Kendudhi North Block	Iron ore & Manganese	14.03.2023	ML	187.86
87	Odisha	Kedesala North East Block	Iron Ore	17.03.2023	ML	100.44
88	Odisha	Orahuri Block (E) Manganese & Iron Ore	21.03.2023	ML	50.203	
89	Odisha	Kusumdhi Block	Manganese	14.03.2023	ML	29.12
90	Rajasthan	4GI-a Nagaur	Limestone	11.04.2022	ML	610.86
91	Rajasthan	Bagawas block	Iron Ore	29.07.2022	ML	5.927
92	Rajasthan	Kala Khunta Manganese Block	Managnese	02.08.2022	CL	6.3
93	Rajasthan	Dhulkhera-Jipiya Block	Iron ore	07.09.2022	CL	868.68
94	Rajasthan	Rupakhera Block Banswara	Manganese	07.10.2022	CL	473.5
95	Rajasthan	Tambesra Block Banswara	Manganese	10.10.2022	CL	241
96	Rajasthan	Ramgarh Block, Jaisalmer	Limestone	14.11.2022	ML	256
97	Rajasthan	NimanaDunia	Limestone	20.01.2023	ML	299.15
98	Uttar Pradesh	SonraiPhosphorite Block V	Phosphorite	08.04.2022	CL	189
99	Uttar Pradesh	SonraiPhosphorite Block I, Lalitpur	Phosphorite	14.09.2022	CL	160
100	Uttar Pradesh	SonraiPhosphorite Block II- IV	Phosphorite	22.12.2022	ML	221
101	Uttar Pradesh	Dhurva-Biadand Block,Sonbhadra	Gold	23.12.2022	CL	

4. Exploration & Development

NATIONAL MINERAL POLICY

The Hon'ble Supreme Court in its judgment dated 02.08.2017 in the Writ Petition (Civil) No.114 of 2014 inter alia directed the Union of India to revisit the National Mineral Policy (NMP), 2008 and announce a fresh and more effective and meaningful policy.

In compliance with the directions of the Hon'ble Supreme Court, Ministry of Mines (MoM) vide its Order No. 15/1/2017-MV dated 14.08.2017 had constituted a Committee. The Committee included representatives from Central Ministries, State Governments, Industry Associates, Professional Bodies and it also consulted NGOs and many other Stakeholders. The Committee went about the consultative process with problem-solving approach and held four meetings wherein exhaustive discussions on the issues raised by the stakeholders were deliberated.

The Committee submitted its report to the Ministry on 31.12.2017. Based on the report submitted by the committee, Ministry of Mines prepared a draft National Mineral Policy (NMP), 2018 and uploaded it on the official website of the Ministry on 10.01.2018 for seeking comments/ suggestions from the stakeholders.

Based on the Committee's Report and the inputs received from stakeholders during subsequent consultations, the Ministry of Mines prepared the National Mineral Policy 2019. The Union Cabinet in its meeting held on 28.02.2019 approved the "National Mineral Policy 2019". The salient features of the "National Mineral Policy 2019" are as follows:

- It proposes to increase the production of MCDR minerals (in value terms) by 200% in 7 years. It also proposes to reduce trade deficit in Mineral Sector by 50% in 7 years.
- It aims to attract private investment through incentives like financial package, right of first refusal at the time of auction etc. or any other appropriate incentive as per international practice.
- Introduces the concept of Exclusive Mining Zones having in-principle statutory clearances for grant of mining lease. It also proposes to identify critically fragile ecosystem and declare such areas as 'no-go areas'/inviolate areas.
- It emphasises implementation of all relevant Acts/Rules related to rehabilitation & resettlement and welfare of tribal communities while grant of mineral concessions.
- Encourages States to auction mineral blocks with pre-embedded statutory clearances.
- To institutionalise the mechanism for ensuring sustainable growth of Mining Sector, an interministerial body is proposed.
- Endeavors shall also be made to grant mining the status of Industry.
- In case of small deposits of precious metals and basemetals, the establishment of common smelting and

refining facilities shall be encouraged.

- It seeks to align downstream regulations for the exploration, development and acquisition of overseas mineral assets for ensuring its adequate supply which are not available in the country.
- It focuses on a long-term export-import policy for the Mineral Sector to provide stability for investing in large-scale commercial mining activity.
- Efforts shall be made to benchmark and harmonise royalty and all other levies and taxes with mining jurisdiction across the world.
- It also introduces the concept of Inter-Generational Equity which is also recognised by the Hon'ble Supreme Court in various judgments.

MINERAL INVESTIGATIONS & EXPLORATION

Geological Survey of India (GSI)

Geological Survey of India (GSI) is an attached office of Ministry of Mines (MoM) and is responsible for mineral resource assessment of the country in addition to the updation of national geoscience information. Natural resource assessment is achieved through the mineral investigations and exploration by acquisition of surface and sub-surface data along with the available geoscience data, i.e., baseline geoscience data.

The exploration programmes of GSI for the field Season 2022-23, were prioritised based on the recommendations of CGPB meeting, CGPB committee meetings & SGPB meetings of different state and time to time guidelines received from MoM.

Mission II: Natural Resources Assessment is categorised into

1. Mission IIA: Mineral Resource Assessment (Non-energy)
2. Mission IIB: Natural Energy Resources (Coal, lignite, shale gas, geothermal etc.)

GSI as part of its activities carries out 'reconnaissance survey' [G4], 'preliminary exploration' [G3] and 'general exploration' [G2] [following the guidelines of United Nations Framework Classification (UNFC) and Mineral Evidence and Mineral Content Rules (MEMC)-2015].

During FS 2022-23, mineral exploration of the following commodities were prioritised: highest number of projects for Basemetals (Copper, Lead, Zinc), followed by Critical & Strategic minerals (Tin, Tungsten, Lithium, Antimony, Molybdenum, Nickel, Vanadium, REE, RM , Cobalt, Tantalum, Niobium, PGE), Precious (Gold, Diamond, Sapphire, Silver, Emerald), Industrial (Limestone, Graphite, Bauxite), Ferrous (Iron, Manganese, Chromite), Fertiliser (Potash/Glauconite, Gypsum, Phosphorite), Coal/ Lignite/ Shale Gas/ Geothermal, belonging to various states. Besides these, projects on RMT (regional mineral targeting), Uncover and research project on coal exploration were also taken up.

During FS 2022-23, total 319 programmes (including 12 exploration programmes of M&CSD) were taken up under Mission-II. The achievement made under Large Scale Mapping (LSM), Detailed Mapping (DM) and drilling pertaining to FS 2022-23 is tabulated below.

The details of exploration work carried out by GSI, National Aluminium Company Limited (NALCO) and The Singareni Collieries Company Limited (SCCL) are furnished in Tables-1 & 2 respectively.

Activity	Achievement
LSM (sq. km)	15995.55
DM (sq. km)	186.71
Drilling (meter)	180934.14

Table 1- Exploration carried out by GSI in 2022-2023

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Basemetal							
Madhya Pradesh, Gwalior	Around Lakhnauti and Ainti	-	-	9	1420.40 m	Drilling	A G-2 stage of investigation was carried out for exploration of copper and associated mineralisation. The mineralisation occurs in the form of disseminated and specks of pyrite, chalcopyrite and covellite within quartz veins. The estimated resource is as per below. (1) By cross section method (at 0.2% Cu cutoff): (a) estimated resource is 0.366 million tonnes with an average grade of 0.258% Cu in Lakhnauti block (b) estimated resource is 0.102 million tonnes with an average of 0.24% Cu in Ainti block (2) By longitudinal vertical section method (at 0.2% Cu cutoff): (a) estimated resource is 0.360 million tonnes with an average grade of 0.257% Cu in Lakhnauti block (b) estimated resource is 0.102 million tonnes with an average grade of 0.24% Cu in Ainti block.
Madhya Pradesh, Chhatarpur	Around Suwara and Dharampura areas	LSM: 1:12,500, DM: 1:2,000	-	5	-	Mapping, Sampling, Scout Drilling	A G-4 stage of exploration was carried out for copper and associated mineralisation. Chemical analysis of samples showed significantly anomalous values for Cu (840 ppm to 1.0%) and Au (25-225 ppb). Ore microscopic study revealed the presence of pyrite, chalcopyrite, chalcocite, covellite and bornite as important sulphide minerals

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Madhya Pradesh, Tikamgarh	Durren kheda, Bheronobar, and Dikoli areas	1: 12,500	100 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for Cu-associated basemetal mineralisation, and barite in Bundelkhand Granitoid Complex. Surface indication of Ba and Cu mineralisation occurs in the form of baryte, pyrite, chalcopyrite, covellite, malachite, bornite, etc. Samples BRS-06 and BRS-14 were collected from Chakarda Pahar Q-B vein which show the analytical values of barium up to 166993 ppm and Cu up to 4700 ppm. Near Chiriya Pahar, BRS-15 shows the Cu analytical values of the Q-B vein is 650 ppm.
Maharashtra, Gondia	In and around Tikaitpur-Kharipar area	1:12,500	100 sq. km	-	-	Mapping, Sampling, Trenching	A G-4 stage of exploration was carried out for Cu and associated elements. From ore petrographic study and SEM-EDX study of the Kharipar quartz reef minerals like Chalcopyrite, Pyrite, Pyrrhotite, Chalcocite, Covellite, Galena, Magnetite, Hematite, Barite, Arsenopyrite, Bismuth, Gold and Tungsten were identified. From Kharipar quartz reef 11 Nos. bedrock samples (with Cu >750 ppm) showed 754 ppm to 0.38% Cu concentration.
Maharashtra, Bhandara	Nerla-Adyal area	1:12,500	100 sq. km	1	150 m	Mapping, Sampling, Scout Drilling	A G-4 stage of exploration was carried out for copper-gold and associated basemetal mineralisation. Mineralisation consists of chalcopyrite, pyrite, bornite and covellite. Analytical results of 55 bedrock samples from the mineralised body of acid metavolcanics show copper value ranges from 10 ppm to 5.75 % with an average of 4151 ppm of Cu. The 22 channel samples from the same rock show copper value ranges from 50 ppm to 2.30 % with an average of 7805 ppm. Out of 12 BRS from the Segaon quartz vein only one sample show 940 ppm Cu and one sample show 990 ppb of gold. Out of 10 BRS from Itgaon quartz vein, only two samples show 1200 and 1400 ppm Pb.
Maharashtra, Chandrapur	Motegaon-Aregaon area	-	-	2	-	Sampling, Pitting, Trenching and Drilling	A G-3 stage of exploration was carried out for copper and associated mineralisation. Sulphide minerals mainly comprise chalcopyrite and pyrite.
Madhya Pradesh, Betul and Chhindwara	Ghana, Bamla, Badur, Khande-Pipariya and Bordehi area	1:12,500	100 sq. km	1	135 m	Mapping, Sampling, Trenching, Drilling	A G-4 stage of exploration was carried out for basemetal, vanadium and associated metal. The maximum concentration of Zn, Cu and Pb observed based on analytical data of the samples collected in and around Ghana, Ghurela and Ghatawari area are 5000 ppm, 2325 ppm and 1410 ppm respectively.
Madhya Pradesh, Chhindwara	Charaneti, Dhagariya, Bargona and Bicchua area	LSM: 1:12,500, DM: 1:2,000	LSM: 50 sq. km, DM: 0.5 sq. km			Mapping, Sampling	A G-4 stage of exploration was carried out for basemetal mineralisation. Few of the BRS samples have given values for Zn ranging from 600 ppm to 1250 ppm and in detailed soil samples have given values for Zn ranging from 100 ppm to 1120 ppm. Channel no. 3 with eight channel samples showed promising Pb values ranging from 500 ppm to 2400 ppm and Zn values upto 715 ppm.
Madhya Pradesh, Chhatarpur	Nayakhera-Bamnaura area	1:12,500	100 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for basemetal and associated mineralization. The most significant and intense (Cu) mineralisation was observed in the form of malachite, azurite/chrysocolla and specks of chalcopyrite. The analytical results show the presence of anomalous concentration of copper in dolomite, ranging from 400 ppm to 13230 ppm, with an average of 1461 ppm.
Madhya Pradesh, Chhatarpur	Satai, Kasar, Bhaira (Bela Pahar) areas	1:12,500	-	-	-	Mapping, Trenching, Sampling	A G-4 stage of exploration was carried out for basemetal and associated mineralisation. The analytical results of BRS sample yielded 1.24% Cu and Ba content ranged from 220 to 486 ppm with total REE content varied up to 676.68 ppm.
Madhya Pradesh, Chhatarpur	Lakhanwan and Nandgawan areas	1:12,500	50 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for Basemetal, REE and associated mineralisation. The chemical data showed 846 ppm of REEs. Except from alkaline body of north of Baharganj no encouraging values of REE & basemetal has been observed from the study area.
Madhya Pradesh, Chhatarpur	Ragauli, Dhargawan and Vijaypur areas	-	-	-	-	Sampling	A G-4 stage of exploration was carried out for basemetal, REE and associated mineralisation. High ΣREE values (403.69-677 ppm) for BRS samples are recorded from small veins of syenites. Alkali felspar granite vein observed nearly 500 m north-west of Nayagoan village showed a ΣREE value of 413.35 ppm and 1.5km south of Kacche Ki Chauki village showed a ΣREE value of 410.89 ppm. BRS sample from Pegmatite vein, 3km

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
							north of Dhargawan village gives a ΣREE 658.98ppm. Copper value in BRS samples in 40 samples ranged from 05 ppm to 0.1023%. Five soil sediment samples collected from various coarse grained granite soil profile showed ΣREE ranging from about 393.26 to 578.22 ppm.
Chhattisgarh, Rajnandgaon	Chirchari-Musuljob area	1:12,500	50 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of exploration was carried out for basemetal. In ore microscopic study, majority of disseminated sulphides are galena, sphalerite and chalcopyrite. Samples collected from trench showed low content of Pb, Zn and Cu (<600 ppm). Channel samples collected from the mineralised showed some sporadic higher values of Zn (10 ppm to 0.31%), Pb (10 ppm to 0.23%) and Cu (10 ppm to 390 ppm).
Chhattisgarh, Rajnandgaon	Khursipar-Kotnapani area	1:12,500	51 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of exploration was carried out for basemetals. Analytical result of 59 channel samples indicated the value of Pb varies from 20 ppm to 3.75%, Zn varies from 10 ppm to 0.16% and Cu varies from 10 ppm to 0.12%. Total Metal Content (TMC) including lead, zinc and copper value ranged from 40 ppm to 3.8175%. Silver value varies from 1 to 6 ppm.
Chhattisgarh, Surguja	Ajirma-Semardih-Nagam block	-	-	-	-	Sampling	A G-4 stage of exploration was carried out for basemetal and associated mineralisation. This work emphasises the preparation of a large-scale map (1:12,500), and different alteration maps with the help of satellite data along with the collection of bedrock, channel, petrological, petrochemical, stream sediment, and trench/pit samples and to determine the basemetal potential of the area along with other possible mineral occurrences.
Maharashtra, Bhandara	Khedepar–Lakhni area	1:12,500	50 sq. km	1	110 m	Mapping, Trenching, Scout Drilling	A G-4 stage of exploration was carried out for basemetal and associated mineralisation. The mineralised zone is characterised by the presence of disseminations of pyrite, chalcopyrite and pyrrhotite. Bedrock samples yielded values from 577 ppm (Cu) to maximum value up to 1.78 % Cu with average 0.4% Cu. Cu values in all five mineralised zones vary from 30 ppm to 1250 ppm with avg. min. Cu value is 204 ppm to avg. max 687 ppm. Results of bedrock samples and trench samples indicated copper values up to 351 ppm and zinc value of 1100 ppm Zn. Results of the soil samples indicated a maximum copper value up to 240 ppm Cu.
Maharashtra, Gadchiroli	Kalamgaon area	1:12,500	50 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of exploration was carried out for basemetal and associated mineralisation. Ore microscopy study shows sulphide minerals such as chalcopyrite, bornite, covellite and pyrite are occurring in disseminated form and are fracture or vein filled. The chemical analysis BRS samples collected from the mineralised zone of Ramsagar quartz reef shows copper values ranging from 150 ppm to 5500 ppm with an average value of 1166 ppm Cu. Other basemetals (Pb, Zn, Co, Ni, Ag and Au) have yielded poor concentration.
Maharashtra, Chandrapur and Gadchiroli	Jungaon-Gowardhan area	-	-	-	-	Sampling	A G-4 stage of exploration was carried out for basemetal and associated mineralisation. The chemical analysis of BRS collected from Gowardhan quartz reef shows an average of 254 ppm Cu (minimum-23 ppm and maximum- 760 ppm), 18 ppm Pb and 35 ppm Zn. Channel sampling in the northern part of the reef show some considerable values of Cu varying from 120 ppm to 920 ppm with an average of 619 ppm.
Odisha, Mayurbhanj	Kanjia block	-	1.2 sq. km	7	1348.30 m	Mapping, Pitting/ Trenching, Sampling, Drilling	A G-3 stage of exploration was carried out for copper and associated precious metals. Analytical results show significant gold value both in trench and borehole samples. The borehole ODKJ-1 has intersected a maximum of 0.11% of Cu and 0.19 ppm of Au (a lode having 5 m x 0.12 ppm of Au at 0.10 ppm). In ODKJ-06 the basemetal analysis shows 5m x 0.14% of Cu and 1m x 0.22% Cu.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Odisha, Mayurbhanj	In parts of Romapahari granite around Jharpokhria sector	-	-	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for copper and associated metals. Chalcopyrite and pyrite mineralisation associated with sheeted veinlet zone hosted within mafic-ultramafic schist and mylonitised granite is recorded. Depending on the pending analytical results, systematic drilling may be proposed in the area for copper, nickel and associated mineralisation.
Bihar, Jamui and Banka	Baghmari-Ambakola-Bhorsar-Phaga-Chandaipati areas	-	108 sq. km	5	421.85 m	Mapping, Pitting, Trenching, Sampling, Scout Drilling	A G-4 stage of exploration was carried out for basemetal mineralisation. In the Ambakola block, analytical results from BRS indicate copper (Cu), lead (Pb), and zinc (Zn) values of up to 1.15%, 3.5%, and 1.7%, respectively, while PTS (pitting and trenching samples) reveal values of up to 0.22% Cu, 0.85% Pb, and 0.15% Zn. In the Baghmari block, BRS analysis yields Cu, Pb, and Zn values of up to 0.2%, 1.99%, and 0.53%, respectively, with PTS analysis reaching up to 0.13% Cu, 0.06% Pb, and 0.25% Zn.
Jharkhand, Giridih	In and around Rakhawat-Paharpur-Dhibra area	-	-	3	-	Mapping, Trenching, Sampling, Scout Drilling	A G-4 stage of exploration was carried out for basemetals (Pb-Zn-Cu) and associated minerals. The reconnaissance survey in the Rakhawat-Paharpur-Dhibra area of Giridih District, Jharkhand revealed the presence of basemetals and associated minerals, highlighting the area's potential for further exploration and mining activities, particularly in copper and gold.
West Bengal, Jhargram	Around Katra-Benghuta block in parts of Dalma volcanic belt and Proterozoic fold belt	1:2,000	2.55 sq. km	4	538.2 m	Mapping, Pitting/ Trenching, Sampling, Drilling	A G-3 stage of exploration was carried out for basemetals (Cu, Pb) and associated mineralisation. Surface sampling efforts encompassed the collection of a total of 87 channel samples and 50 pitting trenching samples from the study area.
West Bengal, Purulia	Mudidih-Laka-Taladih-Chirudih	-	-	-	-	Sampling	A G-4 stage of exploration was carried out for basemetal and gold. Chemical analysis reveals notable copper (Cu) concentrations, with a maximum of 1083 ppm in cherty quartzite around Jamunabad and 1099 ppm in tuffs near Taladih. The highest lead (Pb) value of 1001 ppm is found in a quartz vein traversing tuffaceous rocks near Taladih. Extensive panning of stream sediments yielded multiple gold dots and flakes.
Haryana Mahendragarh and Rajasthan, Alwar	Bihali-Mandhan area	1:12,500	50 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of exploration was carried out for basemetal and associated REE-RM mineralisation. The highest Cu value observed is 1.4%.
Jammu & Kashmir (UT), Doda and Udhampur	In and around Hambal area	1:12,500	30 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for basemetal mineralisation. Analytical results of channel – 1 (MZ-1) in phyllite indicate a concentration of vanadium (20 to 566 ppm, weighted average = 293.4 ppm) and Zn (22 to 707 ppm, weighted average = 234.7 ppm) in a zone of about 40 m thickness and 200 m strike length. The basemetals in channel - 2 (MZ-2), in quartz vein of about 25m in width and 50m in strike length, show values of Cu (118 to 1066 ppm, weighted average = 483 ppm), Pb (10 to 1374 ppm, weighted average = 235.7), Zn (101 to 1086 ppm, weighted average = 253.3 ppm), and Sn (59.7 to 391.1 ppm, weighted average =148.4 ppm).
Uttarakhand, Chamoli and Rudraprayag	Langashu-Pokhri area	1:12,500	50 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for basemetal and associated mineralisation. BRS and channel samples results up to 10230 ppm Cu, 8554 ppm Zn, 1381 ppm Pb, 340 ppm Sb, 82 ppm Mo, 933 ppm W, 15 ppm Bi, 27 ppm Cs, 7 ppm Tl, 0.85 ppm Te, 776 ppm Ni and 296 ppm Co in different samples.
Andhra Pradesh, Prakasam	Krishnare-ddipalle-Nagire-ddipalli area	1:12,500	110 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of exploration was carried out for basemetal and associated mineralisation. During the investigation, a comprehensive survey was conducted, along with systematics bedrock sampling (108 nos), soil sampling (25 nos), stream sediment sampling (25 nos) and excavated trenches across the geophysical anomaly zone and in extension of Gajjelakonda old working (58 nos).

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Andhra Pradesh, Nellore	Kondakuru-Kondagunta-Golapalle area	1:12,500	-	-	-	Mapping, Trenching, Sampling	A G-4 stage of exploration was carried out for basemetal and associated mineralisation.Promisingly, copper concentrations exceeded 1.13% Cu in some areas, with trench samples averaging 730 ppm Cu. Additionally, chromite values reached 3500 ppm. In Kondakoru village, a mineralised zone of 1.2 km by 0.7 km was identified, with potential for further extension northward. The survey highlighted significant basemetal potential in Kondakuru and REE/ RM potential in Palicherla, warranting further exploration and study in these respective areas.
Andhra Pradesh, Prakasam	Ganapa-varam Kottapalle area of Cuddapah Supergroup	1:12,500	110 sq. km	-	-	Mapping, Pitting, Trenching, Sampling	A G-4 stage of exploration was carried out for basemetal mineralisation. The chemical analysis of channel samples revealed Cu values >10ppm to 0.12% with a mean value of 244.08 ppm, Pb values between >10ppm to 2.32% with a mean value of 1879.118 ppm and zinc values of 30 ppm to 660 ppm with a mean value of 115.36 ppm. In SEM studies chalcopyrite, galena, sphalerite, pyrite, chalcocite, covellite, cuprite has been identified.
Andhra Pradesh, YSR Kadapa	Jaukulapalle block	-	0.8 sq. km	-	3973 m	Mapping, Drilling	A G-2 stage of exploration was carried out for Lead & Zinc mineralisation. Galena and sphalerite ore minerals occur as lenses, veinlets, stringers, vugs filling and in dissemination forms. The resources of 1.67Mt (@2% cut off) with 7 25% (Pb+Zn) grade, 1.34Mt (@3% cut off) with 8.46% (Pb+Zn) grade, 1.01Mt (@4% cut off) with 10.17% (Pb+Zn) grade and 0.96Mt (@5% cut off) with 10.44% (Pb+Zn) grade have been calculated in Jaukulapalle block.
Karnataka, Yadgir	Hunasihuli Block	1:2,000	2.1 sq. km	-	-	Mapping, Sampling, Drilling	A G-3 stage of exploration was carried out for Cu-Au mineralisation. During drilling at 200m intervals, a 525m long ore body consisting of low grade copper mineralisation was demarcated with a 0.2% Cu cutoff. Copper resource of 1.70mt and 1.91mt with average grade of 0.3% Cu was estimated by cross section area and longitudinal vertical section method.
Andhra Pradesh, Nellore	Masayapeta block	-	-	23	3123.85 m	Drilling	A G-2 stage of exploration was carried out for copper and associated mineralisation. The resource has been calculated with cutoff 0.2% Cu. The total resource calculated in Masayapeta Block is 2.11 million tons by cross section method and 2.26 million tons by LV method with an average grade of 0.39% Cu.
Andhra Pradesh, Nellore	Jangalapalle area	-	2.13 sq. km	9	1108 m	Mapping, Drilling	A G-3 stage of exploration was carried out for copper and associated mineralisation. Total 0.32 MT of Cu with 0.2% Cu avg. grade calculated by cross section and LV section method.
Tamil Nadu, Dindigul	In and around Vettilamalai Area	1:12,500	100 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of exploration was carried out for copper and associated mineralisation. Pyroxene granulite in eastern and southern flanks of Tandayan Malai resulted 0.56% and 0.54% of Cu in bedrock and 0.11% to 0.38%, 730 ppm to 1.59% of Cu in groove samples and in trench samples, it ranges from 62 to 636 ppm.
Telangana, Bhadradri-Kothagudem	Moti-Turubaka-Krishnasa-garam Block	-	-	-	-	Trenching, Sampling	A G-4 stage of exploration was carried out for copper and gold mineralisation. Cu values of samples from 1st trench varies from 415 ppm to 2.54%, samples, from 2nd trench varies from 140 ppm to 720 ppm and that of 3rd trench varies from 85 ppm to 135 ppm.
Karnataka, Hassan	Around Kattaya	-	-	-	-	Sampling	A G-4 stage of exploration was carried out for copper and associated metals. Bedrock samples from this horizon yielded up to 1.2% Cu, 29.57% Zn & 7481 ppm Pb and trenches analysed up to 5.54% Zn x 4m, 0.15% Cu x 2m, 0.12% Pb x 3m.
Karnataka, Raichur	around Anwar	-	-	-	-	Mapping, Trenching, Sampling	A G-4 stage of exploration was carried out for Cu-Au and REE mineralisation. BRS samples analysed Au values upto 425 ppb and Cu values upto 7900 ppm. Trench sample analysed value upto 4850 ppm for Cu.
Rajasthan, Bhilwara	Sathdhun dhiya Block	1:12,500	50 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of exploration was carried out for basemetal and associated gold and REE mineralisation. Cu concentration values of the samples are ranging from 200 ppm to 4100 ppm.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Rajasthan, Chittorgarh	Hirakhedi Block	-	-	8	1360 m	Drilling	A G-3 stage of exploration was carried out for basemetal mineralisation. Subsurface data indicated that copper mineralisation is not significant in the first level boreholes. However, a zone of 6 m thickness with an average grade of 0.20% Cu (at 0.2% cut off) has been intersected from 127 to 133 m along the borehole RJCH06. Only one second level borehole was drilled and it intersected a Cu zone of 7 m thickness with an average grade of 0.21% Cu (at 0.2% cut off) from 206 m to 213 m depth along the boreholes.
Rajasthan, Udaipur	Kharbar-Pipli Area	1:12,500	50 sq. km	-	230 m	Mapping, Sampling, Scout Drilling	A G-4 stage of exploration was carried out for basemetal mineralisation. Analytical values of channel-1 vary from 0.19% to 1.80 % Cu (Avg. 0.47 % Cu) in dolomite. Analytical values vary from 0.14 % to 0.17 % Ni (Avg. 0.15 % Ni) and Cr content varies from 800 ppm to 0.12% Cr (Avg. 991 ppm Cr) in serpentinite. Channel-4 shows a 6 m thick copper mineralised zone with an average grade of 0.32% Cu in quartzite.
Rajasthan, Chittorgarh and Udaipur	Lasaria-Relwara-Kalibhint areas	1:12,500	100 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for basemetal mineralisation. Encouraging values for copper (upto 3.96% Cu) have been analysed in bedrock samples and channel samples. Thus, Cu zones of 3m x 0.43 % Cu and 5 m x 0.56 % Cu have been demarcated on surface.
Rajasthan, Jaipur	Ladera Block	-	2 sq. km	11	2500 m	Mapping, Sampling, Drilling	A G-3 stage of exploration was carried out for basemetal, REE and associated precious metals. Surface evidences of mineralisation have been observed in the form of significant malachite stain and specks of pyrite and chalcopyrite, mostly within the sheared albitised granite. Chalcopyrite, pyrite, pyrrhotite, molybdenite and magnetite are the dominant mineral phases observed in core. The chemical analytical result of core samples indicates that the copper values in this block ranges from 0.20% to 7.07%. Cobalt values vary upto 0.24% and molybdenum values vary upto 1.37%.
Rajasthan, Nagaur	Arath-Khanpura area	1:12,500	100 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for basemetals and REE. The area preserves indication of sulphide mineralisation as evidenced in the forms of oxidation marks/spots, presence of fresh sulphides, ferruginization etc. within cherty quartzite bands exposed near Arath and Jhalra village. The analytical results of the samples suggest low potential of the area in respect to copper and cobalt. The total REE values received so far are also not promising with Y+TREE concentration is lower than 1000 ppm.
Rajasthan, Sikar	Adharshila-Dariba Block,Neem Ka Thana	-	-	52	10724 m	Drilling	A G-2 stage of exploration was carried out for basemetal. The analytical results received so far have indicated presence of significant copper mineralisation at different level of intersection. The width of sub-surface copper mineralised zones varies from 2m to 57m with average grade of 0.20% to 0.75% Cu.
Rajasthan, Dausa	Gujar Guwara area, Guda Katla	-	2 sq. km	4	580 m	Mapping, Sampling, Drilling	A G-3 stage of exploration was carried out for basemetal and associated precious metals. The chemical analysis result of 12 nos. of PCS shows the maximum values of Cu, Pb and Zn as 32, 20 and 82 ppm respectively. The maximum value of Cu, Pb and Zn in BRS is 1.06%, >25 ppm and 245 ppm respectively. The maximum value of Cu in channel no GG/CH1 is 0.21% in tremolitic marble and in GG/CH2 is 0.18% in tremolitic marble.
Rajasthan, Bhilwara	Lanpiya-Mahuakhurd area	1:2,000	2 sq. km	8	1139 m	Mapping, Trenching, Sampling, Drilling	A G-3 stage of exploration was carried out for basemetal. Sphalerite and galena are the main ore minerals in the area. The resources have been calculated at 2% Pb+Zn cutoff using the cross section and L.V.S. method. The total in situ resources by cross section method are 3.16 million tons and by LVS method 3.19 million tons. The average grade stands at 3.18 % Pb+Zn (0.54% Pb & 2.64% Zn), 27.16 ppm Ag and 135.41 ppm Cd.
Rajasthan, Bhilwara	Kaladhunda Block	1:12,500	50 sq. km	-	-	Mapping, Pitting/ Trenching	A G-4 stage of exploration was carried out for basemetal and associated mineralisation. Based on integration of surface indications of mineralisation, favourable lithological and structural set up, CX Kit data and few analytical results of the BRS, probable potential zones of basemetal mineralisation may be proposed but may be finalised only after all the analytical results are received. The probable area is near Kaladhundha village that is associated with profuse malachite staining.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Rajasthan, Sirohi	Rampura area	1:12,500	50 sq. km	-	-	Mapping	A G-4 stage of exploration was carried out for basemetal and associated gold mineralisation. The surface evidence of mineralisation is seen in the form of malachite staining on rocks and presence of fresh sulphides such as chalcopyrite and bornite.
Rajasthan, Sirohi	Sadalwa Sarjuribali-Singtabhata area	-	50 sq. km	-	-	Mapping, Sampling, Trenching	A G-4 stage of exploration was carried out for basemetal mineralisation. The BRS samples collected from channel show higher value of copper upto 5.89%. The BRS samples collected from trenches show higher value of copper upto 0.46%.
Rajasthan, Sikar & Alwar	Dudawas Ganeshpura areas	-	-	-	-	Field Survey	A G-4 stage of exploration was carried out for basemetal mineralisation. Feeble mineralisation in the form of malachite staining has been recorded at a few locations in of the quartz biotite schist of Thanagazi Formation.
Rajasthan, Udaipur	Gurli-Bhainsra Khurd Block	-	-	8	1006 m	Drilling	A G-3 stage of exploration was carried out for Copper and associated mineralisation. Cu values in core samples range from 10 ppm to 4.02% whereas the Pb and Zn values range from 25 ppm to 1.61% and 10 ppm to 5.63% respectively. Highest value of Cu was analysed from silicified contact zone having specks of chalcopyrite, bornite and pyrite. Maximum values for Pb and Zn were 1.61% and 5.63% respectively.
Rajasthan, Chittorgarh	Rampuriya Block	1: 2,000	1.8 sq. km	5	860 m	Mapping, Sampling, Drilling	A G-3 stage of exploration was carried out for Copper mineralisation. Based on the intersection of copper lodes in boreholes, 0.75 million tonnes of copper resource with an average grade of 0.26% Cu at (0.2% cut off) has been estimated by cross-section method in Rampuriya block.
Rajasthan, Ajmer	Danta, Balwanta and Rajosi area	1:12,500	50 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for Copper and associated basemetal mineralisation. Analytical value of surface bedrock samples for copper varies from 400 ppm to 0.67% and in the channel samples from 900 ppm to 0.58%. In few samples gold value varies from 50 ppb to 200 ppb (0.20 ppm). A prominent gossan zone has been discovered having varying width from 5 m to up to 20 m and strike length of around 800 m to 1000 m with formation of intense iron oxide, i.e., ferruginisation, limonitisation and hematitisation.
Rajasthan, Jhunjhunu	East of Pratappura block	-	-	9	700.70 m	Sampling, Drilling	A G-3 stage of exploration was carried out for Copper and associated mineralisation. The dominant sulphide minerals are pyrite, pyrrhotite and chalcopyrite. The chalcopyrite is the main copper mineral present, occurring as fine veins and veinlets, stringers, fine dissemination, mostly associated with pyrite and pyrrhotite.
Rajasthan, Udaipur	Delwara-Negariya Sector	1:12,500	50 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for Copper and associated mineralisation. Sulphides observed are mainly chalcopyrite, covellite and pyrite.
Rajasthan, Bhilwara	North of Rajaji ka Karera area	1:2,000	1.50 sq. km	4	460 m	Mapping, Sampling, Drilling	A G-4 stage of exploration was carried out for Copper and associated mineralisation. The chemical analysis of 36 samples indicated a total metal content varying from 1600 ppm to 12000 ppm and the rest 29 nos. vary from 800 ppm to 1600 ppm.
Bauxite							
Madhya Pradesh, Anuppur	Around Lamsarai-Kohka-Bicharppur areas	1:12,500	100 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of exploration was carried out for Bauxite and Aluminous Laterite mineralisation. The analytical values of Al2O3 range from 17.71% to 43.47% and SiO2 from 2.77 to 27.02%, V (vanadium) 483 to 1703ppm, Ga (gallium) 25.89 to 89.47 ppm and Li (lithium) 2.4 to 24.01 ppm.
Madhya Pradesh, Dindori	Around Vikrampur mal, Dhanoli mal, Gorkahpur mal and Mohtara	1:12,500	50 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for Bauxite and Aluminous Laterite mineralisation. Analytical results of the bedrock samples show encouraging values of Al2O3 ranging from 35.73% to 60.38% in thirteen (13) samples of bauxite, and Al_2O_3 ranging from 30.76% to 49.15% in twenty-nine (29) samples of aluminous laterite.
Maharashtra, Sindhudurg	Padel area	1:12,500	50 sq. km	-	-	Mapping, Pitting, Sampling	A G-4 stage of exploration was carried out for Bauxite and Aluminous Laterite mineralisation. The Al_2O_3 content in bedrock samples varies from 26.06 % to 53.17 % and correspondingly SiO2 content varies from 1.26% to 22.54%. The Al_2O_3 content in 25 pit samples range from 30.43 % to 53.99% and SiO2 values range from 1.33% to 20.21%.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Maharashtra, Sindhudurg	Baparde area	1:12,500	50 sq. km	-	-	Mapping, Pitting, Sampling	A G-4 stage of exploration was carried out for Bauxite and Aluminous Laterite mineralisation. On the basis of field evidences and analytical results of BRS and PTS, cumulative area of 18 sq. km has been delineated as potential for bauxite in and around Kavtalwadi, Dhangarwadi and Jharkarwadi-Mandewadi in northeastern, central and southern parts of Baparde area. Similarly, cumulative area of 27 sq. km has been demarcated as potential for aluminous laterite in Baparde area.
Maharashtra, Sindhudurg	Devgad area	1:12,500	100 sq. km	-	202.1 m	Mapping, Pitting, Sampling, Scout Drilling	A G-4 stage of exploration was carried out for Bauxite. A cumulative area of 24.47 sq. km of Devgad block has been delineated as potential for bauxite.
Jammu & Kashmir (UT), Reasi	Panasa -Dugga-Baldhanun - Chakar - Sangarmarg (Saro-da-Bas) areas	-	50 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for bauxite, REE, Li and basemetals. The analysis of BRS of bauxite column showed Al_2O_3 from 25.5% to 60.9% (avg. 41.4%) possessing a strong positive correlation with TiO2, Li, V, Zr, Sc & Ga and a strong negative correlation with SiO2 & Fe2O3. Li values in pisolitic bauxite (10 nos.) range from 141-1170 ppm, V-187 to 693 ppm, Ga-19 to 75 ppm. In non-pisolitic bauxites (10nos.), Li ranges from 249 to 602 ppm, V- 134 to 366 ppm, Ga-30 to 65 ppm.
Uttar Pradesh, Chandauli	Naugarh-Pandri-Malewar-Laltapur areas	1:12,500	75 sq. km	8	225.85 m	Mapping, Pitting/ Trenching, Sampling, Drilling	A G-4 stage of exploration was carried out for bauxite and associated mineralisation. In trench samples, Al_2O_3 varying from 23.81% to 47.14% with mean value of 39.25%, TiO2 varies from 2.47% to 18.91% with mean value of 9.98%, Vanadium (V) varies from 602 ppm to 1750 ppm with mean value of 912.90 ppm and Scandium (Sc) values ranges from 66 ppm to 150 ppm with mean value of 97.65 ppm are noted.
Uttar Pradesh, Sonbhadra	Kaimur Group of Vindhyan basin in between Nagwa	1:12,500	100 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of exploration was carried out for bauxite mineralisation. The binary relation of Al_2O_3 and SiO2 has a positive correlation, pointing to lateritic bauxitisation in the area conversely, Al_2O_3 and Fe2O3 have an inverse relationship.
Telangana, Sangareddy	Zaheerabad area	1:12,500	150 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of exploration was carried out for aluminous laterite. The analytical data of 100 BRS samples from Zaheerabad block, FS 2022-23 area are indicating that Al_2O_3 varies from 13 87% to 36. 29%. Resource of bauxite (low grade) is estimated at 441.33 MT with weighted average grade of 32.93 Al2O3% and resource of aluminous bauxite is estimated at 556.87 MT with weighted average grade of 24.29 Al2O3%.
Baryte							
Madhya Pradesh, Dewas	Kaulasa, Piplani and Garari block	1:2,000	-	7	560 m	Mapping, Drilling	A G-3 stage of exploration was carried out for baryte and associated mineralisation. In Kaulasa block, only one borehole MPDKP-01 could be drilled due to poor mineralisation. Borehole no. MPDKP-02 in the Piplani block intersected 7 m barite mineralisation with average grade of 20.64 % Ba. In the Garari block, Borehole no. MPDG-01 was drilled and a substantial barite mineralisation (5 meters) has been intersected along the borehole with an average grade of 17.3% Ba. In Garari, MPDG-01 exhibits a 12-meter stretch of gold mineralisation with an average grade of 175 ppb, while MPDG-03 reveals a 7-meter section with an average gold grade of 86 ppb.
Chromite							
Manipur, Kamjong	Around Kamjong-Pihang-Bhungpa villages, Manipur Ophiolite Belt	-	50 sq. km	-	-	Mapping	A G-4 stage of exploration was carried out for Cr, Ni, PGE and associated minerals. The cumulate Cr-spinel bearing harzburgite host chromite mineralisation as discontinuous pods/lenses. The Cr2O3 in chromitite range from 30.28% to 54.22%. Ni value within the lateritic soil range from 1,773ppm to 10,000 ppm. The IOL and UMIA value for the ultramafic rock ranges from 38.52 to 55.32 and 27.67 to 65.95 indicates moderate to high degree of chemical weathering.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Ladakh (UT), Kargil	Ultramafic bodies of Dras area	1:12,500	50 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of exploration was carried out for chromite, nickel, PGE & associated minerals. Analytical results of channel samples (n=07) show Cr ranging from 0.6% to 6% with Ni ranging from 1695 ppm to 2085 ppm. Among the PGEs, only one of the channels samples yielded Pt: 104 ppb and Pd: 10 ppb. While samples (n=2) collected across the chromitic stringers show Cr values ranging from 32% to 35% with Ni ranging from 1614 ppm to 1642 ppm. Among the PGEs, these two samples yield very high values i.e., Pd: 488 ppb; Pt: 1129 ppb and Pd: 504 ppb; Pt: 1039 ppb respectively.
Kerala, Kasaragod	Around Thayanoor-Chalingal area	1:12,500	100 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of exploration was carried out for Titaniferous-Vanadiferous-Magnetite (TVM) hosted Cr-V-Ni and possible PGE mineralisation. The study brought out the presence of potential chrome bearing titaniferous magnetite hosted Cr-V and PGE mineralisation in the study area, particularly at Canom area where Channel-1 samples from TVM Band-I shows weighted average of 2.89% TiO2, 0.18 % V and 1.69 % Cr over 10-meter zone.
Karnataka, Mandya	Ultramafic rocks of Mancha nahalli Block	1:1,000	2.40 sq. km	4	252 m	Mapping, Trenching, Sampling, Drilling	A G-3 stage of exploration was carried out for Chromite and PGE. The analytical results of 50 BRS revealed Cr from 0.1 to 24.2%, trench samples 0.3 to 2%. Total PGE showed was 112 to 171 ppb in 2 BRS. Two chromiferous serpentinites in boreholes showed Cr concentration (>10000 ppm) from 1.1% to 3% and 10.5m thickness from 1% to 7.1% delineated in borehole no. KMMH-1 Higher Cr concentration of 1.5% recorded in borehole no. KMMH-3.
Cobalt							
Andhra Pradesh, Ysr Kadapa	Uppaluru Area	1:2,000	3 sq. km	-	-	Mapping, Trenching, Sampling	A G-3 stage of exploration was carried out for cobalt, nickel, copper and associated mineralisation. In trench sample copper value ranges from 10 ppm to 170 ppm with mean of 59.56 ppm and median of 60 ppm, for nickel value ranges from 21 ppm to 98 ppm, cobalt ranges from 24 ppm to 94 ppm and chromium ranges from 26 ppm to 235 ppm in the area.
Diamond							
Madhya Pradesh, Ashok Nagar, Chhatarpur, Damoh and Sagar districts, and Uttar Pradesh, Lalitpur	Malthone, Niwar and Pali blocks	-	-	-	-	Sampling	A G-4 stage of exploration was carried out for primary source rocks of diamond. A total of 175 regional stream sediment samples were collected from appropriate trap sites. Through HMS few suspected Kimberlite Indicating Minerals including garnets and spinels were identified.
Jharkhand, Gumla	Silam Block	1:12,500	50 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-3 stage of exploration was carried out for Kimberlite Clan of Rocks (KCR). EPMA (Electron Probe Microanalysis) analysis confirmed the presence of pyrope garnet, clino-pyroxene (Chrome Diopside), Picro-ilmenite, and Aegirine, with Chrome Diopside being reported for the first time in this area. Mineral chemistry analysis suggested a kimberlitic source for some samples, indicating the potential for diamonds.
Uttar Pradesh, Banda & Chitrakoot districts and Madhya Pradesh, Satna district	In and around Nakaila, Kolhua Mafi, Dadwa Manpur areas	1:12,500	105 sq. km	2	500 m	Mapping, Drilling	A G-4 stage of exploration was carried out for diamondiferous bodies. In order to delineate the diamondiferous bodies Large Scale Mapping (LSM) was carried, along with magnetic and gravity surveys (80 LKM and 20 LKM respectively), in and around Nakaila, Kolhua Mafi, Dadwa Manpur areas of Banda & Chitrakoot districts of Uttar Pradesh and Satna district of Madhya Pradesh. Aeromagnetic data interpretation brings out three promising zones (Zone-I, II and III) with the bi-polar magnetic anomaly (69-602nT) that represents a potential kimberlite intrusive.
Uttar Pradesh, Banda and Madhya Pradesh, Satna	Around Baghain River	1:12,500	50 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for placer diamond. Based on the laboratory studies undertaken to date (petrography and XRD analysis) the heavy minerals observed in the investigated stream sediments comprise amphiboles (Mg-rich hornblende, cummingtonite, arfvedsonite, riebeckite, pargasite, edenite, richterite, actinolite, tremolite), magnetite (rich in chromite and silica), ilmenite, hematite, pyroxenes (augite, diopside, enstatite, hedenbergite), anatase, rutile, ankerite, clinochlore, garronite, chlorite, clinozoisite

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Andhra Pradesh, Anantapur	Pamidi-Singanamala area	1:50,000	790 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for primary source rocks for diamond. The pyroxene and garnet recovered from southeast of Kotanka village turned out to be chrome diopside with Cr2O3 (1.82 wt %), Na2O (1.69 wt %) and eclogitic garnet with CaO (6.75 wt %) whereas spinel recovered from northeast of Timmampeta village turned out to be chrome spinel with Cr2O 55.08 wt % and these minerals are the prime indicator mineral for Kimberlite Clan of Rocks KCR.
Karnataka, Tumakuru and Andhra Pradesh, in Parts of Anantapur	Southern extension of the Wajrakarur Kimberlite Field in Clospet and PGC terrain	-	-	-	-	Sampling	A G-4 stage of exploration was carried out for primary source rocks of diamonds. As per the EPMA analysis received so far, Kimberlitic indicator minerals like picroilmenites, pyrope garnets, and chrome diopsides were not recovered from the study area.
Andhra Pradesh, Chittoor and Tamil Nadu, Tirupathur & Krishnagiri	In and around Kuppam Pachchur Vaniyambadi area	-	-	-	-	Sampling	A G-4 stage of exploration was carried out for locating Lamproite Kimberlite bodies. EPMA studies of Lamprophyre dykes reveals that the rock comprises of Amphibole, Biotite, K Feldspar, Plagioglase feldspar with Magnetite and Apatite.
Dunite							
Tamil Nadu, Namakkal	Sirappalli block	-	-	2	156.4 m	Trenching, Sampling, Drilling	A G-3 stage of exploration was carried out for flux grade dunite. The MgO content of the Dunite of Sirappalli Block ranges between 34.62 to 40.26 wt % and are classified as Grade-II dunite. The total dunite (Grade-II) resource for the cut-off grade of 32.44% MgO has been worked out to be 4.55 million tons with an average grade of 38.02% of MgO over an average thickness of 26.46 m
Emerald							
Rajasthan, Rajsamand	Thoriya Block	-	80 sq. km	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for Emerald, REE and associated mineralisation. Bedrock samples collected from the Actino-Tremolite Schist show the anomalous concentrations of Ni ranging from 524 to 2483 ppm & Cr ranges from 827 to 4576 ppm and the bedrock samples collected from the leucogranite, Granite Gneiss, Marble show the concentrations of Ba ranging from 52 to 1483 ppm & Zr ranging from 9 to 542 ppm.
Rajasthan, Rajsamand	Sameecha block	-	-	-	-	Mapping, Sampling	A G-4 stage of exploration was carried out for Emerald, REE and associated mineralisation. Hydrothermally altered/ metasomatic zones, trending NNE-SSE direction are favourable for emerald mineralisation are mapped in the eastern part of the area near Gaongurha, Sogari ki bhagal, Sarvardiya and Bargula villages. Apart from this, a thick mineralised zone of copper for 100m strike length and 15-20m width has been observed near Wanga village.
Rajasthan, Rajsamand	Kuanthal block	-	-	-	-	Pitting	A G-4 stage of exploration was carried out for Emerald, REE and associated mineralisation. Several pits for emerald mining have been reported near village Peethakakhera, Moyana, Sansariya and Beer devgarh. All these pits are present in hydrothermally altered ultra mafic rock and continue in same strike extension which is towards NE- SW.
Reginal Mineral Targeting (RMT) & Research Project (RP)							
Madhya Pradesh, Jabalpur, Katni, Umariya, Rewa, Shahdol, Satna, Sidhi, districts	Mahakoshal belt	-	-	-	-	Field Survey	The objective of this work was to assess the mineralisation potentiality for gold, basemetal and critical minerals. The Surface indic890urs in quartz vein intruded in Dolomite. At places Malachite staining occurs in dolomite and quartzite. Epidotisation, carbonatisation, chloritisation are common alteration associated with basemetal mineralisation.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Chhattisgarh	Sonakhan Greenstone Belt and its surrounding areas in Bastar Craton	-	-	2	245.85 m	Mapping, Sampling, Scout Drilling	The objective of this work was to assess the potential of mineralisation in the area. One inclined (450° towards N800°E azimuth) scout borehole (MTR-01) with 150.05 m drilling depth was carried out in Rajpur-Barnaidadar which intersected gold mineralisation in four discrete zones at 60.88-63.38 m (Min - 0.06 ppm, Max - 0.1 ppm, wtd. Avg. 0.08 ppm Au), 88.80-90.38 m (Min - 0.34 ppm, Max - 1.2 ppm, wtd. Avg. 0.65 ppm Au) and 110.0-113.0 m (Min - 0.06 ppm, Max - 0.1 ppm, wtd. Avg. 0.07 ppm Au) and 119.0 - 124.0 m (Min - 0.06 ppm, Max - 0.12 ppm, wtd. Avg. 0.08 ppm Au) respectively. 95.80 m inclined (450° towards N800°E azimuth) scout drilling (Borehole MKR-01) was carried out in Rachpalpur-Arangi-Karankhol block, in which the mineralised zone comprising of sulfides (Py+Gal) is intersected at 59.0 m and continued upto 75.50 m along with gold bearing zone that confined between 64-64.50 m (0.32 ppm Au) and 72-75.50 m (Min - 0.32 ppm, Max - 7.23 ppm, wtd. Avg. 1.50 ppm Au).
Maharashtra, Nagpur & Bhandara and Madhya Pradesh, Balaghat	In parts of Sausar Mobile Belt	-	-	-	519 m	Mapping, Sampling, Drilling	The objective of this work was to assess the nature of mineralisation and search for potential areas for tin, tungsten, manganese, cobalt and other mineralisation associated with Sausar orogeny. Data integration and preparation of mineral prospectivity maps followed by fieldwork, sampling and scout drilling as part of the regional mineral targeting resulted in identification of eight areas with mineral potential.
Jharkhand, West Singhbhum, Khunti and Simdega	North Singhbhum Mobile Belt (NSMB)	-	-	-	-	Sampling	The region shows promise for polymetallic (gold and basemetal) mineralisation based on existing literature. Bedrock samples reveal gold values ranging from 0.1 to 1.40 ppm, with 15 samples exceeding 0.5 ppm, mainly within a 500 m buffer of the WNW-ESE structural fabric in the potential zone. Regolith samples also show noteworthy gold values, with 27 out of 34 samples ranging from 0.05 to 0.14 ppm. These encouraging results warrant further comprehensive sampling and sub-surface scout drilling in the coming year.
Jharkhand, Simdega, Khunti, Ranchi, Saraikela Kharsawan and West Singhbhum districts	Raniyan -Tamar - Murhu –Hesadih -Ichadih areas, North Singhbhum Mobile belt	-	-	-	-	Mapping, Sampling	During the 2022-23 phase, the research achieved a traverse mapping component of 150 linear kilometers, 50 stream sediment samples, and 25 PCS samples, along with 60 BRS samples. Systematically collected BRS samples from identified zones exhibited anomalous gold values, including RI-80 (Au-0.10 ppm), RI-86 (Au-0.14 ppm), RI-91 (Au-0.08 ppm), RI-96 (Au-0.10 ppm), RI-107 (Au-0.40 ppm), RI-110 (Au-0.13 ppm), RI-113 (Au-0.24 ppm), RI-113A (Au-0.42 ppm), RI-113B (Au-0.13 ppm), RI-129 (Au-0.16 ppm), RI-132 (Au-0.11 ppm), and RI-133 (Au-0.10 ppm).
Odisha, Deogarh, Sundargarh, Angul, Jajpur, Kendujhar, Dhenkanal districts	Telkoi valley-Mankarchua sector	-	-	-	-	Sampling	The objective of this work was to assess and characterise the greenstone hosted gold mineralisation and conglomerate hosted gold and REE mineralisation in the area. The Cr, Ni and Co values in BRS of gabbro-norite-peridotite-pyroxinite suite of rocksfrom Ajaypur-Balabhadrapur area are 8327 ppm, 1741 ppm and 97 ppm respectively and from Nagada area are 6804 ppm, 2087 ppm and 105 ppm respectively. The Au values in BRS of QPC from Nagira-Sandar-Sibida area are up to a tune of 0.95 ppm, while the same from Mankarchua area are up to atune of 0.81 ppm. The Au values in BRS of quartz vein/reef intruding into meta-basalts from Gajpur-Kushkela area are up to a tune of 2 ppm. The Ag values in BRS of rocks of shear zone from Mundashila-Kantabahal area are up to a tune of 2.6 ppm, while the same from Mundasahi-Krushnapur area are up to a tune of 2 ppm. The Cu and Ni values in BRS of Malangtoli basic meta-volcanics/intrusives from Narhamba area are 246 ppm and 131 ppm respectively, while the same from Jambhirpasi-Nayakot area are 191 ppm and 539 ppm respectively.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Haryana, Mahendragarh and Bhiwani districts and Rajasthan, Jhunjhunu district	In parts of North Delhi Fold Belt	-	-	-	-	Mapping, Sampling	The objective of this work was to assess and characterise the nature of mineralisation and search for basemetal potential areas. The surface sample (BRS) collected from Kheri Batter, Mai Khurd and Devsar areas have Cu values ranging in between 468 and 1068ppm (n=3), Pb in between 105 and 383 ppm (n=4) and Zn in between 101 and 388 ppm (n=8). Few soil samples have Pb values between 335 and 3795 (n=4), Cu in between 108 and 681ppm (n=9) and Zn in between 114 and 618 (n=8). The PCS samples have Pb values between 102 and 486 ppm (n=11) and Cu in between 106 and 450 ppm (n=4). Encouraging analytical values of ΣREE ranging from 909 to 2751 ppm (n=6) have been observed from Kapuri Ki Pahadi, Mankawas, Kheri Batter and Kheri Bura areas. The Cu value in 11 groundwater samples collected from the proposed/ prospective Geophysical blocks is promising.
Karnataka, Chitradurga and Davangere	In parts of Chitradurga Schist Belt of Western Dharwar Craton	-	-	-	-	Mapping, Sampling	The primary objective is to identify areas with potential mineralisation, particularly focusing on the characterisation of Mineral Systems. The study area exhibits significant potential for the development of three distinct mineral systems: Archean orogenic lode gold, volcanogenic copper, and granite-hosted Cu-Au mineralisation.
Andhra Pradesh, Nellore, Prakasam and Cuddapah	Kandukuru-Kanigiri-Pamuru area of Nellore Schist Belt	-	-	-	-	Sampling	The objective of this work to assess and characterise the nature of mineralisation and search for basemetal, REE and associated mineralisation. The study has brought out the incidences of sulphide mineralisation in the form of malachite staining and dissemination of thick specks of pyrite, chalcopyrite within the metabasalt, garnetiferous sericite schist, and chlorite-sericite of Nellore schist belt. Bulk rock analysis of a few bedrocks shows Cu vales in range of 2300-5000 ppm in metabasalt. Identified two blocks Duttaluru 5000 ppm and 625 ppm and Dharmavaram 2300 ppm and 510 ppm for further work by geophysical surveys and drilling Petrography followed by SEM-EPMA study of metabasalt reveals the presence of chalcopyrite, bornite and covellite.
Rajasthan, Nagaur and Sikar	In parts of Malbar-Balia and Degana area	-	-	-	-	Field Survey, Sampling	The study in this area helped to identify 10 geologically and geophysically important potential zones with possible mineralisation of granite-hosted REE, RM (Rare metal) and Cu mineralisation and shear zone-controlled Cu mineralisation in the Delhi metasediments.
Rajasthan Barmer	Siwana Ring Complex, Malani Igneous Suite, Siwana-Mokalsar area	-	-	-	-	Sampling	The objective of this work to assess and characterise the nature of mineralisation and search for rare earth elements and rare metals. Studies revealed that the target elements show nearly uniform distribution pattern over peralkaline granites and are localised in the eastern, western and inner ring portions of the Siwana ring complex (SRC). In case of BRS chip samples collected from bore wells, the Nb+ Ta content reported up to 617 ppm, TREE+Y up to 2539.14 ppm and Zr up to 7009 ppm. BRS collected from outcrops show Nb+Ta value up to 458 ppm, TREE+Y up to 5597 ppm and Zr up to 6059 ppm. The chemical data of SSS and regolith samples show that Nb content reported up to 157 ppm and 114 ppm respectively. Synthesis of available data (previous and present) resulted in the identification of two sub-blocks i.e. Mokalsar-Ludrara and Gugrot to carry out ground geophysical survey within the concealed area in order to prioritise areas for commencing drilling work to target RM-RE mineralisation.
Rajasthan, Barmer and Jodhpur	Malani Igneous Suite	-	-	9	2395 m	Sampling, Drilling	The objective of this work was to assess and characterise the nature of mineralisation and search for rare metals, basemetals, rare earth elements. The analytical result of 10 nos. of core samples up to 20 m depth in borehole RJRMTM-01 near Tena village, show value of ΣREE ranging from 2636 ppm to 5445 ppm with the mean value 3893 ppm, mean value of Nb is 514 ppm and mean value of Zr is 5445 ppm. In northern buried ring structure in borehole RJRMTM-09, ultramafic rock intersected with pyrite mineralisation, sample submitted for Ni, Cr, Pg and Pt mineralisation. The analysis of most of the core samples is pending.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Rajasthan , Chittorgarh	In parts of Hamirgarh-Bhiyana area	-	-	-	-	Mapping, Sampling	Rock samples showed encouraging values for copper mineralisation in Tana-Dhundiya (average 0.57% copper in 4 no. of samples near Hiran Mangri, 0.93% Cu near Ranera ki Pal) hosted within the meta-volcano sedimentary litho-package of Rajpura-Dariba Group. To the east of Dhundiya, 2 PCS collected from younger alkali feldspar granite, intrusive into the Mangalwar Complex, occurring at the sheared contact of Rajpura-Dariba Group and Mangalwar Complex yielded anomalous concentration of copper (analysed by AAS method), i.e. 0.23% and 0.18%. Bedrock samples from already demarcated Dadiya block (0.20%and 1.90% Cu), Bindoliya block (0.10%, 0.14%, 0.28% and 0.33% Cu and 0.38% Pb), and Det (0.18% Cu, 0.21% Pb) shows anomalous concentration of copper and lead. In Balicha area BRS shows values of Cu ranging from 0.2% to 0.8%. TREE in one bedrock sample of granite with intense propylitic alteration shows elevated concentration (1294.48 ppm) in Det area. Two BRS, each from Dadiya and Bindoliya block show anomalously high concentration of silver (Ag), 45 ppm and 20 ppm respectively. Available ground water analytical data suggests presence of Cu-Zn-U-Se-Mo association in the northern part of the study area, Cu value up to 100 ppb (ground water sample) found in Det area and Cu-Zn-Mo-U association in the southern part of the study area.
Rajasthan, Ajmer and Bhilwara	In parts of Hanotiya, Vijainagar, Raila, Jaiswanpura	-	-	6	1200 m	Sampling, Drilling	The main objective of the study was to expand mineral search space in buried terrains by geochemical surveys & Integration Geoscience for Creation of Buried Topography, Predictive Geological Map, Foot printing of Geochemical Signals. Based on the analytical results hydro-geochemical samples, six potential areas were identified for further investigations. The blocks are, Hanotiya, Sathana, Lambia-Chipiyan Khera, Mangras-Nimbahera, Raila-Jaswantpura and Devpura-Nanakpura areas. The borehole drilled in the study area showed some positive indications of basemetal mineralisation. However, in borehole RJABH-05, five samples have analysed Cu values of more than 0.10 % with maximum value of 0.7 % Cu, one sample has indicated Pb value of 0.78% and one sample has indicated Zn value of 0.50 %.
Rajasthan, Churu, Sikar and Nagaur	In parts of Salasar, Sujangarh, Ladnun, Nimbi Jodha area	-	-	7	1010 m	Mapping, Sampling, Drilling	The main objective of this work was to prepare the buried topography, predictive geological map, distal foot printing of mineralisation followed by preparation of SOP for taking up regular projects in the covered terrains of western region. Analytical results indicated no significant mineralisation in any of the borehole. Predictive geological map and Buried topography was prepared using the borewell information (gravel of rocks materials at borewell site) and geophysical signatures viz. Bouguer gravity and Aeromagnetic TF data. The granite samples from Kumsiya, Rhyolites of Tanwara and Bhimsar Granite analysed the total REE's upto 1800 ppm and were concluded to be the part of Malani Igneous suite.
Jajpur, Odisha	Sukinda Ultramafic Complex	-	-	-	-	Sampling	The main objective of this work was to perform Geochemical and petrological characterisation of mafic-ultramafic rocks of Sukinda Ultramafic Complex to assess PGE and HREE potentiality. Petrographically, chromite is the major mineral which comprises ~50% to >90% of the chromitite bodies. ΣPGE analysed from the rocks of Sukinda Ultramafic Complex yielded values from 0 to 50 ppb in chromitites, from 12 to 47 ppb in serpentinised dunite, 0 ppb in meta-dolerite, 28 ppb in chromite bearing talc-tremolite schist and from 8 ppb to 22 ppb in limonitised soil formed over the serpentinised dunite.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Maharashtra, Sindhudurg, Ratnagiri and Kolhapur	Western Dharwar sequences and Deccan Traps	-	2,400 sq. km	-	-	Mapping, Sampling	The main objective of this work was to perform Regional assessment of lateritic profiles developed over the western Dharwar sequences and Deccan Traps in parts of Sindhudurg, Ratnagiri and Kolhapur districts. The analytical results of samples of laterite profile show encouraging values of Fe-Al oxides and trace elements like V, Cr, Co, Nb & Hf above their crustal abundance values. Based on the field observations and analytical results of bedrock samples collected from various zones of lateritic profile, they were classified/characterised into ferruginous laterite, aluminous laterite, bauxite, mottled zone, lithomarge clay (fine saprolite) and rocky saprolite. As an outcome of this study, two blocks for bauxite and one block for REE investigations have been delineated for follow-up mineral investigation under G-4 stage.
Odisha, Balangir and Kalahandi	Patnagarh-Titlagarh area	-	-	-	-	Mapping, Sampling	The main objective of this work was to perform predictive mineral potential mapping in Patnagarh-Titlagarh area through geoscience data integration and spatial modelling to identify prospective zones of REE and basemetal mineralisation in Balangir and Kalahandi districts. BRS and regolith samples collected systematically from potential zone yields anomalous values of Pb ranging from 8.9 ppm to 2.89%, Zn ranging from 84 ppm to 0.29% and Cu ranging from 315 ppm to 0.15% from the central part of the area near Dumermunda & Bhuskimal and eastern part of the area near Uparjhar village. Anomalous values of REE from stream sediment samples collected during the field work were obtained from the NE part of the study area near Sibtala and Shahaj Bahal. The value of TREE in these samples ranges from 600 - 3573 ppm.
Gold							
Madhya Pradesh, Katni	Kusera, Sahdar and Selarpur area	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of Gold and associated mineralisation. The dolomite of Nawaliya and Selarpur area shows 150 ppb gold value along with 2800 ppm Cu, 1240 ppm PB and 2500 ppm Zn. Dolomite exposed in NW of Nawaliya shows 0.36% and 0.22% Cu, South of Selarpur shows 1250 ppm and 580 pmm Cu along with 0.15% Pb.
Madhya Pradesh, Katni & Umariya	In and around Barhi and Jhal area	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of Gold and associated sulphide mineralisation in Mahakoshal group of rocks in the area. Based on the limited chemical analysis, it is interpreted that dolomites of the Jhal block with As values up to 15 ppm, Ni values range from 108 ppm-525 ppm and dolomite while metabasalt enriched Cr and Ni 830 ppm and up to 525 ppm. In Barhi subblock, samples collected within the identified mineralised zones. Au values within phyllite intercalated dolomite and phyllite interbedded with quartzite 25 ppb to 300 ppb were reported in 7 locations. Phyllite intercalated dolomite detected upto 830 ppm Cu and phyllite interbedded with quartzite detected values 250 ppm-6630 ppm Cu.
Jharkhand, Saraikela-Kharsawan and East Singhbhum	Amjhor-Hatiyadi area	1:12,500	100 sq. km	-	-	Mapping, Pitting, Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Gold and associated mineralisation. A hydrothermal alteration map revealed a zone rich in hydrothermal activity within the central part of the study area, aligned along the northwest-southeast trend. This observation, coupled with the association of gold with chlorite and iron-hydroxide, as well as the presence of manganese ore associated with quartz veins, strongly suggests a hydrothermal origin for the mineralisation in this region.
Jharkhand, East Singhbhum	In and around Dangar-Gobarghusi-Chanra areas	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of Gold and associated mineralisation. Visible gold grains were found in stream sediment samples near Mahuldih and Belgora areas. Analytical results indicated varying levels of arsenic, tungsten, copper, manganese, and gold.
Jharkhand, Ranchi	Chogadih block	1:1,000	1 sq. km	7	966.50 m	Mapping, Trenching, Sampling, Drilling	A G-3 stage of investigation was carried out for exploration of Gold and associated mineralisation. Core samples from JRCBH-1 and JRCBH-2 displayed gold values ranging from 0.3 ppm to 0.62 ppm Au using the fire assay method, while JRCBH-3 samples showed gold values ranging from 0.13 ppm to 3.01 ppm using AAS analysis.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Odisha, Angul	Mankarha chua block	1:1,000	2.2 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-3 stage of investigation was carried out for exploration of Gold and associated mineralisation. Out of 70 nos of BRS sample, sample no-18 shows Au 0.93 ppm, sample no-42 shows 5.56 ppm respectively. Trench no-1 has two encouraging value TR-1/8 (Au-2.75 ppm), TR-1/9 (Au-2.50 ppm). Channel -1 has two sample CH-1/3 (Au-0.86 ppm), CH-1/4 (Au-0.85 ppm), remaining channel sample are not encouraging value.
Odisha, Sundargarh	Gurundia-Darjing area	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of Gold. Chemical result of bedrock samples (29 Nos.) from Gurundia-Dajing area shows gold values in the range from 0.05 ppm to 0.14 ppm. Chemical results of SSS show Au value varies from 0.05 to 0.23 ppm. Chemical results of pit/trench samples from Gurundia-Darjing area (85 Nos.) show gold value ranging from 0.05 ppm to 0.5 ppm (two values showing more than 1 ppm).
Odisha, Sambalpur, Deogarh and Sundargarh	Laimura area	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of Gold. The analytical results indicate insignificant value of Au. However, bedrock samples collected from the silicified rock, brecciated quartzite, carbonaceous phyllite, chlorite schist/metabasic rock in the area indicate elevated value for gold i.e.>0.1 ppm.
West Bengal, Bankura	In and around Durlabhpur and Gangajal ghati area	-	-	-	-	Field Survey	A G-4 stage of investigation was carried out for exploration of Gold and associated mineralisation. Traces of gold mineralisation, in conjunction with basemetal sulphides, were detected under backscattered electron (BSE) imaging analysis.
West Bengal, Bankura	In and around Rajbandh and Rajapathar area	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of Gold and associated mineralisation. Notably, sulphide mineralisation was identified in various zones within the calc-silicate/calc-granulite rocks. These sulphides are often associated with quartz and calcite pegmatite veins, and in some instances, malachite and azurite stains were also observed. Intriguingly, traces of gold were recorded in samples from the BRS.
West Bengal, Bankura and Jhargram	In and around Maisamura and Shrinathpur area	1:12,500	100 sq. km	-	-	Mapping, Sampling	A G-4 stage of investigation was carried out for exploration of Gold mineralisation. Analytical findings revealed the highest gold values of 0.17 ppm in bedrock samples, 0.15 ppm in channel samples, and 0.14 ppm in trench samples. Consistent values, such as 0.12 ppm and 0.10 ppm, were observed primarily along the western part of the silicified zone, at the contact between granite gneiss and the silicified zone.
Assam, Dhemaji	Geruamukh Block	-	-	-	-	Mapping, Sampling	A G-3 stage of investigation was carried out for exploration of Placer Gold. Channel sampling from different horizons of the Corramore Formation was done to estimate the vertical distribution of gold flakes. The channel sampling revealed consistently small gold flakes, weighing below 10 µg in all channels, with only one sample yielding a weight of 13 µg. Bulk sampling from five pits yielded an average value of 0.026 grams/ cu.m. ±10%.
Andhra Pradesh, SPS Nellore District	Ananta puram-Kesavaram Area	1:12,500	120 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Gold, Silver, Associated Basemetal, REE and RM Mineralisation. Mineralisation is in the form of sulphide minerals like chalcopyrite, covellite and chalcocite, oxides and hydroxides like magnetite, goethite and malachite. REE mineralisation is mainly confined within the syenogranite and tourmaline bearing pegmatite veins. Allanite, zircon, titanite, apatite, tourmaline and thorite are REE bearing phases. During the investigation, highest value of TREE (LREE + HREE + Y + Sc) has been found to be 4696 ppm in BRS of pegmatite near Chintalapalem.
Karnataka, Chitradurga	In and around Doddakitta-dahalli area	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of Gold and associated Basemetals. The area is not promising for Au and other basemetals from an economic perspective. The encouraging assay values of Ni, Cu, and Zn can be considered for further studies in and around the shear domain with dyke emplacements.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Karnataka, Tumakuru	Around Sanabagatta, Pura, Huliyurdurga and Bandihalli areas	1:12,500	149 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of gold and associated mineralisation. BRS samples shows Au value <25 ppb except one in pegmatite vein within the schist belt, near Sanabagatta which shows upto 240 ppb Au value. Mn bearing BIF in Lakshmipura shows Mn content upto 18.3%. Ultramafic body analysed with 3570 ppm Cr and 1193 ppm Ni but no encouraging values of PGE.
Karnataka, Raichur	Around Yeragera	1:12,500	100 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Au, Cu and associated mineralisation. The assay value showed Cu values ranges from 450 to 3545 ppm. The average assay value of Cu is calculated as 570 ppm 1 m, 700 ppm 3 m, 1045 ppm 12 m, 2215 ppm 2 m and 2545 ppm 1 m. Moreover, feeble Au mineralisation up to 30 ppb is also observed in the Kannandoddi reef
Karnataka, Tumakuru	Around Bellara area	1:12,500	125 sq. km	-	-	Mapping	A G-4 stage of investigation was carried out for exploration of Gold. The investigation brought out 5 Nos. of potential zones delineated across the lithologies on the basis of shearing and alterations. The alterations in the mapping area include silicification, carbonitisation, sericitation and sulphidation
Tamil Nadu, Tiruvannamalai	In and around Melchengam area	-	-	-	-	Mapping, Sampling	A G-4 stage of investigation was carried out for exploration of gold and associated mineralisation. Fourteen numbers of BMQ samples collected in this zone, of which only four samples yield gold values ranging from 25 ppb to 70 ppb and rest of samples show less than detection limit (<25 ppb). Twenty-eight numbers of pyroxene granulite sample collected and analysed gold values less than detection limit (<25 ppb). Analytical results of copper in the quartz carbonate veins ranges from 748 ppm to 2350 ppm.
Tamil Nadu, Krishnagiri and Dharmapuri	Around Andipatti-Elavadi-Ammapettai-Vellampatti areas	1:12,500	100 sq. km	3	218.4 m	Mapping, Pitting, Trenching, Sampling, Scout Drilling	A G-4 stage of investigation was carried out for exploration of Gold and associated mineralisation. BRS collected from Vellampatti quartz vein shows good values of Gold (Au) and Silver (Ag) and the analysed Au values is 3.6 ppm and Ag is 5.0 ppm
Karnataka, Haveri	Kaginelli and Herur areas	1:12,500	100 sq. km	-	332.30 m	Mapping, Pitting, Trenching, Sampling, Drilling	A G-4 stage of investigation was carried out for exploration of Gold. Borehole No. KHK 02 drilled in Kabbur Tanda Block and two samples reported Au values of 50 & 60 ppb, Borehole No. KHK 03 in Malapur Block and four samples reported Au values from 110 to 140 ppb. Borehole No. KHK 04 is drilled in Park Block and all the samples reported less than 25 ppb Au.
Karnataka, Chitradurga	JN Kote North Block between Jamapana yakanakote and Ennegere	1:1,000	1. 5 sq. km	9	1069.45 m	Mapping, Pitting, Trenching, Sampling, Drilling	A G-3 stage of investigation was carried out for exploration of Gold. Analytical results revealed 0.33 ppm gold. Resource estimation at 0.3 ppm cut off is being carried out considering the preciousness of gold
Tamil Nadu, Tiruvanna malai	Rajapalayam South Block	-	-	-	-	Sampling	A G-3 stage of investigation was carried out for exploration of Gold and associated mineralisation. EPMA revealed the presence of gold occurs as free milling (native gold grains) as well as in the form of alloy like electrum (Au: 76.4% + Ag: 21.1%) associated with veins of pyrite and pyrrhotite. SEM also revealed that gold occurs as telluride phase like sylvanite (Ag= 39.06%, Te= 54.10% and Au=6.83%) and calaverite (Ag= 41.83%, Te=45.12% and Au=13.05%) along with its silver alloy in the system
Rajasthan, Udaipur and Dungarpur	Deoli-Andli-Payra area	1:12,500	100 sq. km	-	-	Mapping, Pitting, Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Gold and associated mineralisation. Among 200 nos. of BRS, only two samples indicated gold (Au) values as 0.20 ppm and 0.22 ppm. Except these two samples all the samples showed value less than 0.05 ppm. Out of 50 nos. of trench and pit samples only one sample showed Au values as 0.10 ppm.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Rajasthan, Banswara	Bichhawara-Ganora-Dudka-Bhuwasa area	1:12,500	105 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Gold and basemetal mineralisation. Analytical results of gold and basemetal are not encouraging in the area.
Rajasthan, Sirohi	Jharoli-Danva-Basantgarh area	1:12,500	-	-	241 m	Mapping, Pitting/ Trenching, Sampling, Scout Drilling	A G-4 stage of investigation was carried out for exploration of Gold and basemetal mineralisation. Structural analysis unveiled multiple deformation phases, and surface indicators hinted at potential mineralisation, although subsequent scout boreholes yielded limited mineralisation (VE=<0.2%) despite the presence of magnetic and gravity anomalies in the region.
Graphite							
Madhya Pradesh, Hoshangabad	Around Nazarpur, Jamai Kalan and Ghogari village	-	100 sq. km	-	-	Mapping	A G-4 stage of investigation was carried out for exploration of graphite, vanadium and associated mineralisation. The maximum value of fixed carbon 2.94% and maximum values of Vanadium 397 ppm were recorded from the carbonaceous phyllite.
Madhya Pradesh, Betul	Kolhudhana-Selu-Chauki-Pangra areas	-	-	-	-	Trenching, Sampling,	A G-4 stage of investigation was carried out for exploration of Graphite, Basemetal and associated mineralisation. The analytical data shows Cu upto 110 ppm, Pb upto 25 ppm, Zn upto 95 ppm in sheared porphyritic granite. Channel sample across graphite body shows FC upto 15.9%, moisture 1.37%, volatile matter upto 7.71%, ash content 81.26%, vanadium 1548 ppm, Thorium 8.60 ppm, Uranium 5.95 ppm. 5.95 ppm.
Madhya Pradesh, Sidhi	Bahera-Goriara block	-	-	10	776.2 m	Drilling	A G-3 stage of investigation was carried out for exploration of graphite, basemetal and REE mineralisation. With the help of cross section method; a cumulative tonnage for copper rich lodes was calculated to 1118831.27 tones, 0.57% average grade, and 9.15 m average thickness and that of graphitic rich lodes was calculated to 1223537.80 tones, 5.16% average grade, and 7.54 m average thickness. With the help of longitudinal vertical section method, a cumulative tonnage for copper rich lodes was calculated to 1105596 tones, 0.58% average grade, and 9.13 m average thickness and that of graphitic rich lodes was calculated to 1218258.12 tones, 5.16% average grade, and 7.52 m average thickness
Chhattisgarh, Balrampur	Oranga-Revatipur Area	1:4,000	3.6 sq. km	35	3729 m	Mapping, Pitting/ Trenching, Sampling, Drilling	A G-2 stage of investigation was carried out for exploration of Graphite. Ore beneficiation studies for bulk drilled core sample of the Oranga-Revatipur area assayed with 4.90% Fixed Carbon (FC), 3.05% Volatile matter, 0.32% moisture and 91.73% Ash content. The grade of the graphite concentrate could be upgraded up to 68% FC, with 66.43% recovery (wt% yield: 4.79%). A total of 7.04 million tonnes indicated resource (332) was estimated by cross section method and 6.67 million tonnes by L-V panel method with avaerage grade of 5.47% of fixed carbon at 2% cut off grade.
Jharkhand, Garhwa	Chapiya-Totki area	1:12,500	50 sq. km	-	-	Mapping, Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Graphite, Vanadium and associated minerals. Chemical analysis of 65 BRS samples indicates an average REE value of approximately 205 ppm, with a maximum value of 1416 ppm.
Jharkhand, Garhwa	Rud-Hesatu area	-	-	-	-	Pitting/ Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of graphite, vanadium and associated minerals. REE phases found from EPMA and SEM studies are those of zircon, monazite, thorite, xenotime and bastnasite. Small specs of gold also have been identified from EPMA and SEM studies. The analytical results of BRS samples showed tREE value ranging from 24.66 ppm to 1837.30 ppm.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Jharkhand, Latehar and Palamu	Chama-Barwaiya area	-	-	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of graphite, vanadium and associated minerals. The analysis of 100 bedrock samples revealed fixed carbon content ranging from 0.02% to 28.02%, while in 100 trench samples, fixed carbon content ranged from 1.01% to 34.77%. Vanadium values also varied, with concentrations ranging from 49 ppm to 1263 ppm in bedrock samples and from 49 ppm to 2555 ppm in trench samples
Jharkhand, Latehar	Budhiyabagi block	-	-	-	-	Trenching, Sampling	. A G-3 stage of investigation was carried out for exploration of graphite, vanadium and associated minerals. Chemical analyses of bedrock samples have revealed FC values ranging from 5.96% to 31.86% and V concentrations spanning from 81 ppm to 1750 ppm. Trench samples display FC values between 7.30% and 22.84% and V concentrations ranging from 150 ppm to 1099 ppm
Jharkhand, Latehar and Chatra	Besra-Jhirmatkoma block	1:12,500	100 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of graphite, vanadium and associated minerals. Analytical data reveals that the fixed carbon content in BRS within graphite-bearing sillimanite gneiss ranges from 0.01% to 1.3%, while PTS samples from the same rock type range from 0.01% to 1.7%. Vanadium concentrations in bedrock samples vary from <20 ppm to 794 ppm, while PTS samples exhibit vanadium concentrations ranging from 130 ppm to 787 ppm.
Jharkhand, Palamu	Adhmaniya block	-	-	19	-	Drilling, Sampling	. A G-2 stage of investigation was carried out for exploration of Graphite and Vanadium. Drilling at G3 stage estimated a graphite resource of 12.61 MT at a 2% cut-off grade and 10.31 MT at a 5% cut-off grade. Vanadium was also associated with graphite mineralisation. Adhmaniya block was further explored in the G2 stage, involving the drilling of 19 boreholes. Significant graphite mineralisation was encountered, with varying grades in different boreholes. Vanadium was also identified, showing a positive correlation with graphite content.
Jharkhand, Latehar	Balumath-Kathartoli block	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of graphite, vanadium and associated minerals. Chemical analyses of some samples indicate higher V (vanadium) values, with a maximum of 682 mg/kg. Fixed carbon values range from 1.02% to 4.81%.
Odisha, Nayagarh	In and around Tumandi village, Daspalla block	-	1.50 sq. km	38	2089 m	Mapping, Pitting/ Trenching, Sampling, Drilling	A G-3 stage of investigation was carried out for exploration of Graphite. Based on the analytical results, in the borehole no. ODT-6 (Band-I), average FC of 2.98% is analysed in 25.5 m thick graphite zone (28 m to 53.5 m). In borehole no. ODT-22 (Band-III), average FC of 4.45% is analysed in 29.5 m thick graphite zone (24.5 m to 54 m).
Odisha, Angul	Thakurgarh-Mindol area	1:12,500	100 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Graphite. In structurally complex, hilly and forested Mindol area, in two locations about 500 m apart, graphite rich khondalitic units have been sampled, having fixed carbon values as; BRS 09-22%, BRS 49- results awaited.
Odisha, Kalahandi	Around Pengsur area	1:12,500	100 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Graphite. The Fixed carbon (F.C) content varies from 14% to 27% which are collected from the trenches of Pengsur and Ranikot area.
Andhra Pradesh, Vizianagaram	Parasam-Garudabilli area	-	-	-	-	Mapping, Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Graphite, manganese and associated mineralisation. The bedrock sample analytical results have F. C values ranges from 0.17 % to 3.33% with an avg of 1.21 (%n=9).

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Gujarat, Dahod	Devgadh Bariya Nagwav Block	1:12,500	100 sq. km	-	-	Mapping, Pitting/ Trenching, Sampling	A G-4 stage of investigation was carried out for exploration of Graphite and associated mineralisation. The analytical results of received samples (BRS, channel and pitting/trenching) indicating FC value varies from 6.18% to 20.18% in BRS, channel samples show values from 6.00% to 18.85%, whereas FC values of pit/trench ranges from 1.0% to 15.80%.The analytical results of trace elements in the received results have been obtained as obtained as Cr (49 to 342 ppm), Rb (4 to 452 ppm), Sr (81 to 299 ppm), V(10 to 296 ppm) and Zr (26 to 325 ppm) in BRS samples where as in channel samples the analytical results have been obtained as Cr (215 to 500 ppm), Sr (83 to 132 ppm), V (132 to 245 ppm), Zr (213 to 292 ppm). The PTS samples shows values as Cr (134 to 259 ppm), Sr (43 to 220 ppm), V (102 to 241 ppm), Zr (24 to 206 ppm).
Gypsum							
Himachal Pradesh, Kinnaur	Chango-Nichala Chango blocks	1:4,000	3 sq. km	-	-	Mapping	A G-3 stage of investigation was carried out for exploration of Gypsum. The XRD studies reveal that gypsum occurs as a major mineral i.e.>40%. In small amounts i.e.10-20%, anhydrite, calcite and hornblende are present
Himachal Pradesh, Lahaul and Spiti	Giu block	-	-	2	125 m	Drilling, Sampling	. A G-3 stage of investigation was carried out for exploration of Gypsum. The analytical results show that the gypsum values in borehole HPLSGBH-02, Zone III, Giu block range from 84.94% to 99.26%, with weighted average of 96.47%. In borehole HPLSGBH-03, Zone II, Giu block it ranges from 78.56% to 96.49%, with weighted average of 91.92%
Iron ore							
Madhya Pradesh, Gwalior	Santau, Kansar & Mangor area	1:12,500	100 sq. km	-	-	Mapping, Trenching, Sampling	. A G-4 stage of investigation was carried out for exploration of iron ore mineralisation. Out of 110 bedrock/ channel sample, 73 nos. of BRS shows Fe2O3T values vary from 6.39% to 86.72% and total Fe ranges from 4.47 to 61.39%. In 37 nos. of channel samples Fe2O3T values vary from 16% to 87.11% and total Fe vary from 11.2 to 60.97%. On the basis of the above chemical value, three areas around Maheshwara and Mangor, Santau and Kushrajpur, and Londra are demarcated for potential iron ore mineralisation.
Madhya Pradesh, Sidhi	In Umariha, Khadi, and Bajrangarh area	-	-	-	-	Sampling	A G-4 stage of investigation was carried out for exploration of iron ore mineralisation. Analytical results of 102 bedrock samples distributed among four main BIF bands showed average Fe% grades classifying the ores as low-grade (Fe% ranging 14.65-56.72% with average value 32.5).
Chhattisgarh, Balod	Gidhali-Chiklakasa-Putarwahi area	1:12,500	100 sq. km	-	-	Mapping	A G-4 stage of investigation was carried out for exploration of iron ore mineralisation. In the study area, Banded iron Formation (BIF) is the principal source of iron. The most important ore of iron recorded in the area is hematite which occurs in different forms.
Bihar, Jamui	Ganesh Nawada Block	-	-	4	-	Drilling	A G-4 stage of investigation was carried out for exploration of Magnetite. The exploration in Ganesh Nawada block did not reveal the continuation of the previously confirmed mineralised body from the Majos block, as it abruptly terminated at the block's boundary. Even a detailed geophysical magnetic survey failed to indicate any further extension of the mineralised body in this area
Odisha, Sundargarh	Jaldihi - Tantigram block	1:2,000	2.70 sq. km	8	435.95 m	Mapping, Pitting/ Trenching, Drilling	A G-3 stage of investigation was carried out for exploration of iron ore mineralisation. Cumulative thickness of ore zone intersected in boreholes varies from 17.05m (OKJT-3) to 50.00m (in OKJT-1). The ore zone comprises lateritic ore, reddish to brown powdery ore, soft laminated ore with intercalations of shale/ferruginous shale and minor pieces of BHC/ BHJ

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Odisha, Sundargarh	Kedesala west block	-	-	7	474.70 m	Drilling	A G-3 stage of investigation was carried out for exploration of iron ore mineralisation. During drilling, cumulative thickness of ore zones intersected varies from 8.20 m to 64.00 m. The mineralised zone intersected comprises of lateritic iron ore, purple/brown powdery ore, SLO, minor blue dust, few pieces of hard laminated ore (HLO) and BHJ inter-banded with ferruginous shale
Uttar Pradesh, Sonbhadra	Near Sobna and Chakariya area	1:4,000	2.1 sq. km	-	617.05 m	Mapping, Drilling	A G-3 stage of investigation was carried out for exploration of iron ore mineralisation. The total estimated resource for iron ore, Block 'B' Bharhari, for 2022-23 is 19.94 million tonnes (MT) with an average grade of 35.76% Fe at 30% cut off and 10.78 million tonnes (MT) with an average grade of 38.32% of Fe at 35 % cut off.
Manganese							
Singbhum District, Jharkhand	Tatiba Block	-	-	40	-	Drilling	G2 investigation was carried out. In terms of estimated resources, approximately 2.32 million metric tons of iron ore were calculated, with an average iron grade of 39.17%. Additionally, around 2.6 million metric tons of manganese ore were estimated, boasting an average manganese grade of 13.72%.
Bolangir district, Odisha	Dandapani block	-	2	49	4550.70 m	Mapping, Sampling & Drilling	G2 investigation was carried out. Analytical results shows 14-20% Mn with an average grade of 15% having 3.00 m to 35.00 width of mineralised zone.The associated graphite and vanadium mineralisation have been intersected in a number of boreholes.
Bolangir district, Odisha	Uchhabapalli - Thakurpalli Block	-	-	39	2588.95 m	Pitting, Sampling & Drilling	G2 investigation was carried out.Analytical results show Mn content varying from 10% - 31.4% and fixed carbon varying from 2-13.21%. Based on the Mn and graphite zones intersected in boreholes drilled during the F.S 1999-2001 and 2021-23, a total of tentative 4.51 Mt of indicated resource (3.1 Mt of Mn oxides and 1.4 Mt Mn carbonates) has been estimated by cross-section (CS) method of 16.95% Mn at 10 % cut-off over a strike length of 4000 m. At 2.0% F.C cut-off, indicated resource of 0.55 Mt by crosssection (CS) method has been estimated with an average grade of 3.39% F.C.
Sundargarh district, Odisha	Dengula block	1:2,000	25 sq. km	22	1707.40 m	Mapping & Drilling	G2 investigation was carried out.The manganese ore resource estimated by cross section method for 10-25% Mn is 4.37 MT with 13.95% average Mn at 10% cut off, for 25-35% Mn is 0.08 MT with 27.5% average Mn at 25% cut off and for 35-45% Mn 0.007 MT with 44.5% average Mn at 35% cut off. The total resource of manganese ore in Dengula block including all categories is 4.52 million tonnes with average grade Mn 14.24%.
Kendujhar district, Odisha	Kendudihi-Parulipada block	-	-	88	5027.25	Drilling	G2 investigation was carried out.The total resource of manganese ore in Kendudihi-Parulipada block including all categories is 3.60 million tonnes
Sundargarh district, Odisha	Gobira-Talsara area	1:12,500	100 sq. km	-	-	Mapping, Trenching Sampling,	G4 investigation was carried out.The principal manganese mineral is pyrolusite. The analytical results of three bedrock samples collected from Gobira area shows Mn content varying from 18 to 27.28%
Srikakulam District, Andhra Pradesh	Garraju-Cheepuru palli Block	-	-	34	2681.25 m	Drilling	G2 investigation was carried out. Based on the assessment of the geological axis and considering the other two axes, i.e., feasibility assessment and economic viability, the resource of Garraju-Cheepurupalli Block can be considered as 332 as per UNFC.
Vizianagaram District, Andhra Pradesh	Gumpam konda block	-	-	23	1735.50 m	Drilling	G2 investigation was carried out.The total resource of Mn in the Gumpamkonda block has been estimated as 1.16 MT with an average grade of 13.28 % by the cross-section method
Vizianagaram District, Andhra Pradesh	Gadaba-valasa Block	-	-	16	1001.5 m	Driling	G3 investigation was carried out.The total cobalt resource in Gadabavalasa Block-1, with a cutoff grade of 200 ppm, was estimated at 0.067 million tonnes, boasting an average grade of 375.29 ppm.
Vizianagaram District, Andhra Pradesh	Ginnam & Lingala-valasa areas of Eastern Ghat Mobile Belt	-	100 sq. km	3	202.70m	Mapping & Drilling	G4 investigation was carried out. No thick Mineralisation was found.
Limestone							

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Neemuch district, Madhya Pradesh	Mahpura-Puran-Badi- Jodha kundal-Junap aran	1:12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out.It has yielded tonnage 1337.88 M tonnes (considered specific gravity 2.61gm/cm as per IBM report and thickness 11m observed in the well section).
Shivpuri district, Madhya Pradesh	Nayapura, Kharai, Kanti, Renjha and Singhan area	1:12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. The limestone has yielded tonnage 863.80 million tonnes.
Shivpuri District, Madhya Pradesh	Rasoi, Chirola, Kumaraoa and Kishanpur area	-	-	-	-	Trenching, Sampling & Pitting	G4 investigation was carried out. The limestone has yielded tonnage 1252.8 million tonnes.
Alirajpur district, Madhya Pradesh	Kanwara-Akhara Barkhera-Devlai area	-	-	-	-	Sampling & Pitting	G4 investigation was carried out. High concentration of CaO range from 27 to 50% in 93 nos. samples and uniformly low in range of Fe2O3 (<1%) and MgO (MgO >3.5%) with low to moderately high concentration of SiO2 (8% to 50%) are observed.
Kabirdham District, Chhattisgarh	Talpur and Daihandih area	1:12,500	50 sq. km	3	-	Mapping & Drilling	G4 investigation was carried out. As per the analytical result of the core samples three types of lodes were intersected in the Borehole No CKTD-01 &CKTD -02. CKTD-03 contains dolomite only. Portland grade limestone (CaO: 44%-52% &MgO<3.5%) bands are intersected in borehole no. CKTD-01 at a depth of. 1.9m-3.9m (band 1: 2m), 9.9m-16.9m (band 2: 7m), 24.9m-31.9m (band 3: 7m) from the surface.
Balod district, Chhattisgarh	Semhardih block	-	-	15	907.25m	Drilling	G3 investigation was carried out. The phosphate resource estimated with assumptions for beneficial grade at 5-10% at 2 m stopping width is 3.39 MT, with an average grade of 6.02% P2O5. A total of 428.89 MT cement grade limestone was estimated at 2 m stopping width with average grade 47.75% CaO.
Balod District, Chhattisgarh	Raipura Block	1: 4,000	10.24 sq. km	13	605.65m	Mapping & Drilling	G3 investigation was carried out. Inferred resource of cement grade (Portland, CaO 44-52%) limestone at 2m stopping width has been calculated as 145.75 MT with weightage average grade of 48.32% CaO.
Janjgir-Champa District, Chhattisgarh	Nariyara-Amora Block	1: 4,000	5.6 sq. km	7	427.15m	Mapping & Drilling	G3 investigation was carried out. Total 25.49 million tonnes of limestone have been estimated with CaO varying from 34% to 38%for the entire block with weighted average grade of 35.36% CaO, 3.30% MgO and 21.28% SiO_2 is of low grade
Dima Hasao district, Assam	Sikilangso block	-	-	6	439.8m	Drilling	G3 investigation was carried out. Grade-wise resource estimated from the chemical analytical result indicates 84.12 million tonnes under Cement (Portland), 93.03 million tonnes under Cement (Blendable/Beneficiable) and 172.42 million tonnes
Kiphire District, Nagaland	Khongjiri and Khongka area	-	-	-	-	Sampling & Pitting	G4 investigation was carried out. This limestone is suitable for cement grade limestone.
Jagtial District, Telangana	Birpur area	-	-	-	-	Sampling	G4 investigation was carried out. The CaO contents vary from 42.93 to 54.15 wt%, and MgO ranges from 0.05 to 0.77 wt%. The SiO2 value ranges from 3.24 to 15.88 wt%, Al_2O_3 contents vary from 0.43 to 1.59 wt%, and Fe2O3 value ranges from 0.30 to 1.18 wt%.
Bhadradri - Kothagudem district, Telangana	Maddirala Dharma puram Block	-	-	-	-	Sampling	G4 investigation was carried out. The dolomite occurring in the investigation block (Dharmapuram) is having similar chemical specifications that are mandatory for a flux/SMS grade dolomite variety
Karur and Dindigul districts, Tamil Nadu	Gudalur-Kottanatham area	1:12,500	100 sq. km	3	303.40 m	Mapping, Sampling & Drilling	G4 investigation was carried out. A total 9.005 million tons (TNDK-1 :2.706 million tons; TNDK-2 :0.274 million tons and TNDK-3 :6.693 million tons) of Portland cement grade crystalline limestone and 4.62 million tons of blendable cement grade (TNDK-1 :1.633 million tons; TNDK-2 :0.958 million tons and TNDK-3 :2.028 million tons) crystalline limestone have been estimated in Gudalur-Kottanatham block.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Karur district, Tamil Nadu	Varavanai west block	1: 4,000	3 sq. km	12	1141.9 m	Mapping, Sampling & Drilling	G3 investigation was carried out. The total limestone resource for the portlandcement grade is 14 million tons with anaverage grade of CaO 47.48%; 11.12 % of SiO2 and MgO of 2.03% over an average thickness of 7.79 m.The resource of blendable grade is 9.8 million tons with an average grade of CaO 41.8% and MgO 2.02%, over an average thickness of 4.2 m .The resource of threshold grade is 6.61 million tons with an average grade of CaO 37% and MgO 1.98 %. The resource estimated in Varavanai West Block is categorised as 333 or inferred resource category.
Chittorgarh District, Rajasthan	Area East of Palanpur	-	100 sq. km	-	-	Sampling & Pitting	G3 investigation was carried out. The total limestone resource for the portlandcement grade is 14 million tons with anaverage grade of CaO 47.48%; 11.12 % of SiO2 and MgO of 2.03% over an average thickness of 7.79 m.The resource of blendable grade is 9.8 million tons with an average grade of CaO 41.8% and MgO 2.02%, over an average thickness of 4.2 m .The resource of threshold grade is 6.61 million tons with an average grade of CaO 37% and MgO 1.98 %. The resource estimated in Varavanai West Block is categorised as 333 or inferred resource category.
Jaisalmer District, Rajasthan	Khabhiya east block, Nibh Dungar area	1:2,000	2 sq. km	4	205 m	Mapping, Sampling & Drilling	G4 investigation was carried out. The resource above threshold value for cement grade limestone is 131.13 MT, with average grade: CaO: 44.69%, MgO: 1.20%, SiO2: 13.60% and Al2O3: 3.75%. The total inferred mineral resource for portland cement category estimated by extended area method as per the specification of Mineral Year Book 2020 of IBM is 59.08 MT, with average grade: CaO: 49.98%, MgO: 0.90%, SiO2: 7.48% and Al2O3: 1.77%. The total inferred mineral for beneficiable and blendable cement grade limestone resource is 60.92 MT, with average grade: CaO: 41.29%, MgO 1.40%, SiO2:16.91% and Al2O3: 5.32%.
Jaisalmer District, Rajasthan	Amar Sagar-Lodorua area	1:12,500	50 sq.km	-	-	Mapping & Sampling	G4 investigation was carried out. On the basis of BRS and vertical channel samples the study area has been recommended for further G3 investigation
Jaisalmer District, Rajasthan	Khabhiya block, Nibh Dungar area	1:2,000	2 sq. km	4	226 m	Mapping, Sampling & Drilling	G4 investigation was carried out. A total mineral resource of Portland cement at 1 m stopping width is 91.37 million tonnes with weighted average grade CaO 50.61%, MgO-1.07%, Al_2O_3 1.50% and SiO2 6.93% has been arrived at satisfying the specification of Portland cement grade limestone category as per IBM, Mineral year book, 2020. Total mineral resource of Portland cement grade limestone at 2 m stopping width is 83.57 million tonnes with weighted average grade CaO 50.86%, MgO-1.09%, Al_2O_3 1.56% and SiO2 6.47%. A total mineral resource of Beneficial/ blending cement grade limestone at 1m stopping width has been estimated to be 18.46 million tonnes with weighted average grade of CaO 42.17% and MgO-1.29%. Total mineral resource of Beneficial/ blending cement grade limestone at 2 m stopping width is 11.26 million tonnes with weighted average grade CaO 41.78% and MgO-1.36%. Total mineral resource of limestone above threshold values is 155.83 million tonnes with weighted average grade of CaO 46.84%, MgO-1.18%, Al2O3-2.96% and SiO2-10.90%
Lithium							
Raigarh and Jashpur districts, Chhattisgarh	Tamta, Raghu-nathpur and Sureshpur area	1:12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. The analytical results of these pegmatite-aplite dykes show encouraging values of Li (390 ppm to 3800 ppm), Cs (62.65 ppm to 352.35 ppm), Ta (43.91 ppm to 235.26 ppm), Rb (944.66 ppm to 2665.46 ppm) and Be (58.54 ppm to 500.59 ppm).
Korba District, Chhattisgarh	Katghora Rampur area	-	2.4 sq. km	15	612.40m	Sampling & Drilling	G3 investigation was carried out. Resource of Li2O (at 500 ppm cutoff grade) is estimated to be 184.05 MT with weighted average grade of 638.36 ppm.
Koderma district, Jharkhand	Tilaiya block	1:12,500	100 sq. km	-	-	Mapping Pitting, & Sampling	G4 investigation was carried out. Li values varied from 4.94ppm to 93.21ppm.
Phek District, Nagaland	Hutsu and Phor areas	-	1.5 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Geophysical survey carried out along 1.5 sq. km indicate a 30m wide zone of low resistivity upto a depth 45m indicating the presence of saline waters beneath.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
East Garo Hills District, Meghalaya	William nagar-Nengkhra area	-	50 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Li values are not much encouraging and ranges from 34 to 201 (with average of 85.8 ppm) in clay samples
Tirap district, Arunachal Pradesh	Pullung, Paniduriya, Borduria and Kaimoi area	-	-	-	-	Sampling	G4 investigation was carried out. Li value analysed from the bedrock samples yielded 29 ppm to 70 ppm from shale, siltstone, sandstone and soil. The values of Li for brine samples ranges from 8.8 ppb to 809.1 ppb collected during post monsoon with an average of 264.58 ppb. While from pre monsoon samples the values of Li ranges from 7.53 ppb to 194.92 ppb with an average value of 69.89 ppb.
Leh District, UT Ladakh	Tsokar, Pangong, Tsomorari, Kyagar and Kyun Tso lakes	-	-	-	-	Sampling	G4 investigation was carried out. The analytical results of Li received do not show much significant values in the surrounding rocks, water samples and lake sediment samples which can be due to less aridity, open basin, absence of associated hydrothermal activity, less evaporation and more fresh water influx. However, high values of Sr have been observed in Tsokar Lake.
Molybdenum							
Mahasamund district, Chhattisgarh	Bichhiya-Chirralewa block	-	-	-	-	Drilling	G3 investigation was carried out. Mo value ranges up to 433.49ppm
Mahasamund district, Chhattisgarh	Bhurkoni-Dongajhar area	1:12,500	80 sq. km			Mapping & Sampling	G4 investigation was carried out. Molybdenite mineralisation is very discrete in nature. BRS showed a maximum of 9 ppm of molybdenum (Mo).
East Khasi Hills district, Meghalaya	Mylliem and Lailynkhwir	-	-	-	-	Mapping & Sampling	G4 investigation was carried out. The Pegmatite vein intruded into the porphyritic granite is associated with the Li bearing mineral lepidolite along with pyrite and pyrrhotite. Overall, the porphyritic granite in the south-central part of the study area is showing the analytical result of Li value ranging from 45 ppm to 86 ppm. The greisenised porphyritic granite developed along the fracture plane shows the highest Li value of 86 ppm and reddish clay developed within ferruginous granite gave Li value of 80ppm.
Kamrup (Metro) district, Assam	Magursila area	-	-	-	-	Mapping & Sampling	G4 investigation was carried out. In regolith profiles, the overall trend of the REE enrichment shows a definite enrichment mostly in the C-horizon in the study area when compared to B-horizon.
Kurnool District, Andhra Pradesh	Lanjabanda-Govardha-nagiri area	-	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Mo in the quartzo feldspathic veins ranges from 0.01 to 2.40 % (Avg.=0.52%, n=23). The value of Mo of the host granite ranges from 0.25 ppm to 3833.67 ppm (avg.=216.93 ppm, n=44)
Chitradurga district, Karnataka	Ghattiho sahalli, Lamba dihatti area, Holalkere Taluk	-	-	-	-	Reconnai ssance & Sampling	G4 investigation was carried out. The mineralised block 01 demarcated at the southern-west portion, the mineralised block-2, at the central portion and mineralised block-3 demarcated at the northern portion of the investigated block. The block 01 and 03 have given indication towards probable mineralisation related to Cu-Mo system and Cu-Mo-Zn-Y system respectively and the block-2 has given indication for pegmatite hosted Li-Cs-Nb-Ta and Ba-W-Ni mineralisation in the adjoining mafic-ultramafic suit.
Raichur District, Karnataka	Ashapura and Bijenagara areas	1:12500	103 sq .km	-	-	Mapping & Sampling	G4 investigation was carried out. The maximum values for Mo i.e., 0.57% reported from this sector, where 32 samples have Mo values >50 ppm Mo > 500 ppm, n-13).
Nickel-Ni-Cr-Pge/Cr-Ni-PGE							
Mayurbhanj district, Odisha	Naphri, Balarampur blocks	-	-	-	-	Sampling	G4 investigation was carried out. All the samples have assayed more than 0.15% Ni and highest value of 0.32 % is assayed in Naphri area.
Tumakuru District, Karnataka	Banasandra Block	-	-	-	-	Sampling	G2 investigation was carried out. The resource is estimated based on two different cut-off grades i.e., for 0.5 and 0.3 % Nickel namely 2.46 million tonnes with an average grade of 0.61% nickel and 0.02% cobalt at a cut-off grade of 0.5% Nickel. And 10.45 million tonnes with an average grade of 0.42% nickel and 0.017% of cobalt at cut-off grade of 0.3% Nickel

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Pali District, Rajasthan	Khiwandi Block	-	-				G4 investigation was carried out. Ni values in the serpentinsed ultramfic unit rock vary from 1674 ppm to 4501 ppm (0.167% to 0.45%) in channel samples 1774 ppm to 2941 ppm (0.177% to 0.29%) in pit and trench samples and from 870 ppm to 3200 ppm (0.087% to 0.32%) in BRS samples.
Udaipur district, Rajasthan	Jhadol area	-	-	9	1347m	Drilling	G3 investigation was carried out. Results obtained till now shows presence of low-grade nickel ore averaging around ~1900 ppm. 3 samples from ultramafic zone have analysed for gold as 70ppb, 90ppb and 110ppb. PGE sample results are awaited
Phosphate/Phosphorite							
Chhatarpur District, Madhya Pradesh	Tigoda-Manakpura-Gorakhpura areas	1:25,000	-	-	-	Mapping & Sampling	G4 investigation was carried out. SEM study of ferruginous chert breccias and sandstone shows occurrence of apatite mineral as source of phosphorite in the area. Disseminated basemetal mineralisation is observed in the form of malachite staining, pyrite, and chalcopyrite in dolomite, quartz reef, and granite of BGC and, 5 BRS samples analysed for basemetal analysis. The chemical result of the BRS sample collected for sulphide mineralisation from cherty quartzite south of Dalipur village shows a Cu value of 1845 ppm, while the sample collected from banded cherty quartzite near Padsila village shows a Cu value of 625 ppm.
Sundargarh district, Odisha	Garjanjor block	1:5,000	10 sq. km	5	355.20 m	Mapping, Sampling & Drilling	G3 investigation was carried out. No phosphatic zones of appropriate thickness having some economic significance could be found.
Ib-river coalfield	Shahasapur-Chuakani area	1: 12,500	100 sq. km	-	-	Mapping, Sampling	G4 investigation was carried out. Approximately 2.5 km strike length of phosphatic zone is demarcated (Based on Saphiro solution test). Average thickness of phosphatic zone varies from 3 cm to 22 cm approx. Most of the phosphatic zone is in reserved forest. In this area phosphatic zones occur in two forms, a) as thin lenses (sise varies from 0.5 cm to 1 cm) within siltstone and claystone horizon and b) as nodular and lensoidal form within siltstone horizon with sise varying from 1 to 20 cm.
Upper Subansiri district, Arunachal Pradesh	Bomdila Group in Menga area	-	50 sq. km	-	-	Mapping, Sampling	G4 investigation was carried out. Analytical result received of 185 bedrock samples in which P2O5 ranging from <0.01 to 0.94% with a mean of 0.10% which is not encouraging.
Tehri Garhwal District, Uttarakhand	Garhwal Syncline	1:12,500	-	-	-	Mapping, Sampling	G4 investigation was carried out. No anomalous zones were demarcated since the investigated commodities show low values. The phosphorite resource of the area falls under 334 code of United Nations Framework Classification (UNFC) of mineral resources
YSR (Kadapa) district, Andhra Pradesh	Chennur area	1:12,500	115 sq. km	-	-	Mapping, Sampling	G4 investigation was carried out. No visible phosphorite bearing zones could be delineated in the study area.
YSR (Kadapa) district, Andhra Pradesh	Khajipeta-Nandya lampeta area	-	-	-	-	Sampling	G4 investigation was carried out. Analytical results received of samples collected from cherty dolomite, fragmentary dolomite and brecciated dolomite shows that P2O5 varies in between 0.75-1.08%.
Koppal District, Karnataka	Dombarahalli Block	-	-	6	581.50 m	Drilling	G3 stage investigation was carried out. At 5% P2O5 cutoff the resource (UNFC 333) is 3.70MT and 3.6MT with average P2O5 of 5.93 wt% and TREO is 0.26 wt% by thiessen polygon and extended area method respectively. At 3% P2O5 cutoff, resource is 15.47 MT and 15.69 MT with average 4.26wt% of P2O5 and TREO is 0.22% by thiessen polygon and extended area method respectively.
Banswara District, Rajasthan	Shivpura area	1:2,000	1.5 sq. km	2	107 m	Mapping, Sampling & Drilling	G3 stage investigation was carried out. 52 nos. of core samples, 20 nos. of petrological samples, 20 nos. of petrochemical samples, 5 nos. of samples for XRD and 5nos.of samples EPMA have been collected from the study area

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Fatehgarh, Jaisalmer and Barmer Districts, Rajasthan	North-western part of the Jaisalmer basin	-	-	-	-	Sampling	G3 stage investigation was carried out. Resource will befalls under 333 category of UNFC.
Potash							
Shergarh -Fazilka district, Punjab	Dalmirkhera block	-	-	5	4518 m	Sampling & Drilling	G4 investigation was carried out. Polyhalite/potash mineralisation is recorded in halite cycles thus, the whole potash mineralisation in the Evaporite Group is sedimentary and strata-bound in nature.
Hanumangarh District, Rajasthan	Chistiyan South block, Satipura sub-basin, Nagaur - Ganganagar Evaporite Basin	-	-	06	4650 m	Mapping, Drilling, Sampling	G3 stage investigation was carried out. The chemical results are awaited
Hanumangarh district, Rajasthan	Makkasar Block, Satipura sub-basin, Nagaur-Ganganagar Evaporate Basin	1: 10,000	6 sq. km	8	6110.50 m	Mapping, Drilling, Sampling	G3 stage investigation was carried out. Analytical results of submitted samples are awaited.
Bikaner District, Rajasthan	Hanseran area in Nagaur-Ganganagar Evaporite Basin	1: 10,000	100	5	4556.50 m	Mapping, Sampling, Drilling	G4 investigation was carried out. The chemical results are awaited.
Hanumangarh District, Rajasthan	Bawriyan wali Dhani southeast Block, Satipura sub-basin of Nagaur-Ganganagar Evaporite Basin	-	-	10	-	Drilling	G4 investigation was carried out. Potash bearing zones identified between 640.00 m to 671.00 m depth & 730.00 m to 755.0 m depth. Estimated resource will fall in category 333.
Pyrophyllite							
Chhatarpur district, M.P.	Sarkana area	-	-	-	-	Sampling	G4 investigation was carried out. The analytical results shows low grade pyrophyllite/ diaspore which might not bear substantial economic significance in present scenario.
Scandium							
Jaisalmer District, Rajasthan	Dand Dungar-Charu-Kanod area	1:12,500	-	-	-	Mapping	G4 investigation was carried out. Chemical analytical result shows anomalous concentration of Scandium within bioturbated limestone, fossiliferous limestone and lime mudstone unit of Badabag Member
Sillimanite							
East Garo Hill District, Meghalaya	Mangsang-Niangbr akithim Block	-	-	-	-	Sampling	G4 investigation was carried out. Till now from the chemical results Li values lie between <5 to 17 ppm and the Avg Al2O3% of Quartz sillimanite schist from PTS samples is 13.78% which is very low grade.
Strontium							
Jaisalmer district, Rajasthan	Shri Mohangarh-Lakhakhadar area	1:12,500	400 sq. km	-	480 m	Mapping, Sampling, Drilling	G4 investigation was carried out. Chemical analysis showed very encouraging results with Sr concentration ranging from 4773 ppm to 9188 ppm. Pit samples (06 nos.) also give high value of Sc (54ppm) and Y (120ppm) along with Sr. core samples with gypsum bearing sediments give anomalous value of Sr up to 3010 ppm.
Silver							

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Bhilwara District, Rajasthan	Bharak North Block	-	-	8	1138 m	Sampling & Drilling	G3 investigation was carried out. Results indicated that this deposit may be of very low significance as far as Ag mineralisation is concerned. Moreover, our work indicated the presence of Pb, Zn and Cu in the same block and the Ag occurs in the lattice of galena.
Tellurium							
Udaipur district, Rajasthan	Khuna-Merpur-Pandibor area	1:12,500	100 sq. km	3	360 m	Mapping, Sampling, Drilling	G4 investigation was carried out. The bedrock sample analysed higher concentration of Sr (11619 ppm) with >5000 ppm of Sr (n=35) and Te (1.29 ppm) with >0.5ppm Te (n=14). The analytical results of few of the submitted samples are awaited.
Titanium							
East Singhbhum District, Jharkhand	Katin block	-	3.0 sq. km	7	300 m	Mapping, Sampling, Drilling	G3 investigation was carried out. Further exploration and assessment will be essential to determine the extent and economic viability of these resources.
Tungsten							
Bankura District, West Bengal	Ratanpur – Ghatpal Block	1:2,000	2.00 sq. km	-	-	Mapping & Sampling	G3 investigation was carried out. Chemical analytical data reveals variable mineral concentrations, particularly in the Ghatpal area, with the southwestern quartz vein demonstrating significant tungsten (W) content, rare earth elements (TREE), and negligible gold (Au) values. Ratanpur's presents noteworthy W and TREE values, along with minimal Au content, while the northern vein shows modest W and TREE values but negligible Au concentrations
East Garo Hills, District, Meghalaya	Rongjeng-Darugri-Nongchram Block	-	50 sq. km	-	-	Sampling	G4 investigation was carried out. Analytical value of tungsten ranges from 3.52 ppm to 222.11 ppm with an average of 81.37 ppm. Out of 15 BRS sample results, 5 nos. of samples only yielded >110 ppm of tungsten with maximum value of 222.11 ppm yielded from medium-grained alkali granite.
Chamba district, Himachal Pradesh	Gothri area	1:12500	50 sq. km	-	-	Sampling & Mapping	G4 investigation was carried out. The highest W value of 146.7 ppm is from oxidised granite of Dalhousie Granitoid
Kinnaur district, Himachal pradesh	Asrang-Purbani area	1:12500	70 sq. km	-	-	-	G4 investigation was carried out. Geochemical analysis of Rakcham granite rocks reveals high SiO2 (59.4% to 72.54 wt.%), Al2O3 (13.94 to 19.06 wt.%), K2O (2.07 to 5.92 wt.%), and Na2O (1.77 to 4.76% wt.%), indicating a diverse source. Notably, variable Na2O + K2O (4.58–9.0 wt%), ΣREE (231–1196.88 ppm), Rb (69.0–331 ppm), and Nb (2.5–9.0 ppm) levels suggest heterogeneity. The granite is strongly peraluminous (A/CNK: 1.38–2.31), resembling S-type granites. Enrichment in LREE and slightly negative Eu anomalies (Eu/Eu* = 0.35–1.17) imply pre-existing crustal assimilation. Metasedimentary xenoliths within the granite further affirm this. Fractional crystallization is evident from La vs. La/Sm and Zr vs. Zr/Sm plots. High CaO/Na2O (>0.3) and Rb/Ba vs. Rb/Sr ratios point to the melting of clay-poor, mature psammitic sources.
Anantapur District, Andhra Pradesh	Balepalyam area	-	-	7	586.31 m	Mapping, Sampling, Drilling	G3 investigation was carried out. As per chemical data, details of the lodes are as follows: (i) one lode at APAB-1 (L-2: at 61.80-63.30m with avg. WO3 of 0.034%; (ii) one lode at APAB-3 (L-3: at 43.81-45.81 m with avg. WO3 of 0.03%) (iii) two lodes in borehole APAB-4 (L-1: at 32.25-35.25 m with WO3 0.22% and L-2: at 49.25-50.85 m with WO3 0.13%) and (iv) one lode in APAB-5 (L-1: at 61.45-63.45 m with avg. WO3 of 0.05%). Maximum molybdenum (Mo) value of 204.82 ppm and gold (Au) value of 0.9 ppm is observed in core sample of APAB-1 at 19.20-19.70 m and 67.50-68.00 m respectively. WO3 value of channel samples and trench samples reached upto 6975.49 ppm and 230.5 ppm respectively. Cross section method and LV method estimated 0.09 million tonnes of WO3 at 0.1% grade and 0.08 million tonnes of WO3 at 0.1% grade, respectively, at 0.03% cutoff for 1.5 m stoping width
Degana, Nagaur District, Rajasthan	NW Extension Rewat Hill	-	-	30	6986.8 m	Sampling & Drilling	G2 investigation was carried out. Analytical results of 2620 core samples indicated very significant rare metal potentials. It includes main commodity tungsten and associated Li, Rb, Bi, Sn, Mo, Nb and Cs mineralisation.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Degana, Nagaur District, Rajasthan.	SE Extension of Rewat Hill	-	-	22	4954.65 m	Sampling & Drilling	G2 investigation was carried out. Analytical results of 1360 core samples indicated very significant rare metal potential. It includes main commodity tungsten and associated Li, Rb, Bi, Sn, Mo, Nb and Cs mineralisation.
Pali District, Rajasthan	Mohangarh (Motiya) Block	-	-	8	1580 m	Sampling & Drilling	G3 investigation was carried out. Analytical results of 226 core samples indicated very significant rare metal potentials. It includes main commodity tungsten and associated Li, Sn and Rb mineralisation.
Nagaur District, Rajasthan	Pipaliya Block	-	-	9	1480 m	Sampling & Drilling	G3 investigation was carried out. Analytical results of 212 core samples indicated very significant rare metal potentials. It includes main commodity tungsten and associated Li mineralisation.
Sirohi District, Rajasthan	Uttara-Balda area	1:12,500	100 sq. km	2	300m	Mapping, Sampling & Drilling	G4 investigation was carried out. Analytical results received indicate encouraging values of F (upto 10.8%), Y (upto 1922 ppm), Li (upto 417 ppm), Cs (upto 573 ppm), Sn (upto 719 ppm), Ta (upto 1431 ppm), Sc (upto 65 ppm), W (upto 5489 ppm), Nb (upto 293 ppm), & Rb (upto 1086 ppm
Vanadium							
Lower Subansiri District, Arunachal Pradesh	Sito-Sikhe areas	-	-	5	799.05 m	Sampling & Drilling	G3 investigation was carried out. A. By Cross Section method: 1. 0.05% V2O5 cutoff: 4.68 million tonnes with average grade of 0.3041 % V2O5 2. 0.1% V2O5 cutoff: 4.62 million tonnes with average grade of 0.3218 % V2O5 3. 0.2% V2O5 cutoff: 3.33million tonnes with average grade of 0.4064 % V2O5 4. 2% Fixed carbon cutoff: 4.68 million tonnes with average grade of 12.973% Fixed carbon 5. 10% Fixed carbon cutoff: 4.37 million tonnes with average grade of 14.2207% Fixed carbon B. By Longitudinal Vertical Section method: 1. 0.05% V2O5 cutoff: 4.68 million tonnes with average grade of 0.2673 % V2O5 2. 0.1% V2O5 cutoff: 4.75 million tonnes with average grade of 0.2785 % V2O5 3. 0.2% V2O5 cutoff: 3.31 million tonnes with average grade of 0.3163 % V2O5 4. 2% Fixed carbon cutoff: 4.68 million tonnes with average grade of 13.7895% Fixed carbon 5. 10% Fixed carbon cutoff: 4.38 million tonnes with average grade of 14.0811% Fixed carbon.
Pakke Kessang district, Arunachal Pradesh	Pakro block	-	-	6	697.3 m	Sampling & Drilling	G3 investigation was carried out. The mineralised bands were intersected in all the boreholes with varying thickness ranging between 1 m to 19 m along the borehole length.
West Siang District, Arunachal Pradesh	Siku Angu and Lipu	-	50 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Three Carbonaceous Phyllite bands were delineated from Angu village. Band 1:30m width, 400m strike extension (631 ppm V with FC of 4.75 % in BRS, upto 1062 ppm V with 10.6% FC in channel sample, upto 589 ppm V in PTS). Band 2:30-60 m width, 700 m strike (154 ppm V with 2.12% FC in BRS. Band 3:60 m width, 500 m strike extension (709 ppm V with FC of 3.92 % in BRS, upto 745 ppm V with 5.6% FC in Channel sample, 673 ppm V in PTS). Marble band of 150-160 m width from Pushidoke area yields CaO content ranges from 24.29-43.62%. ΣREE analysed upto 1344 ppm in Marble, 681 ppm in CP of Jeyi Bagra area and 1223 ppm in CP from Angu area
Sirmaur district, Himachal Pradesh	Rajana-Batewari blocks	-	-	-	-	Sampling & Drilling	G3 investigation was carried out. Based on analytical analysis of channel samples and borehole data so far received, both the blocks i.e. Rajana and Batewari blocks have economic potential for vanadium

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Sirmaur district, Himachal Pradesh	Kathwar-Ghaton blocks	1:4,000	3 sq. km	5	-	Mapping, Sampling, Drilling	G3 investigation was carried out. In the cross-section method, 13.8 million tonnes of ore at a 0.1% cut-off and 7.4 million tonnes of ore at a 0.2 % cut-off are estimated. Similarly, in LV section method, 14.9 million tonnes of ore at a 0.1% cut-off grade and 7.6 million tonnes at a 0.2% cut-off grade is estimated. In the Kathwar block, the ore resources have been calculated by Cross Section (CS) and Longitudinal Vertical Section (LVS) methods. Total resource is 10.8 million Tonnes with 0.32% vanadium (V_2O_5: 0.57%) at 0.2% cut-off when computed by the LVS method. It comes out to be 9.3 million Tonnes with 0.32% vanadium (V_2O_5: 0.57%) at a 0.20% cut-off when computed by the CS method.
Champawat district, Uttarakhand	Chaura, Sirmoli and Lohaghat areas	-	-	-	-	Sampling	G4 investigation was carried out. The Vanadium values obtained vary from <1000 ppm to 5212 ppm. The associated Barium values are also found high with values up to 40,682 ppm.
Almora district, Uttarakhand	Nishni-Malta area	-	26 sq. km	-	-	Mapping, Sampling	G4 investigation was carried out. The samples show significant Vanadium content, the minimum is 86 ppm and whereas maximum content of 3436 ppm.
Chandauli district, Uttar Pradesh	Dhandraul Sandstone of Kaimur Group	-	-	7	194.00 m	Sampling & Drilling	G4 investigation was carried out. V values range from 730 to 1391 ppm with the average of 1013.62 ppm.
Sonbhadra district, Uttar Pradesh	Khaliari, Siaria and Manchi blocks	1: 12,500	52 sq. km	-	-	Mapping, Sampling & Pitting/ Trenching	G4 investigation was carried out. The investigated area has shown low values of Al_2O_3 (average 15.72%, median 16.67%), SiO_2 (average 44.25%, median 42.70%) and Fe_2O_3 (average 25.88%, median 27.34%). Chemical values of some trace elements viz. Ba (144-5428 ppm), Sc (8-63 ppm), V (63-744 ppm), Y (20-111 ppm), Zr (127-786 ppm), Cr (41-517 ppm), Co (<10 to 189 ppm), Pb (<20 to 502 ppm), Ce (51.07-559.70 ppm), Th, U (2.01- 12.95 ppm) have shown somewhat higher values than the crustal abundance
Uncovered project							
West Bengal, Jharkhand and Odisha	Singhbhum Craton and North Singhbhum Mobile Belt	-	-	-	-	Mapping, Sampling & Geophysical survey	Special emphasis on less explored central portion of Dhanjori basin which is occupied the metabasalts predominantly. Quartz vein in association with one of the splays of the shear zone within the basin gives 2600 ppm Cu while another random sample from a nearby vein gives 0.46 ppm gold value which is very promising. Semi regional gravity magnetic on 65 sq. km area and 12 pts for vertical electrical soundings has been done. Maximum 2811ppm Ni value has been obtained with kambalda ratio of 1.0 and the area is potential for Ni prospectivity while the zones with kambalda ratio >1 and Ni value >1000 ppm are the zones of interest.
Andhra Pradesh and Karnataka	Western and Eastern Dharwar cratons	-	1. 03 sq.km	2	-	Mapping & Drilling	Focused mainly on drilling in order to know the nature of deep-seated gold mineralisation especially in Gadag belt within the southern transect. Boreholes have intersected a good arsenopyrite zone at different depths, analytical results did not show good Au value except one sample upto 1.6 ppm. During drilling zones of sulphide concentration including arsenopyrite is intersected but did not yield any economic viable zone.Further advance research study is required to understand the intricacy and erratic nature of gold and PGE mineralisation along the southern transect in the Dharwar craton.
Ananthapur District, Andhra Pradesh	Kalyandurg-Timmasa mudram-Chigicherla	-	-	-	-	Mapping & Sampling	Study to derive subsurface structure beneath the Kalyandurg-Timmasamudram-Chigicherla (KTC) Kimberlite cluster and gold mineralisation/basemetal in Ramagiri-Penakacherla Schist Belt by deploying different geophysical methods and integrated with geological studies for understanding the occurrence of kimberlite pipes and gold mineralisation. Occurrences of sulphides along with gold mineralisation are generally associated with structurally controlled veinlets characterised by numerous brittle–ductile shear zones. Chemical analysis of PCS samples proximal to the Ramagiri main shaft shows encouraging gold values of 14900 ppb (14.9 ppm) and 9200 ppb (9.2 ppm) in phyllite and smoky quartz vein respectively.
REE & RM							

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Alirajpur District, Madhya Pradesh	Sorwa-Beharwa-Malwai-Rordha-Alirajpur area	1:12,500					G4 investigation was carried out. The values of ΣREE range from 9.32 ppm to 962.39 ppm in bedrock samples, 101.16 ppm to 945.02 ppm in soil/ regolith samples, 22.51 to 740.05 ppm in PCS samples. The results for stream sediment samples received show range of total REE from 54.12 ppm to 284.33 ppm and pitting/trenching samples show range of total REE from 236.55 ppm to 1442.96 ppm.
Balrampur district, Chhattisgarh	Bhagwanpur-Duba area	1:12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. The area remains a good prospect for sub-surface exploration of strategic metal in future.
Balrampur District, Chhattisgarh	Dhanwar and Dindo	-	100 sq. km area	-	-	Mapping & Sampling	G4 investigation was carried out. Present study indicates higher REE values in certain areas as secondary enrichment
Jashpur district, Chhattisgarh	Kunkuri, Kharijhiria area and part of Kunjara RF	1:12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Petrochemical sample shows, ΣREE value as 625 ppm from coarse-grained syenogranite of Donga Amba. 03 nos. of stream sediment sample show anomalous values of 1291.26 ppm in medium grained granite at the contact of granite and metasedimentary unit; 1174.45 ppm and 1254.85 ppm from coarse grained syenogranite. In situ soil sample shows higher value of 1031.14 ppm in coarse syenogranite; and soil samples from Siri-river bank shows ΣREE concentration of 3316.7 ppm and 1089 ppm, this is to be noted that it is not in-situ soil but deposits of river. Bedrock Sample (BRS) and Petrochemical Sample (PCS) show highest values of 838.15 ppm and 840 ppm respectively both from weathered coarse grained syenogranite.
Korba District, Chhattisgarh	Rangole and Nunhapara area	-	-	-	-	Sampling	G4 investigation was carried out. A total of 4 sectors were demarcated based on field studies and association of phoscorite and syenite and/ or granite viz., 1) Kanjipani West (1.3 sq. km); 2) Nunhapara (1.0 sq. km); 3) Chaitma (1.3 km) and 4) Kadaihpara (0.5 km). Phoscorite rocks analyse anomalous P2O5 content to the tune of 5.8%, besides high tREO (0.5%); anomalous Ba (0.8%) and Sr (0.9%) enrichment is reported where syenite veins mingles with phoscorite. Coarse grained apatite diopside phoscorite has analysed higher tREO in Chaitma and Nunhapara Blocks. A total of 3.78 Lkh Tons of igneous phosphate in the form of phosphate pentaoxide (P2O5) with average grade of 3.81% in two blocks viz., Chaitma and Nunhapara is estimated in phoscorite (PR).
Sindhudurg District, Maharashtra	Talavada and Vengurla areas	1:12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Based on the findings of this study, a potential area of 1.28 sq. km has been delineated between Matond and Hodavada
Sindhudurg District, Maharashtra	Adeli-Palkarwadi areas	1:12,500	100 sq. km	-	-	Mapping & sampling	G4 investigation was carried out. On the basis of the encouraging tREE values in BRS, regolith and groove samples collected from the mapped area, two blocks- Block A with an area of 1.5 sq. km (2.4 km x 0.63 km) and block B having an area of 2 sq. km (1.35 km X 1.5 km) have been demarcated between Zarap and Keravade areas as potential areas for REE mineralisation.
Banka District, Bihar	Dhawabaran – Kalyanpur –Bhalu alangi-Chauga hima	1:12,500	100 sq. km	-	-	Mapping, sampling & Drilling	G4 investigation was carried out. Analytical data from 18 borehole rock samples (BRS) indicate total rare earth element (tREE) values spanning from 61.55 ppm to 856.13 ppm, with 7 samples showing tREE values exceeding 500 ppm. Similarly, data from 67 soil samples reveal tREE concentrations ranging from 109 ppm to 1254.10 ppm, with 7 samples displaying tREE values exceeding 500 ppm out of the 70 samples tested.
Banka and Jamui districts, Bihar	Gaura and Karma	1:12,500	100 sq. km	-	-	Mapping & sampling	G4 investigation was carried out. The analytical results of 16-unit cell samples, sourced from composite numbers 4, 5, 18, and 19, have yielded promising total REE (tREE) values, ranging from 321 to 1914 ppm.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Jamui District, Bihar	Kanhaydih, Ukhariya and Bakhauri-Bathan Area	1:12,500	100 sq. km	-	-	Mapping & sampling	G4 investigation was carried out. Analytical results from 88 bedrock samples have revealed a maximum total REE (tREE) value of 1499 ppm, with 19 samples exhibiting tREE values exceeding 500 ppm. Lithium (Li) values in bedrock samples ranged from 2 ppm to 232 ppm, while beryllium (Be) values ranged from 1 ppm to 109 ppm, and germanium (Ge) values ranged from 1 ppm to 4 ppm. Rubidium (Rb) values in bedrock samples spanned from 3 ppm to 938 ppm.
Jamui District, Bihar	Auraiya-Narganjo-Dotna area	1:12,500	100 sq. km	-	-	Mapping & sampling	G4 investigation was carried out. Petrochemical samples revealed total REE (tREE) values ranging from 16.88 ppm to 1332.14 ppm. Bedrock samples yielded tREE values spanning 5.15 ppm to 1940.40 ppm, while stream sediment samples exhibited a wide range from 209.16 ppm to 28468.48 ppm. Regolith soil samples presented tREE values varying from 86.03 ppm to 1456.14 ppm, and auger soil samples showed values ranging between 139.65 ppm and 833.84 ppm.
Koderma District, Jharkhand	Domchanch area	1:12,500	100 sq. km	-	-	Mapping, Sampling & Pitting/ Trenching.	G4 investigation was carried out. Analytical results from BRS, PTS, SSS, and soil samples indicate tREE values ranging from 52.52-1838.75 ppm, 53.55-1206.29 ppm, 238.91-1446.92 ppm, and 175.22-619.89 ppm, respectively.
Boudh and Sonepur districts, Odisha	Gabjor area					Mapping, & Sampling	G4 investigation was carried out. Two potential zones have been marked for REE mineralisation in the soil and stream sediments based on the surface evidences. The stream sediments collected from zone-I have yielded tREE values of 0.85% and 1.4% and those from Zone-II have yielded tREE values of 0.63% and 1.7%.
Nayagarh district, Odisha	Notara-Baulasahi area	1:12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. From the chemical data, received so far, the highest value for ΣREE detected is about 5.2% which is from apatite veins. The rocks are strongly enriched in LREEs in comparison to HREEs. Their overall REE potentiality however can only be ascertained on receipt of the total chemical data.
Nogaon and Karbi Anglong districts, Assam	Anjakpani - Rionpahar area	-	50 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. The granite of the area is metaluminous-peraluminous and bears REE bearing mineral phases of zircon, monazite, apatite, allanite and bastnasite. REE shown in rocks are: granite (10 nos.)- max. 1301ppm, meta-rhyolite (13 nos)- max. 385 ppm and pegmatite (2 nos.)- max. 505ppm. Chlorite-actinolite schist (3 nos) gives max. Cr-1253, Ni-416ppm. W value in BRS show 0.63-339.85 ppm and in stream sediment 369.84-1338.05 ppm. Tiny gold grain in granite has also been observed under SEM.
West Karbi Anglong district, Assam	Krawgaon block, Jashora Alkaline Complex	1:2,000	1 sq. km	23	1651.05m	Mapping, Sampling & Driling	G3 investigation was carried out. Chemical data of 953 core samples show encouraging values of ΣREE upto 14760 ppm. Weighted average in individual boreholes is 447-6843 ppm. Also, niobium (Nb), vanadium (V) and TiO_2 show high values in core samples with maximum values of 3739 ppm, 750 ppm and 21.26% respectively.
Kamrup (Metro) and Morigaon Districts, Assam	Paschim Nagaon and Sonaikuchi areas	-	-	-	-	Mapping & Sampling	G4 investigation was carried out. ΣREE content in porphyritic granites varies from 46 ppm – 1028 ppm. Anomalous values of WO_3% are observed in quartz vein to the south of Talni (0.15%), alkali feldspar granite near Nibiragaon (0.12%), pegmatite near Rabingaon (0.11%) and calc-silicate towards the north of Umbat Khal (0.09%). The thickness of regolith over the granites ranges from 5 m to 20 m. The thickness of the B horizon ranges from 1m to 6 m and the thickness of the C horizon ranges from 1.5 m to 5 m. The ΣREE (REE+Sc+Y) concentration in the soil samples ranges from 213 ppm to 1462 ppm with an average value of 655 ppm. The enrichment of ΣREE is more in the B horizon (399 ppm to 1462 ppm) than in the C horizon in the soil profile.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Dimapur District, Nagaland	Jharnapani	-	-			Sampling	G4 investigation was carried out. Bulk of the analytical data is awaited.
West Khasi Hills District, Meghalaya	Seinduli Pluton	-	63 sq.km			Mapping & Sampling	G4 investigation was carried out. The granitoids of Seinduli Pluton are having high potential of REE mineralisation in both granite and weathered granitic crust
Ri-Bhoi district, Meghalaya	Amjong, Umtrai and Umlaber area	-	-			Sampling	G4 investigation was carried out. The analytical results in bedrock samples (41 nos.) show average concentration of TREE is 400 ppm, LREE-is 350 ppm and HREE-350 ppm. Whereas the maximum value of TEE is 1130 ppm received in diorites from Umtrai block.
Vizianagaram district, Andhra Pradesh	Garividi area	1:12,500	65 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. In old Mn pits manganese occurs in association with feldspathic quartzite and intensely kaolinised and limonitised garnet-sillimanite-gneiss. MnO (in %) in PTS varies from 0.05% to 7.31% with mean value of 1.94ppm. Only 2 nos. of PTS samples have more than 5% MnO which is distributed around Geddapuvalasa village. MnO in BRS varies from 0.02% to 11.25% with mean value of 1.33%. Only 3 nos. of BRS has more than 5% total Mn as MnO. REE in soil samples varies from 49.104 ppm to 1428 ppm with the mean value of 534.29 ppm. REE values in soil samples vary from 119.76 ppm to 1696.52 ppm with the mean value of 560.31 ppm. Fixed Carbon values in graphite samples vary from 0.11% to 2.04%.
Nellore district, Andhra Pradesh	Ayyagari palem – Palicher lapadu area	1:12,500	-	-		Mapping & Sampling	G4 investigation was carried out. Total 57 BRS were collected systematically from the study area. On the basis of chemical data received, 8 no. of BRS samples show encouraging REE values.
West Godavari District, Andhra Pradesh	Kottapalle area	-		-	-	Sampling	G4 investigation was carried out. Bedrock samples show TREE values range from 61 ppm to 1222 ppm with LREE range of 59 ppm to 1107 ppm and HREE value of 2 ppm to 114 ppm. The SSS have been analysed total REE of 268 ppm to 7309 ppm. The LREE in SSS range from 241 ppm to 7086 ppm with HREE values of 17 ppm to 222 ppm. Soil samples analysed with TREE values of 212 ppm to 1854 ppm. The LREE values range from 195 ppm to 1789 ppm and HREE range from 16 ppm to 66 ppm. The HM samples TREE range from 673 ppm to 89720 ppm. The range of LREE and HREE are 636 ppm to 86552 ppm and 36 ppm -3168 ppm respectively. In all the sample media, the LREE dominant HREE. The mineralisation in Kotatapalle is alluvial placer type.
Chittoor district, Andhra Pradesh	Chillama kulapalle-Narsim haraju puram area	-	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Preliminary analytical results of soil samples are having high Li upto 64 ppm
Chamraj nagar district, Karnataka	Gundlupet block	1:1,000	-	13	1885.15 m	Mapping, Sampling & Drilling	G3 investigation was carried out. The estimated Rare Earth Oxide resource of Gundlupet area is 19.71 million tonnes at 0.1% REO cut-off with an average grade of 3093 ppm of Total Rare Earth Oxide content; 6.37 million tonnes at 0.3% REO cut-off with an average grade of 5434 ppm of TREO content and 3.62 million tonnes at 0.5% total REO cut-off with average grade of 6801 ppm of TREO content by cross-section method. As per UNFC, the resource estimated is considered as 'Inferred Resource' (333).
Thrissur District, Kerala	Kodasseri area	1:12,500	-		-	Mapping & Sampling	G3 investigation was carried out. Analytical results of 156 nos. of regolith samples show ΣREE ranges from 106.48 ppm to 11409.51 ppm (1.14 %). 16 nos. of regolith samples show ΣREE values >1000 ppm. 24 nos. of granite show ΣREE ranges from 125.83 ppm to 1373.21 ppm, 20 nos. of granite gneiss show ΣREE ranges from 145.96 ppm to 786.63 ppm and 2 nos. of pegmatite samples show ΣREE ranges from 64.86 ppm to 637.60 ppm. 51 nos. of pit/trench samples show ΣREE ranges from 216.17 ppm to 1107.95 ppm. All the samples have LREE (La to Eu) enrichment and HREE depleted nature. 51 nos. of SSS show ΣREE ranges from 304.38 ppm to 2280.46 ppm.

Table- 1 (Cont.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Idukki District, Kerala	Rajakumari	1:12,500	100 sq. km	-	200 m	Mapping, Sampling & Drilling	G4 investigation was carried out. The resource is calculated from the analytical results of auger drilled soil samples and it is estimated in extended area grid pattern method. In Rajakumari Block, a total resource of 53.9 million tonnes of ΣREEO has been estimated with weighted average of 1572.2 ppm at 1000 ppm ΣREEO cut-off for an area of 10 sq.km A total resource of 26.68 million tonnes of ΣREEO has been estimated with weighted average of 1958.8 ppm at 1500 ppm ΣREEO cut-off for an area of 5 sq. km.
Alappuzha and Pathanamthitta Districts, Kerala	-	-	-	-	-	Sampling	G4 investigation was carried out. The analytical results imply that the REE concentration in Chengannur granite is mainly concentrated in the pegmatites and in granite.
Bhadradri-Kothagudem District, Telangana	Patrwa-rugudem	-	-	-	-	Sampling	G4 investigation was carried out. Based on the concentration of ∑REE values of Soil, regolith, clay (raw & heavy fraction), Stream sediment (raw & heavy fraction), and bedrock sample, four anomalous zones have been delineated to carry out the further detailed study
Nalgonda and Rangareddy districts, Telangana	Mal and Saire ddigudem areas	-	-	-	-	Sampling	G4 investigation was carried out. The chemical analysis of BRS shows ΣREE ranging from 25 ppm to 2433 ppm, in RM Li ranging between 5 ppm and 94 ppm, Cs is < 2 ppm, Mo is yield with 0.5 ppm to 5.4% and few sample contain W ranging between 244 ppm to 539 ppm. Similarly, regolith and trench samples show ΣREE between 261.84 ppm to 3264.09 ppm and 104 ppm to 2307 ppm respectively.
Bhadradri Kothagudem District, Telangana	Gangaram Block					Sampling	G3 investigation was carried out. The REE values in stream placers are noticed up to 1.73 wt%. The REE values in samples is majorly contributed by Ce, La and Nd.
Tirupattur district, Tamil Nadu	Koratti Syenitic Complex	-	-	4	641 m	Drilling & Sampling	G2 investigation was carried out. A total of 20.29 million tonnes of ore resources with 0.15% of TREO has been estimated.
Dharmapuri andKrishnagiri Districts, Tamil Nadu	Hanumanta puramand adjoining areas	1:12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. An anomalous zone is demarcated in the north western part of the study area, around north of Annamalahalli village. Granite gneiss (2 nos.) from this zone show ΣREE of 1011.88 to 1023.91 ppm, Stream sediment sample (1 no.) show ΣREE of 2040.97 ppm, soil sample (1 no.) show ΣREE of 1051.58 ppm. Trench samples (7 nos.) show ΣREE from 900.31 to 1432.20 ppm.
Sabarkantha district of Gujarat and Sirohi, Udaipur districts of Rajasthan	Padlai-Adabela area	-	-	-	-	Sampling	G4 investigation was carried out. Samples have been submitted for chemical analysis
Banaskantha and Sabarkantha Districts, Gujarat	Pathora-Digthali block	1: 12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Chemical analysis results of a few samples have been received in which some of the samples have yielded a total REE of approx. 2000 ppm.
Banaskantha and Sabarkantha districts of Gujarat	Jodhsar-Unchidhanal villages	-	-	-	-	Sampling	G4 investigation was carried out. Chemical analysis results of a few samples have been received in which some of the samples have yielded a total REE of approx. 2000 ppm
Barmer District, Rajasthan	Bachharau-Dhorimana area	-	170 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. Interpretation will be done after receiving the complete chemical analysis result of the submitted samples
Sikar District, Rajasthan	Ladi Ka Bas Area	1: 4,000	5.0 sq. km	-	1238.50m	Mapping, Sampling & Drilling	G3 investigation was carried out. The analytical results of these channel samples show values of ΣREE ranging between 1151-13818 ppm; based on which two mineralised zones, MZ-I and MZ-II have been delineated. On the basis of those analytical results of channel samples, 9 first level and 1 second level boreholes have been drilled. The analytical results of priority core samples show ΣREE values ranging between 315 ppm and 11725 ppm. Sulphide mineralisation in the boreholes is manifested

Table- 1 (Concld.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
							in the form of small patches of Fe-sulphides, mainly pyrite and pyrrhotite minerals. Surface manifestation of mineralisation was found only in the form of sporadic occurrences of malachite. Detailed geophysical studies also indicate that the south-central part of the block is characterised by a zone of high magnetism and high chargeability which corelates well with the geological observations and chemical analytical data. Both the mineralised zones fall on high magnetic gradients and high chargeability zone.
Sikar district, Rajasthan	Kalakhera area	1:4,000	5.33 sq. km	-	100.20 m	Mapping, Sampling & Drilling	G3 investigation was carried out. The resource estimation for the Kalakhera block was not done because only one borehole was drilled based on the feeble encouraging results of channel KCH-01. Further drilling in the area has been discontinued by the competent authority and drilling was suspended
Bhilwara district, Rajasthan	Kodukota-Raser-Lulas-Kallyakhera area	-	-	-	-	Mapping & Sampling	G4 investigation was carried out. Analytical results of bedrock samples show maximum ΣREE value of 664 ppm from tourmaline rich pegmatite body and ΣREE of 515.77 ppm from granite gneiss near Sidariyas village. Silimar value of ΣREE having value in the range of 507 ppm to 646.38 ppm is detected from the K-feldspar rich pegmatite on the south-western part of Sarsari village. Near Salariya Khurd village ΣREE of 653 ppm is detected from the biotite granite
Jalore district, Rajasthan	Ahor-Beria-Ajitpur area	1:12,500	170 sq. km	4	-	Mapping, Sampling & Drilling	G4 investigation was carried out. Channel samples also collected from Kotra area has yielded 0.13% wt avg. Zinc in 3 m zone. Another 2 m channel samples has yielded 0.12% Copper, 0.12% Zinc and 15ppm Silver. Another 2m zone has yielded 0.39% Zinc, 0.21% Copper and 10ppm Silver. These values are from NS and NE-SW trending quartz veins intruded within k-feldspar granite in Kotra area.
Barmer District, Rajasthan	Relon Ki Dhani - Telwara areas	1: 12,500	100 sq. km	-	-	Mapping & Sampling	G4 investigation was carried out. A total 21 nos. of petrological samples were also collected from major lithology exposures in the mapped area for petrography study.
Barmer District, Rajasthan	Sukleswar ka Mandir	1:12,500	100 sq. km	-	1466 m	Mapping, Sampling & Drilling	G3 investigation was carried out. Analytical results of drill core samples are awaited, for demarcation of REE rich zones and therefore for resource estimation.
Barmer district, Rajasthan	SE of Gugrot	1:2,000	1 sq. km	7	-	Mapping, Sampling & Drilling	G3 investigation was carried out. Resource estimation will be attempted after receiving of results of all chemical samples submitted
Barmer district, Rajasthan	South of Gura nal	1:2,000	1.5 sq. km	14	1210 m	Mapping, Sampling & Drilling	G3 investigation was carried out. The chemical analysis (surface and core) is pending, based on which resource estimation will be carried out.
Barmer District, Rajasthan	SE of Mawri	1:2,000	1.5 sq. km	11	1250 m	Mapping, Sampling & Drilling	G3 investigation was carried out. Resource estimation will be attempted after receiving results of analysis of all chemical samples and results of geotechnical studies.
Barmer District, Rajasthan	North of Kalaur ka Danta	1:2,000	2 sq. km	20	-	Mapping, Sampling & Drilling	G3 investigation was carried out. The average Total LREE's and HREE's value in the channel samples are 2594.101 ppm (0.0.25%) and 319.816 ppm respectively. A total of 624 nos. of core samples were submitted in total 30 boreholes. The average Total LREE's and HREE's value in the borehole RJBSS-01 are 3863.128 ppm (0.39%) and 438.74 ppm respectively. The average total LREE's and HREE's value in the borehole RJBSS-02 are 3192.95 ppm (0.319%) and 339.95 ppm respectively. The average total LREE's and HREE's value in the borehole RJBSS-03 are 3350.81 ppm (0.319%) and 376.98 ppm respectively. The average total LREE's and HREE's value in the borehole RJBSS-08 are 3863.128 ppm (0.319%) and 438.74 ppm respectively. The average total LREE's and HREE's value in the borehole RJBSS-18 are 2112.21 ppm (0.21%) and 202.58 ppm respectively.

Table- 1 (Concld.)

State/District	Location	Geological mapping		Drilling		Details of work done	Result obtained/Remark
		Scale	Area (sq.km)	Boreholes	Meterage		
Barmer District, Rajasthan	Kalaur Ka Danta	1:2,000	1.5 sq. km	-	-	Mapping & Sampling	G3 investigation was carried out. As per the latest chemical analytical results received pertaining to the work carried recently between 2022-23, 10592 ppm of TREE+Y value recorded in KKD/PCS-14 (green microgranite), 5840 ppm TREE+Y recorded in KKD/BRS-36 (microgranite). 8894 ppm TREE+Y recorded in channel sample no. KKD/C5A (microgranite). EPMA studies yet to be carried out
Barmer District, Rajasthan	Kaluri-Tapra-Buriwara Area	1:12,500	220 sq. km	3	-	Mapping & Sampling	G4 investigation was carried out. The analytical results suggest a maximum of REE values reaching up to 36,555 ppm in channel samples and 2,929 ppm in core samples from ferruginised rhyolite.

Table-2 - Exploration carried out by NALCO and SCCL in 2022-23

Agency/ Mineral/ State/ District	Location	Geological mapping		Drilling		Sampling (nos)	Remarks Reserves/resources estimated
		Scale	Area (sq. km)	Boreholes	Meterage		
NALCO/ Bauxite	Panchpatmali Bauxite Mine Central & North Block, Koraput District, Odisha	-	-	-	-	-	The entire deposit has been covered in (100m X 100m) grid and the reserve of entire bauxite deposit has been estimated based on 100m X 100m grid drilling data. The Mineable part of measured resource of bauxite is kept under proved category with 82.12 Mill.MT Bauxite as on 31.03.2023 while remaining resource is kept under feasibility resource category with 12.17 Mill.MT Bauxite. The reserve data is subject to change as per 25mX25m grid preproduction drill data. In C&N-Block Mine, The ROM production in 2022-23 was 64,51,688 MT.
NALCO/ Bauxite	Panchpatmali Bauxite Mine South Block Koraput District, Odisha	-	-	-	-	-	The entire deposit has been covered in (100m X 100m) grid and the reserve of entire bauxite deposit has been estimated based on 100m X 100m grid drilling data. The Mineable part of measured resource of bauxite is kept under proved category with 77.85 Mill.MT Bauxite as on 31.03.2023 while remaining resource is kept under feasibility resource category with 9.38 Mill.MT Bauxite. The reserve data is subject to change as per 25mX25m grid preproduction drill data. In S-Block Mine, The ROM production in 2022-23 was 10,05,088 MT.
SCCL, Godavary Valley Coal Fields/ Coal	Lingala-Koyagudem Coal Belt/ Bhadradri Kothagudem District, Telangana	-	-	2	236.00 m	7 Bhs	Diamond core drilling was carried out for mining purpose. Total 7 nos. of Borehole samples (Bhs) covering a total meterage of 140.41 m were chemically analysed.
SCCL, Godavary Valley Coal Fields/ Coal	Yellandu Coal Belt/ Bhadradri Kothagudem District, Telangana	-	-	26	2330.00 m	23 Bhs	Diamond core drilling was carried out for mining purpose. Total 23 nos. of Borehole samples (Bhs) covering a total meterage of 153.47 m were chemically analysed.
SCCL, Godavary Valley Coal Fields/ Coal	Kothagudem coal Belt/ Bhadradri Kothagudem District, Telangana	-	-	9	3154.00 m	5 Bhs	Diamond core drilling was carried out for mining purpose. Total 5 nos. of Borehole samples (Bhs) covering a total meterage of 62.73 m were chemically analysed.
SCCL, Godavary Valley Coal Fields/ Coal	Manuguru-Cherla Coal Belt/ Bhadradri Kothagudem District, Telangana	-	-	3	419.00 m	5 Bhs	Diamond core drilling was carried out for mining purpose. Total 5 nos. of Borehole samples (Bhs) covering a total meterage of 143.29 m were chemically analysed.
SCCL, Godavary Valley Coal Fields/ Coal	Sattupalli-Chintalapudi Coal Belt Khammam District, Telangana	-	-	19	2947.00 m	13 Bhs	Diamond core drilling was carried out for mining purpose. Total 13 nos. of Borehole samples (Bhs) covering a total meterage of 389.10 m were chemically analysed.

Table- 2 (Concld.)

Agency/ Mineral/ State/ District	Location	Geological mapping		Drilling		Sampling (nos)	Remarks Reserves/resources estimated
		Scale	Area (sq. km)	Boreholes	Meterage		
SCCL, Godavary Valley Coal Fields/ Coal	Ramagundam Coalbelt/ Peddapalli district, Telangana	-	-	14	4840.50 m	12 Bhs	Diamond core drilling was carried out for exploratory and mining purpose. Total 12 nos. of Borehole samples (Bhs) covering a total meterage of 226.50 m were chemically analysed.
SCCL, Godavary Valley Coal Fields/ Coal	Mulug Coalbelt/ Bhupalpalli Jayashankar & Mulug District, Telangana	RF- 1:5,000	1.50	334	12576.50 m	56 Bhs	Diamond core drilling was carried out for exploratory and mining purpose. Total 56 nos. of Borehole samples (Bhs) covering a total meterage of 458.30 m were chemically analysed.
SCCL, Godavary Valley Coal Fields/ Coal	Dorli-Belampalli Coalbelt/ Asifabad District, Telangana	-	-	7	891.00 m	4 Bhs	Diamond core drilling was carried out for mining purpose. Total 4 nos. of Borehole samples (Bhs) covering a total meterage of 67.68 m were chemically analysed.
SCCL, Godavary Valley Coal Fields/ Coal	Somagudem-Indaram Coalbelt/ Mancherial District, Telangana	-	-	30	6709.00 m	13 Bhs	Diamond core drilling was carried out for mining purpose. Total 13 nos. of Borehole samples (Bhs) covering a total meterage of 169.51 m were chemically analysed.
SCCL, Talcher Coal Field/ Coal	Naini Coal Block/ Angul District, Odisha	-	-	-	-	-	Resources estimated during the year 2022-23 were 365.52 MT (Part of Naini).
SCCL, Talcher Coal Field/ Coal	New Patrapara Coal Block/ Angul District, Odisha	-	-	-	-	-	Resources estimated during the year 2022-23 were 1063.46 MT (Part of NPTPR)

5. Research & Development

Research and Development (R&D) in the mining and minerals sector in India has witnessed significant progress over the years, driven by the need for sustainable resource management, improved extraction techniques, and the development of value-added products. The Indian government, along with private and public sector entities, has focused on advancing mining technologies, such as, automation, remote sensing, and geospatial mapping, to optimize the exploration and extraction of minerals. R&D efforts are also directed towards environmental sustainability, with initiatives to reduce the ecological impact of mining activities and improve waste management. Moreover, innovations in mineral processing, including beneficiation and refining, aim to enhance the quality and recovery of minerals. India's rich mineral reserves, coupled with growing global demand, make R&D in this sector crucial for enhancing efficiency, reducing dependence on imports, and ensuring long-term industry growth.

The National Mineral Policy (NMP), 2019 has accorded higher priority to Research & Development (R&D) programmes. With a view to promote R&D in the Mining Sector, Ministry of Mines has launched a comprehensive Science & Technology Programme which includes R&D component. The underlying principle behind R&D component of Science and Technology (S&T) programmes is to foster utilisation of the available mineral resources judiciously, economically, efficiently in a sustainable manner. Under the R&D component of the S&T Programme, Research projects are funded through grant-in-aid by Ministry of Mines.

Ministry of Mines, Govt. of India provides funds to academic institutions, universities, national institutes and R&D institutions recognized with the Department of Scientific and Industrial Research, Government of India for implementing R&D projects under Science and Technology Programme Scheme of Ministry of Mines with the vision to promote research in applied geosciences, mineral exploration, mining and allied areas, mineral processing, optimum utilization and conservation of the mineral resources of the country, for the benefit of the nation and its people. The broad thrust areas for supporting Research in Mining are given below:

- Prospecting / exploration for strategic, rare and rare earth minerals.
- Development of new technology for mineral exploration and mining on land and deep sea to locate and exploit new mineral resources.
- Research in mining methods. This includes rock mechanics, mine designing, mining equipment, energy conservation, environmental protection and mine safety.
- Improve efficiency in process, operations, recovery of by-products and reduction in specification and consumption norms.
- Research in metallurgy and mineral beneficiation techniques to utilize lower grade and finer size ores.
- Extraction of value-added products from mine waste, plant tailings etc.
- Development of new alloys and metal-related products, etc.

- Evolve low capital and energy saving processing systems.
- Production of materials of high purity.
- Cooperative research among organizations associated with the mineral sector.
- In 2023, the Ministry of Mines enlarged the scope of the S&T programme by launching S&T-PRISM (Promotion of Research and Innovation in Start-ups and MSMEs) to fund research and innovation in Start-ups and MSMEs working in the field of mining and mineral sector in order to bridge the gap between R&D and commercialisation.

Ministry of Mines has launched SATYABHAMA (Science and Technology Yojana for Aatmanirbhar Bharat in Mining Advancement) Portal (research.mines.gov.in), dedicated to project proposals under Science and Technology Programme Scheme of Ministry of Mines. Based on scrutiny which passes through different stages of evaluation including presentation of shortlisted projects before the Project Evaluation and Review Committee (PERC) and final approval of an inter- ministerial Standing Scientific Advisory Group (SSAG), grants are given to the projects submitted by R&D institutions.

Science and Technology Programme of Ministry of Mines has following three components–

1. Research and Development (R&D) component
2. Information, Education and Communication (IEC) component
3. Promotion of Research and Innovation in Startups and MSMEs in Mining, Mineral Processing, Metallurgy and Recycling Sector (S&T-PRISM) component.

A brief of these components is mentioned below:

1. Research and Development (R&D) component: Under this component, funds are released to academic institutions, universities, national institutes and R&D institutions recognized with the Department of Scientific and Industrial Research, Government of India for undertaking research and development projects
2. Information, Education and Communication (IEC) component : Under this component, funds are released to Industry Associations, recognised universities, recognized academic and research bodies having at least three years' experience in the mining and mineral sector by organizing or being associated with promotional events
3. Promotion of Research and Innovation in Startups and MSMEs in Mining, Mineral Processing, Metallurgy and Recycling Sector (S&T-PRISM): Under this component, funds are released to Startups to ensure timely availability of the seed support to the deserving startups.

The project proposals under the Science & Technology Programme Scheme of Ministry of Mines were invited online on SATYABHAMA portal (research.mines.gov.in). The last date of receipt of proposals was 13th May 2022.

A total number of 319 project proposals were received online on the portal. A two stage review process was adopted to evaluate the proposals for recommendation to Standing Scientific Advisory Group (SSAG). The first stage comprised preliminary screening of the proposals done by a team of experts constituted by Ministry of Mines. Based on the guidelines as adopted in 14th PERC, the experts conducted pre-screening of the proposals. After screening, 82 proposals covering five areas, namely

(i) Geosciences and Exploration

(ii) Mining

(iii) Mineral Processing & recovery from waste

(iv) Metal Extraction (Metallurgical processes) and

(v) Alloys, specialty materials and product;

were shortlisted for further review in the second stage.

Three virtual meeting rooms were arranged by JNARDDC, Nagpur for

a. Mining–(i& ii)
b. Mineral Processing (iii) and
c. Metallurgy(iv & v).

In addition to the new proposals the committee reconsidered 9 proposals, which were recommended for resubmission by the last PERC/SSAG with certain changes. Thus (82+9) = 91 project proposals were presented by the respective Principal Investigators (PIs) and evaluated by the committee during the VC meeting held on 03-05 Aug 2022.

Furthermore, 4 completed and 35 ongoing projects were also reviewed by the committee. As per the terms of reference of PERC, the concerned members recused themselves, to avoid conflict of interest, from the proceedings from that part of the meeting when project(s) related to their institute(s) was/were under consideration.

Based on the detailed review and evaluation, the following new project proposals are being recommended to SSAG. The details of recommended projects and specific recommendations are given hereunder:

1

Project No.	SNTMOM/684/2022
Project Title	Potentiometric low-cost sensing of rare earth and other heavy metals with high specificity in prospecting for minerals
Institution	Indian Institute of Technology Delhi
Principal Investigator	Madhusudan Singh (7503608075, msingh@ee.iitd.ac.in)
Project Cost & Duration	Rs. 67,80,450.00 3 years
Objectives of the project	A. Develop non-specific rare earth atom / heavy metal sensing devices, based on our existing work on Cu and Cd sensing ISEs and ISFETs, for rapid in-field testing of minerals. B. Develop a library of metal-organic framework (MOF) based functionalized with a range of chelating ligands for highly specific coordination of rare earth ions, and integration of these layers into one-time use sensors. C. Develop artificial intelligence (AI) / machine learning (ML) based models to use sensor data from non-specific sensors (a) to predict presence of specific rare earth ions in presence of confounding data. Training of models will employ sensors (b) along with currently standard analytical methods like ICP-MS/XPS/EDX, etc.

2

Project No.	SNTMOM/700/2022
Project Title	Estimation and Fingerprinting of Chromite, Ni, PGE Resources in Selected Geological tracts of Singhbhum (Sukinda) and Western Dharwar Craton (Nuggihalli chromite belt). Geosciences and Exploration
Institution	CSIR National Geophysical Research Institute
Principal Investigator	P V SUNDER RAJU (9490748152, pvsraju@ngri.res.in)
Project Cost & Duration	Rs. 15,12,000.00 1 year
Objectives of the project	To collate the published reports from GSI etc, available in public domain Integrated Geological, Geochemical and Geophysical studies for the delineation of Chromitite extensions in Nuggihalli Schist Belt and implications for Ni-Cu+-PGE mineralization. 2. Develop a database 3. Controls on platinum group element variation in mafic-ultramafic-magmatic systems 4. Prospectivity indicators for magmatic Ni-Cu sulfides. 5. Apply the Fingerprinting for chromite in virgin potential geological tracts

3

Project No.	SNTMOM/718/2022
Project Title	Development of supercapacitor devices for grid-level energy storage application based on natural mineral Chalcopyrite and bauxite residue. Mining (includes rock mechanics, design, equipments, energy, environment, safety)
Institution	Indian Institute of Technology Bhubaneswar
Principal Investigator	Saroj Kumar Nayak (9438290179, nayaks@iitbbs.ac.in)
Project Cost & Duration	Rs. 31,42,600.00 3 years
Objectives of the project	We present a research proposal explaining the significant role of nanostructured $CuFeS_2$ along with the waste, bauxite residue (red mud), in playing a major role towards electrochemical charge storage. The proposal highlights the importance, current progress and futuristic prospects of supercapacitor based on nanostructured materials based $CuFeS_2$ and red mud. ? One of the core objectives of this proposal is to develop $CuFeS_2$ and red mud-based supercapacitors which can provide long term and cost-effective solution in the field of electric energy storage. The surge in energy demand is inevitable considering the fact that the electronic industry and transportation sector are expanding rapidly to meet the public demand. ? The purpose of taking red mud is to introduce the novel concept of “waste to energy”. As the red mud contains maximum amount of Fe_2O_3, so after purification of red mud, Fe_2O_3 can be used as electrode material of supercapacitor. Apart from the experimental development, first principles based theoretical investigations will be carried out for the understanding the atomic/electronic level mechanism of $CuFeS_2$ based supercapacitor devices Synthesis, characterization, and performance evaluation of the supercapacitor devices.

4

Project No.	SNTMOM/723/2022
Project Title	Synthesis of precipitated silica from waste beach sand tailings and its value addition in glass making industries Beneficiation, Ore Dressing, Mineral Processing & Recovery from Waste
Institution	SOCIETY RAMAN EDUCATION

Principal Investigator	SUNITA ROUTRAY (7327847963, sroutray1@cvrce.edu.in)
Project Cost and duration	Rs. 26,90,700.00
Objectives of the project	Value addition of waste beach sand tailings To generate wealth from waste To produce precipitated silica Utilization of precipitated silica for industrial applications especially in glass making industries.

5

Project No.	SNTMOM/726/2022
Project Title	Development of low-cost heterogeneous catalyst using Red mud for Biodiesel Production. Beneficiation, Ore Dressing, Mineral Processing & Recovery from Waste
Institution	Jawaharlal Nehru Aluminium Research Development and Design Centre
Principal Investigator	PRACHIPRAVA PRADHAN (9438760367, prachi@jnarddc.gov.in)
Project Cost & Duration	Rs. 29,35,800.00 2 years
Objectives of the project	Conversion of red mud as low-cost heterogeneous catalyst for biodiesel synthesis from waste cooking oil in Oscillatory Baffle Reactor. (ii) To assess engine performance of biodiesel produced from trans esterification of waste cooking oil using red mud as a catalyst and its blends with petro diesel.

6

Project No.	SNTMOM/744/2022
Project Title	Dissolution of chalcopyrite and other sulphide ores using extractive deep eutectic solvents
Institution	K.C college, HSNC University, Mumbai (Hyderabad Sind National Collegiate Board)
Principal Investigator	Hemlata K. Bagla (9821420698, hemlata.bagla @kccollege.edu. in)
Project Cost & Duration	Rs. 50,00,000.00 3 years
Objectives of the project	1. Very limited water consumption 2. Reduced energy consumption 3.Process intensification 4. Reduced consumption of acids 5. Higher selectivity for leaching 6. Suitable for the treatment of low-grade ores, mine tailings, and industrial process residues 7. Useful for the treatment of urban waste 8. New separation processes with low generation of toxic gases and waste

7

Project No.	SNTMOM/745/2022
Project Title	Techno Economic survey of copper recycling industry in India Metal Extraction (Metallurgical processes)
Institution	Jawaharlal Nehru Aluminium Research Development and Design Centre
Principal Investigator	KOLA IMMANUEL RAJU (9980574024, immanuelkola@jnarddc.gov.in)
Project Cost & Duration	Rs. 57,33,000.00 1 year
Objectives of the project	1. To establish techno-economic scenario of copper scrap recycling Industry in the country. 2. To corroborate facilities, current and best practices for collection, processing and value addition in entire copper scrap recycling.

8

Project No.	SNTMOM/747/2022
Project Title	Recovery of Li, Ni, Mn and Co from spent Li-ion Battery using facile and ecofriendly recovery process Metal Extraction (Metallurgical processes)
Institution	Banaras Hindu University
Principal Investigator	Rajendra Kumar Singh (9451000681, rajendrasingh.bhu@gmail.com)
Project Cost & Duration	Rs. 28,46,655.00 3 years

Objectives of the project	Electric vehicle (EV) battery market of India has targeted to achieve $300 billion by 2030. The National Electric Mobility Mission (NEMM) Project 2020 of India has aimed to bring ~7 million EVs with clean energy aim of 175 GW by 2022. Owing to high cost associated with batteries (40–50 % of EV cost), the spent batteries without recycling can be turned into severe environmental hazard. Rapid expansion of LIB market has resulted significant battery waste. The recycling rate is only at sporadic level worldwide, while no significant project has started yet in our country. Most of these spent LIBs are ending up in landfills. Present project is aimed at developing spent LIB derived precious Li, Ni, Co and Mn metals for fabricating Li nickel manganese cobalt oxide (NMC) cathodes for LIBs for EVs and HEVs. Specific objectives are: To dismantle and discharge spent lithium ion batteries (LIBs) to recover Li and other costly metals Ni, Co and Mn using hydrometallurgical and leaching processes. To recover about 95% of Li, and about 90% of Ni, Co, Mn from spent LIBs using ecofriendly and energy efficient routes using ionic liquid (IL). To reuse the recovered metals Li, Ni, Co and Mn from spent LIBs for fabricating LIBs and test the performance of LIBs fabricated.
9	
Project No.	SNTMOM/749/2022
Project Title	Processing of Bauxite Residue Dressing, Mineral Processing & Recovery from waste by Innovative Pyro-Hydrometallurgical Process for Exploring Value Added Bulk Waste Utilization Beneficiation, Ore
Institution	CSIR Institute of Minerals and Materials Technology)
Principal Investigator	Chinmaya Kumar Sarangi (8895198482, cksarangi@immt.res.in)
Project Cost & Duration	Rs. 91,31,390.00 2 years
Objectives of the project	(1) Establishment of the process for extraction of alumina, iron and titania from Bauxite residue through an innovative process of gaseous reduction followed by hydrometallurgical routes. (2) Utilization of final residue generated after recovery of metal and material values from Bauxite residue. (3) Process parameters optimization for each unit operation involved in the extraction of metal and material values from Bauxite residue. (4) Scale-up testing of the flowsheet at 5-10 kg Bauxite residue processing scale for its validation. (5) Material balance and cost economics of the process. (6) Feasibility, way forward (pilot plant scope) and project report preparation.
10	
Project No.	SNTMOM/752/2022
Project Title	Studies on ilmenite mineral using synthesis gas generated from gasification of carbonaceous materials Beneficiation, Ore Dressing, Mineral Processing & Recovery from waste
Institution	CSIR Institute of Minerals and Materials Technology
Principal Investigator	Rakesh Saini (09680842254, rakeshsaini@immt.res.in) CSIR Institute of Minerals and Materials Technology
Project Cost & Duration	Rs. 48,57,000.00 3 years
	Recovery of titanium and iron metal from ilmenite ore fines using synthesis (syn) gas, Hydrogen, and natural gas is gaining popularity due to the simultaneous availability of heat and reductant sources with the utilization of biomass or coal. This novel process majorly utilizes ilmenite ore fines of less than 100-micron size. It applies reducing gases such as hydrogen, syngas, methane etc., at high temperatures to recover valuable metals such as Ti and Fe from ilmenite ore fines. Compared to the conventional technologies, which are highly energy and resource-intensive, the ilmenite ore-reduction process using the reducing gas has environmental benefits and is considered a sustainable approach. In this process, biomass, coal, lignite, or petcoke supply high-temperature reducing gas by applying the gasification process. This process can eliminate the energy-intensive and complex steps and thus improves the overall energy consumption in a sustainable way. As per the literature, Ti and Fe metal production from ilmenite ore fines could be improved by 35% to 40% in terms of overall energy consumption if a technology independent of complex processes is developed. The reduction process will be carried out in a fluidized bed gasification reactor with a limited residence time of a few seconds. Here, the fluidized bed gasification reactor design and syn-gas composition are critical to the process performance; therefore, a software-based optimization and scale-up study will be carried out along with the lab- scale experimental work. The major objectives of the proposed project could be categorized as – (a) Studies on ilmenite to recover valuable titanium and titanium-based compounds for industrial applications using synthesis gas generated from gasification.(b) Development of a fluidized gasification reactor based ilmenite conversion process from the cost-effective carbonaceous materials.(c) Energy optimization of the aforementioned process by applying and developing the model.

13

Project No.	SNTMOM/764/2022
Project Title	Designing lightweight and highly formable Mg-Li-Zn-Ca-RE based alloys using the CALPHAD method
Institution	Indian Institute of Technology Jodhpur
Principal Investigator	Jaiveer Singh (9022080900, jaiveer@iitj.ac.in)
Project Cost & Duration	Rs. 46,88,200.00 3 years
Objectives of the project	The major objectives of the proposed work are as follows: 1. Design of binary (Mg-Li/Zn/RE) and complex (Mg-Zn-Ca, Mg-Zn-RE, Mg-Zn-Ca- RE, Mg-Li-Zn-RE) Mg alloy systems by thermodynamic modelling based on the CALPHAD approach for getting optimized compositions. 2. Successful fabrication of the newly designed alloys using the induction melting furnace by controlling the cooling rates and the casting atmosphere. 3. Optimization of thermo-mechanical processing parameters for obtaining the weaker basal texture using the Gleeble thermo-mechanical simulator. 4. Detailed microstructural characterization (OM, SEM, EBSD, t-EBSD (TKD), and X-ray diffraction) and evaluation of room temperature mechanical properties to establish the microstructure-property relationships for the developed Mg alloys. 5. Experimental investigation of crystallographic texture and change in c/a ratio of h.c.p. unit cell in the developed Mg alloys will be performed to understand the active deformation mechanisms at room temperature. 6. Detail investigation of corrosion behavior for selected processing conditions of optimized alloys in various corrosive media will be carried out and a microstructure- corrosivity relationship will be established.

14

Project No.	SNTMOM/783/2022
Project Title	Enhancement of Mechanical and Electrical properties of Iron (Fe) by incorporation of Graphene (Gr) for advance applications Alloys, Rare Earths, Specialty materials and product
Institution	Balaram Panda Trust
Principal Investigator	Priyambada Nayak (7873008101, dr.priyambada@gift.edu.in)
Project Cost & Duration	Rs. 24,41,800.00 3 years
Objectives of the project	The present proposal is the enhancement of composites by following specially developed process. 1. Aimed to develop Iron based special composites with the incorporation of graphene, and workout the cost effectiveness vis-à-vis advanced properties for engineering applications. 2. To improve the mechanical and electrical properties of the develop Iron-graphene metal matrix composite with improved properties. 3. To work out the cost economics compared with the existing composites for different applications. 4. Explore development of prototype and validation of the newly prepared composites in association with industry partner.

15

Project No.	SNTMOM/795/2022
Project Title	Agglomeration of spent garnet for possible reuse as abrasives in water jet applications Beneficiation, Ore Dressing, Mineral Processing & Recovery from Waste (Duration: 2 Yrs, 0 Mth) Submitted
Institution	SSN TRUST
Principal Investigator	V.E.Annamalai (9840359093, annamalaive@ssn.edu.in)
Project Cost & Duration	Rs. 27,47,000.00 2 years
Objectives of the project	i) The background: Garnet is an environmental friendly material withspecific applications. Large quantities are used in waterjet application as abrasives. The usable size is around grit 80. After use, the material gets too fine and becomes unusable. At this stage it is a waste that needs to be handled only by landfilling. Objectives: The objective is to reconstruct the spent garnet into required bigger / usable size by material processing techniques. From larger agglomerates of spent garnet, required usable size can be generated by size reduction methods. This may enable reusing the material again, in water jet applications.

16

Project No.	SNTMOM/796/2022
Project Title	Techno-economic Survey of Lead recycling Industry Metal Extraction (Metallurgical processes)
Institution	Jawaharlal Nehru Aluminium Research Development and Design Centre
Principal Investigator	V N S U VISWANATH AMMU (7798546794, viswanatha@jnarddc.gov.in)
Project Cost & Duration	Rs. 58,38,000.00 1 year
Objectives of the project	• To establish a techno-economic scenario of lead scrap recycling industry in the country • To provide support in promoting sustainable recycling of lead and circular economy for lead recycling

17

Project No.	SNTMOM/814/2022
Project Title	Setting up of pilot cum demonstration plant for recovery of alumina and value-added products from fly ash Beneficiation, Ore Dressing, Mineral Processing & Recovery from waste
Institution	CSIR Institute of Minerals and Materials Technology
Principal Investigator	KALI SANJAY (9338291970, ksanjay@immt.res.in)
Project Cost & Duration	Rs. 3,92,16,000.00 3 years
Objectives of the project	• Validation of Proof of Concept, Generation of engineering data and preparation of Basic Engineering Package (BEP) for setting up of pilot plant (50 kg/day fly ash) at NALCO • Preparation of Detailed Engineering data sheet for bought out equipment and installation of pilot cum demonstration plant (50 kg/day fly ash) and commissioning at NALCO • Pilot plant campaigns including fine-tuning of process parameters for generating data and products • Product evaluation/testing/developing sub-processes for utilizing by-products including recovery of REEs in lab-scale • Technical Feasibility report with viability for processing of fly ash to extract alumina and other valuables.

18

Project No.	SNTMOM/832/2022
Project Title	Development of a sustainable material using chromite mine overburden and other industrial wastes for stowing or backfilling of underground mines in Sukinda Valley, Odisha Mining (includes rock mechanics, design, equipments, energy, environment, safety)
Institution	National Institute of Technology Rourkela)
Principal Investigator	Himanshu Bhushan Sahu (9437245625, hbsahu@nitrkl.ac.in)
Project Cost & Duration	Rs. 38,88,600.00 3 years
Objectives of the project	The main objective of the research work is to develop a sustainable material using chromite mine overburden and other industrial wastes for stowing/backfilling of underground mines in Sukinda Valley, Odisha. Keeping the aforementioned problem in mind, the work has been planned with the following objectives: 1. Characterization of OB material collected from Sukinda valley 2. Determination of strength and water drainage characteristics for different size fractions of OB 3. Determination of strength and water drainage characteristics for different size fractions of OB-fly ash and/or tailing mixture 4. Study of leachates using chemical analysis 5.Numerical simulation for stability and material flow modeling. 6. Development of a suitable material based on the laboratory investigation and simulation results.

19

Project No.	SNTMOM/834/2022
Project Title	SiAlON based Novel Composites for Rock Drilling-A plausible aternative of Hard WC-Co composite
Institution	CSIR Central Glass and Ceramic Research Institute
Principal Investigator	Soupitak Pal (8777541388, soupitak@cgcri.res.in)

Project Cost & Duration	Rs. 48,04,674.00 3 years
Objectives of the project	The broad objective of the proposed research is to design and develop potential candidate material for the replacement of the WC as a drilling tool material used in mining industries. However, in the milieu of the present proposal, the specific objectives are given below: 1) Processing of SiAlON and SiAlON-Co composite (less than 5 wt.% of Co)with microstructure tailoring to produce a tougher (KIC ˜ 10 MPavm) and hard (hardness ˜20 GPa) ceramics-metal composite. 2) Qualify the as-fabricated composite in terms of strength, hardness, and toughness as a replacement for WC-Co composite. 3) Characterization of tribological behavior of the as-fabricated composite at room temperature and development of wear mechanism map against EN31 tool steel. 4) Near net shape components fabrication of simple geometries and evaluation of cutting performance of the as-processed composite for mild steel and Ni-base superalloy machining.

20

Project No.	SNTMOM/845/2022
Project Title	Development and scale up -TRL 5 – of cost effective Copper Graphene materials using in-situ synthesis and coating in Fluidized Bed Process systems
Institution	CSIR Advanced Materials and Processes Research Institute AMPRI
Principal Investigator	TILAK (7906445435, tilak@ampri.res.in)
Project Cost & Duration	Rs. 91,71,500.00 2 years
Objectives of the project	• Design and development of fluidized bed apparatus for in- situ synthesis of Cu-graphene composite powders and synthesis. • Synthesis of Cu-graphene composite powders using fluid-bed coating • Thermo-mechanical processing of Cu-Gr composites from above routes to obtain PM compacts and mill forms. • Characterization of Cu-graphene composites developed using powders obtained through above routes.

21

Project No.	SNTMOM/847/2022
Project Title	Techno-economic Survey of Zinc recycling Industry in India Metal Extraction (Metallurgical processes)
Institution	Jawaharlal Nehru Aluminium Research Development and Design Centre
Principal Investigator	RAMAVAJJALA ANIL KUMAR (9491318525, anilkumar@jnarddc.gov.in)
Project Cost & Duration	Rs. 54,09,600.00 1 year
Objectives of the project	To establish techno-economic scenario of zinc scrap recycling in the country

22

Project No.	SNTMOM/863/2022
Project Title	Process for the preparation of iron oxide nanoparticles and zeolite nanoparticles from iron and bauxite mine rejects and evaluation of products for the environmental applications Beneficiation, Ore Dressing, Mineral Processing & Recovery from waste
Institution	CSIR Institute of Minerals and Materials Technology
Principal Investigator	SUJANA M G (9438399955, sujana@immt.res.in)
Project Cost & Duration	Rs. 57,46,244.00 3 years
Objectives of the project	Sampling and complete physical and mineralogical characterization of the selected iron and bauxite mine rejects for phase and elemental analysis through XRD, XRF, SEM EDS, TG/DTA and wet chemical analysis, using ICP-OES. Analysis of minor elements such as rare earth elements by ICP-MS. • To investigate the optimization of the technical parameters for effective recovery of metal oxides by hydro/biometallurgical reaction processes using mine rejects as starting materials. • Separation, and Preparation of iron oxide nanoparticles /zeolite materials • Mapping of minor elements distribution in the flow sheet for identification of possible points at which the sub-processes can be made in future. Sink-float studies will be carried out using heavy organic liquids such as bromoform ($CHBr_3$; specific gravity, 2.89), as a medium for separation of heavier fractions from the lighter one. Methylene iodide (di-iodo methane, 3.3 specific gravity) heavy medium will be used to determine the very heavy minerals and light heavy minerals from the total heavy minerals (sinks) obtained by using the bromoform as heavy medium. • Characterization of the developed materials by systematic structure characterizations with X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), transmittance electron microscope (TEM), X-ray fluorescence spectroscopy (XRF), X-ray photoelectron spectroscopy (XPS) and DRS UV visible spectra and particle size analysis,BET Surface area and RAMAN spectroscopy.

• To explore the possible utilization of developed materials through modification or as such for the environmental applications by conducting feasibility studies on contaminants (As(III)/(V), Selenium/dye degradation).

23

Project No.	SNTMOM/865/2022
Project Title	Design and development of an instrument for unmanned noise mapping of mines using a drone-mounted acoustic camera Mining (includes rock mechanics, design, equipments, energy, environment, safety)
Institution	National Institute of Technology Rourkela
Principal Investigator	Dibya Prakash Jena 9938084602, jenad@nitrkl.ac.in
Project Cost & Duration	Rs. 1,32,65,500.00 Duration: 2 years,
Objectives of the project	The acoustic camera is an advanced instrument that is used for noise source localization and at the National level the competencies don't exist. The said acoustic camera is a general instrument that has been used by researchers for traffic noise localization in complex environments like ports, however, never been attempted for mines. The additional complexity of the mine is geospatial discontinuities. Currently, the noise map of a mine is generated with a sound level meter where the measurements of a few set points is used to estimate the noise map which in principle is not much accurate. So, the present research aims at design and development of an instrument for unmanned noise mapping of mines using a drone-mounted acoustic camera.

24

Project No.	SNTMOM/885/2022
Project Title	Development of Nanostructure Chalcopyrite Materials as Sustainable Thermoelectric and Supercapacitor Applications
Institution	Hindustan Institute of Technology and Science
Principal Investigator	Indrajit Shown (7596917050, shownindrajit@gmail.com)
Project Cost & Duration	Rs. 50,27,700.00 3 years
Objectives of the project	• To evaluate the thermoelectric (TE) and supercapacitor (SC) behaviour of hierarchically nanostructured chalcopyrite doped heavily by p-type silver. • To explore the feasibility of producing a novel thermoelectric and supercapacitor material by using Cd or Se as a ternary addition to form nanostructured chalcopyrite. Attractive TE properties of Zn added chalcopyrite make it appear that the study may discover a high ZT stable thermoelectric material. • To develop optimized synthesis techniques by microwave assisted hydrothermal means so as to produce nanostructures (nanowires or nanoplates) by bottom up approaches. Moreover, suitable thermomechanical treatment will be evolved for creating nonuniformity in distribution of nanoprecipitates/ doping elements within nanostructured matrix that helps in modulation doping. Both Mechanical alloying and liquid metallurgy and routes will be tried. • To study the effect of fullerene C70 addition on the stability and thermoelectric behavior of TE and SC behavior of chalcopyrite-C70 nanocomposites with or without silver doping. • To explore the feasibility of He ion implantation followed by annealing to create homogeneously distributed pores and to study its effect on thermoelectric and supercapacitor properties. Abstract Herein we propose to develop nanostructure chalcopyrite with dopant as universal materials that can be used to generate electrical energy from thermal energy as a thermoelectric generator and store the energy as a structural supercapacitor. It is expected that this material can be used in the structural body of electric vehicles or heat generators with ion-exchanging rechargeable supercapacitors and form a hybrid energy storage system. The use of thermoelectric material to harvest waste heat energy is not new, but if the same material can store that energy, it will be a game changer in the field of sustainable energy application.

25

Project No.	SNTMOM/886/2022
Project Title	Recovery of Molybdenum, Nickel and Alumina values from spent hydrotreating catalyst of HPCL and Demonstration at Pilot plant (TRL-7) and techno-economic feasibility studies Beneficiation, Ore Dressing, Mineral Processing & Recovery from waste
Institution	Non Ferrous Materials Technology Development Centre
Principal Investigator	D Lokeswara Rao (9849604852, lokesh@nftdc.res.in)

Project Cost & Duration	Rs. 99,77,000.00 1 year 6 months
Objectives of the project	Approximately 220 Tons (110 Tons – $CoMo/Al_2O_3$, 110 Ton-$NiMo/Al_2O_3$)/ year from HPCL Mumbai refinery and 230 tons (110tons- $CoMo/Al_2O_3$, 120 tons – $NiMo/Al_2O_3$) /year spent hydro treating catalyst wastes are generated. The typical Mo and Ni content of the spent hydro treating catalyst after usein the refining by HPCL contains 5-15% Mo and 1-5% Nion Al_2O_3 substrate. This spent catalyst was taken for prior work. 1.Development of process flow sheet for recovery of Molybdenum, Nickel/ Cobalt and pure alumina from the spent HDS catalyst. 2. Process intensification techniques of Microwave and sonication to be incorporated in the leaching circuit. 3. Development of a closed loop, zero discharge process without effluent. 4. Achievement of 90% leaching efficiencies with an overall 80% material recovery. 5.Pilot plant at 25 kg level (TRL-7) for demonstration up to 1-ton operations. (Six months) 6. Techno-economic study at DPR for 400 TPY spent catalyst plant (yielding approx. 40 TPY Mo values and 10 TPY of Ni values and 300 TPY of alumina values at HPCL-NFTDC site.

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Project No.	SNTMOM/900/2022
Project Title	Development of Eco-friendly molten salt extraction process for Nd and Pr and Establishment of 25- 50 TPY Nd and Pr Metal Extraction Demonstration Plant (TRL7-8) for Rare Earth Magnet Production
Institution	Non Ferrous Materials Technology Development Centre
PrincipalInvestigator	Nirmal Panda(9985509736, nirmalpanda@nftdc.res.in)(Non Ferrous Materials Technology Development Centre)
Project Cost & Duration	Rs. 19,52,87,000 2 years
Objectives of the project	WP-1: Design and fabrication of 25-50TPY demonstration Nd/PrExtraction Plant of 8KA Molten Salt Electrolytic Cell WP-2: Innovative process development in terms of eco-friendliness using coated carbon or non-carbon electrodes. WP-3: Nd/(Nd-Pr) FeB alloy powder using rapid solidification process and process equipment development WP- 4: Establishment of demonstration plant: 25-50 TPY entry level plants (TRL 7/8) and demonstration up to 6 tons of metal production.

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Project No.	SNTMOM/923/2022
Project Title	Pre-feasibility Studies on Biological Extraction of RE (Nd, Pr, Sm, Dy, Gd) ions from leached solutions
Institution	CSIR Institute of Microbial Technology
Principal Investigator	Srinivasan Krishnamurthi (7837306552, kmurthi@imtech.res.in)
Project Cost & Duration	Rs. 20,39,730.00 1 year
Objectives of the project	Screening for siderophore producing bacteria from wealth of marine bacterial cultures available with PI research group. Concurrent selection and screening of bacterial cultures in NFTDC suitable for REE biosorption. Establishment of enrichment cultures and/or assays for determining mobilization of REE from mineral ores/wastes. Deposition of selected biomass on Silica spheres to created sorption columns and desorption of immobolized REEs (NFTDC)

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Project No.	SNTMOM/557/2021
Project Title	Conversion of natural mineral based tetrahedrite compounds into high performance thermoelectric devices used in the conversion of waste heat into electricity
Institution	Indian Institute of Technology Bhubaneswar
Principal Investigator	SIVAIAHBATHULA (9958923766, sivaiahb@iitbbs.ac.in)
Project Cost & Duration	Rs. 42,06,750.00 3 years

Objectives of the project	1. To develop novel material designing strategies for making the naturally available tetrahedrite minerals as potential thermoelectric materials in clean energy generation applications. 2. To tune the thermoelectric transport properties (band structure engineering and nanostructuring) of naturally available tetrahedrite ($Cu_{12}Sb_4S1_3$) as well as synthetic tetrahedrite minerals. 3. To perform systematic microstructural, and thermoelectric characterization to optimize the base composition of tetrahedrite. 4. To scale up the indigenously developed tetrahedrite materials into the thermo-element devices (dimensions, 8 x 8 mm) with ohmic contact engineering (low specific contact resistance). 5. To fabricate uni-couple thermoelectric devices using natural metal tetrahedrite based un-couple TE device (p-type tetrahedrite with matchable n-type) and to demonstrate reasonable power density (~0.5 W/cm2) with improved mechanical properties (Fracture toughness, thermal shock resistance).
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Project No.	SNTMOM/607/2021
Project Title	Nano Ion-Chromatograph in Action - Sustainable and Scalable Quantum Dots Paves a Facile Route for Rare-Earth Ions Separation Through Advanced Hydrometallurgy.
Institution	Banaras Hindu University
Principal Investigator	SomenathGarai (8400098731, sgarai@bhu.ac.in)
Project Cost &Duration	Rs.1,61,58,500.00 3 years
Objectives of the project	The tunable nature of the concave surface of the Keplerate is truly unique and provides a powerful tool in the design and development of novel nanocontainer molecules. Therefore, the specific objectives to be achieved by this project include: 1. The use of the Nano-Keplerates as highly efficient rare- earth metal absorber under confinement. 2. Facile separation of the rare earth metals selectively from the other naturally occurring trivalent cations in the corresponding ores through Nano-Ion Chromatograph behavior of the voltage gated {Mo9O9}-pores of the Quantum Containers. 3. The evaluation of corresponding Dissociation Constants KD(s) of rare earth metals as compared to the different cations to enable Nano-engineering of the Quantum Containers towards optimization. 4 The high throughput recyclability of the Novel Quantum Containers will be tested for the bulk real-life Nanotechnology application to finally, set-up of a pilot hydrometallurgical demo unit for upscaling of a minimum of 100 L/Day of raw digested ore solution.

RESEARCH & DEVELOPMENT ACTIVITIES CARRIED OUT BY MINERAL PROCESSING DIVISION OF IBM DURING THE YEAR 2022-23

BAUXITE ORE:

- Bench scale beneficiation studies carried out on a Bauxite ore from Madhya Pradesh employing dry as well as wet methods. The original sample assayed 42.36% Al_2O_3, 15.23% Fe(T), 2.17% SiO_2, 1.91% reactive silica, 6.24% TiO_2, 23.64% LOI, and 0.29% V_2O_5. The R&D conducted by dry separation process without grinding yielded a composite of non-mag fraction as concentrate, assaying 46.06% Al_2O_3 with recovery of 80.4% and weight yield of 75.3%. In wet separation with grinding, wet high intensity magnetic separation yielded a non-magnetic fraction as concentrate, which assayed 49.18% Al_2O_3, 10.31% Fe(T) and 1.93% SiO_2 with recovery of 54.2% Al_2O_3 and weight yield of 46.6%.

COPPER ORE:

- Bench scale beneficiation studies carried out on a copper ore sample of G2 stage exploration samples from Singbhum Copper Belt, East Singbhum district, Jharkhand. The original sample assayed 1.25% Cu, 55.3% SiO_2, 8.37% Al_2O_3, 10.89% Fe(T), 2.14% S(T), 692 ppm Ni, 124 ppm Co and 0.26 ppm Au. R&D was carried out employing different techniques by varying various parameters. By adopting froth flotation, the 2nd cleaner float assayed 22.64% Cu, 0.44% Ni and 0.083% Co with recovery of 92.9% Cu, 32.6% Ni and 28.9% Co and weight yield of 5.1%. The 3rd cleaner float assayed 26.51% Cu with recovery of 91.7% and weight yield of 4.3%. In the developed process route, copper value was enhanced to higher grade with very high recovery and critical minerals such as Ni and Co values were upgraded and pre-concentrated with copper concentrate.
- Bench-scale beneficiation studies carried out on a copper ore sample of G2 stage exploration samples from Khetri, Jhunjhunu District, Rajasthan. The as received sample assayed 0.28% Cu, 57.08% SiO_2, 9.17% Fe(T), 12.1% Al_2O_3,

1.76% S(T), 54.8 ppm Mo, 78.36% Acid insolubles and 1.81% LOI. The process route evolved through R&D study consisted of crushing grinding and froth flotation. The 2nd cleaner copper concentrate assayed 21.49% Cu with 90.8% Cu recovery and Wt. % yield 1.2.

GRAPHITE ORE:

Bench-scale beneficiation studies were carried out on lean grade Graphite ores of G2 stage exploration samples. Amenability to beneficiation of the graphite ores was assessed and suitable process routes were developed.

- The graphite ore from Nabarangapur district, Odisha, assayed 2.28 % Fixed Carbon, 94.83% ash, 2.89% volatile matter & moisture. The ash contained 76.18% SiO_2, 9.37% Al_2O_3, 3.94% Fe_2O_3, 1.68% CaO and 2.38% MgO. R&D study employing Froth Flotation technique yielded a composite Concentrate which assayed 58.46% F.C. with recovery of 50.8% F.C. and Wt.% yield 2.0.
- The graphite ore from East Godavari district, Andhra Pradesh, assayed 4.54% F.C., 4.76% volatile matter & Moisture and 90.75% Ash. The ash contained 71.26% SiO_2, 5.25% Al_2O_3 and 3.40% Fe_2O_3. R&D studies employing flotation techniques were carried out with primary circuit and secondary circuit (coarse and fine circuits). The combined concentrate assayed 90.02% F.C with recovery 87.1% F.C. and Wt.% yield 4.4. The concentrate obtained assayed high grade with higher recovery. Also, the study deciphered presence of critical minerals in the tails.

GLAUCONITIC SANDSTONE – POTASH ORE:

- Bench-scale beneficiation studies carried out on lean grade glauconite ore of G2 stage exploration samples. The glauconite ore from Mahasamund District, Chhattisgarh, assayed 0.3% K_2O, 2.35% Fe_2O_3, 1.42% Al_2O_3 and 93.14% SiO_2. The beneficiation study employing magnetic separation yielded glauconite mineral concentrate, which assayed 4.4% K_2O with wt.% yield 1.4. Successful R&D study carried out in laboratory scale for extraction of potash from glauconite mineral concentrate.

IRON ORE:

Bench-scale beneficiation studies carried out on different low-grade and lean-grade iron ores received from industry and exploration agencies. The characteristics of iron ores were different. R&D studies were carried out employing dry as well as wet separation techniques.

- Bench-scale beneficiation study was conducted on an iron ore sample from Sindhudurg, Maharashtra employing dry-cum-wet beneficiation process. The as received sample assayed 55.11% Fe(T), 9.70% SiO_2, 2.78% Al_2O_3, 0.34% FeO and 7.88% LOI. The composite Magnetic fraction assayed 62.11% Fe(T) with 4.74% SiO_2 with a Fe(T) recovery of 88.0% and Wt.% yield 81.5.
- Bench Scale Beneficiation Studies on a Banded Magnetite Quartzite (BMQ-A) sample was received from Raipur, Chhattisgarh with an objective to upgrade the iron ore value suitable for industrial use at coarser particle size separation employing dry or dry-cum-wet processes. The as received sample assayed 40.5% Fe(T), 8.4% FeO, 37.4% SiO_2, and 1.5 % Al_2O_3. Three process routes were planned at three different crushing sizes viz. at -5mm, -1mm and -10#. The best result was obtained employing dry-cum-wet process. The composite mag. product assayed 65.03% Fe (T), 5.21% SiO_2, 1.01% Al_2O_3 with wt % yield 41.6 and wt recovery 65.4%.
- Bench scale beneficiation studies carried out on an iron ore of G2 stage exploration samples. The iron ore from Keonjhar district, Odisha, assayed 57.24% Fe(T), 4.25% Al_2O_3, 6.91% SiO_2 and 3.76% LOI. In the R&D study both dry and wet process routes were experimented to upgrade the sample. The process route consisted of reducing the as received sample by stage crushing, screening followed by desliming and gravity separation. The concentrate assayed 62.68% Fe, 2.28% Al_2O_3, 2.80% SiO_2 and 2.23% LOI with a Fe(T) distribution of 61.2% and Wt% yield 56.1.
- Bench scale beneficiation studies on a lean grade Iron Ore from Chhatrapur District, Madhya Pradesh. The as received sample assayed 48.18% Fe(T), 12.85% SiO_2, 9.80 % Al_2O_3, 0.15% P_2O_5 and 4.11% LOI. The R&D study comprising crushing, grinding, sizing, gravity separation and magnetic separation yielded a composite concentrate assaying 60.72% Fe(T), 3.68% SiO_2, 3.73% Al_2O_3 and 1.51% LOI with Fe(T) recovery of 41.9% and weight % yield 32.9.

MANGANESE ORE:

- Bench scale beneficiation studies on a Manganese Ore from Balaghat District, Madhya Pradesh. The as received sample assayed 37.42% Mn, 5.39% Fe(T), 20.15 SiO_2, 1.80% Al_2O_3, 3.51% CaO, 0.18% P, 1.20% BaO and 4.77 % LOI. The process involving crushing, wet screening, gravity separation and magnetic separation were carried out. Silica content was reduced significantly. The composite manganese concentrate assayed 44.61% Mn, 6.80% Fe(T), 9.70 SiO_2 with 92.3% Mn recovery and wt% yield 77.

Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC):

Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur, is a Central Government Autonomous Body under Ministry of Mines. This "Centre of Excellence" was set up in 1989 with a view to provide major R&D support system for the emerging modern aluminium industry in India.

JNARDDC is an ISO/IEC-17025:2017 & ISO-17034:2016 NABL accredited lab and is also recognized as a scientific & industrial research organization by the Department of Scientific & Industrial Research, Ministry of Science & Technology, Government of India. It is the only institute of its kind in India pursuing the cause of R&D from bauxite to finished product under one roof.

The objective of the Centre is to assimilate the technology available in the country and abroad for the production of alumina, aluminium, aluminium alloys as well as to develop technical know-how for the basic engineering process and downstream areas. Centre provides training to the personnel employed in the Indian aluminium industries. The new objective to promote and develop recycling industry and transition to a circular economy in Non-Ferrous Metal Sector has been added.

JNARDDC has made key contributions in the areas of beneficiation, characterization, technological evaluation, upgradation of bauxites, Bayer process modeling, reduction of energy consumption and environmental pollution in smelter, development of alloys, product development, effective utilization of aluminium industry residue such as red mud, dross, spent pot lining and scrap for both primary and secondary industry.

DESIGNATED SECTOR EXPERT:

JNARDDC is the designated aluminium sector expert for the following key authorities: -

NITI Aayog –

- REE (Rare earth element) from red mud and coal fly ash
- Strategy paper on Resource efficiency in the aluminium sector

Bureau of Energy Efficiency (BEE), Ministry of Power -

- Sector expert for "National Mission for Enhanced Energy Efficiency"-PAT 2/3/4 cycle

BIS, Bureau of Indian Standards for standards

- Guidelines for Al-scrap
- The standard for aluminium alloys

MoM (Ministry of Mines) –

- Zero waste policy for the non-ferrous primary and secondary sector
- Metal Recycling Authority (MRA) - to carry out the functions earmarked for MRA as stipulated in the "National Non-Ferrous Metal Scrap Recycling Framework 2020."
- Implementing Agency of the S&T(Mines) – PRISM program to promote start-ups and MSMEs.

Referee Lab for Coal -

- JNARDDC is nominated referee lab for coal sample analysis of third party sampling of coal by CSIR-CIMFR, Dhanbad.

JNARDDC has been conducting various research activities since its inception. During 2022-23, it has submitted the following research publications in various journals through its scientific community.

1. Multi-Layer Flexible Packaging: Solution for Sustainable Recycling; P A Mohamed Najar, MRAI's Material Recycling, 4(3), 2022,14-17
2. Nano processing of industrial rejects for controlling operational energy of buildings; Sandeep Tembhurkar, Priyanka Nayar, Numanuddin Azad, Upendra Singh, Mangesh Madurwar Advances in Civil Engineering; Jun 2022; https://doi.org/10.1155/2022/2969266
3. "Effect of geological, mineralogical characteristics on grindability of Bauxite: A case study on Indian lateritic bauxite deposits" P G Bhukte; Journal of the Geological Society of India, Vol.99, Jan 2023 pp 55-60, Springer, SCIE
4. Zero Residual Heavy Metals in Aqueous Media Using Composite Coagulant Converted from Bauxite Residue; S. Hena, N. F. bt Abdullah, L. C. Keong, P. A. Mohamed Najar, L. Gutierrez, J.-P. Croué; International Journal of Environmental Science and Technology, Iranian Society of Environmentalists (IRSEN) and Science and Research Branch, Islamic Azad University, Springer, 19 (07), 2022; https://doi.org/10.1007/s13762-022-04336-z, SCIE/SSCI, Indexed, Impact factor 3.519
5. Influence of aluminum trihydrate (ATH) particle size on mechanical, thermal, flame retardancy and combustion behavior of polypropylene composites; Malaya Ranjan Parida, Smita Mohanty, Manoranjan Biswal, Sanjay K Nayak, Suchita Rai, Journal of Thermal Analysis and Calorimetry. https://doi.org/10.1007/s10973-022-11851-1. 08.12.022. Springer Nature, SCI, IF: 4.755
6. A critical review on nanomaterial based therapeutics for diabetic wound healing; Swati Sucharita Singh, Susanta Kumar Behera, Suchita Rai, Suraj Tripathy, Snakha Chakraborty, Amrita Mishra, Biotechnology and Generic Engineering Reviews, - -https://doi.org/10.1080/02648725.2022.2161732. 28.12.2022. Taylor and Francis, SCIE, IF: 4.200 Bauxite
7. Granulometry Impact on Digestion Efficiency and Cost-Economics in Alumina Refinery for East Coast (India); Suchita Rai, M.J. Chaddha, Prachiprava Pradhan, K. J. Kulkarni, M. Panchal In: Broek, S. (eds) Light Metals 2023. TMS 2023. The Minerals, Metals & Materials Series. Springer, Cham. 156-165, 2023; - https://doi.org/10.1007/978-3-031-225321_19.
8. An overview of research progress on ceramic-based membranes; Prachiprava Pradhan, Ajit P Rathod, Suchita B Rai, Soumya S Mohapatra, Materials Today: Proceedings, Elsevier, March 2023; https://doi.org/10.1016/j.matpr.2023.03.300
9. Use of red mud as advanced soil stabilization material, Suchita Rai, Sneha Bhadure, M. J. Chaddha, A. Agnihotri; Advanced Materials from Recycled waste, Book Chapter (Publisher: Elsevier), Chapter 3:2023 - https://doi.org/10.1016/B978-0-323-85604-1.00016-0

PATENTS FILED BY JNARDDC DURING 2022-23 (source: JNARDDC website)

1. Title of Patent:

A process for delamination of a multi-layered packaging material and selective recovery of aluminium metal values

- Application Number : Granted vide no. 427584 [2023-24]
- Date of grant : 29/03/2023
- Inventors : Mohamed Najar, Amrita Karan, Paresh Nageshwar, Ram Chouhan, Anupam Agnihotri

2. Title of Patent:
Partially Lateritised Khondalite based ceramic proppant and its preparation

- Application Number : Granted vide no. 427235 [2022-23]
- Date of grant : 28/03/2023
- Inventors : Pravin Bhukte, Suresh Puttewar, Mukesh Chaddha, Anupam Agnihotri, Gopal Daware (JNARDDC), Bhimsen Pradhan, Bandopadhyay P(NALCO)

3. Title of Patent :
A Process For Selective Enrichment And Separation Of Alumina And Silica

- Application Number : Granted vide no. 427093 [2022-23]
- Date of grant : 27/03/2023
- Inventors : Mohamed Najar, Amrita Karan, Paresh Nageshwar, Mukesh Chaddha, Anupam Agnihotri

4. Title of Patent :
A Process for selective reduction of Al_2O_3, SiO_2, Na_2O and CaO in reed mud for enrichment of Fe_2O_3

- Application Number : Granted vide no. 421167 [2022-23]
- Date of grant : 10/02/2023
- Inventors : Dr Mohamed Najar, Shoeb Ansari, Shama Wadsariya, Kiran Janbandhu, Rajashekhar Rao, S P Puttewar and Anupam Agnihotri

5. Title of Patent :
A Light Weight Foamed Geopolymer (LWFGEOP) and its preparation

- Application Number : Granted vide no. 409005 [2022-23]
- Date of grant : 12/10/2022
- Inventors : Dr Mohamed Najar, Mukesh Chaddha, Pravin Bhukte, Numanuddin Azad, Shama Wadsariya, Suresh Puttewar, Anupam Agnihotri (JNARDDC) And Saket Jain (Swarnalatha Holdings)

6. Title of Patent :
A process for selective leaching of iron from alumina hydrate

- Application Number : Granted vide no. 407793 [2022-23]
- Date of grant : 28/09/2022
- Inventors : Dr Mohamed Najar, M T Nimje, S P Puttewar, Anupam Agnihotri (JNARDDC) & Subrat Kar, V Krishna Kumari P K Behera, (NALCO)

7. Title of Patent :
A process for conversion of Hazardous 1st Cut SPL Waste of Aluminium Industries into Non Hazardous Material by Converting Inorganic Toxic Cyanide to Non Toxic Species by Selective Heat Treatment and Recovery of Sodium, Fluoride and Carbon Value

- Application Number : Granted vide no. 407276 [2022-23]
- Date of grant : 21/09/2022
- Inventors : M T Nimje, Mohamed Najar Anupam Agnihotri, (JNARDDC) & A S P Mishra (VEDANTA)

8. Title of Patent :
Process for preparation of low ferric alum from waste or low grade aluminium dross

- Application Number : Granted vide no. 406384 [2022-23]
- Date of grant : 12/09/2022
- Inventors : Dr Upendra Singh, J Mukhopadhyay, (JNARDDC) & Binuta Patra and P Bandopadhyay (NALCO)

9. Title of Patent :
A PROCESS FOR PREPARING SMELTER GRADE ALUMINA

- Application Number : Granted vide no. 404896 [2022-23]
- Date of grant : 29/08/2022
- Inventors : S B Rai, M J Chaddha, M T Nimje, R J Sharma, K J Kulkarni & K R Rao (JNARDDC)

The above mentioned research and development details are not exhaustive but restricted to only selected topics and information.

6. Mineral-Based Industries

Minerals are vital raw materials for many basic industries and are major components for growth and industrial development. The management of mineral resources, hence, has to be closely integrated with the overall strategy for development and exploitation of minerals, alligning with the long-term national goals. In tune with the Economic Liberalisation Policy adopted in July 1991, the National Mineral Policy announced in March 1993 has opened the Mineral Sector for private entrepreneurs, both domestic and foreign. The changing global scenario necessitated revision in the National Mineral Policy which led to notifying of National Mineral Policy 2019, with an objective to have more effective, meaningful and implementable policy which ensures transparency, better regulation, enforcement, balanced social and economic growth as well as sustainable mining practices.

The National Mineral Exploration Policy (NMEP) approved by Government of India in June, 2016, aims at accelerating the exploration activity in the country through enhanced participation of the Private Sector and these policy initiatives are expected to bring about a turnaround to the entire Mineral Sector across the country.

Production in Mineral-based Industries

Production in mineral-based industries involves various stages that transform raw minerals into valuable products used in almost every sector of the economy. The process includes extraction, processing, refining, and sometimes recycling. These industries are crucial for economic development and contribute significantly to global trade, technology, infrastructure, and manufacturing. The growth of industries like automotive, construction, electronics, and energy further boosts demand for mineral-based products, making these industries central to economic progress. With advancements in technology and growing global demand, these mineral-based products will continue to play a crucial role in supporting industries worldwide. Capacity and Production of Important Mineral-based Products, 2021-22 to 2022-23 is given in Table -1

Table - 1 Capacity and Production of Important Mineral-based Products, 2020-21 to 2022-23

Mineral-based product	Unit of quantity	Annual Installed Capacity	Production		
			2020-21	2021-22	2022-23
Ferrous Metals					
Sponge iron #	million tonnes	49.273	34.376	39.2	43.62
Crude/liquid steel		154.026	103.545	120.293	127.2
Ferro-Alloys#					
Ferrochrome/Chargechrome	'000 tonnes	1690*	868	1113	1126
Ferromanganese	tonnes	3160*	NA	NA	NA
Silicomanganese	'000 tonnes	-	329	349	356
Ferrosilicon	'000 tonnes	250	NA	NA	NA
Magnesium Ferro-Silicon	'000 tonnes	-	10	15	17
Ferromolybdenum	tonnes	-	428	436	581
Ferrotitanium	tonnes	-	249	416	347
Ferrovanadium	tonnes	-	634	850	839
Ferroaluminium	tonnes	-	1119	1139	966
Non-ferrous Metals					
Aluminium	million tonnes	4.126	3.62	4.02	4.06
Copper (Cathode)	'000 tonnes	785	364	359	333
Lead (primary) *	'000 tonnes	210	214	191	211
Zinc Ingote*	tonnes	951	715	776	821
Silver*##	tonnes	966	706	647	794
Cement^	million tonnes	590	300	360.19	391.4
$Fertilizers					
Complex Fertilizer	lakh tonnes	85.97@	93.21	83.27	70.77
SSP	lakh tonnes	123.15@	49.35	53.34	43.45
DAP	lakh tonnes	74.52@	37.74	42.22	31.80

Source::
** MSMP, March, 2023 published by IBM*
 # Data on Ferro Alloys taken from MSMP, March, 2023 published by IBM
$ Annual Report 2021-22 and 2022-23, Department of Fertilizer. Fertilizer statistics (upto Dec., 2022)*
@Installed capacity is as on 01.11.2023
: Includes production reported by Hindalco Industries.
^from Annual Report of DPIIT, 2023

FERROUS METALS

Steel Industry

The National Steel Policy 2017 projected a target of 300 million tonnes of domestic steel production by 2030. The total production of Total Finished Steel Consumption (Non-alloy + alloy + stainless steel) stood at 119.89 million tonnes 2022-23 which is 13.37% more than 2021-22 when the value stood at 105.75 million tonnes.

In view of the long-term demand projection for steel, the Government adopted a two-pronged strategy for increasing steel production in the country through modernisation and expansion of existing Public Sector steel plants in the country and encouraging creation of new steel capacities in Private Sector.

The total finished steel (alloy+stainless+non-alloy) production in India has grown from a mere 1.1 million tonnes in 1951 to 123.195 million tonnes (Crude Steel Equivalent) in 2022-23. Out of this, 66.92 million tonnes was Non-Flat steel and the remaining 56.28 million tonnes was Flat steel. The contribution of non-alloy finished steel, alloy finished steel and stainless steel segment is 113.55 million tonnes, 6.87 million tonnes and 2.77 million tonnes, respectively.

Steel exports from India began in 1964. Exports in the first five years were mainly as a result of low demand in the domestic Iron and Steel market. Exports subsequently declined due to revival of domestic demand. India once again started exporting steel in 1975 which subsequently registered a slump due to rising domestic demand. Post liberalisation, rejuvenation in the Steel Sector resulted in large-scale exports of iron and steel. The total finished steel exports stood at 6.71 million tonnes in 2022-23, while imports stood at 6.02 million tonnes.

LIBERALISATION OF THE INDIAN STEEL SECTOR

At the time of independence in 1947, India had only three steel plants–the Tata Iron & Steel Company, the Indian Iron & Steel Company and Visveswaraya Iron & Steel Ltd and a few electric arc furnace-based plants. during the period till 1947, the viable steel producers in the country that operated with a capacity of about 1 million tonnes were wholly under the Private Sector. The provisions of the economic policy implemented during different phases of time engendered several marked changes in Indian Steel Industry. From the fledgling one million tonnes capacity status at the time of independence, India has now risen to be the 2nd largest crude steel producer in the world and the largest producer of Sponge Iron. From a negligible global presence, the Indian Steel Industry is now globally acknowledged for its product quality.

The rapid pace of growth of the Industry and the observed market trends called for certain guidelines and framework. Thus, the concept of the National Steel Policy was born with the aim to provide a roadmap of growth and development for the Indian Steel Industry. The National Steel Policy (NSP), 2005 was announced in November 2005 as a basic blueprint for the growth of a self-reliant and globally competitive Steel Sector. The long-term objective of the National Steel Policy 2005 was to ensure that India has a modern and efficient Steel Industry of world standards, catering to diversified steel demand. The focus of the policy was to attain levels of global competitiveness in terms of global benchmarks of efficiency and productivity. Then, after a detailed review in 2017, the Government released the National Steel Policy 2017, which laid down the broad roadmap for encouraging long-term growth for the Indian Steel Industry, both on demand and supply sides, by 2030-31, with a vision to create a technologically advanced and globally competitive Steel Industry which would promote economic growth. At the same time, as a facilitator in the present-day de-regulated, liberalised economic/market scenario, the Government also announced a policy for providing preference to domestically manufactured Iron & Steel products in Government procurement. This policy seeks to accomplish the Hon'ble Prime Minister's vision of 'Make in India' with the objective of nation building and to encourage domestic manufacturing and is applicable on all Government tenders where price bid is yet to be opened. To ensure quality scrap for the Steel Industry, the Govt. of India came out with a Steel Scrap Recycling Policy that aims to reduce imports, conserve resources and save energy.

The structure of the Indian Steel industry in 2022-23 along with the production for 2021-22 to 2022-23 is furnished in Table-2. Production of iron & steel, crude steel, pig iron and finished steel (alloy + non-alloy) by SAIL, TSL Group, RINL, AM/NS (erstwhile Essar Steel), JSWL, JSPL and other producers along with production of crude steel from oxygen route, electric arc furnace route and induction furnace route during the year 2018-19 to 2022-23 is reflected in Table-3 along with the production of sponge iron through gas-based & coal-based units during the year 2018-19 to 2022-23. The production of iron & steel by Public and Private Sectors during 2018-19 to 2022-23 is furnished in Table-4. The details on plant-wise capacity and production of hot metal and crude/liquid steel are listed out in Table-5. Table-6 elucidates the production of crude/liquid steel by BOF and Electric route (EAF/IF) routes.

Table – 2 : Structure of the Indian Steel Industry, 2021-22 & 2022-23

(Capacity/Production: In million tonnes)

Sector	Total Annual Capacity	2021-22 Production	2022-23 Production
Crude Steel	154.062	120.293	127.2
(A) Producer-wise			
SAIL, TSL GROUP, RINL, AM/NS, JSWL, JSPL	88.232	74.875	80.06
Other Producers	65.83	45.419	47.14
(B) Sector-wise			
Public Sector	26.932	22.636	22.42
Private Sector	127.13	97.658	104.78
Hot Metal	84.834#	78.223	81.16
Pig iron	NA	6.262	5.86
Sponge Iron	49.273	39.2	43.62
Total Finished Steel (Non alloy + Alloy + stainless)	NA	113.597	123.19
Total (Non-Flat)		59.564	66.91
(Total Flat)		54.033	56.28
1) Finished Steel (Non-alloy)	NA	106.615	113.55
A) Non-Flat Products	NA	54.998	61.78
Bars & Rods		46.338	51.67
Structural		7.314	8.60

(Capacity/Production: In million tonnes)

Sector	Total Annual Capacity	2021-22 Production	2022-23 Production
Rly Material		1.346	1.49
B) Flat Products	NA	51.617	51.77
PM Plates		5.355	5.33
HR Coil/Strip		46.262	46.43
2) Finished Steel (Alloy)	NA	4.17	6.87
A) Non-Flat Products	NA	3.832	4.28
B) Flat Products	NA	0.337	2.58
3) Finished Steel (Stainless)	NA	2.812	2.77
A) Non-Flat Products	NA	0.733	0.80
B) Flat Products	NA	2.078	1.92

Source: Annual Statistics, 2022-23 of JPC
Note : Finished steel data are reported in terms of Crude Steel
 # : Combine Capacity pig Iron & Hot metal ; Figures rounded off.

Table – 3 : Production of Iron and Steel, 2018-19 to 2022-23

(In '000 tonnes)

Item/producers	2018-19	2019-20	2020-21	2021-22	2022-23(P)
I. Pig Iron : Total	**6414**	**5421**	**4877**	**6262**	**5861**
SAIL,TSL GROUP , RINL, AM/NS, JSWL, JSPL	1663	1193	1413	1462	1184
Other Producers	4751	4227	3464	4801	4677
II. Sponge Iron : Total	**34705**	**37102**	**34376**	**39200**	**43621**
Gas based	6899	6564	6175	8866	8007
Coal based	27806	30539	28201	30334	35614
III. Crude Steel : Total	**110921**	**109137**	**103545**	**120293**	**127197**
Integrated steel Plants (SAIL, TSL GROUP, RINL,					
AM/NS, JSWL and JSPL)					
Oxygen Route	47412	46735	43947	52515	56665
EAF Units	21295	21647	21106	22359	23389
Other Producers					
Oxygen Route	2043	1838	1138	2070	2127
EAF Route	7181	6719	8301	8138	4815
IF Route	32990	32198	29052	35211	40201
IV. Total Finished Steel (Non alloy +Alloy + Stainless)	***101287***	***102621***	***96204***	***113597***	***123196***
SAIL,TSL GROUP , RINL, AM/NS, JSWL, JSPL	61283	61286	55322	65055	72265
Other Producers	**40004**	**41336**	**40882**	**48542**	**50931**

Source: Annual Statistics, 2022-23 of JPC
Note :
1. Finished steel data are reported in terms of Crude Steel Equivalent.This change is due to change in reporting system of JPC as approved by Ministry of Steel and Industry Experts; Figures rounded off.
2 TSL Group includes Bhushan Steel Limited, Tata Steel Long Products Limited & BMW - Gamharia (Jharkhand) along with TSL plants in Jamshedpur & Kalinganagar.

Table – 4 : Production of Iron and Steel, 2018-19 to 2022-23

(By Sectors)

(In '000 tonnes)

Item/producers	2018-19	2019-20	2020-21	2021-22	2022-23
I. Pig iron : Total	**6414**	**5421**	**4877**	**6262**	**5861**
Public sector (SAIL+RINL)	588	614	669	634	401
Private sector (JSWL+JSPL+TSL Group	1075	580	744	792	783
Other Blast Furnace /Corex Unit)	4751	4227	3464	4801	4677
II. Crude steel /SEMIS: Total	**110921**	**109137**	**103545**	**120293**	**127197**
Public sector	21496	20905	19515	22636	22429
Private sector	89425	88232	84030	97658	104768
III. Finished steel (Non-Alloy+Alloy+ Stainless): Total	**101287**	**102621**	**96203**	**113597**	**123195**
Public sector (SAIL+RINL)	16933	16029	13783	17579	18926
Privatesector{TSL+AM/NS(ESL)+JSWL+JSPL+Other Producers}	84353	86593	82420	96017	104269

Source: Annual Statistics, 2022-23 of JPC

Note : Finished steel data are reported in terms of Crude Steel Equivalent.This change is due to change in reporting system of JPC as approved by Ministry of Steel and Industry Experts; Figures rounded off

Table – 5 : Capacity and Production of Hot Metal and Crude/Liquid Steel, 2021-22 and 2022-23

(By Principal Producers)

(In '000 tonnes)

Unit	Annual installed capacity		Production of Hot metal		Production of Crude/Liquid steel	
	Hot metal	Crude/ Liquid steel	2021-22	2022-23	2021-22	2022-23
SAIL	17105	20632	18734	19409	17363	18292
Rashtriya Ispat Nigam Ltd (Andhra Pradesh)	6300	6300	5774	4407	5272	4137
Private Sector						
JSW Steel Ltd	16500	25750	16794	22476	18023	23623
TSL Group	17169	20600	19405	19835	19464	19805
AM/NS (Essar Steel Ltd)	3490	9600	3335	3375	7295	6688
Jindal Steel & Power Ltd	5325	8100	6068	6165	7458	7509
Others	13680	69317	8112	5496	45419	47143
Other BOF	-	3177	-	-	2070	2127
Other EAF	-	8743	-	-	8138	4815
IF Units	-	57397	-	-	35211	40201

Source: Annual Statistics, 2022-23 of JPC

Table – 6 : Production of Crude/Liquid Steel, 2018-19 to 2022-23

By Route

(In '000 tonnes)

Route/plant	2018-19	2019-20	2020-21	2021-22	2022-23
All Routes: (A+B) Total	**110921**	**109137**	**103545**	**120293**	**127197**
A. Oxygen Route : Total	**49455**	**48573**	**45085**	**54585**	**58792**
SAIL	16045	15946	15054	17153	18055
RINL	5233	4749	4302	5272	4137
TSL Group	16038	16399	15811	17215	17514
JSW Steel Ltd	10096	9641	8780	10380	14236
Other Oxygen Route	2043	1838	1138	2070	2127

(In '000 tonnes)

Route/plant	2018-19	2019-20	2020-21	2021-22	2022-23
B. Electric Route: Total	**61466**	**60564**	**58460**	**65708**	**68405**
Electric Arc Furnace	28476	28366	29407	30498	28204
SAIL	218	210	158	210	237
TSL Group	2363	2126	1392	2249	2290
AM/NS (Essar Steel Ltd)	6813	7121	6696	7295	6688
JSW Steel Ltd	6647	6329	6080	7643	9387
Jindal Steel & Power Ltd	5254	5861	6859	4963	4786
Lloyds Steel Ltd	518	495	452	681	538
Jindal Stainless Ltd	1554	1418	1458	1812	1577
Bhushan Power & Steel Ltd	2778	2901	3754	2720	-
Other Electric Arc Furnace	2331	1905	2638	2926	2701
Electric Induction Furnace	32990	32198	29052	35211	40201

Source: Annual Statistics, 2022-23 of JPC
Note:- TSL Group includes Bhushan Steel Ltd, Tata Steel Long Products, TSL Jamshedpur & TSL Kalinganagar, Figures rounded off

A. Crude Steel

At 127.19 million tonnes (mt) in 2022-23, India's crude steel production increased by 5.7% as compared to 120.29 million tonnes during 2021-22. Given the above production for 2022-23 and with capacity at 161.23 million tonnes, crude steel capacity utilisation stood at 78.85% during 2022-23. The Crude Steel working Capacity and Capacity Utilisation during the last five years are furnished below in Table- 7.

With 82% share, the Private Sector (104.76 million tonnes, led the crude steel production in 2022-23. In fact, India's crude steel production has been consistently led by the Private Sector in the last five years ending 2022-23.

The following are the two primary routes of crude steel production:

(i) BF/BOF route also called the Oxygen route.

(ii) Electric route comprising of Electric Arc Furnace and Electric Induction Furnace.

Tabe- 7: Production and Working Capacity Crude Steel (2018-19 to 2022-23)

(Quantity in million tonnes)

Year	Working capacity	Production	% Utilisation capacity
2018-19	142.236	110.921	78%
2019-20	142.299	109.137	77%
2020-21	143.914	103.545	72%
2021-22	154.062	120.293	78%
2022-23	161.299	127.197	79%

Figures rounded off.
Source: Annual Statistics, 2022-23 of JPC

Basic Oxygen Furnace (BOF)

Presently, there are around 18 Basic Oxygen Furnace units which are available in the Indian Iron & Steel Sector with a total capacity of 67.29 million tonnes and with reported production of 58.79 million tonnes of crude steel through BOF route in 2022-23 at 87.36% of its capacity utilisation.

Electric Arc Furnace (including corex & MBF/EOF)

Crude steel produced in the Electric Arc Furnace (including corex & MBF/EOF) is mostly by recycling of steel scrap using Electric Arc Furnace (EAF). Electric Arc Furnace units, which are popularly known as mini steel plants, are significantly contributing to the production of steel in the country. Presently, in the Electric Arc Furnaces, there are 34 working units with total capacity of 36.60 million tonnes which produced 28.20 million tonnes crude steel through EAF route in the year 2022-23 at 77% of its capacity utilisation. The recent developments in EAF technology, viz, to increase oxygen consumption, to reduce power consumption and to reduce tap time, have led to increase in metal production. The development of thin slab casting has made EAF route more productive. This route enables slab strips rolling at lesser cost, facilitating production of cheaper strips/sheets than those that can be achieved through BF/BOF route.

Induction Furnace (IF)

In case of the Induction Furnace (IF) segment, there are presently 887 IF working units with total capacity of 57.397 million tonnes which produced 40.201 million tonnes crude steel through IF route in 2022-23 at 70 % of its capacity utilisation. These units are better than their EAF counterparts mainly because of their low cost of production and other factors mainly related to local market supply-demand conditions. Over the time, the IF sector has witnessed considerable technological upgradation with better charge-mix of DRI and refining facilities.

An analysis of the production of crude steel through various process routes indicates that the above performance has been contributed largely by the strong trends in growth of the electric route of steel making, particularly, the induction furnace route (encouraged by strong growth in sponge iron).This is reflected in Table- 8.

On further analysis of the relative shares of the various routes in total production of crude steel, electric furnace route is dominated by the Induction Furnace route, which has emerged as a key driver of crude steel production in the country.

Table-8 : Crude Steel Production — By Process (2018-19 to 2022-23)

(million tonnes)

Process Route	2018-19	2019-20	2020-21	2021-22	2022-23
Oxygen	49.455	48.573	45.085	54.585	58.792
EAF	28.476	28.366	29.407	30.498	28.204
IF	32.99	32.198	29.052	35.211	40.201
Total	110.921	109.137	103.545	120.293	127.197

Source: Annual Statistics, 2022-23 of JPC

B. Hot Metal

At 81.16 million tonnes in 2022-23, domestic hot metal production increased by 3.80% over 2021-22.

C. Total Finished Steel (Crude Steel Equivalent)

1. Trend in Production of Total Finished Steel

In the year 2022-23, the production of finished steel, stood at 123.196 million tonnes.

An analysis of the broad divisions in terms of the total production of finished steel reflects the following —

- Contribution of the Non-alloy Finished Steel stood at 113.52 million tonnes.
- Contribution of the Alloy Steel stood at 6.871 million tonnes.
- Contribution of the Stainless Steel stood at 2.77 million tonnes.

2. Trends in Consumption of Total Finished Steel

Finished Steel consumption stood at 119.89 million tonnes in 2022-23 as compared to 105.752 million tonnes during 2021-22, registering down a growth of 13.4 %. Data on overall consumption of total finished steel (non-alloy + alloy + stainless) d uring the last five years is provided in Table-9 and these indicate a steady growth in domestic steel consumption during the said period. However, reflecting on the year-on-year (yoy) rate of growth it could be said that such a trend, impacted and shaped largely by macroeconomic factors and prevailing steel market conditions, has followed a zig-zag track (Table-10).

Table-11 highlights the growth pattern yoy along with share of domestic total finished steel consumption, in terms of its two broad components – flat steel and non-flat/long steel – in 2022-23 and 2021-22. Both these components include non-alloy, alloy and stainless steel constituents as well.

Table-12 shows detailed consumption data for major categories of finished steel in 2022-23 over 2021-22 in terms of crude steel equivalent of finished steel as per the present reporting system.

Table –9 : Total Finished Steel Consumption (Non-alloy + Alloy + Stainless Steel) (Crude Steel Equivalent)

(2018-19 to 2022-23)

(In '000 tonnes)

Year	Total Finished Steel Consumption	% yoy change
2018-19	98708	8.8
2019-20	100171	1.5
2020-21	94891	-5.3
2021-22	105752	11.44
2022-23	119893	13.37

Source: Annual Statistics, 2022-23 of JPC

Table- 10 : Total Finished Steel Consumption - Non-alloy / Alloy / Stainless Steel Wise Crude Steel Equivalent (2021-22 To 2022-23)

(In '000 tonnes)

ITEM	2021-22 (R)		2022-23 (P)	
	Qty	% share	Qty	% share
Total Finished Steel (Non alloy+ alloy + stainless)	**105752**	**-**	**119893**	**-**
Non-alloy Finished Steel	98194	92.85	110421	92.1
Alloy Finished Steel	4514	4.27	6038	5.04
Stainless steel	3044	2.88	3435	2.87

Table- 11 : Total Finished Steel Consumption— Non - flat/Flat wise Crude Steel Equivalent (2021-22 to 2022-23)

(include non-alloy + alloy + stainless)

(In '000 tonnes)

ITEM	2021-22 (R)		2022-23 (P)	
	Qty	% share	Qty	% share
Total Finished Steel (Non Flat+ Flat)	**105752**	**-**	**119893**	**-**
Non-Flat Finished Steel	58780	55.58	65294	54.46
Flat Finished Steel	46972	44.42	54599	45.53

Source: Annual Statistics, 2022-23 of JPC

Table – 12 : Detailed Consumption for Major Categories of Total Finished Steel in 2022-23 over 2021-22

(Crude Steel Equivalent)

(In '000 tonnes)

ITEM	2021-22	2022-23	% yoy Change
Total Finished Steel (Non-alloy + Alloy + stainless)	**105752**	**119893**	**13.37**
1. Finished Steel (Non-alloy)	98194	110421	12.45
a) Non-Flat Products	54665	60402	10.49
Bars & Rods	46002	50529	9.84
Structural	7244	8319	14.84
Rly Material	1419	1554	9.51
b) Flat Products	43529	50020	14.91
PM Plates	4651	4800	3.20
HR Coil/Strip	38878	45220	16.31
2. Finished Steel (Alloy)	4514	6038	33.76
a Non-flat Products	3543	4215	18.97
b) Flat Products	971	1823	87.74
3. Finished Steel (Stainless)	3044	3435	12.84
a) Non-flat Products	572	678	18.53
b) Flat Products	2472	2757	11.53

Source: Annual Statistics, 2022-23 of JPC

D. Pig Iron

Pig iron is a product in solid (lumpy) form obtained upon solidification of Hot Metal in Pig Casting Machine. It is called Pig or Pig Iron because of its typical humpy shape. It is a basic input for making iron casting, which finds application in industrial and other sectors of economy. Pig iron is one of the basic raw materials required by the Foundry & Casting Industry for manufacturing various types of castings for the engineering section. In advanced countries, pig iron is also used as a partial substitute of melting scrap in the charge mix of Electric Arc Furnaces. Pig Iron is mainly classified into two grades, ' Basic Grade' used for making steel and 'Foundry Grade', used for manufacturing iron castings. Domestic production of pig iron lags behind and is not in tandem with the demand. Efforts were, therefore, made to increase pig iron manufacturing facilities in the secondary sector. Production of pig iron in merchant units in the secondary sector got its first major boost in 1992. Thereafter, the growth of this sector accelerated greatly as Foundry-grade pig iron fast became the preferred raw material for the quality conscious foundries.

The working capacity of hot metal & pig iron during

2022-23 was reported as 88.935 million tonnes. The location and capacity of principal pig iron/ hot metal as well as State-wise capacity and production of hot metal and pig iron units are furnished in Table- 13 & Table- 14, respectively. The domestic production of pig iron was at 5.81 million tonnes in 2022-23. Capacity of Principal Pig Iron Units is given at Table – 13A.

As a result of various policy initiatives taken by the Government, the Private Sector showed considerable interest in setting up new pig iron units, especially in the post-liberalised period. This has resulted in drastic change in the contribution of Private Sector producers.

Table – 13 : Location and Capacity of Principal Pig Iron Units

(In thousand tonnes)

Sl.No.	Plants/unit	Location	Capacity
1	Adhunik Metaliks Ltd, Odisha	Odisha	70
2	Ankit Metal and Power Ltd	West Bengal	12
3	Aparant Iron and Steel Pvt. Ltd	Goa	125
4	Arcelor Mittal Nippon Steel India Ltd, Surat	Gujarat	3490
5	Arjas Steel Pvt Ltd (Gerdau Steel)	Andhra Pradesh	300
6	Atibir Industries Co. Ltd. (Unit Ii)	Jharkhand	600
7	B R G Iron and Steel Co. Pvt. Ltd	Odisha	120
8	Balmukund Sponge and Iron Pvt. Ltd	Jharkhand	40
9	Bhushan Power and Steel Ltd, Odisha	Odisha	2500
10	Electro Steels Ltd, Jharkhand	Jharkhand	1450
11	Electrosteel Castings Limited, Khardah	West Bengal	250
12	Electrotherm (India) Ltd	Gujarat	277
13	Ispat Damodar Ltd	West Bengal	15
14	J S W Steel Ltd, Salem (Siscol)	Tamil Nadu	1000
15	J S W Steel Ltd, Vijaynagar	Karnataka	12000
16	Jai Balaji Industries Ltd West Bengal Unit-3	West Bengal	429
17	Jai Balaji Industries Ltd West Bengal Unit-4	West Bengal	81
18	Jai Balaji Industries Ltd - I	West Bengal	30
19	Jayaswals Neco Inds Ltd	Chhattisgarh	650
20	Jindal Steel and Power Ltd, Chhattisgarh	Chhattisgarh	2125
21	Jindal Steel and Power Ltd, Odisha	Odisha	3200
22	JSW Ispat Special Products Ltd, Raigarh	Chhattisgarh	613
23	JSW Steel Ltd, Dolvi	Maharashtra	3500
24	K I C Metaliks Ltd	West Bengal	165
25	Kalyani Steels Ltd	Karnataka	480
26	Kirloskar Ferrous Inds Ltd	Karnataka	385
27	Kohinoor Steels Ltd	Jharkhand	48
28	Makers Casting India Pvt Ltd	Jharkhand	2
29	Mideast Integrated Steels Ltd	Odisha	460
30	Narsingh Ispat Ltd	Jharkhand	83
31	Neelachal Ispat Nigam Ltd	Odisha	1099
32	Neo Metaliks Ltd	West Bengal	188
33	Niranjan Hi- Tech Ltd.	Jharkhand	15
34	Rashmi Metaliks Limited	West Bengal	170
35	SAIL–Bhilai Steel Plant	Chhattisgarh	3925
36	SAIL–Bokaro Steel Plant	Jharkhand	4360
37	SAIL– Durgapur Steel Plant	West Bengal	1802
38	SAIL– Iisco Steel Plant	West Bengal	2500
39	SAIL–Rourkela Steel Plant	Odisha	4400
40	SAIL–Visveswaraya Iron And Steel Ltd, Bhadravati	Karnataka	118
41	Sathavahana Ispat Ltd	Andhra Pradesh	240
42	Satyam Ferro Tech Ltd	Jharkhand	30
43	Shyam SEL and Power Ltd, Jamuria	West Bengal	60

(In thousand tonnes)

Sl.No.	Plants/unit	Location	Capacity
44	SLR Metaliks Ltd	Karnataka	240
45	Sree Metaliks Ltd	Odisha	36
46	Sri Kalahasthi Pipes Limited (Lanco)	Andhra Pradesh	300
47	Suraj Products Ltd	Odisha	24
48	Swati Concast and Power Pvt Ltd	Jharkhand	43
49	Tata Metaliks Ltd, West Bengal	West Bengal	600
50	Tata Steel BSL Ltd, Odisha	Odisha	3919
51	Tata Steel Long Products Limited	Jharkhand	650
52	Tata Steel Ltd, Jamshedpur Works	Jharkhand	9600
53	Tata Steel Ltd, Kalinganagar Works	Odisha	3000
54	Uttam Galva Metallics Ltd	Maharashtra	600
55	Vedanta Limited	Goa	625
56	VISA Steel Ltd	Odisha	225
57	VIZAG Steel Plant	Andhra Pradesh	6300

Table – 13A : Capacity of Principal Pig Iron Units

(In lakh tonnes)

Sl.No.	Unit	Location	Capacity
1	JSW Steel Ltd	Vijaynagar, Karnataka	120
2	Tata Steel Ltd	Jamshedpur, Jharkhand	96
3	Rashtriya Ispat Nigam Ltd	Visakhapatnam, Andhra Pradesh	63
4	SAIL—Rourkela Steel Plant	Odisha	44
5	SAIL—Bokaro Steel Plant	Jharkhand	43.6
6	SAIL—Bhilai Steel Plant	Chhattisgarh	39.25
7	Tata Steel Ltd (BSL)	Odisha	39.19
8	JSW Steel Ltd	Dolvi, Maharashtra	35

Source: JPC and IMYB-2022

Table-14: State-wise Capacity and Production of Sponge Iron (2022-23)

State	No.of working Units Units	Working Capacity ('000 tonnes)	Annual Production ('000 tonnes)
Total	**310**	**54754**	**43621**
Western Region	**95**	**23511**	**17988**
Chhattisgarh	73	11408	9917
Goa	3	221	199
Gujarat	10	8371	5577
Maharashtra	9	3512	2296
Eastern Region	**148**	**23841**	**19776**
Jharkhand	23	3623	2783
Odisha	83	13388	10623
West Bengal	42	6831	6370
Northern Region	**4**	**785**	**557**
Uttar Pradesh	4	785	557
Southern Region	**63**	**6617**	**5300**
Andhra Pradesh	8	959	591
Karnataka	39	4643	3957
Tamil Nadu	6	528	379
Telangana	10	487	374

Source: Annual Statistics, 2022-23 of JPC

E. Sponge Iron

India is the largest producer of sponge iron in the world. Sponge iron means porous iron produced by direct reduction (DR) process which may be either gas-based or coal-based. This is a solid-state reaction process (i.e., solid-solid or solid-gas reaction) by which removable oxygen is removed from the iron ore, using coal or reformed natural gas as reductants, below the melting and fusion point of the lump ore or agglomerates of fine ore. The external shape of the ore remains unchanged. Due to removal of oxygen, there is about 27 to 30 per cent reduction in weight, a honey combed microstructure remains which is called Sponge Iron (means solid porous iron, lumps/pellets, with many voids filled with air). It is also known as Direct Reduced Iron (DRI).

During early 1990s, Sponge Iron Industry was specially promoted to provide an alternative to steel melting scrap which was increasingly becoming scarce. The installed capacity of sponge iron has also increased over the years from 1.52 million tonnes in 1990-91 to 43.62 million tonnes in 2022-23. The total number of working units are 310. At 43.62 million tonnes in 2022-23, India's sponge iron production increased by 11.3% over that of 2021-22.

Over the years, the coal-based route has emerged as a key contributor to overall production and its share increased from 63% in 2004-05 to about 82% (35.61 million tonnes) of total sponge iron production in the country in 2022-23. State-wise capacity and production of sponge iron are reflected in Table-14.

Indian Iron & Steel Industry at a glance for all types of Industry covering the No. of working Units, Working Capacity and their Production is furnished in Table-15.

Table- 15: INDIAN IRON & STEEL INDUSTRY AT A GLANCE DURING 2022-23

Sl. No.	Type of Industry	No.of working Units Units	Working Capacity ('000 tonnes)	Annual Production ('000 tonnes)
I	**Pellets**	**40**	**107316**	**79327**
II	**Sponge Iron**	**310**	**54754**	**43621**
III	Blast Furnace	50	88935	87023
	1 BOF	18	67295	58792
	2 Electric Arc Furnace	34	36607	28204
	3 Induction Furnace	887	57397	40201
IV	**Crude Steel (1-3)**	**939**	**161299**	**127197**
V	Finished Steel (Crude Steel Equivalent)			
	4 Re-rolling	1076	93398	70464
	5 HR Product	21	57853	52732
VI	**Value - added steel**			
	6 HR Product	21	57853	3312
	7 CR Product	**68**	**30435**	**19052**
	8 GP/GC Sheets	30	11049	8474
	9 Colour Coated	21	4301	2668
	10 Tin plate	4	999	637
	11 Pipes	115	11873	5252

Source: Annual Statistics, 2022-23 of JPC

Iron & steel scrap

Iron & steel scrap is one of the essential requirements for manufacture of steel in Mini-steel Industry. It is also consumed by some major steel plants. Scrap, especially from the Ship Breaking Industry supplies substantial quantity of re-rollable steel as well as steel scrap for the Iron & Steel Industry and Secondary Sector, such as, Micro, Small &Medium Enterprises (MSME). Other forms of scrap, i.e., end-of-life cycle scrap or obsolete scrap these get generated in large quantities and form substantial reserves of scrap that could be efficiently put to use. Iron scrap is available in the country in the form of pressed bundles, a mixture of used steel components (called as a commercial scrap), turnings & borings and heavy melting scrap. These are generated by industries of all sectors like automobiles, railways and engineering workshops.

The collection and processing of scrap in an organised manner is undertaken by a few units in the country. In the local market, scrap is supplied by dealers who in turn arrange to have scrap collected manually or through sub-dealers.

The consumption of scrap is mainly reported by Induction Furnace &Electric Arc Furnace units, Integrated Steel Plants and Alloy Steel & Foundry industries. Scraps are used in the Steel Sector after recycling. Recycling of one tonne of steel scrap saves about 1.1 tonnes of iron ore, 0.6 to 0.7 tonnes of coking coal and around 0.2 to 0.3 tonnes of fluxe besides saving of energy by about 16–17%. It also reduces the water consumption and GHG emission by 40% and 58%, respectively. Recycling scrap helps in conservation of energy as remelting of scrap requires much less energy than production of iron or steel from iron ore. Also, the consumption of iron and scrap by remelting reduces the burden on landfill disposal facilities and prevents the accumulation of abandoned steel products in the environment. It increases the availability of semi-finished material, which otherwise would have to be produced using the ore. Thus, it helps in conservation of natural resources.

FERROALLOYS

The Indian Ferroalloy Industry was established during the second Five-year plan as an ancillary Industry to cater to the growing needs of the domestic Steel Industry. As a deoxidant and alloying agent, ferroalloys are in demand for crude steel and alloy steel production. Bulk ferroalloys of high-carbon category are produced by large-scale industries. The Noble ferroalloys are of low-carbon category and include ferro-vanadium, ferro-tungsten, ferro-niobium, ferro-molybdenum and ferro-titanium. There are also a number of units under the small-scale sector for the manufacture of ferroalloys, particularly, ferrosilicon, ferrochrome and ferromanganese. India is the net exporter of ferroalloys. India is an established regular exporter of high-carbon ferro- manganese, silicomanganese and high-carbon ferrochrome.

The capacity of Indian Ferroalloys Industry is furnished in Table-17.

Table – 16 : Capacity of Ferroalloys Industry

(In tonnes per annum)

Ferroalloys	Installed capacity
Total	**5150000**
Bulk Ferroalloys :	**5100000**
Manganese alloys	3160000
Chrome alloys	1690000
Ferrosilicon	**250000**
Noble Ferroalloys :	**50000**

Source: Indian Ferroalloys Producer's Association (IFPA), Mumbai.

Bulk Ferroalloys

Bulk ferroalloys consist of principal alloys, viz, ferro-manganese, silico-manganese, ferro-chrome, charge chrome and ferro-silicon. The production data of different kinds of ferro-alloys was not received from IFAPA as well as from other sources. However, the production data as partial coverages on ferro alloys that have been published in IBM's Monthly Statistics of Mineral Production (MSMP) in its March, 2023 have been mentioned below. which does not reflect the actual entire production of ferroalloys in the country.

Ferromanganese and Silicomanganese

The total production of silicomanganese was 3,56,095 tonnes in the year 2022-23, as compared to 3,49,414 tonnes in the previous year. MOIL has a Ferro Manganese Plant of 12000 (TPY) capacity at Balaghat. The production of ferromanganese reported by MOIL was at 8,660 tonnes in the year 2022-23 as against the 10,245 tonnes in the previous year. As part of diversification strategies, MOIL is aiming to set up new ferro alloy plants at strategic locations near their mines.

Ferrochrome and Charge chrome

Stainless and Alloy-steel Industry are the chief consumers of ferrochrome. The total production of ferro-chrome in 2022-23 was about 11,26,000 tonnes, as compared to 11,13,000 tonnes in previous year.

Noble Ferroalloys

Noble Ferroalloys are one of the vital inputs required for producing special types of steel & alloy. The total capacity of noble ferro-alloys was around 50,000 tpy and they majorly include ferromolybdenum, ferro-vanadium, ferrotungsten, ferrotitanium, ferro-silico-magnesium, ferroaluminium, ferroboron, etc. Mishra Dhatu Nigam (A Govt. of India Undertaking), produced different types of super-alloy chiefly, cobalt, molybdenum, titanium and tungsten-based super-alloys and products.

Electrolytic Manganese Dioxide (EMD)

EMD is consumed along with natural manganese dioxide for the manufacture of dry battery cells. EMD is made of manganese and is used in making batteries and is also an input in pharmaceutical industry. MOIL has the only EMD manufacturing plant in India, located near MOIL's Dongri Buzurg mine in Bhandara district of Maharashtra, having a capacity of 1,500 tpy. The production of EMD by MOIL was 1,100 tonnes in 2022-23 as against 1,202 tonnes in 2021-22.

NON-FERROUS METALS

Aluminium

The Indian Aluminium Industry scaled lofty notches since the establishment of the first manufacturing company, namely, Indian Aluminium Company (INDAL) in 1938. In 2004, all business activities of INDAL have been merged subsequently with Hindalco Industries Limited (Hindalco). Four major primary producers, National Aluminium Co. Ltd, Hindalco Industries Ltd, Bharat Aluminium Co. Ltd and Vedanta Aluminium Ltd (VAL) are at the forefront in aluminium production. The primary producers have a strong presence in the sheet business and are enlarging their roles in the foil segment. The primary producers are also in the extrusion segment in which a large number of secondary manufacturers participate with fragmental capacities. The overall total annual installed capacity of aluminium plants in the country has decreased to 41.45 lakh tonnes from 41.65 lakh tonnes in previous year. The production of aluminium comes from the plants viz, Nalco, Hindalco, Balco, & Vedanta. Producer-wise capacity of aluminium is furnished in (Table-18).

The production of aluminium at 4.06 million tonnes in 2022-23 registered an increase of 1% as compared to that in the previous year. Seven plants reported production of aluminium during the year. (Table–19).

Table – 17 : Capacity and Production of Aluminium, 2020-21 to 2022-23

(In million tonnes)

Producer	Annual Capacity	Production		
		2020-21	2021-22 (P)	2022-23 (P)
Total	4.126	3.62	4.01	4.07
Public Sector				
National Aluminium Co. Ltd (Angul)	0.46	0.418	0.46	0.46
Private Sector				
Bharat Aluminium Co. Ltd (Korba)	0.57	0.57	0.58	0.57
Hindalco Industries Ltd (Aditya, Hirakud, Mahan & Renukoot)	1.346	1.23	1.294	1.32
Vedanta Aluminium Ltd (Jharsuguda)	1.75	1.4	1.68	1.72

Figures rounded off.
Source: Monthly Summary on Minerals & Non Ferrous Metals, Ministry of Mines. Information received from individual plants/Annual reports / Data provided by MMS Division, IBM.

Table – 18: Production of Aluminium 2021-22 and 2022-23 (By Plants)

(In tonnes)

Producer	Plant	Production	
		2021-22	2022-23 (P)
National Aluminium Co. Ltd	Angul	460020	459564
Hindalco Industries Ltd	Aditya	365466	368058
	Hirakud	172071	175693
	Mahan	367168	368781
	Renukoot	389470	409047
Bharat Aluminium Co. Ltd	Korba	580426	568549
Vedanta Aluminium Ltd	Jharsuguda	1682000	1716767

Alumina

The production of alumina at 4,928 thousand tonnes in 2022-23 increased by 5% as compared to that in the previous year. NALCO continued to be the leading producer of alumina accounting for 41% of the total production during the year under review. The installed capacity of alumina plants in the country was 74.75 lakh tpy. Producer-wise capacity of alumina is furnished in (Tables-20 and 21).

Table – 19 : Capacity and Production of Alumina (including calcined alumina) 2020-21 and 2021-22

(In million tonnes)

Producer	Annual Capacity	Production		
		2020-21	2021-22 (P)	2022-23 (P)
Total	7.9	6.52	7.23	7.26
Public Sector				
National Aluminium Co. Ltd (Damanjodi)	2.1*	2.2	2.11	2.02
Private Sector				
Bharat Aluminium Co. Ltd	0.2#	-	-	-
Hindalco IndustriesLtd	3.6	2.63**	3.15**	3.45
Vedanta Aluminium Ltd (Lanjigarh)	2	1.69	1.97	1.79

Figures rounded off.
Source: Information received from individual plants/Annual Reports.
** (Normative capacity)*
*** It includes the Calcined Alumina also as produced by Utkal Alumina International Limited.*
 # Plants remained non-operational during the year/no information in this regard

Table – 20: Production of Alumina 2021-22 and 2022-23 (By Plants)

(In tonnes)

Producer	Plant	Production	
		2021-22	2022-23(P)
National Aluminium Co. Ltd	Damanjodi	2110000	2024000
Hindalco Industries Ltd	Belgaum	307600	262400
	Muri	262373	272523
	Renukoot	559717	576782
	Utkal Alumina	2021908	2336000
Vedanta Aluminium Ltd.	Lanjigarh	1967910	1792744

National Aluminium Company Limited (NALCO): NALCO is in the process of setting up of 5th Stream expansion of its existing Alumina Refinery which would reportedly add 10.0 lakh tonnes to its existing installed capacity of 22.75 lakh tonnes per year (total capacity 32.75 lakh tonnes). This expansion would be based on improved Medium Pressure Digestion technology of M/s Rio Tinto Alcan International Limited (RTAIL).

Sourcing of bauxite for 5th Stream expansion of alumina refinery has been envisaged from Pottangi Bauxite Mines. The availability of bauxite from Pottangi Mines is expected beyond the scheduled commissioning of 5th Stream expansion. Hence, sourcing of bauxite from South Block of Panchpatmali Mines has been planned through setting up of a crushing & conveying system.

The Pottangi Bauxite mine (75 million tonnes) has been reserved by Government of India in favour of NALCO for meeting the bauxite requirement of 1 million tonnes alumina refinary under expansion. The mining plan has already been approved. The pre-project activities are underway. The mine is likely to be operational in the 4th quarter of financial year 2023-24.

Mining Lease of Utkal-D coal block has been granted by the Govt of Odisha over an area of 301.28 Ha and the lease is executed on 25.03.2021 thereafter Utkal coal block will be operationalised after obtaining of statutory clearances.

Nalco, a JV Company Mishra Dhatu Nigam Ltd (MIDHANI) named Utkarsha Aluminium Dhatu Nigam Ltd (UADNL) in August 2019 for establishment of 60,000 TPA for setting up of High End Aluminium Alloy Plant in JV mode for Defence, Aerospace & Automobile Sectors. The plant is expected to be commissioned by financial year 2024-25. The Company has formed JV with Neelachal Ispat Nigam Ltd (NINL) to set up a Coal Tar Distillation plant of 20,000 TPA based on the Coal Tar generated in NINL's Coke Oven Plant.

NALCO and Odisha Industrial Infrastructure Development Corporation (IDCO) have formed a JV Company for establishment of Angul Aluminium Park Pvt. Ltd (AAPPL) for promotion of downstream industries in the State of Odisha. The project is expected to be completed by financial year 2021-22.

HINDALCO: In the field of aluminium, Hindalco operates in primary aluminium and downstream aluminium segments and is one of the world's largest integrated aluminium producers. Hindalco's subsidiary Novalis, with 61% recycling capability is the largest aluminium recycler and producer of rolled aluminium products in the world. Hindalco launched India's first indigenous lightweight and eco-friendly aluminium bulker in India. This bulker saves up to 13,000 litres of fuel, generates 20 tonnes lower GHGs and is BS-VI compliant.

Hindalco is planning to expand its Aluminium downstream business with a focus on Value added product over the next 3-7 years. Products would cater to customised requirement for varied and complex applications of Aluminium. It plan to invest around ₹ 8,000-10,000 crore in expanding flat rolling capacity at Hirakud, new extrusion plant at Silvassa and in a greenfield site at Mundra with a recycling facility. The Hirakud plant capacity for flat rolled products is estimated to be 340 KTPA. The planned capacity of the extrusion plant at Silvassa is 34 KTPA, which would have three extrusion presses to service premium customers in building and construction, automobile and transport, electrical, consumer and industrial good sectors. In addition, the new extrusion and recycling unit at Mundra is awaiting land acquisition process and would have a capacity of 93 KTPA.

VEDANTA: Vedanta Aluminium Ltd (VAL) is the largest aluminium producer in India with a capacity of 1.75 million tonnes per annum. The aluminium smelting unit at Jharsuguda has come a long way to establish itself as the world's largest single-location smelter. With an already installed capacity of 1.75 mtpa, backed by two smelters – 0.5 million tonnes per annum and 1.25 million tonnes per annum (SEZ) and two power plants with a combined capacity of 3,615 MW, which is over 1.3 million tonnes per annum. It could be achieved further by scaling up to the production capability of the smelter and the refinery has been significantly enhanced in the last few years. With the ramp up of both smelters, production of aluminium has increased during the last couple of years. Similarly, production of Alumina has also increased due to debottlenecking of the refinery operations.The bauxite requirements for alumina refinery are met from captive mines, domestic source and imports.

BALCO operates through its plant at Korba in Chhattisgarh with a smelter capacity of 0.57million tonnes per annum and power generation capacity of 2,010 MW. The state-of-the-art alumina refinery at Lanjigarh feeds the aluminium smelters at Jharsuguda and BALCO and forms a crucial link in the value chain. It is one of the world's largest one-site integrated alumina refining complexes with a current capacity of 2 million tonnes per annum that can be ramped up to 5 million tonnes per annum.

CADMIUM

Cadmium (99.95 min.) is obtained as a by-product from zinc smelters of HZL at Debari, Visakhapatnam, Chanderiya and of BZL, Binanipuram. These together have an annual capacity of 913 tonnes. Out of the total annual installed capacity of 913 tpy, HZL accounted for 833 tpy capacity. Binani Zinc Ltd (Edayar Zinc Ltd) reported the remaining 80 tpy capacity. HZL produces cadmium of high quality in its zinc smelters which is casted in the form of pencils weighing from 250 g to 500 g. The purity is 99.95% Cd (max.) at Debari; 99.97% Cd (max.). These by-products of cadmium are cast in the form of pencils weighing from 250 g to 500 g. In India, cadmium is consumed in industries like paint, glass and chemicals. No information received on cadmium production in 2021-22 and 2022-23, however the last reported production of cadmium was 47 tonnes in 2017-18.

COPPER

Copper is vulnerable for substitution on grounds of price, technical superiority or weight. Aluminium is used as substitute for copper in various products, such as, electrical power cables, electrical equipment, automobile radiators and cooling/refrigeration tubing. Optical fibre has substituted copper in some telecommunication applications and plastics are used as substitute for copper in water pipe, plumbing, fixtures and many structural applications. The production of copper ore at 3.33 million tonnes in 2022-23 decreased by 7% as compared to that in the previous year.

The metal content in the ore produced in 2022-23 works out to 27,728 tonnes as against 27,622 tonnes in previous year. During the year under review, 3.26 million tonnes of ore were treated for obtaining copper concentrates as against 3.60 million tonnes in previous year.

Production of copper concentrates at 1,12,746 tonnes in 2022-23 decreased by about 2% as compared to that in the previous year. Madhya Pradesh was the leading producer of copper concentrates, accounting for about 57% of the production during 2022-23, followed by Rajasthan (43%). The number of reporting mines was five in both the years, i.e., 2022-23 and 2021-22 (Tables- 21 to 25).

Table-22: Producer of Copper Concentrates, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
Hindustan Copper Ltd. Tamra Bhavan, 1, Ashutosh Choudhury Avenue, Kolkata - 700019	Madhya Pradesh	Balaghat
	Rajasthan	Jhunjhunu

Table–23: Production of Copper Ore, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22			2022-23 (p)		
	Ore Produced	Cu%	Metal Content	Ore Produced	Cu%	Metal Content
India	**3569632**	**0.77**	**27622**	**3326337**	**0.82**	**27728**
Jharkhand	25834	0.81	209	53375	0.88	471
Madhya Pradesh	2442459	0.74	18105	2165042	0.91	19702
Rajasthan	1101339	0.85	9308	1107920	0.68	7555

(p): Provisional

Table–24: Copper Ore Treated, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22			2022-23 (p)		
	Ore treated	Cu%	Metal Content	Ore treated	Cu%	Metal Content
India	**3604690**	**0.76**	**27545**	**3257190**	**2.35**	**76494**
Jharkhand	-	-	-	-	-	-
Madhya Pradesh	2486190	0.73	18149	2144220	0.83	17826
Rajasthan	1118500	0.84	9396	1112970	5.27	58668

(p): Provisional.

Table–25: Production of Copper Concentrates, 2020-21 to 2022-23

(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2020-21		2021-22		2022-23 (p)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**108718**	**8533354**	**115313**	**11024312**	**112746**	**11438445**
Jharkhand	1208	23707	-	-	-	-
Madhya Pradesh	64920	5137695	65914	5560337	63860	6423658
Rajasthan	42590	3371952	49399	5463975	48886	5014787

(p): Provisional .

Table–26: Production of Copper Concentrates, 2021-22 and 2022-23

(By Sector/States/Districts)

(Quantity in tonnes Value in ₹ '000)

State	No. of Mines	2021-22		No. of Mines	2022-23 (p)	
		Quantity	Value		Quantity	Value
India	**5**	**115313**	**11024312**	**5**	**112746**	**11438445**
Public Sector	5	115313	11024312	5	112746	11438445
Jharkhand	**2**	**-**	**-**	**2**	**-**	**-**
Singhbhum (East)	2	-	-	2	-	-
Madhya Pradesh	**1**	**65914**	**5560337**	**1**	**63860**	**6423658**
Balaghat	1	65914	5560337	1	63860	6423658
Rajasthan	**2**	**49399**	**5463975**	**2**	**48886**	**5014787**
Jhunjhunu	2	49399	5463975	2	48886	5014787

(p): Provisional

Hindustan Copper Limited

Hindustan Copper Limited, established in 1967 is a Central Public Sector undertaking under the administrative control of Ministry of Mines, Government of India. The registered office of the Company is situated in Kolkata. The principal activities of the company are exploration, exploitation, mining of copper and copper ore including beneficiation of minerals, smelting and refining. The Company has copper mines & concentrator plants at Malanjkhand Copper Project.

(MCP) in Madhya Pradesh, Khetri Copper Complex (KCC) in Rajasthan and Indian Copper Complex (ICC), Ghatsila in Jharkhand. The Company has facilities of Smelter & Refinery plant at ICC and Gujarat Copper Project (GCP), Gujarat for production of copper cathode and thereafter conversion of cathode to Copper wire rod at Taloja Copper Project, Taloja (TCP), Maharashtra. The Company is primarily engaged in the business of mining and processing of copper ore, which has been grouped as a single segment in accordance with the 'Ind AS 108 - Operating Segments'. The Company is listed with BSE Ltd and National Stock Exchange of India Ltd. HCL is targeting to enhance the ore production capacity to 12.20 MTPA by FY 2028-29.

The capacity of Khetri Copper Complex (KCC) smelter is 31,000 tpy. However, HCL has shut down the Khetri smelting refining plant due to economic reasons. KCC has a concentrator plant at Khetri in Jhunjhunu district, Rajasthan, having a capacity of 2.02 million tpy. KCC & ICC Ghatsila, Jharkhand with 1.55 million tpy each and Malanjkhand, Madhya Pradesh with two million tpy capacity also operate sulphuric acid plant.

Chhattisgarh Copper Ltd (CCL) established in the year 2018 is a joint venture Company between Hindustan Copper Ltd and Chhattisgarh Mineral Development Corporation Ltd. The Company was established for exploration, mining and beneficiation of copper and its associated minerals in the State of Chhattisgarh.

Gujarat Copper Project (formerly Jhagadia Copper Ltd.)

Gujarat Copper Project is located at Jhagadia in Bharuch district, Gujarat. HCL acquired the assets of Jhagadia Copper Ltd and renamed it as GCP. It is a scrap-based electrolytic smelter that produces cathodes with a capacity of 50,000 tpy and additional 20,000 tpy of copper anodes. The plant was in technical collaboration with Outokumpu Technology (formerly Boliden contech AB), Sweden. The precious metals like gold, silver, platinum, palladium, etc. are also recovered as part of anode slime during the refinery process. The refinery is based on ISA-Technology from Mount ISA Mines Ltd, Australia.

Hindalco Industries Limited (Birla Copper)

The Company's copper smelters located at Dahej, Lakhigam, district Bharuch, Gujarat, has an installed capacity of 5,00,000 tpy. The copper operation consists of producing copper through smelting, refining copper from imported copper concentrates and converting refined copper cathode into continuous cast rod. It is now one of the world's largest smelter at a single location. It is based on Outokumpu Tech¬nology. The Company also produces continuous cast copper rods (CCR) with an annual capacity of 97,200 tonnes.

LEAD AND ZINC

HZL is the only integrated lead and zinc metal producer in the country. Its operations can be classified into mining and smelting. At present, HZL's eight mines and all mining operations are located in Rajasthan. The eight mines are Rampura Agucha mine (Bhilwara district), Kayad mine (Ajmer district), Rajpura Dariba mine, Sindesar Khurd mine (both in Rajsamand district) and Zawar group of mines (4 mines in Udaipur district i.e. Mochia, Balaria, Zawarmala and Baroi), Rajasthan. All the mines of HZL undertake underground mining operations. Rampura Agucha mine was completely turned to underground mine with an annual production capacity of 5 million tonnes of lead & zinc ore. Sindesar Khurd mine is highly mechanised and the largest ore producing underground mine with annual production capacity of 6 million tonnes. The other six mines viz, Rajpura Dariba, Zawar group of mines (Mochia, Balaria, Zawarmala and Baroi) and Kayad mine are underground mines with an annual production capacity of 1.25 million tonnes, 4.41 million tonnes and 0.93 million tonnes of lead & zinc ore, respectively.

The total installed capacity of primary lead smelting is 2,10,000 tpy. The smelting capacity of HZL for lead is distributed between two smelters at Chanderiya (90,000 tpy) and Dariba (1,20,000 tpy). Primary lead is produced entirely by HZL at lead-zinc smelter at Chanderiya, district Chittorgarh, and Rajpura-Dariba Plant, district Udaipur, Rajasthan.

There are a number of secondary producing units in the Organised and Unorganised Sector. Lead acid batteries are the major consumer of lead metal in the country.

HZL is the major producer of Zinc. The smelting capacity of HZL for Zinc is distributed between three smelters at Debari (88,000 tpy), Chanderiya (5,85,000 tpy) and Dariba (2,40,000 tpy). Edyar Zinc Ltd's plant at Binanipuram, Kerala, has a capacity of 38,000 tpy. Thus, the smelting capacity for zinc in the country is 9,181,000 tpy. The primary product of Debari and Vizag smelters is high-grade zinc, while cadmium was being recovered as by-product (no information on cadmium at present). Chanderiya smelter complex with a total capacity of 5,85,000 tpy of zinc is the world's largest single location zinc smelting complex. Besides Lead and Zinc, HZL also produces silver as by-product at its Pant Nagar plant in Uttarakhand whose capacity is 800 tonnes per year.

The product range of HZL constitutes two grades, namely, Special High Grade (SHG) zinc containing 99.995% Zn (min.) and Prime Western (PW) containing 98.65% Zn (min.). Both these products are available in the form of slabs weighing 25 kg, SHG Jumbo weighing 1,000 kg and PW Jumbo weighing 600 kg. Lead is available as HZL Grade containing 99.99% Pb (min.) in the form of slab weighing 24 kg. In October, 2016, a new zinc alloy value-added product, HZDA or Hindustan Zinc Die-cast Alloy was added to the Company's portfolio from Chanderiya Lead-Zinc Smelter. HZL produce refined silver; recovered as a by-product of zinc-lead facility, it has high quality silver bullion having a minimum purity 99.9% of silver is listed on LBMA Good delivered List (LGD) and supply silver in the form of Standard 30 kg bars, 1 kg bars and silver powder. HZL also produce 98% concentrated sulphuric acid at production facilities in Chanderia, Debari and Dariba in the state of Rajasthan.

ABRASIVES

Natural abrasives, which include calcite, emery, diamond, zircon, corundum, novaculite, pumice, etc. are generally sold as dressed stones. Synthetic abrasives include borazon, ceramic, dry ice, glass powder, silicon carbide, etc. Commercial abrasives are manufactured in many shapes as bonded or coated abrasives including belt discs, wheels, sheets, blocks, rods and loose grains. A large number of units exist in the unorganised sector. However, important producers of coated abrasives were: Grindwell Norton Ltd, Mora, Uran, district Raigad, Maharashtra; Flexoplast Abrasives (India) Ltd, Aurangabad, Maharashtra; Associated Abrasives Ltd, Nashik, Maharashtra; Carborundum Universal Ltd, Chennai, Tamil Nadu; Cutfast Abrasives Tools Pvt. Ltd, Chennai, Tamil Nadu; and John Oakey and Mohan Ltd, Ghaziabad, Uttar Pradesh. Important producers of bonded abrasives (grinding wheels) are Associated Abrasives Ltd, Nashik, Maharashtra; Carborundum Universal Ltd, Chennai, Tamil Nadu; Cutfast Abrasives Tools Pvt. Ltd, Chennai, Tamil Nadu; and K.L. Thirani & Company Ltd, Kolkata, West Bengal.

Silicon Carbide (SiC)

Silicon Carbide (SiC) is a synthetic material most commonly produced by the so called Archean process in electrical resistance furnaces. SiC does not occur naturally except in some types of pre-solar metorites, along with diamonds. SiC can be produced either in black colour or green colour depending on the raw material. SiC products have applications in metallurgical refractories, abrasives, slurry wire sawing, and for technical ceramics.

Major producers of silicon carbide are: Grindwell Norton Ltd, Renigunta, Andhra Pradesh and at Bengaluru, Karnataka; Indian Metals & Carbide Ltd, Therubali, Odisha; Carborundum Universal Ltd, Tiruvottiyur, district Chennai, Tamil Nadu; and Speedfam (India) Pvt. Ltd, Navi Mumbai, Maharashtra.

CEMENT

The Cement Industry which is one of the key infrastructure industries recorded exponential growth pattern in successive years since the introduction of partial decontrol in 1982, total decontrol in 1989 and post delicencing of the Industry and Policy Reforms initiated in 1991. As per DIPP, with more than 600 million tonnes per annum of cement production capacity, India is the second largest cement producer in the world and accounts for over 8 percent of global installed capacity. The capacity utilization of Indian Cement Industry during the last 10 years has fallen from 83% to 60%. The continuous downward trend of capacity utilization is indicative of the idle capacity of over 230 million tonne which is growing year by year. The cement industry comprises about 150 integrated large cement plants, 116 grinding units, 62 mini cement plants and 5 clinkerisation units. The total production of cement in 2022-23 was about 391.40 million tonnes as compared to around 360.19 million tonnes in the previous year. The Cement Industry produces a variety of cement, such as, Ordinary Portland Cement (OPC) Portland Pozzolana Cement (PPC), Portland Blast Furnace Slag Cement (PBFC), Oil Well Cement, White Cement, etc. to suit a host of applications. Cement Information System (CIS) Portal was launched in 2014 for compilation of data regarding capacity, production etc. from cement plants in the country; format for data collection has been simplified to ease complex data requirement and the same is now available for user industries. Users from the Industry can submit their monthly production details on the portal. Currently around 95% of Cement Units submits their Cement Production data on CIS Portal on monthly basis.

Bureau of Indian Standards in India have specified 16 types of cements and clinker specification. These include Ordinary Portland Cement (OPC), Portland Pozzolana Cement (PPC), Portland Slag Cement (PSC), Composite Cement Limestone Caleined clay cement and other special purpose cements. Among all these, three most common cement types produced in India are OPC, PPC and PSC. The Portland Pozzolana Cement (PPC) enjoys the majority share (65%) of the total cement production in India followed by Ordinary Portland Cement (OPC) (27%) and Portland Slag Cement (PSC) (7%). A positive trend towards the increased use of blended cement can be seen with the share of blended cement increasing continuously. The continuous increase in the production of blended cement will reduce the problem of disposal of fly ash and slag, improve energy efficiency and reduce carbon footprint.

ASBESTOS - CEMENT PRODUCTS

The installed capacity of asbestos-cement pressure pipes in the Organised Sector was about 1,49,640 tpy. Production capacity of asbestos cement sheets was not available. By virtue of the high tensile strength and bonding properties with cement, it is used in the manfacture of fibre cement products.

Industries that deal with asbestos–cement products include Everest Building Products Ltd which has units located at Kymore in Madhya Pradesh and at Podanur in Tamil Nadu. Similarly, Hyderabad Industries Ltd has three plants at Sanatnagar, Ranga Reddy dis¬trict in Andhra Pradesh; Jasidih in Jharkhand; and Ballabhgarh in Haryana. Ramco Industries Ltd has three plants at Arakkonam, dis¬trict Vellore, Tamil Nadu; Karur in district Dharwad, Karnataka; and Maksi in district Shajapur, Madhya Pradesh. Southern Asbestos Cement Ltd has two plants at Karur in district Dharwad, Karnataka; and Arakkonam, district Vellore in Tamil Nadu. Shree Pipes Ltd Hamirgarh, dis¬trict Bhilwara, Rajasthan; Malabar Building Products Ltd, Malakunnathukavu, district Thrissur, Kerala; Konark Cement and Asbestos Industries Ltd at Bhubaneswar in Odisha; Shri Digvijay Cement Co. Ltd, Digvijayna¬gar, Ahmedabad in Gujarat; Uttar Pradesh Asbestos Ltd, Mohanlal¬ganj, district Lucknow, Uttar Pradesh; Assam Asbestos Ltd, Bonda, Narangi, district Guwahati, Assam; Utkal Asbestos Ltd, Dhenkanal in Odisha; and Visaka Asbestos, Pattencheru (Medak) in Andhra Pradesh are some of the other industries that produce asbestos cement products.

Besides, Swastik Industries, Pune, in Maharashtra; Kalani Asbestos, a Division of Kalani Industries Pvt. Ltd, Pitampur, district Dhar in Madhya Pradesh; Tamil Nadu Asbestos (Pipes), a unit of Tamil Nadu Cement Corp. Ltd, Mayanur, district Tiruchirapalli in Tamil Nadu; and Ganga Asbestos Cement Ltd, Raebareli in Uttar Pradesh produced only asbestos pressure pipes. The present status of all these asbestos cement units is not available with Indian Bureau of Mines.

REFRACTORY INDUSTRY

Refractory Units fall under Medium and Small-scale Sectors. Steel Industry is the biggest group of customers of this Industry, which consumes about 70% of total refractory production, followed by 12% in cement, 5–6% in non-ferrous, 3% in glass and balance in other industries. There are more than 100 refractories in India, out of which around 14 are major, 33 are medium-sized and the rest are relatively smaller in respect of production. The estimated annual installed capacity of all types of refractory was 2,015 thousand tonnes and the production in 2020-21 of all types of refractories was 1,264.06 thousand tonnes as compared to 1,208.92 thousand tonnes in 2019-20. Bharat Refractories Ltd (BRL), a Government of India Undertaking, has four units that are engaged in the manufacture and supply of various kinds of refractories to the integrated steel plants and to smaller steel plants. The important refractory producers are Calderys India Refractories Ltd, Associated Ceramic Ltd, Dalmia Bharat Ltd, IFGL Refractories Ltd, Orient Refractories Ltd, TRL Krosaki Refractories Ltd, Vesuvius India Ltd, Maithan Ceramic Ltd, National Refractories, etc.

With the modernisation and renovation of steel plants, the requirements for various types of refractories have undergone revolutionary changes. The stress is now on for more sophisticated products like precast monolithics. The domestic Refractory Industry, taking cue of this change, has acquired the technical know-how for production of sophisticated refractories, such as, magnesia carbon bricks, new generation sliding-gate plate refractories, for ladles, gunning materials and castables. Manufacture of carbon bonded silicon carbide crucible and clay graphite foundry products is continuously done with constant upgradation for production of improved products. The use of these special refractories has brought down the consumption of refractories per tonne of steel production. However, the customers are benefited by way of improved performance, lower shutdown time and savings on energy. The specific consumption of refractories at present in integrated steel plants varies from 8 to 10 kg/tonnes of crude steel as compared to 6–8 kg/tonnes of crude steel in advanced countries. Refractory play important role in the efficient performance of different manufacturing process of steel, aluminium, glass, cement, petrochemical, industries and improves the quality of the products. It is apt to mention here that the marketing of refractories is totally different presently in companies in comparison to the situation that existed 30 years ago as the users decide the prices of refractories on the total performance basis.

The price and supply of imported raw materials are subject to international demand and supply situation and most of the refractory makers are completely dependent on imported raw materials, especially for making high-end products. Refractory production in India during 2019-20 & 2020-21 is furnished in Table-26.

Table – 27: Refractory Production in India, 2019-20 and 2020-21

(In tonnes)

Item	Production	
	2019-20	2020-21
Total	**1208926**	**1264064**
Fireclay Bricks & Shapes	197803	197148
High Alumina Bricks & Shapes	230319	225911
Silica Bricks & Shapes	79259	65437
Basic Bricks & Shapes	180299	173386
Monolithics/ Castables/ Pre-cast Blocks	392837	470256
Special Products (incl cc)	60802	61964
Others	67607	69962

Source: IRMA Journal volume LIV No.3 September 2021

CERAMIC & GLASS INDUSTRY

Ceramic Industry

Ceramic Industry in India is about 100 years old. The main product segments in ceramic industry are the Wall tile, Floor tile, Vitrified tile and Industrial tile segments. Ceramic products are made from clay and felspar and are manufactured in Large and Small-scale Sectors with wide variations in type, range, quality and standard. Ceramic items have properties, such as, glassy smooth finish, high thermal shock resistance, poor thermal electrical conductivity, high abrasion resistance, acid resistance and weather resistance. During the last two decades, there has been a phenomenal growth in the field of ceramics to meet specific demands of the industry, such as, high alumina ceramics, cutting tools and other structural ceramics. The state-of-the-art technology of international standards is adopted for production of high quality, ceramic goods in the country. The major industries include Kajaria Ceramics, Somani Ceramics, Asian Granite India, Orient Ceramics & Industries, Nitco, Regency Ceramics, Euro Ceramics, Bell Ceramics, RAK Ceramics etc. Ceramics Technological Institute (CTI), Bengaluru, a National Level Institute for R&D in BHEL, offers the much-needed technical support for product development by enabling the Indian Ceramic Industry to adopt a modernised technology for development of new and advanced ceramics. Areas of research are nano-technology, separation technology, microwave processing, etc.

Ceramic Tiles

Following the development and growth of the Building Industry, ceramic glazed tiles producing industries too flourished considerably during the last decade. Indian tiles are competitive in the international market and are chiefly exported to East and West Asian countries. In India, both traditional methods of manufacturing (tunnel) as well as the latest single fast firing methods are in vogue in manufacturing of ceramic tiles.

Sanitarywares

The basic raw materials for sanitaryware are feldspar, ball clay, kaolin and quartz. The major manufacturers of sanitaryware include Hindustan Sanitaryware Industries Ltd, Parryware Roca Bathroom Products, Cera Sanitaryware, Neycer India, Kohler India, Toto, RAK Ceramics India, Duravit Sanitaryware Pvt. Ltd, Golf Ceramics, etc.

Potterywares

Potterywares include crockery and tableware and its manufacturers are a part of an age old handicraft industry in the country. Produced both in the Large-scale and the Small-scale Sectors, there were 16 units in the Organised Sector with a total installed capacity of about 43,000 tpy, while in the Small-scale Sector, there were over 1,400 plants with a capacity of 3 lakh tpy. Out of these, over 600 units are located in Uttar Pradesh. The present status of all these Potterywares units is not available with the Indian Bureau of Mines.

Glass Industry

The Glass Industry includes manufacturing unit that makes glass products, such as, glass containers and hollow-wares, tablewares, flat glass (including float, sheet, figured, wired and safety, mirror glass), speciality glass (such as, electronics, optics, lighting, ophthalmic lenses) vacuum flasks, refills, laboratory glasswares, fibre glass, kitchen glassware, glass bangles, etc. Principal raw materials used in the manufacture of glass are silica sand, soda ash, calcite, dolomite, etc.

Glass Industry comes under the category of deli¬censed industry and manufacturing units are spread all over India. The large-scale producers are located mostly in Mumbai, Kolkata, Bengaluru, Hyderabad and in Gujarat and are equipped mostly with modern melting furnace technology. The Medium and Small-scale Industries, on the other hand, include cottage industries that still use outdated technology for production of glass products. The share of Organised Sector in the Glass industry is dominant at about 55% whereas, the Unorganised Sector accounts for about 45%. There is considerable scope and demand for glass fibre products, particularly due to growth in Petrochemical Sector, solar products, Packaging Industry and allied products. Glass Industry in India remained in the form of Cottage Industry till the beginning of 20th century. First glass plant in India was set-up in August 1908 by freedom fighter & Bharat Ratna Lokmanya Bal Gangadhar Tilak at Talegaon in the State of Maharashtra. Glass Industry in India has made a steady progress since then, particularly after independence. Firozabad, known as glass city of India, continues to be a place of master craftsmen and entrepreneurs, where traditional processes are still used for production of a wide variety of glass items. About 70% of the total glass production in the Unorganised Sector in the country is contributed by Firozabad Glass Industry.

Glass Containers and Hollow-wares

Glass containers are ideal packaging medium, but are increasingly being replaced by other packaging materials like plastic, PET, aluminium and tetrapack. The major producers include Hindustan National Glass & Industries, Piramal Glass, Haldyn Glass Gujarat, La Opala RG, Mohan Meakin, Gujarat Glass, Associated Glass Industries (AGI), etc.

Laboratory Glasswares

There were six units in this Sector which manufacture neutral glass tubing, laboratory glasswares and chemical process equipment. The installed capacity of neutral glass tubing was 46,600 tpy. The data on production are not available. The demand for neutral glass tubing has not picked up due to sizeable switch over from glass items to plastic items.

Flat Glass

Silica sand, dolomite, limestone are some of the mineral ingredients used in the manufacture of flat glass. The term flat glass includes float glass, sheet glass or plate glass, figured and wired glass. These are further processed into mirror, toughened glass, laminated glass, double glazing, etched glass, glass doors, etc. The total capacity of Flat Glass Industry in India is about 1.2 million tonnes annually for which the major producers are Saint Gobain Glass, Asahi India Glass, Gujarat Guardian Glass, Gold Plus Glass and Hindustan National Glass. There has been growing acceptability of the Indian flat glass products in the global market.

Fibre Glass (Glass-reinforced plastic)

Silica sand, limestone, kaolin, fluorspar, dolomite, etc. are some of the important minerals used in manufacturing fibre glass. Fibre glass is highly capital and technology-intensive Industry. Fibre glass is lighter than aluminium but stronger than steel. Moreover, being an inorganic material, it does not pose any health hazard.

GRANITE INDUSTRY

Major production of granite in raw as well as processed form is generally from Andhra Pradesh, Rajasthan, Karnataka, Tamil Nadu and Gujarat. Granite is used in monuments, building slabs, tiles, surface plates, etc. Over 160 varieties of granite with exotic colours/shades have been identified as products that could be exported after processing.

Granite is a minor mineral as defined under Section 3(e) of MMDR Act, 1957, and as per Section 15 of MMDR Act, 1957, all powers to make rules and grant of Mineral Concessions for minor minerals have been entrusted with concerned State Government. Granite Conservation and Development Rules, 1999; were notified separately on 1.6.1999 for ensuring systematic/scientific exploitation and conservation of granite resources of the country. The deposits are dispersed widely across all parts of the country.

Granite is a Non-scheduled Industry and the processing of granite is a phenomenon that was started in 1930s. The mining and processing techniques of granite adopted in the country have improved over the years. Looking at its export potential, the Government of India has been encouraging setting up of 100% EOU in this Sector to promote export of value-added granite products. Exports of granite are freely allowed. The export of Granite Blocks/ Tiles (polished) during 2019-20 was 190 thousand tonnes as compared to 213 thousand tonnes during previous year.

CHEMICALS

Caustic Soda (Sodium hydroxide)

Caustic soda is a basic inorganic chemical prepared by electrolysis of salt brine and is consumed in Textile, Organic chemicals, Alumina, Paper & Pulp, Soaps & Detergents, Inorganic chemicals and for water treatment. These sectors accounted for almost 76.1% of the demand in the country.

A significant quantity of caustic soda is used in the manufac¬ture of other inorganic chemicals and dyestuffs, in metallurgical operations and in petroleum refining. In the year 2021-22, the total installed capacity of caustic soda was 41.51 lakh tonnes as compared to 38.98 lakh tonnes in the previous year. The production of caustic soda during 2021-22 was 34.63 lakh tonnes as compared to 29.64 lakh tonnes in the previous year. The major Indian producers are Gujarat Alkalies & Chemicals, Grasim Industries, Nirma, Shriram Alkali & Chemicals, Reliance Industries, Aditya Birla Chemicals (India), etc.

Soda Ash

Soda ash is an important chemical used widely as a raw material in the manufacture of glass and glassware, sodium silicate, textile, paper & pulp, in metallurgical industries, desalination plants and in the preparation of a host of chemicals. Soda ash is an essential ingredient in the manufacture of detergent, soap, sodium salts and dyes. The major soda ash producers are Tata Chemicals, Gujarat Heavy Chemicals Ltd, Nirma, Saurashtra Chemicals, DCW, etc. The manufacture of soda ash in India started in 1932 at Dhrangadhra in Gujarat with installed capacity of 50 tpd.

In the year 2021-22, the total installed capacity of soda ash was 36.14 lakh tonnes which was same as in the previous year. The production of soda ash during 2021-22 was 30.78 lakh tonnes as compared to 26.38 lakh tonnes in the previous year.

Calcium Carbide

Calcium carbide is used in the manufacture of flammable acetylene gas for Rubber, Synthetic and Plastic Industry. It is used as a raw material for manufacturing various rubber goods. It is self-reinforcing filler. It is also used for cutting & welding of metals besides its use in manufacturing various chemical substances. The major Indian producers are Birla Carbide, TECIL, ICML and Panyam.

In the year 2021-22, the total installed capacity of calcium carbide was 1.12 lakh tonnes which was same as in the previous year. The production of calcium carbide during 2021-22 was 0.98 lakh tonnes as compared to 0.86 lakh tonnes in the previous year.

Synthetic Cryolite (Na_3AlF_6)

Navin Fluorine chemical Ltd, Bhestan, Gujarat, is an important producer of synthetic cryolite. Other producers are Tanfac Industries Ltd, Cuddalore, Tamil Nadu; (Aditya Birla Group) and Adarsh Chemicals and Fertilizers Ltd, Udhna, Gujarat. GMDC, Gujarat has a beneficiation plant at Village Kadipani that produces 96% CaF_2 acid-grade & 90% CaF_2 metallurgical-grade concentrate. The acid-grade finds use in aluminium fluoride, synthetic rutile and fluorine chemicals.

Aluminium Fluoride

Aluminium fluoride, with the molecular formula AlF_3, is an inorganic compound that is used in a variety of industrial processes, most notably in the production of aluminium. It is a colourless solid that can be made synthetically or can be naturally found as the minerals, rosenbergite and oskarssonite. The important units that produce aluminium fluoride include Navin Fluorine Industries, Maya Rasayan Ltd, Mumbai, Tanfac Industries Ltd, SPIC and Aegis Chemical Industries Ltd.

Titanium Dioxide

Titanium Dioxide (TiO2) is a chemically inert white pigment used in a wide range of consumer products from paints, paper and toothpaste to plastics and cement. The key raw materials used in the production of TiO2 are ilmenite and rutile found mainly in coastal regions of Tamil Nadu, Kerala, Andhra Pradesh and Odisha. Anatase and rutile are the two major types of TiO2 which are manufactured by the sulphate and chloride process, respectively. The 4 key players in the Indian Titanium Dioxide Industry are Kerala Minerals and Metals Limited (KMML), Travancore Titanium Products Limited (TTPL), Kilburn Chemicals (VVTi Pigments Ltd) and Kolmak Chemicals Ltd.

In the year 2021-22, the total installed capacity of Titanium Dioxide was 82.50 thousand tonnes which was same as in the previous year. The production of Titanium Dioxide during 2021-22 was 56.96 thousand tonnes as compared to 51.22 thousand tonnes in the previous year.

Sulphuric Acid

Sulphuric Acid is primarily being used as a feedstock for the synthesis of nitrogenous and phosphatic fertilizers against the backdrop of its abundant demand from the fertilizer industry. Besides, the growing consumption of Sulphuric Acid in the water treatment process and metal processing is anticipated to contribute well to propel its demand in the forecast period. Sulphuric Acid can be produced by either the smelter or sulfur route. The annual capacity of sulphuric acid in the year 2022-23 is around 16.470 million tonnes. There are several organised and unorganised players operating in the country's Sulphuric Acid market, making it highly fragmented. Hindustan Zinc Limited is one of the largest manufacturer of Sulphuric Acid operating in the domestic market. They produce 98% concentrated Sulphuric Acid at their production facilities in Chanderia (Installed Capacity – 0.6 Million Tonnes annually), Debari (Installed Capacity – 0.3 Million Tonnes annually) and Dariba (Installed Capacity – 0.6 Million Tonnes annually) in the state of Rajasthan. In addition, sulphuric acid is also recovered at HCL, Hindalco & Sterlite.

Phosphoric Acid

Important units that produce phosphoric acid of various grades, such as, pharma-grade, food-grade, technical-grade, analytical reagent grade, etc. include Gujarat State Fertilizer & Chemicals Ltd,Vadodara, Gujarat; Fertilizers and Chemicals Travancore Ltd, Udyogmandal, Kerala; Fertilizers and Chemicals Travancore Ltd, Cochin II, Kerala; Coromandel International Ltd, Vizag (A.P.); Coromandel International Ltd, Ennore (A.P.); Green Star Fertilizers Ltd, Tuticorin, Tamil Nadu; IFFCO Ltd, Paradeep Odisha; Krishna Phoschem Ltd, Meghnagar (M.P.); Madhya Bharat Agro Products Ltd, Sagar (M.P.); Paradeep Ohos. Ltd, Paradeep, (Odisha); Patel Phoschem Ltd, Udaipur (Raj.); Rashtriya Chemicals & Fertilisers Ltd, Trombay (Maharashtra). As on 01.11.2023, the total manufacturing capacity of phosphoric acid (as P_2O_5) is around 23.73 lakh tonnes per annum.The production of phosphoric acid (as P_2O_5) in the year 2021-22 is estimated around 17.53 lakh tonnes. The important uses of phosphoric acid are in the manufacture of phosphatic fertilisers, agricultural feed, waxes, polishes, soaps & detergents, and in waste water treatment, tea-leaf processing, sugar refining, as well as anodising & stabilising agent.

Ferro-phosphorus (FeP)

Ferro-phosphorus is obtained as a by-product during steel manufacturing, during the production of yellow phosphorus or is smelt by phosphate rock & ferro-rock in blast furnace. It is used as an ingredient in high strength low-alloy steel, foundry products, as de-oxidiser in Metallurgy Industry & as a brake liner with 23% minimum phosphorus and 1% maximum carbon. Ferrophosphorus is also used as a dying agent and as an additive in metallic paints.

Red Phosphorus

Star Chemicals (Bombay) Pvt. Ltd. and United Phosphorus Ltd, Gujarat, are the leading manufacturers and suppliers of red phosphorus in the country. It is mainly consumed in the Match Industry for making strike plate of match box. Besides, in Agriculture Industry, it is used as fumigant and in the making of pesticides. Red phosphorus finds application in the manufacture of phosphoric acid, semi-conductors and also as flame retardant for polymers. It is also used in pharmaceuticals for synthesis of drugs. In the year 2021-22, the total installed capacity of Red Phosphorus was 1.68 thousand tonnes which was same as in the previous year. The production of Red Phosphorus during 2021-22 was 1.15 thousand tonnes as compared to 1.07 thousand tonnes in the previous year.

Borax

Borax is used as a component of glass, ingredient in enamel glazes, pottery & ceramics. The main manufacturer of borax is Borax Morarji Ltd with an installed capacity of 24,000 tpy at Dahej, GIDC in the State of Gujarat. The plant uses imported crude sodium borate concentrates (rasorite) and crude calcium borate (colemanite) as these are not produced indigenously. Indo-Borax & Chemical Ltd also operates borax and boric acid plants at Pithampur, Madhya Pradesh. As a thumb rule, for one tonne production of boric acid about 2 tonnes of boro-gypsum is produced. However, boro-gypsum does not have ready market for its disposal.

CHEMICAL FERTILIZERS

Agriculture accounts for about 17-18% of India's GDP and employs nearly 50% of the workforce. Fertilizers improve crop productivity and soil fertility, helping India sustain its growing population. India has a mix of public, private, and cooperative sector enterprises. India imports a significant share of its phosphate and potash requirements. Raw materials for fertilizer production, such as natural gas, are also largely imported.

Types of Fertilizers:

- Nitrogenous Fertilizers: Urea is the most widely used.
- Phosphatic Fertilizers: Includes DAP (Di-Ammonium Phosphate).
- Potassic Fertilizers: India imports most of its potash.
- Complex Fertilizers: Contain a mix of N, P, and K.

In India, the Agricultural Sector plays a vital role in the economic development of the country as securing food for 1.4 billion plus population is a mammoth task. To maximise agricultural output, it is imperative that better agricultural methods and greater, but judicious use of fertilizers be put to effect. The application of fertilizers is well known for over a hundred years, but the use of chemical fertilizer started in the beginning of this century. The first phosphate fertilizer plant in India was commissioned in 1906. Since then, the Phosphatic Fertilizer Industry has grown considerably, but, the growth has not been able to keep pace with the ever increasing demand.

At present, there are 33 large size urea plants in the country manufacturing urea, 21 units producing DAP & other Complex fertilizers and 102 units for production of SSP. Installed Capacity and Production of Various Types of Fertilizers is given in Table –28

As per Fertilizer Association of India, as on 01.11.2023 the total installed capacity of Urea, DAP, Complex fertilizer and SSP stands at 313.02 lakh tonnes, 74.52 lakh tonnes, 85.97 lakh tonnes and 123.15 lakh tonnes, respectively. India is the second largest consumer and third largest producer of finished fertilizers in the world. India is net importer of fertilizers, both finished products as well as raw materials

Different types of straight and complex fertilizers are manufactured from rock phosphate, such as, SSP, DAP, nitrophosphate, urea ammonium phosphate etc.

In the absence of commercially exploitable resources of potash in the country, the entire demand of potassic fertilizers is met through imports.

Table – 28 : Installed Capacity and Production of Various Types of Fertilizers

(In lakh tonnes)

Products	No. of Units	Installed Capacity* (as on 01.11.2023)	Production	
			2021-22	2022-23 (upto Dec., 22)
Urea	33	313.02	250.72	210.98
DAP	21	74.52	42.22	31.80
Complex Fertilizers		85.97	83.27	70.77
SSP	102*	123.15	53.34	43.45

Source: Annual Report 2021-22 and 2022-23, Department of Fertilizer, Government of India
** Fertilizer statistics*

India's fertilizer plants form the backbone of its agricultural productivity, producing essential nutrients to sustain the country's food security. These plants are spread across the nation, managed by public, private, and cooperative sectors, and focus on producing nitrogenous, phosphatic, and potassic fertilizers. Geographic Distribution

- **Northern Region:** Focused on nitrogenous fertilizers like urea, due to high demand in wheat and rice belts.
- **Eastern Region:** Hosts emerging plants like those in Sindri and Barauni, supported by government revival initiatives.
- **Western Region:** Dominated by cooperative and private players with significant phosphatic and NPK fertilizer production.
- **Southern Region:** Known for its phosphatic fertilizer plants, catering to cash crop regions.

Modernisation and Expansion

Many plants are being revamped to increase efficiency, adopt green technologies, and meet growing agricultural demands. The government has also encouraged the use of neem-coated urea and promoted the production of bio-fertilizers to reduce environmental impact.

India's fertilizer plants are critical in achieving agricultural sustainability, contributing significantly to the nation's economy and food security.

Principal Fertilizer Plants of India are given in Table 29:

Table – 29 : Principal Fertilizer Plants

Sl. No.	Plant	Location
Public Sector		
1	National Fertilizer Ltd	Nangal and Bhatinda (Punjab), Panipat (Haryana),Vijaipur-I & II (Madhya Pradesh)
2	Brahmaputra Valley Fertilizer Corp. Ltd	Namrup- II and III (Assam)
3	Fertilizers & Chemicals Travancore Ltd	Udyogmandal and Cochin-I & II (Kerala)
4	Rashtriya Chemicals & Fertilizers Ltd	Thal Vaishet,Trombay I & IV and Trombay V (Maharashtra)
5	Madras Fertilizers Ltd	Manali (Tamil Nadu)
6	Steel Authority of India Ltd	Rourkela (Odisha),Bhilai (Chhattisgarh),Bokaro (Jharkhand),Durgapur (West Bengal),IISCO,Burnpur-Kulti (West Bengal)
7	Hindustan Urvarak & Rasayan Ltd*	Gorakhpur (Uttar Pradesh),Barauni (Bihar),Sindri (Jharkhand)
8	Ramagundam Fertilizers & Chemicals Ltd*	Ramagundam (Telangana)
9	Rashtriya Ispat Nigam Ltd	Visakhapatnam (Andhra Pradesh) (Visakhapatnam Steel Plant)
Private Sector Large Units		
10	Gujarat State Fertilizers & Chemicals Ltd	Vadodara and Sikka I & II (Gujarat)
11	KRIBHCO Fertilisers Ltd	Shahjahanpur (Uttar Pradesh)
12	Yara Fertilisers India	Babrala (Uttar Pradesh)
13	Matix Fertilizers & Chemicals Ltd	Panagarh (West Bengal)
14	Coromandel International Ltd.	Vizag and Kakinada (Andhra Pradesh), Ennore ,(Tamil Nadu)
15	Krishna Phoschem Ltd	Meghnagar (Madhya Pradesh)
16	Gujarat Narmada Valley Fertilizers & Chemicals Ltd	Bharuch (Gujarat)
17	Greenstar Ferts. Ltd.	Tuticorin (Tamil Nadu)
18	Madhya Bharat Agro Product Ltd	Sagar II (Madhya Pradesh)
19	Mangalore Chemicals & Fertilizers Ltd	Mangalore (Karnataka)
20	Nagarjuna Fertilizers & Chemicals Ltd	Kakinada I & II (Andhra Pradesh)
21	Tuticorin Alkali Chemicals & Fertilizers Ltd	Tuticorin (Tamil Nadu)
22	Indorama India Pvt.Ltd	Jagdishpur (Uttar Pradesh), Haldia (West Bengal)
23	Mahadhan Agri Tech Ltd	Taloja (Maharashtra)
24	Shriram Fertilisers & Chemicals	Kota (Rajasthan)
25	Southern Petrochemical Industries Corporation Ltd	Tuticorin (Tamil Nadu)
26	Chambal Fertilizers & Chemicals Ltd	Gadepan I, II & III Kota (Rajasthan)
27	Kanpur Fertilisers & Chemicals	Kanpur (Uttar Pradesh)
28	Paradeep Phosphates Ltd	Paradeep (Odisha), Zuari Nagar (Goa)
29	Hindustan Chemicals Co.	Surat (Gujarat)
Co-operative Sector		
30	Indian Farmers Fertiliser Co-operative Ltd	Kalol and Kandla (Gujarat), Aonla I & II, Phulpur I & II (Uttar Pradesh), Paradeep (Odisha)
31	Krishak Bharti Co-operative Ltd	Hazira (Gujarat)

Modernisation and Expansion

India's fertilizer plants are critical in achieving agricultural sustainability, contributing significantly to the nation's economy and food security. Many plants are being revamped to increase efficiency, adopt green technologies, and meet growing agricultural demands. The government has also encouraged the use of neem-coated urea and promoted the production of bio-fertilizers to reduce environmental impact.

PAPER & PAPER BOARD INDUSTRY

India is among the fastest growing market for paper and the domestic market size is pegged as per reported estimates at over Rs 80,000 Crore. As per estimate there are around 900 pulp and paper mills in India using varied raw materials such as wood, recycled fiber. bagasse, wheat straw, market pulp etc. Thus, based on the raw materials the paper industry can be categorized into wood based, agro-residues based and waste paper or recycled fiber based mills. Based on end products the industry can be classified into writing and printing paper, industrial paper/packaging grade paper, newsprint and specialty grade paper. In general, the total production share of wood agro and waste paper-based mills is estimated to be around 18-20%. 5-8% and 74- 76% respectively. in all the Indian. Paper industry accounts for about 5-6 % of the world production of paper, paperboard, and newsprint. (5% largest producer in the world), with an estimated production of around 23 million tons per annum.

The overall installed capacity of 30 million tons out of which 5.50 million tons capacity lies idle for various reasons. As on date around 550 pulp and paper mills are reported to be in operation. As per an estimate, the domestic paper production in the country during 202122 was 20.977 million metric tons1. The total demand for paper, paper board, and newsprint was close to around 24 million tons in 2022-23. In India the per capita consumption of paper is estimated to be about 15-16 kg which is much lower than the world average of 57 kg. This provides significant potential for the growth of the paper sector to reach the world's average per capita consumption.

In the newsprint sector, at present, there are more than 125 newsprint mills with total installed capacity of 3.30 million tons. However, as per INMA, currently, out of 125 newsprint mills, 46 mills have stopped making newsprint due to demand-related reasons as over 70% of the newsprint demand is captured by cheap and dumped imports. Therefore, despite having surplus domestic installed capacity of newsprint is 3.3 million tons against consumption of 1.2 million tons, absence of regular orders resulting in under capacity utilization is reported by mills. The product Newsprint is having only one specific end use therefore production is strictly based on confirmed orders. Free flow of cheap Imports with concessional duty resulting in poor domestic sales of about 1.0 million tons, has impacted domestic industries since last two years. As per industry sources, there is a need for suitable policy intervention to arrest cheap imports. Import of Newsprint in 2021-22 stood at 60% of total consumption.

PAINT & ALLIED PRODUCTS INDUSTRY

The Paint & Allied Products Industry comprises paints, enamels, varnishes, pigments, synthetic resins, printing inks, etc. Approximately, 65% of the production is contributed by the Organised Sector. The per capita consumption of paint in India is around 4 kg.

The Indian Paint Industry is expected to grow at a rate of 12–13% annually. India is self-sufficient in the production of paints. Barytes, bentonite, calcite, china clay, mica powder, rutile, talc/steatite/soapstone, ochre, silica & dolomite powder are some of the important minerals consumed in the Paint Industry.

The Paints & Allied Industry which has been exempted from compulsory licensing mainly consists of paints, enamels, varnishes, pigments, printing inks, etc. These play a vital role in the economy by way of protecting national assets from corrosion. These items are manufactured both in the organized sector and small-scale sector.

PETROLEUM REFINERIES

There were 23 refineries operating in the country (20 in Public/Joint Sector and 3 in Private Sector). India is the fourth largest refiner in the world. While production is largely in the hands of publicly owned companies, India's largest refineries are privately owned, notably the world's largest refinery is Reliance-owned Jamnagar refinery located on the western coast of Gujarat.

Installed capacity and Refinery-wise Crude Oil processed are provided in Table-30.

The total refining capacity in the country as on 31.03.2022 is around 251.22 million tpy. The total crude throughput increased to 248.30 million tonnes from 241.70 million tonnes in 2022-23. Production of petroleum products from crude oil was 266.54 million tonnes 2022-23 as against 254.31 million tonnes in 2021-22. Import of petroleum crude was 232.70 million tonnes in 2022-23 as against 212.38 million tonnes in 2021-22. During 2021-22, crude oil and condensate production in the country was at 29.69 million tonnes, while the natural gas production was at 34.02 billion cubic metres (BCM).

Table- 30: Installed Capacity and Refinery-wise Crude Oil Processed

(Crude Steel Equivalent)

(In '000 tonnes)

Refinery	Annual installed capacity (as on 1.4.2022)	Refinery Crude throughput		
		2020-21	2021-22	2022-23
Total	**251220**	**221773**	**241703**	**248301**
Public/Private Sector & Subsidiaries	143920	127504	138081	154569
IOCL, Digboi, Assam	650	605	708	713
IOCL, Guwahati, Assam	1000	849	730	1080
IOCL, Barauni, Bihar	6000	5469	5620	6785
IOCL, Koyali, Gujarat	13700	11603	13474	15567
IOCL, Haldia, West Bengal	8000	6759	7305	8506
IOCL, Mathura, Uttar Pradesh	8000	8926	9123	9573
IOCL, Bongaigaon, Assam	2700	2450	2639	2775
IOCL, Panipat, Haryana	15000	13181	14849	13810
IOCL, Paradeep, Odisha	15000	12508	13217	13599
BPCL, Mumbai, Maharashtra	12000	12941	14437	15456
BPCL (formerly KRL), Kochi, Kerala	15500	13282	15402	16017
HPCL, Mumbai, Maharashtra	9500	7374	5558	9804
HPCL, Visakhapatnam, Andhra Pradesh	8300	9050	8410	9287
CPCL, Manali, Tamil Nadu	10500	8243	9040	11316
CPCL, Narimanam, Tamil Nadu	0	-		-
Numaligarh Refinery Ltd., Numaligarh, Assam	3000	2707	2624	3091
MRPL, Mangaluru, Karnataka	15000	11475	14871	17116
ONGC, Tatipaka, Andhra Pradesh	70	81	75	74
Joint Venture	19100	16262	20437	12735**
Bharat Oman Refineries Ltd., Bina@	7800	6190	7410	NA
HPCL Mittal energy Ltd. (HMEL), Bathinda#	11300	10072	13027	12735
Private Sector	88200	78008	83186	80997
RIL, Jamnagar, Gujarat	33000	34100	34757	34433
RIL, Jamnagar (SEZ), Gujarat	35200	26841	28264	27872
Nyara Energy Ltd. (NEL),Vadinar, Gujarat	20000	17067	20164	18692

Source: Indian Petroleum and Natural Gas Statistics, 2022-23, Ministry of Petroleum & Natural Gas, Government of India.
@: Bharat Oman Refineries Ltd (BORL) is a Joint Venture Company promoted by BPCL and Oman Oil Company Ltd (OOCL).
*** Production details of 2022-23 is Not available hence total of JV considers only for HMEL*
#: HPCL Mittal Energy Ltd is a Joint Venture Company promoted by HPCL and Mittal Energy Investment Pvt. Ltd.
Note:(i) CPCL and BRPL are subsidiaries of IOCL; NRL of BPCL; and MRPL of ONGC.
(ii) Crude throughput in terms of crude oil processed.
(iii) Total may not tally due to rounding off.
(iv) CPCL refinery is under shutdown due to limitation in meeting required product specification.

7. Production

MINERALS

The mineral production (excluding Atomic Minerals and Minor Minerals) in India increased by 5.8% (as per index of mineral production base year 2011-12) during 2022-23 as compared to the previous year due to increase in the production of Raw Coal and Natural gas among Fuel minerals; bauxite, gold, iron ore lead conc., zinc conc., manganese ore, tin conc. etc among Metallic minerals; and diamond graphite, limeshell, limestone, phosphorite and wollastonite among Non-metallic minerals.

Fuel Minerals

The production of coal at 893 million tonnes during 2022-23 increased by about 14.8 % as compared to 778 million tonnes in the previous year. The production of lignite at 44 million tonnes during 2022-23 decreased by about 7.3% as compared to that of the previous year. The production of petroleum (crude) at 29 million tonnes decreased by 1.7% whereas production of natural gas at 34,450m.cu.m increased by 1.3% as compared to that of the previous year.

Offshore regions remain the largest producing area and contributed 50% of total production of petroleum (crude) followed by Rajasthan (17%) and Assam (14%). The remaining 2% was contributed by a few other States. Offshore region, the largest source for natural gas in the country accounted for 68% of the total production, while Assam contributed 10 per cent and Rajasthan 7 per cent. The remaining was contributed by other States.

Metallic Minerals

The value of production of metallic minerals in 2022-23 at ₹ 107815 crore decreased by about 14.7% over that of the previous year mainly due to very less production reported in iron ore. Among the principal metallic minerals, iron ore contributed ₹ 79,928 crore or 74%, lead (concentrate) & zinc (concentrate) together 11707 crore or 11%, silver ₹ 4,381 crore or 4%, chromite ₹ 4,805 crore or about 4%, manganese ore ₹ 2,291 crore or about 2%, bauxite ₹ 2,788 crore or 3% and the remaining value was from copper (concentrates), gold, and tin concentrates in the total value of metallic minerals.

The production of iron ore at about 258 million tonnes in 2022-23 increased marginally by 1% over that of the previous year. Production of iron ore was mainly from Odisha (54.46%), Chhattisgarh (16.50%), Karnataka (15.44%), and Jharkhand (8.95%) during the year. The remaining 4.65% production was reported from Andhra Pradesh, Goa, Madhya Pradesh, Maharashtra, Telangana and Rajasthan.

The production of chromite at 3.56 million tonnes in 2022-23 decreased by 6% as compared to the previous year. Odisha reported almost entire output of chromite in the country. The production of copper ore at 3.33 million tonnes was 7% lower, while that of copper concentrate at 113 thousand tonnes in 2022-23 decreased by marginally 2% as compared to the previous year. The average metal content in copper conc. was 22.47% Cu . The production of manganese ore at 2.83 million tonnes in 2022-23 increased by 5% as compared to that in the previous year. Of the total production of manganese ore in 2022-23, Madhya Pradesh continued to be the largest producer by contributing 30%, followed by Maharashtra (27%) and Odisha (23%). The remaining production was reported by Andhra Pradesh, Karnataka Jharkhand, Rajasthan and Telangana.

The production of gold at 1,433 kg (excluding gold recovery from imported concentrates) in 2022-23 increased marginally by 2% as compared to the previous year. Karnataka was the leading producer of gold accounting for almost 98% output followed by Jharkhand (2%). The production of bauxite at 23.84 million tonnes in 2022-23 increased by 6% as compared to the previous year. During the year under review, Odisha accounted for 73% of the total output followed by Jharkhand (9%) and Gujarat (7%). The remaining production was reported from Chhattisgarh, Maharashtra and Madhya Pradesh. During 2020-21, the production of lead concentrate at 377 thousand tones increased by 2% and that of zinc concentrate at 1,670 thousand tonnes increased by 5% over the previous year. Average metal content produced in lead concentrate was 58.67% Pb and in zinc concentrate it was 51.04% Zn. Rajasthan was the only State reporting production of lead concentrate and zinc concentrate during 2022-23. (Table-1 & 2)

Non-Metallic Minerals

The value of production of non-metallic minerals at ₹ 12,293 crore during 2022-23 increased by 11.8% as compared to the previous year.

Reporting Mines

Reporting mine is defined as "A mine reporting production or reporting 'nil' production during a year but engaged in developmental work; such as, overburden removal, underground driving, winzing, sinking work, exploration by pitting, trenching or drilling as evident from the MCDR returns".

There were 1,408 reporting mines (excluding fuel minerals, atomic fuel and minor minerals) in India located in all States and UTs during 2022-23. Among them, 577 belong to metallic minerals and 831 to Non-metallic minerals. There were 161 mines in Public Sector and the rest of 1,247 mines were in Private Sector.

Employment

The average daily employment of labour engaged in Mining Sector (excluding fuel minerals, atomic and minor minerals) was 1,02,337 in 2022-23. Out of this, 35,909 or 35.1% were in Public Sector and 66,428 or 64.9% in Private Sector. Metallic minerals accounted for 75.9% and Non-metallic minerals 24.1 % of the total labour force during the year.

Role of Public Sector

The Public Sector has played significant role in the overall mineral production in 2022-23.

The entire production of copper ore & conc., among metallic minerals and diamond, Salt (rock) & selenite in respect of non-metallic minerals was reported from the Public Sector. By and large, the entire production of gold (primary) Tin Conc., Fluorite, Kyanite and Phosphorite came from Public Sector during 2022-23. More than 50% of the production of tin concentrate was in the Public Sector during this year.

Index of Mineral Production

The index of mineral production (excluding atomic and minor minerals) (with base year 2011-12=100) for 2022-23 at 119.9 displayed a increase of 5.8% as compared to the previous year (Table-3).

Table - 1 : Mineral* Production in India, 2020-21 to 2022-23

(By Mineral Groups & Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21	2021-22		2022-23 (P)	
		Value	Quantity	Value	Quantity	Value
All Minerals		**1597481344**		**2129892982**		**1965907190**
Fuel Minerals						
Coal	'000t	-	778210	-	893191	-
Lignite	'000t	-	47492	-	44029	-
Natural Gas (ut.)	m c m	-	34024	-	34450	-
Petroleum(crude)	'000t	-	29691	-	29179	-
Metallic Minerals		**721985419**		**1264284201**		**1078152727**
Bauxite	t	16793448	22494049	25284169	23843262	27884996
Chromite	t	21862796	3785625	47969167	3560267	48045941
Copper Conc.	t	8533354	115313	11024312	112746	11438445
Copper Ore	t	-	3569632	-	3326337	-
Gold	kg	5475470	1407	6761018	1433	7654670
Gold Ore	t	-	474994	-	633514	-
Iron Ore	'000t	527292469	254099	1008264608	257859	799284510
Lead & Zinc Ore	t	-	16338564	-	16744080	-
Lead Conc.	t	18810483	368040	22025747	376666	24761930
Manganese Ore	t	17415461	2692408	22067826	2826964	22909630
Silver	kg	42664424	647156	42126921	713768	43814376

Table- 1 (Concld.)

Mineral	Unit	2020-21	2021-22		2022-23 (P)	
		Value	Quantity	Value	Quantity	Value
Tin Conc.	kg	10413	26301	32619	45429	51850
Zinc Conc.	t	63127101	1594085	78727814	1670207	92306379
Non-metallic Minerals		**92361844**		**109934850**		**122927249**
Diamond	crt	147696	266	18051	388	61473
Fluorite(graded)	t	8018	1237	9430	1135	5831
Garnet (abrasive)#	t	26378	8182	24660	10324	36138
Graphite (r.o.m.)	t	87147	62888	122147	89645	162481
Iolite	kg	73	27	191	-	-
Kyanite	t	9251	9320	17267	2765	5319
Limeshell	t	-	100	231	250	658
Limestone	'000t	86484948	392034	102022622	406462	108788978
Magnesite	t	314676	113497	554772	107526	467062
Marl	t	417184	1853481	326498	1452489	307699
Moulding Sand	t	4150	17583	5256	17260	5383
Phosphorite	t	4694525	1394959	6648070	1978449	12904533
Salt (rock)	t	14156	286	712	1002	10725
Selenite	t	602	716	902	328	443
Siliceous Earth	y	14686	33898	22837	32070	17535
Sillimanite	t	13987	3432	8283	1437	4249
Sulphur**	t	-	880858	-	925663	-
Vermiculite	t	2157	3060	3765	2303	1484
Wollastonite	t	122210	108335	149156	110793	147258
Minor Minerals@		**783134081**		**755673931**		**764827214**

** Excluding the minerals declared as prescribed substances under the Atomic Energy Act,1962.*
(p): provisional : $ Excludes the value of fuel minerals.
*** Obtained as by-product from fertilizer plants and oil refineries. The coverage relates to PSUs only*
@ : Figures for earlier year(s) have been repeated as estimates, wherever necessary, because of non-receipt of data from respective state governments.
 # Other than BSM (Beach Sand Minerals)

Table - 2 : Mineral* Production (Quantity), 2021-22 and 2022-23
(By Sectors)

Mineral	Unit	All India		Public Sector		Private Sector		Share of Public Sector in Total Production		Overall increase or decrease in production in 2022-23 over 2021-22
		2021-22	2022-23 (P)	2021-22	2022-23 (P)	2021-22	2022-23 (P)	2021-22	2022-23 (P)	
Metallic Minerals										
Bauxite	t	22494049	23843262	11066108	10993539	11427941	12849723	49.20	46.11	6.00
Chromite	t	3785625	3560267	1163755	1043173	2621870	2517094	30.74	29.30	-5.95
Copper Conc.	t	115313	112746	115313	112746	-	-	100	100	-2.23
Copper Ore	t	3569632	3326337	3569632	3326337	-	-	100	100	-6.82
Gold	kg	1407	1433	1395	1411	12	22	99.15	98.46	1.85
Gold Ore	t	474994	633514	470456	593677	4538	39837	99.04	93.71	33.37
Iron Ore	'000 t	254099	257859	99809	106282	154290	151577	39.28	41.22	1.48
Lead & Zinc Ore	t	16338564	16744080	-	-	16338564	16744080	-	-	2.48
Lead Conc.	t	368040	376666	-	-	368040	376666	-	-	2.34
Manganese Ore	t	2692408	2826964	1238812	1309285	1453596	1517679	46.01	46.31	5.00
Silver	kg	647156	713768	143	148	647013	713620	0.02	0.02	10.29
Tin Conc.	kg	26301	45429	24812	44895	1489	534	94.34	98.82	72.73
Zinc Conc.	t	1594085	1670207	-	-	1594085	1670207			4.78
Non-metallic Minerals										
Diamond	Crt	266	388	266	388	-	-	100	100	45.86
Fluorite	t	1237	1135	1237	1010	-	125	100	88.99	-8.25

Table- 2 (Concld.)

Mineral	Unit	All India		Public Sector		Private Sector		Share of Public Sector in Total Production		Overall increase or decrease in production in 2022-23 over 2021-22
		2021-22	2022-23 (P)	2021-22	2022-23 (P)	2021-22	2022-23 (P)	2021-22	2022-23 (P)	
Garnet (Abrasive)#	t	8182	10324	-	-	8182	10324	-	-	26.18
Graphite	t	62888	89645	36214	54136	26674	35509	57.58	60.39	42.55
Iolite	kg	27	-	-	-	27	-	-	-	-100.00
Kyanite	t	9320	2765	4245	2405	5075	360	45.55	86.98	-70.33
Limeshell	t	100	250	-	-	100	250	-	-	150.00
Limestone	'000 t	392034	406462	11322	20147	380712	386315	2.89	4.96	3.68
Magnesite	t	113497	107526	61324	60461	52173	47065	54.03	56.23	-5.26
Marl	t	1853481	1452489	-	-	1853481	1452489	-	-	-21.63
Moulding Sand	t	17583	17260	-	-	17583	17260	-	-	-1.84
Phosphorite	t	1394959	1978449	1295429	1878579	99530	99870	92.87	94.95	41.83
Rock Salt	t	286	1002	286	1002	-	-	100	100	250.35
Selenite	t	716	328	646	328	70		90.22	100	-54.19
Siliceous Earth	t	33898	32070	-	-	33898	32070	-	-	-5.39
Sillimanite	t	3432	1437	-	-	3432	1437	-	-	-58.13
Sulphur**	t	880858	925663	880858	925663			100	100	5.09
Vermiculite	t	3060	2303	690		2370	2303	22.55	-	-24.74
Wollastonite	t	108335	110793	-	-	108335	110793	-	-	2.27

* *Exclude Atomic, Fuel and Minor minerals.*
** *Obtained as by-product from fertilizer plants and oil refineries. The coverage relates to PSUs only*
# *Other than BSM (Beach Sand Minerals)*

Table - 3 : Index of Mineral Production, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Base year 2011-12=100)

Year	Index of mineral production 1000	Coal & lignite	Crude petroleum & natural gas 444.318	Metallic minerals 230.004	Non-metallic minerals 18.824
2020-21	101.0	131.4	70.7	117.7	117.4
2021-22	113.3	143.5	74.4	146.8	130.1
2022-23(P)	119.9	163.6	74.1	148.6	137.7

Note: Figures in parentheses indicate the weights attached to respective groups

Gross Value Added from Mining & Quarrying Sector

The Ministry of Statistics &Programme Implementation has released the provisional estimates of national income, revising the base year from 2004-05 to 2011-12 in the year 2015. The industry-wise estimates are now presented as Gross Value Added (GVA) at basic prices. Certain changes have been made in this series including for Mining & Quarrying Industry. During 2022-23, Mining and Quarrying Industry accounted for about 2.4 % of the GVA at current prices. The GVA at current and constant prices for the period from 2020-21 to 2022-23 is furnished in Tables-4 & 5.

Table - 4 Gross Value Added at Basic Price, 2020-21 to 2021-22

(At Current Prices) (31.05.2023)

(Value in ₹ 'crore.)

Industry	2020-21 (2nd RE)	2021-22 (1st RE)	2022-23 (PE)	% Change in 2022-23 over the previous years
GVA (All)	**18188780**	**21438883**	**24742871**	**15.4**
Mining & Quarrying	316268	429364	583535	35.9

Source : NSO RE: Revised Estimates PE : Provisional Estimates

Table - 5 Gross Value Added at Basic Price, 2020-21 to 2021-22

(Value in ₹ 'crore.)

Industry	2020-21 (2nd RE)	2021-22 (1st RE)	2022-23 (PE)	% Change in 2022-23 over the previous years
GVA (All)	**12681482**	**13798025**	**14764840**	**7.0**
Mining & Quarrying	289905	310415	324708	4.6

Source : NSO RE: Revised Estimates PE : Provisional Estimates

METALS

Ferrous Metals

As per the provisional data received from the office of Joint Plant Committee, Kolkata, India produced 123 million tonnes of Finished Steel, 127 million tonnes of Semi-finished Steel, 6 million tonnes of Pig iron and 44 million tonnes of Sponge Iron in 2022-23.

Production of various items of Iron & Steel (Ferrous Metals) for the last three years is furnished in Table-6.

Table 6 : Production of Ferrous Metals during 2020-21 to 2022-23

(Qty. in '000' tonnes)

FERROUS METALS	2020-21	2021-22	2022-23
Finished Steel (incl. Cr. Sheet)	**95122**	**113596**	**123196**
Semi-Finished Steel	103044	120007	127197
Pig Iron	4839	5759	5861
Sponge Iron	34155	39031	43621

Source: Office of Joint Plant Committee, Kolkata.

Ferroalloys

Indian Bureau of Mines collects production figures of ferroalloys from the producing plants in the country on non-statutory basis.

The information on production of ferroalloys was received from 16 operating plants in 2022-23. The data were received from JPC for ferro-chrome; Essel and Moldex for ferro-molybdenum; Essel and MMCPL (Minex) for ferro-titanium; Essel for ferro-vanadium; MMCPL (Minex) for ferro-aluminum; SNAM (Pakala) and SNAM (Pondicherry) for magnesium ferro-silicon; Anjaney ferro alloys, Chandrapur ferro alloys, Bihar foundry, Hira ferro alloys, INDSIL, Maithan and Sarda for silico-manganese.

As such the production data presented here relates to the extent received and may not reflect the entire production of ferroalloys in the country. Production of ferroalloys for the years 2020-21 to 2022-23, to the extent received (including partly estimated due to non-receipt of data), is presented in Table - 7.

Table 7: Production of Ferroalloys during 2020-21 to 2022-23

FERROUS METALS	Unit of Qty.	2020-21	2021-22	2022-23
Ferro - Chrome	**'000 tonne**	**868**	**1113**	**1127**
Ferro - Molybdenum	kg.	428210	435860	581016
Ferro-Titanium	kg.	249162	416109	346915
Ferro-Vanadium	kg.	634160	850120	839000
Ferro-Aluminium	kg.	1119259	1138829	965812
Magnesium Ferro-Silicon	tonne	10220	15081	17147
Silico-Manganese	tonne	329295	349414	356095

Note: 1. Figures for the latest available month have been repeated as estimates, wherever necessary, due to non receipt of data.
Source: Individual plants

Non-Ferrous Metals

The production of aluminium at 4066 thousand tonnes in 2022-23 registered a increase of 1% as compared to that in previous year.

Smelting and refining of copper is carried out by Hindustan Copper Ltd in their existing plants located at Ghatshila (Jharkhand) and Raigad (Chhattisgarh). Copper metal is also produced from imported copper concentrates at the plant of Vendanta Ltd [formerly Sterlite Industries (India) Ltd] and Hindalco Industries Ltd. There was nil production of copper blister in 2022-23 as well as in the previous year. The production of copper cathodes at 554242 tonnes in 2022-23 increased by 15% as compared to that in the previous year. The production of copper continuous cast wire rods at 4,23,282 tonnes in 2022-23 increased by 20% as compared to that in the previous year.

The production of lead (primary) at 2,10,690 tonnes in 2022-23 increased by 10% as compared to that in the previous year. No production of lead (secondary) was reported since last ten years. The production of zinc ingots in 2022-23 was 8,20,899 tonnes which showed an increase of 6% from that of previous year (Table-8).

Table – 8: Production and Value of Non-Ferrous Metals, 2020-21 to 2022-23

(Quantity in tonnes : Value in ₹ '000)

Mineral	Unit	2020-21		2021-22		2022-23 (P)	
			Value	Quantity	Value	Quantity	Value
Aluminium	**tonnes**	**3619237**	**415967702**	**4016621**	**714320396**	**4066459**	**809764986**
Alumina	tonnes	4877842	99988538	5207600	130475653	4928449	151965578
Cadmium	tonnes	-	-	-	-	-	-
Copper (blister)	tonnes	-	-	-	-	-	-
Copper (cathode)	tonnes	363609	190616200	483994	363507671	554242	390034135
Copper (continuous cast wire rod)	tonnes	341563	188445400	351464	261303186	423282	304546759
Gold	kg	7387	35813770	10087	48426018	13854	73341570
Lead (primary)	tonnes	214399	34531700	191185	34944605	210690	39567243
Silver	kg	746377	45207924	713653	46424521	794431	48789075
Tin	kg	4337	5400	4868	7307	17160	35435
Zinc ingot	tonnes	715445	147976396	775808	202092090	820899	241626520

Source: Data for metals and alloys are obtained from individual producers/Units

Precious Metals

Gold primary is produced from gold ore by HGML in the State of Karnataka. Gold is also recovered as by-product from copper slime of Hindalco Industries Ltd in Gujarat. The total production of gold bullion during the year 2022-23 at 13,854 kg increased by 37% as compared to 8,364 kg in the previous year.

Production of silver in India is reported as a by-product from lead and zinc concentrates and copper slime and as a co-product of gold refining.

The production of silver at 7,94,431 kg registered an increase of 11% as compared to that in the previous year.

Other Metals

Production of cadmium is reported as by-product of zinc smelting and was nil in 2022-23.

8. Prices

MINERALS

Domestic Markets

Fuel Minerals

The pit head prices of different varieties of coking coal, semi-coking coal and the weighted average of crude oil prices are furnished in Table-1.

Table – 1: Pit Head (Run of Mine) Price (Rupees per Tonne) of Coking Coal Applicable for Consumers other than Power Utilities (including IPPs), Fertiliser and Defence [Price- ₹ /tonne] & Weighted Average Crude Oil Prices

(In ₹ per tonne)

Grade	2020-21	2021-22	2022-23
South Eastern Coalfields Ltd			
Semi-Coking grade I	2260	2260	2260
Semi-Coking grade II	1890	1890	1890
Eastern Coalfields Ltd (Ranigunj)			
Semi-Coking grade I	2800	2800	2800
Semi-Coking grade II	2330	2330	2330
Bharat Coking Coal Ltd *			
Washery grade I	5028	5028	5028
Washery grade II	3840	3840	3840
Washery grade III	3060	3060	3060
Washery grade IV	2892	2892	2892
Western Coalfields Ltd			
Washery grade II	2220	2220	2220
Washery grade III	1830	1830	1830
Washery grade IV	1680	1680	1680
Central Coalfields Ltd			
Washery grade I	3450	3450	3450
Washery grade II	3210	3210	3210

Table- 1 (Concld.)

Grade	2020-21	2021-22	2022-23
Washery grade III	2750	2750	2750
Washery grade IV	2300	2300	2300
Crude Oil (weighted average price)			
Basic Price Offshore	24187	43745	56837
Basic Price Onshore	23081	41088	52719
Basic Price Offshore & onshore	23832	42874	55436

Sources:
1. Coal directory of India 2022-23, Ministry of Coal, for prices of coal
2. Indian Petroleum & Natural Gas Statistics, 2022-23, Ministry of Petroleum & Natural Gas, for basic prices of crude oil.
**: Prices of BCCL (unspecified) has been substituted with BCCL due to non-availability of prices.*

METALS

Domestic Markets

In the Mumbai and Delhi domestic markets mostly downward trend was observed in 2022-23 in the prices of non-ferrous metals as compared to the previous year. Prices of metals (non-ferrous) in domestic markets are listed in Table-2.

Prices of most of the items of steel have registered a positive growth during 2020-21 to 2022-23. Prices of steel in domestic markets are listed in Table-3.

Foreign Markets

The prices of metals have mostly shown an upward trend during 2021 to 2023. Prices of metals in foreign market are listed in Table-4.

Table-2: Prices of Metals (Non-Ferrous), March 2022 & March 2023 (Domestic market)

(In ₹ per quintal)

Grade	Market	Mar-22	Mar-23
Aluminum			
Utensil Scrap	Mumbai	20376	16485
Ingot	Mumbai	29362	21905
Wire Scrap	Mumbai	23490	20419
Sheets (Scrap)	Delhi	27776	21972
Utensil Scrap	Delhi	20319	16653
Wire Scrap	Delhi	23152	20576
Brass			
Honey	Mumbai	51476	47819
Utensil Scrap	Mumbai	54167	48490
Sheet Cutting	Mumbai	54910	49180
Gun Metal Scrap	Delhi	57086	53695
Copper			
Wire Scrap	Mumbai	79424	71000
Utensil Scrap	Mumbai	71110	67561
Wire Rod	Mumbai	80567	75147
Wire Bar	Mumbai	79014	73933
Cathode	Mumbai	82095	76133
Wire Scrap	Delhi	81481	71133
Wire	Delhi	79338	74709
Mixed Scrap	Delhi	77290	71809
Lead			
Ingot	Mumbai	18967	19414
Soft	Delhi	18610	19576
Hard (4%)	Delhi	18286	19680
Nickel			
Ingot	Mumbai	259100	205538
Ingot(4x4)	Delhi	257148	205714

Table- 2 (Concld.)

Grade	Market	Mar-22	Mar-23
Tin			
Ingot	Mumbai	389248	215057
Ingot	Delhi	389010	215247
Zinc			
Ingot	Mumbai	33633	26257
Ingot	Delhi	33243	26395
Dross	Delhi	33071	26552

Source: Minerals and Metals Review

Table – 3 : Prices of Steel, 2020-21 to 2022-23 (Domestic market)

(In ₹ per tonne)

Grade	Market	2020-21	2021-22	2022-23
TMT Bars (ISI, 8mm)	**Delhi**	-	-	-
MS Squares (8mm)	Delhi	43998	49383	63694
MS Angles (25 x 3mm)	Delhi	45550	51011	63289
Channels (75 x 40 mm)	Delhi	45979	51335	64184
Joists (150 x 75 mm)	Delhi	46451	52416	64492
Melting Scrap	Delhi	29857	40515	42856
Induction Ingots	Delhi	36334	47258	50911
TMT Bars (local 8 mm)	Mumbai	44879	50682	63725
MS Rounds (8 mm)	Mumbai	43052	48358	61391
MS Angles(40 x 6 mm)	Mumbai	45197	50893	63665
Joists (150 x 75 mm)	Mumbai	43251	49986	61070
Melting Scrap (Foundry Grade)	Mumbai	34052	45980	52645
Melting Scrap (Steel Grade)	Mumbai	28864	43625	51779
Melting Scrap (CRCA)	Mumbai	35403	46201	50103
Induction ingots	Mumbai	36819	47950	51953
Arc Ingots	Mumbai	36481	47827	51700
Concast Billet ingots	Mumbai	36899	46627	51906
TMT Bars (ISI, 8 mm)	Kolkata	46683	51752	59127
MS Squares (8 mm)	Kolkata	45955	51161	58572
MS Angles (25 x 3 mm)	Kolkata	45785	51530	63410
Channels (75 x 40 mm)	Kolkata	45931	51318	63313
Joists (150 x 75 mm)	Kolkata	44554	50396	61082
Induction Ingots	Kolkata	37004	47740	51462
Arc Ingots	Kolkata	37094	48231	52311
Concast Billet Ingots	Kolkata	37311	47525	51730
Induction ingots (round)	Gobind (Punjab)	35462	46456	50325
Blooms (SAIL, 150 mm)	Gobind (Punjab)	35674	47052	51192
Old Ship Breaking Scrap	Gobind (Punjab)	31721	39898	49351
Melting Scrap (rolling)	Gobind (Punjab)	30410	41169	45768
MS Rounds (10 mm)	Gobind (Punjab)	44841	58165	57108
MS Squares (8 mm)	Gobind (Punjab)	46805	59723	59819
MS Angles (25 x 3 mm)	Gobind (Punjab)	43963	56954	58903
MS Sponge Iron	Gobind (Punjab)	26693	37985	40042

Table- 3 (Concld.)

Grade	Market	2020-21	2021-22	2022-23
MS Flat (3 x 20 mm)	Gobind (Punjab)	50050	60044	59549
Pig Iron Foundry Grade – A*	Mumbai	38527	49710	57416
Pig Iron Foundry Grade – B**	Punjab	37359	48285	54195
Pig Iron Steel Grade	Punjab	32346	46050	50813

Source: Minerals & Metals Review.
A: Low Sulphur/Phosphorus i.e. 0.09% Max which is used in Critical automotive engine components and specialize casting.*
*B**: High Sulphur / Phosphorus i.e. above 0.09% which is used in Non-Critical castings*

Table – 4 : Prices of Metals, 2021 to 2023 (Foreign Markets)

Metal/Grade	Unit	Currency	2021	2022	2023
Aluminum HG	Tonne	$	1944.56*	1958.29*	2249.48*
Antimony (min. 99.65 %)	Tonne	$	NA	NA	NA
Bismuth	Pound	$	NA	NA	NA
Cadmium (min. 99.95%)	Pound	Cents	NA	NA	NA
Cadmium (min. 99.99%)	Pound	Cents	NA	NA	NA
Chromium (min. 99%)	Tonne	$	NA	NA	NA
Cobalt (99.80%)	Pound	$	NA	NA	NA
Copper Grade A	Tonne	$	6513.25*	6555.57*	8477.77*
Germanium Dioxide	kg	$	NA	NA	NA
Gold (London)	tr OZ	$	NA	NA	NA
Indium	kg	$	NA	NA	NA
Iridium (min. 99.9 %)	kg	yuan	NA	NA	NA
Lead	Tonne	$	2077.72*	2081.16*	2138.18*
Magnesium (min. 99.9 %)	Tonne	yuan	NA	NA	NA
Manganese (min. 99.7%)	Tonne	$	NA	NA	NA
Mercury	Flask	$	NA	NA	NA
Molybdenum Molybdic Oxide	Pound	$	NA	NA	NA
Nickel	Tonne	$	13242.07*	13359.89*	21474.38*
Palladium (min. 99.9%)	tr OZ	$	NA	NA	NA
Platinum (min. 99.9%)	tr OZ	$	NA	NA	NA
Rhodium (min. 99.9%)	tr OZ	$	NA	NA	NA
Ruthenium (min. 99.9%)	tr OZ	$	NA	NA	NA
Selenium	mt	$	NA	NA	NA
Silver (London)	tr OZ	$	NA	NA	NA
Silicon 99.9%	Tonne	$	NA	NA	NA
Tungsten	mtu	$	NA	NA	NA
Tin HG	Tonne	$	21140.99*	21409.03*	25959.00*
Vanadium Pentoxide, min. 98%V	mtu	$	NA	NA	NA
Zinc SHG	Tonne	$	2623.85*	2636.64*	2646.57*

Source: Minerals and Metals Review.
**: Annual average based on calendar year*
NA: Not Available; Tr OZ: Troy Ounce

9. Foreign Trade

Export Import Review 2022-23
EXPORTS

Ores & Minerals

During the year 2022-23 the value of exports (including re-exports) of ores and minerals is ₹ 2,42,326 crore. The export value which had increased from ₹ 1,96,654 crore in 2020-21 to ₹ 2,57,863 crore in 2021-22, decreased to ₹ 2,42,326 crore in 2022-23. The value of mineral exports showed a decrease of 6.03% in 2022-23 as compared to that in the previous year.

Diamond continued to be the largest constituent item with a share of 75.82 % in the total value of mineral exports in 2022-23. Next in order of share was Iron ore with contribution of 5.95 % followed by Granite 5.18 %, Alumina 2.65% and Sulphur (exc. Sublimed Precipited and Colloidal) 1.37%. The individual share of remaining minerals in the total value of exports of ores and minerals from India during the year under review was less than one per cent.

The value of exports of ores & Minerals (including re-exports) showed a mixed trend for most of the minerals in 2022-23 as compared to that of the previous year. A significant increase was also noticed in some cases. The exports value of minerals which have shown significant growth are Chromite (908%), Sulphur excluding sublimed (Precipited & colloidal) (58%) and Alumina (36%). On the other hand, the exports value recorded significant decline in the cases of Coke (62%) Limestonnee (89.40%), Iron ore (40%) and copper ores & conc. (39%) as compared to that in the previous year. (Table–2)

Ores and minerals were exported to various countries in 2022-23. About 85.49% of the total value of exports of ores and minerals was confined to only ten countries. During 2022-23, USA occupied the top position in terms of value accounting for 28.45% of the total value of mineral exports, Hong Kong was in the second place and contributed 18.33% followed by UAE (8.85%), Belgium (8.61%), China (8.32%), Israel (4.09%), Thailand (3.45%), Singapore (2.14), UK (1.40%) and Japan (1.35%). The individual share of remaining countries was less than one per cent.

Countrywise analysis of value of mineral exports revealed that exports of minerals witnessed significant positive growth as compared to the previous year for Philippines (1126.04%), Croatia (591.57%), Romania (331.90%), South Africa (316.89%), Italy (263.31%), France (143.40%), Netherlands (121.77%) and Belgium (107.02%).

However, value of export of ores & minerals declined significantly in respect of Bangladesh (59.78%), China (29.11%), Algeria (17.63%), Baharain (17.16%), Japan (10.43%) and Kuwait (9.72%) (Tables -1 to 3).

Table 1: Exports of Ores & Minerals for the period 2020-21 to 2022-23

(Value in ₹ '000)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
All Minerals		**	**1966539540**	**	**2578629646**	**	**2423263731**
Abrasive (natural)	tonne	23411	376713	14106	236450	4689	42219
Alabaster	tonne	4	184	++	11	52	1732
Alumina	tonne	1265941	28280781	1487035	47334417	2014428	64237704
Andalusite	tonne	9	476	18	1233	19	1515
Arsenic Sulphide (natural)	tonne	277	1697	51	505	++	++
Asbestos	tonne	299	11991	1906	68026	3286	217449
Asbestos (chrysotile)	tonne	275	11895	1905	67961	3220	217275
Asbestos (others)	tonne	24	96	1	65	66	174
Ball Clay	tonne	170915	410109	266680	664037	993811	3779211
Barytes	tonne	1010894	6261470	1874837	11075666	2445691	16613885
Bauxite	tonne	240841	951442	378081	1005256	177535	479019
Bentonneite	tonne	1557484	5215656	1585962	5850483	1375350	6607488
Borax	tonne	2996	414601	4725	656472	4151	818305
Natural Borate	tonne	55	5633	44	3489	94	6417
Sodium Borate	tonne	741	56265	1534	104106	894	87107
Borax:other Borates	tonne	2200	352703	3147	548877	3163	724781
Building and Monumental Stones Nes	tonne	13134116	24200968	13295779	24912268	12276938	20638218
Calcite	tonne	23867	155049	24789	163372	27892	208639
Chalk	tonne	1104	6155	1129	7557	1057	7330
Chromite	tonne	2872	71979	2625	89710	33881	904154
Chrome Conc.	tonne	204	3104	--	--	29578	780686
Chrome Lump	tonne	--	--	11	12851	--	--
Chrome Others	tonne	2668	68875	2614	76859	4303	123468
Clay (others)	tonne	45346	402787	49635	361745	34138	314150
Coal (ex Lignite)	000' tonnes	2943	5736794	1314	11233701	1165	15001652
Coal,gas Water Etc.(except Gaseous Hydrocarbons)	tonne	--	--	++	2	++	1
Coal:lignite	000' tonnes	2	234709	1	203336	1	90369
Coke	tonne	207412	4771075	1299461	41017403	365897	15566657
Copper Ores and Conc.	tonne	82463	7689376	34827	3964549	26336	2435371
Corundum (natural)	tonne	62	137	89	241	59	144
Diamond		**	1258209200	**	1893641728	**	1837280521
Diamond (mostly Cut)		**	1257345848	**	1892188684	**	1836070859
Diamond (industrial)	ct	7015880	688082	12125962	1162179	12527927	901704
Diamond Powder	000' ct	10628	175270	13991	290865	16747	307958
Diatomite	tonne	3240	69439	1964	58544	1901	62622
Dolomite	tonne	95892	349090	113380	391843	77124	307324
Earth Clay	tonne	3881	22220	3775	53782	9432	96235
Emerald (cut and uncut)		**	5316603	**	10808861	**	17096852
Emerald (cut)	000' ct	4076	5270862	5945	10596194	7402	17002198
Emerald (uncut)	tonne	++	45741	++	212667	2	94654

Table- 1 (Cont.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Felspar (cut and uncut)		**	198059	**	254062	**	275473
Felspar (cut)	000' ct	10839	167136	16944	231801	24139	246802
Felspar (uncut)	tonne	24	30923	33	22261	66	28671
Felspar (natural)	tonne	705280	3931135	763219	4194510	716776	4292153
Fire Clay	tonne	5324	43606	4473	45578	8654	48207
Flint	tonne	406	2953	570	5837	976	8675
Fluorspar	tonne	474	22436	844	43463	1024	65899
Garnet (cut and uncut)		**	280824	**	378455	**	484011
Garnet (cut)	000' ct	76049	260630	12258	359152	60232	452710
Garnet (uncut)	tonne	111	20194	29	19303	3	31301
Garnet (abrasive)	tonne	76799	1265586	81270	1433741	103398	1903765
Granite	tonne	7522159	113279766	7572368	126460352	6632215	125512876
Granite (cut Blocks/slabes)	tonne	674353	8810152	895870	11084741	699533	9359466
Granite (polished Blocks/tiles)	tonne	240445	5969769	241062	5419911	363358	7482645
Granite (crude or roughly trimmed)	tonne	4705266	32700873	4290170	35806960	3405304	30180986
Granite (others)	tonne	1902095	65798972	2145266	74148740	2164020	78489779
Graphite (natural)	tonne	716	42994	764	46963	2239	120029
Gypsum	tonne	213061	723888	220634	765738	191717	574560
Iron Ore	000' tonnes	57723	362556021	26494	241480427	21168	144299670
Iron Ore Conc: Non-agglomated	000' tonnes	363	1781069	100	669724	102	913160
Iron Ore Fines	000' tonnes	40661	215190641	14570	83677314	14457	71125032
Iron Ore Lumps	000' tonnes	2239	13118637	433	1876849	183	696000
Iron Ore Pellates	000' tonnes	14460	132419634	11391	155225838	6426	71532986
Iron Ore Pyrites	000' tonnes	++	46040	++	30702	++	32492
Kaolin	tonne	287260	1610489	339591	2398327	490071	3440275
Kieselguhr	tonne	27	917	28	516	41	3329
Kyanite	tonne	252	9033	1655	15376	297	8631
Lead Ores and conc.	tonne	9	1076	12	1595	137	7521
Limestonnee	tonne	3528973	42939083	12160342	4551537	2515714	3124865
Magnesite	tonne	5477	171020	5384	173809	5263	239139
Magnesia (fused)	tonne	41	863	2	585	1	781
Magnesite (calcined)	tonne	100	2102	117	5014	401	14462
Magnesite (not calcined)	tonne	220	5202	436	11483	460	10164
Magnesite:dead-burnt Magnesia	tonne	2	93	208	6829	862	37034
Magnesium Oxide	tonne	1646	119899	1886	110791	1260	139762
Magnesite (other)	tonne	3468	42861	2735	39107	2279	36936
Manganese Ore	tonne	82363	974940	113606	588189	1557	21566
Manganese Ore (30% or more but below 35% mn)	tonne	20200	214707	--	--	--	--
Manganese Ore (35% or more but below 46% mn)	tonne	40108	698245	18379	321424	1367	20378
Manganese Ore (46% or more mn)	tonne	10	330	21	1059	++	24

Table- 1 (Cont.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Manganese Ore (ferruginous,10% Or More But Below 30%)	tonne	--	--	24570	59450	--	--
Manganese Ore (others)	tonne	22045	61658	70636	206256	190	1164
Marble	tonne	295085	10082272	324267	11352007	265229	11941092
Marble (dressed)	tonne	148619	2115113	158060	2361734	111125	2170658
Marble (others)	tonne	146466	7967159	166207	8990273	154104	9770434
Mica	tonne	144121	5733785	151706	6594832	115898	5557843
Mica (unmanufactured)	tonne	143291	4724093	150805	5113041	114945	4333392
Mica (blocks)	tonne	1870	354192	1469	390254	1433	428594
Mica (condenser films)	tonne	13	239	--	--	1	486
Mica (powder)	tonne	84031	2811539	110005	3535632	80825	2844915
Mica (splittings)	tonne	28810	753109	23581	672270	19931	597198
Mica (waste and scrap)	tonne	28567	805014	15750	514885	12755	462199
Mica (worked)	tonne	830	1009692	901	1481791	953	1224451
Mica (bricks)	tonne	1	115	++	512	1	436
Mica (cond. Films, Plates, Cuts Nes)	tonne	32	18288	44	14811	39	15279
Mica (sheets and strips)	tonne	19	115884	11	94814	13	78794
Mica (washers and discs)	tonne	7	14057	4	23513	9	40987
Micanite and other Built-up Mica	tonne	13	3452	19	9924	14	5498
Mica Worked (others)	tonne	758	857896	823	1338217	877	1083457
Molybdenum Ores and conc.	tonne	45	43181	++	120	60	223955
Natural Gas	tonne	17992	658242	3	883	23	93848
Nickel Ores and Conc.	tonne	--	--	20	5183	--	--
Niobium or Tantalum Ores and Conc.	tonne	++	217	++	18	105	1007
Ochre	tonne	4126	71626	6085	103351	4580	105155
Ochre: Earth Colours	tonne	3276	44387	5159	63310	3719	53015
Ochre:yellow Ochre	tonne	212	9000	153	7416	119	4459
Persian Red	tonne	13	1666	--	--	--	--
Red Oxide	tonne	625	16573	773	32625	742	47681
Precious and Semi-precious Stones (cut and uncut):total		**	23463605	**	50616826	**	20516238
Precious and Semi -precious Stones (uncut)	tonne	2250	1300940	7420	31012547	7233	1690206
Precious and Semi-precious Stones Cut	000' ct	1300016	22162665	1291573	19604279	1184771	18826032
Preciuos Metal Ores and Concentrates	kg	260175	5435	26253	1265	26070	318
Quartz and Quartzite	tonne	772127	6213690	965159	7559270	1069301	9221459
Quartz (natural)	tonne	692520	5289217	863212	6770721	938962	8321576
Quartzite (natural)	tonne	79607	924473	101947	788549	130339	899883
Rock Phosphate	tonne	825	5602	540	11316	532	19359
Salt (other ihan Common Salt)	tonne	8260913	10571743	8863780	13393717	13631830	24294751

Table- 1 (Concld.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Sand (excl. metal-bearing)	tonne	1178	13630	619	17107	2761	4882
Sandstonnee	tonne	794445	11220825	691771	11282294	406815	5822370
Silica Sand	tonne	43061	63008	825	4928	767	5944
Sillimanite	tonne	4998	94359	3120	64355	2161	73954
Slate	tonne	66335	2453970	68569	2733090	50909	2505184
Slate (worked)	tonne	13975	1250220	18913	1526699	17592	1616143
Slate (others)	tonne	52360	1203750	49656	1206391	33317	889041
Steatite	tonne	283303	4364076	324593	5201974	338297	5626721
Steatite Blocks	tonne	468	8525	292	5970	136	2927
Steatite Lumps	tonne	107566	1744449	136104	2316878	136957	2246370
Steatite Powder and Others	tonne	175269	2611102	188197	2879126	201204	3377424
Sulphur (exc. sublimed precipited and colloidal)	tonne	802713	4328627	1290620	21010532	1554999	33267617
Tin Ores and Conc.	tonne	--	--	--	--	++	17
Titanium Ores and Conc.	tonne	246534	5348323	215910	6155343	143607	7288953
Titanium Ores and Conc. (ileminite)	tonne	246534	5348321	215857	6148952	143607	7288953
Titanium Ores and Conc.(rutile)	tonne	++	2	52	6239	--	--
Titanium Ores and Conc.(others)	tonne	--	--	1	152	--	--
Tripoli Earth	tonne	--	--	--	--	10	556
Tungsten Ores and Conc.	tonne	--	--	13	7139	--	--
Vermiculite	tonne	853	11573	1263	21780	989	12888
Witherite	tonne	++	104	++	128	11	762
Wollastonneite	tonne	13716	311809	11705	282266	12847	365656
Zinc Ores and Conc.	tonne	399	20716	1762	46757	43877	182437
Zirconium Ores and Conc.	tonne	++	21	++	180	43	15779
Other Minerals Nes	tonne	3842874	4244574	3419980	5523312	4610149	8875576

Source: DGCIS, Kolkata
P: Provisional
++: Negligible; --: Nil
***: Quantity not additive*

Table 2: Value of Exports of Ores & Minerals (including Re-export) for the period 2020-21 to 2022-23

(By Principal Minerals)

(Value in ₹ '000)

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value in 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
All Minerals	**1966539540**	**100.00**	**2578629646**	**100.00**	**2423263731**	**100.00**	**-6.03**
Diamond	1258209200	63.98	1893641728	73.44	1837280521	75.82	-2.98
Iron Ore	362556021	18.44	241480427	9.36	144299670	5.95	-40.24
Granite	113279766	5.76	126460352	4.90	125512876	5.18	-0.75
Alumina	28280781	1.44	47334417	1.84	64237704	2.65	35.71
Sulphur (exc. sublimed precipited and colloidal)	4328627	0.22	21010532	0.81	33267617	1.37	58.34
Salt (other than common salt)	10571743	0.54	13393717	0.52	24294751	1.00	81.39

Table- 2 (Concld.)

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value in 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
Building and Monumental Stones Nes	24200968	1.23	24912268	0.97	20638218	0.85	-17.16
Precious and Semi-precious Stones (cut and uncut):total	23463605	1.19	50616826	1.96	20516238	0.85	-59.47
Emerald (cut and uncut)	5316603	0.27	10808861	0.42	17096852	0.71	58.17
Barytes	6261470	0.32	11075666	0.43	16613885	0.69	50.00
Coke	4771075	0.24	41017403	1.59	15566657	0.64	-62.05
Coa (ex Lignite)	5736794	0.29	11233701	0.44	15001652	0.62	33.54
Marble	10082272	0.51	11352007	0.44	11941092	0.49	5.19
Quartz and Quartzite	6213690	0.32	7559270	0.29	9221459	0.38	21.99
Titanium Ores and Conc.	5348323	0.27	6155343	0.24	7288953	0.30	18.42
Bentonneite	5215656	0.27	5850483	0.23	6607488	0.27	12.94
Sandstonnee	11220825	0.57	11282294	0.44	5822370	0.24	-48.39
Steatite	4364076	0.22	5201974	0.20	5626721	0.23	8.17
Mica	5733785	0.29	6594832	0.26	5557843	0.23	-15.72
Felspar (natural)	3931135	0.20	4194510	0.16	4292153	0.18	2.33
Ball Clay	410109	0.02	664037	0.03	3779211	0.16	469.13
Kaolin	1610489	0.08	2398327	0.09	3440275	0.14	43.44
Limestonnee	42939083	2.18	4551537	0.18	3124865	0.13	-31.34
Slate	2453970	0.12	2733090	0.11	2505184	0.10	-8.34
Copper Ores and Conc.	7689376	0.39	3964549	0.15	2435371	0.10	-38.57
Garne t(abrasive)	1265586	0.06	1433741	0.06	1903765	0.08	32.78
Chromite	71979	0.00	89710	0.00	904154	0.04	907.86
Borax	414601	0.02	656472	0.03	818305	0.03	24.65
Gypsum	723888	0.04	765738	0.03	574560	0.02	-24.97
Garnet (cut and uncut)	280824	0.01	378455	0.01	484011	0.02	27.89
Bauxite	951442	0.05	1005256	0.04	479019	0.02	-52.35
Wollastonneite	311809	0.02	282266	0.01	365656	0.02	29.54
Other Minerals	8329969	0.42	8529857	0.33	11764635	0.49	37.92

P: Provisional
Source: DGCIS, Kolkata

Table 3: Value of Exports of Ores & Minerals (including Re-export) for the period 2020-21 to 2022-23

(By Principal Countries)

(Value in ₹ '000)

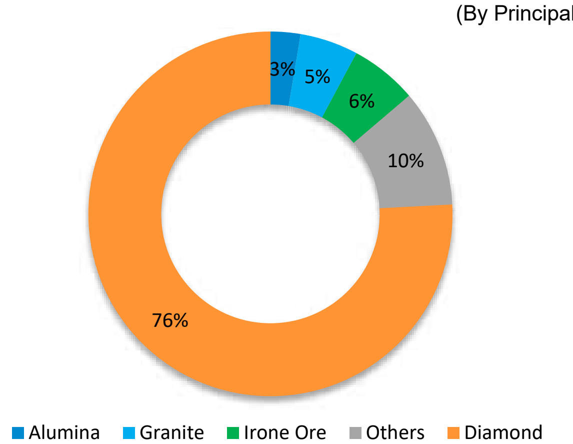
Country	2020-21		2021-22		2022-23 (P)		% change in total value in 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
All Countries	**1966539540**	**100.00**	**2578629646**	**100.00**	**2423263731**	**100.00**	**-6.03**
USA	493499087	25.09	775283196	30.07	689487092	28.45	-11.07
Hong Kong	447951892	22.78	522968433	20.28	456438219	18.84	-12.72
UAE	104335194	5.31	179559328	6.96	213795762	8.82	19.07
Belgium	96560613	4.91	199900233	7.75	208829925	8.62	4.47
China	380077162	19.33	269437808	10.45	201683332	8.32	-25.15
Israel	61431650	3.12	107492020	4.17	99132873	4.09	-7.78
Thailand	47659389	2.42	85463819	3.31	83733176	3.46	-2.03
Singapore	6303074	0.32	8125303	0.32	51874352	2.14	538.43

Table- 3 (Concld.)

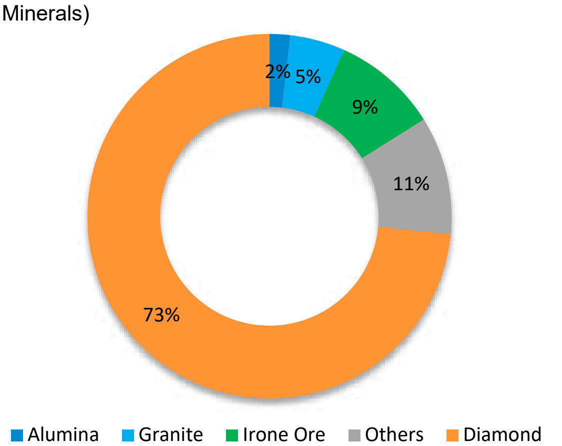
Country	2020-21		2021-22		2022-23 (P)		% change in total value in 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
UK	26731073	1.36	36373510	1.41	34075353	1.41	-6.32
Japan	42054415	2.14	37666712	1.46	32816521	1.35	-12.88
Vietnam	16797196	0.85	25418876	0.99	23744137	0.98	-6.59
Switzerland	4955789	0.25	9863912	0.38	22830038	0.94	131.45
Oman	12308820	0.63	17560103	0.68	22598295	0.93	28.69
Bangladesh	55737626	2.83	22420438	0.87	22542134	0.93	0.54
Italy	6717453	0.34	24405274	0.95	19885570	0.82	-18.52
Nepal	10092486	0.51	13236890	0.51	16652939	0.69	25.81
Australia	10907001	0.55	16985203	0.66	15285324	0.63	-10.01
France	6279841	0.32	15284936	0.59	14707433	0.61	-3.78
Turkey	4371213	0.22	6605758	0.26	14639291	0.60	121.61
Germany	8452053	0.43	13757661	0.53	13514209	0.56	-1.77
Indonesia	9845335	0.50	19256998	0.75	13342395	0.55	-30.71
Korea, Rep. of	14650431	0.74	18673345	0.72	12338369	0.51	-33.93
Saudi Arabia	8618105	0.44	8119577	0.31	11046187	0.46	36.04
Russia	1470036	0.07	2468849	0.10	10167382	0.42	311.83
Botswana	9889759	0.50	17209700	0.67	9253885	0.38	-46.23
South Africa	3680561	0.19	15344009	0.60	8543685	0.35	-44.32
Malaysia	11498522	0.58	13864237	0.54	8377126	0.35	-39.58
Canada	6324114	0.32	9828951	0.38	8306528	0.34	-15.49
Brazil	5207377	0.26	6227607	0.24	6426209	0.27	3.19
Taiwan	3637479	0.18	5123655	0.20	6159467	0.25	20.22
Netherlands	3266707	0.17	7244455	0.28	5744958	0.24	-20.70
Poland	4179084	0.21	7895620	0.31	4922955	0.20	-37.65
Bhutan	2389754	0.12	4082048	0.16	4786101	0.20	17.25
Qatar	4047316	0.21	5467328	0.21	4589087	0.19	-16.06
Sri Lanka	1269968	0.06	2087422	0.08	4537495	0.19	117.37
Spain	1780286	0.09	2531040	0.10	3183201	0.13	25.77
Morocco	1011060	0.05	1342192	0.05	3051149	0.13	127.33
Egypt	4161003	0.21	5870241	0.23	2836973	0.12	-51.67
Croatia	424795	0.02	2937756	0.11	2732834	0.11	-6.98
Romania	536699	0.03	2317998	0.09	2020348	0.08	-12.84
Other countries	25428122	1.29	32927205	1.28	32631422	1.35	-0.90

P: Provisional
Source: DGCIS, Kolkata

Fig 1: Value of export ores & Minerals, 2021-22 and 2022-23
(By Principal Ores & Minerals)



Total Export of Ores & Minerals ₹ 2,57,863 crore in 2021-22



Total Export of Ores & Minerals ₹ 2,42,326 crore in 2022-23

Metals & Alloys:

The value of exports (including re-exports) of metals & alloys stands at ₹ 2,85,908 crore in the year 2022-23. The export value which had increased from ₹ 2,07,222 crore in 2020-21 to ₹ 3,47,457 crore in 2021-22, decreased to ₹ 2,85,908 crore in 2022-23. The value of metal exports showed a decrease of 17.71% in 2022-23 as compared to the previous year. The contribution of metals & alloys in the total value of India's exports was 11.04% during the year under review.

In terms of value of exports, Iron & Steel has the largest share of 53.60%, followed by Aluminum and Alloys Incl. Scrap 24.81%, Ferroalloys 9.43% and Copper & Alloys (Incl. Brass & Bronze) 3.80%. Ferroalloys and copper & alloys (including brass & bronze) occupied the third & fourth place with a contribution of 7.81% and 4.93%, respectively. The contributions of zinc & alloys including scrap and silver were 2.15% and 1.04% respectively while pig & cast iron (incl. speigeliesen) and lead & alloy including scrap were 1.42% & 1.16% respectively. The individual share of other remaining metals and alloys was less than one per cent.

As compared to previous year, the value of exports for different important metals had shown a mixed trend in 2022-23. The export value Chromite registered a huge spike of 907.86 %, Ball Clay (469.13%), Sulphur (exc. Sublimed Precipited and Colloidal) (58.34%), Emerald (cut and uncut) (58.17%) and Barytes (50%). However, the export values showed significant negative growth during 2022-23 as compared to that of the previous year in the cases of Coke (62.05%), Precious And Semi-precious Stones (cut and uncut): total (59.47%) and Bauxite (52.35%).

India exported metals & alloys to various countries in 2022-23. Bulk of the metals and alloys having share of more than 1% to the total value were exported to 10 countries. These countries together accounted for 85.49% of the total value of exports during 2022-23. USA led the group with a share of 28.45% followed by Hong Kong (18.84), UAE (8.82%), Belgium (8.62%), China (8.32%), Israel (4.09), Thailand (3.46) and Singapore (2.14). The individual share is less than two per cent in respect of the remaining countries.

The countries that have recorded significant increase in value of exports of metals & alloys during the year 2022-23 are Malaysia (88.54%), Saudi Arabia (70.81%) and Netherlands (50.57%) (Tables - 4 to 6).

Table 4: Exports of Metals and Alloys for the period 2020-21 to 2022-23

(Value in ₹ '000)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Aluminium and Alloys Incl. Scrap	tonne	2735588	427759670	3454121	791688112	2870455	709309716
Antimony Alloys and Scrap	tonne	2134	932922	1918	1507988	1590	1554406
Bismuth and Scrap	tonne	++	2528	11	45115	NA	NA
Boron	tonne	5	525	++	6093	++	6402
Cadmium (incl. Waste and Scrap)	tonne	208	24971	169	23278	++	152
Chromium and Alloys	tonne	168	119489	284	229068	158	164829
Cobalt and Alloys (incl Waste and Scrap)	tonne	340	364327	1340	895452	2705	2216211
Cobalt and Alloys	tonne	340	364006	1309	812402	2219	1821280
Cobalt and Scrap	tonne	++	321	31	83050	486	394931
Copper (cement Copper Precipitated)	tonne	4	1066	501	25047	293	19034
Copper and Alloys (incl. Brass and Bronze)	tonne	209332	102064524	246963	171342596	160431	108765921
Brass and Bronze	tonne	61018	30956169	56963	41245793	39223	23986694
Copper and Alloys	tonne	139540	67619065	169736	120781592	105952	75679770
Brass and Bronze (scrap)	tonne	1484	511456	2020	1002659	2261	1134445
Copper (scrap)	tonne	7290	2977834	18244	8312552	12995	7965012
Ferroalloys	tonne	1843322	127735114	2537463	271246477	2564465	269482234
Ferroboron	tonne	39	9728	33	11024	15	6010
Ferrochrome	tonne	720539	49939983	753389	76899138	745829	83050361
Ferrocobalt	tonne	++	29	++	250	++	36
Ferrocolumbium	tonne	++	1522	1	1787	--	--

Table- 4 (Cont.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Ferromanganese	tonne	335229	23997006	638850	74044066	532543	56487483
Ferromolybdenum	tonne	279	324540	324	529440	974	2588532
Ferronickel	tonne	77	65052	1	2822	1	1976
Ferroniobium	tonne	14	25114	25	69528	11	32186
Ferrophosphorous	tonne	77	11038	156	16804	108	14912
Ferroselenium	tonne	++	979	5	3653	++	720
Ferrosilicon	tonne	11236	1194260	19567	3246485	36069	6084574
Ferrotitanium	tonne	2553	567131	1860	689076	1765	909712
Ferrotungsten	tonne	++	1150	1	4368	2	10724
Ferrovanadium	tonne	240	346840	168	353217	85	233314
Ferrozirconium	tonne	3	1644	16	7127	32	10215
Ferro Silicochrome	tonne	32	12095	20	8932	1059	194107
Ferro Silicomanganese	tonne	764747	50326047	1112950	113600728	1232727	117179220
Ferro Silicomagnesium	tonne	4192	483234	6407	1098652	11422	2278094
Ferroalloys (others)	tonne	4065	427722	3690	659380	1823	400058
Gold (Non-monetory and Monetory):Total	kg	4191	18895717	126	463986	2623	11920184
Gold, Monetory	kg	++	25	--	--	--	--
Gold non-monetory	kg	4191	18895692	126	463986	2623	11920184
Gold, non-monetory, Powder	kg	++	16	++	565	--	--
Gold,non-monetory:other Semi manufactured forms	kg	++	1218	12	40141	++	2608
Gold,non-monetory, Other Unwrought Forms	kg	4191	18894458	114	423280	2623	11917576
Gold-clad Metals/base Metales Nes	tonne	++	306	++	770	30	1925
Iron and Steel		**	1225105321	**	2034353812	**	1532329704
Iron and Steel (finished Steel Inc. Cr Sheet)	tonne	6108963	358432755	6798430	607736761	5226893	524940706
Iron and Steel (semi-finished Steel Incl. Stl Ingo)	tonne	12577510	480956813	13492292	874972590	4545495	383068371
Iron and Steel (sponge Iron)	tonne	524566	11248671	789189	25256226	1096806	38009852
Iron and Steel (steel Wire)	tonne	169631	25750975	250944	48353501	182786	43621658
Iron and Steel Material	tonne	70062	4250996	92907	7905836	103820	9191213
Iron and Steel(stainless Steel)	tonne	12889	3197360	16901	4444268	13348	6052557
Iron and Steel: (Alloy Steel (Granules)	tonne	422	29056	678	45269	487	39652
Iron and Steel: Alloy Steel (Powder)	tonne	4	1760	129	66798	78	29057
Iron and Steel (scrap)	tonne	25613	649151	11492	941199	14610	1547783
Iron and Steel (other Finished Steel, Nes)	tonne	528920440	119084454	4505929	2195779	3085262	2024879
Iron and Steel (other Finished Steel, Nes)	tonne	989002	221503330	2788205	462435585	2306806	523803976
Lead and Alloys Incl. Scrap	tonne	176601	25845466	229864	40542449	202248	38752553
Lead and Alloys	tonne	176569	25841849	229727	40523557	202238	38750995
Lead and Waste and Scrap	tonne	32	3617	137	18892	10	1558

Table- 4 (Concld.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Magnesium and Scrap	tonne	1266	143710	7269	1314210	5069	1400550
Manganese and Alloys (incl Waste and Scrap)	tonne	469	375616	616	631089	432	539489
Manganese and Alloys: (wrought and unwrought)	tonne	188	106409	288	307908	380	514599
Manganese and Alloys Nes	tonne	249	260113	280	298469	12	3841
Manganese Waste and Scrap	tonne	32	9094	48	24712	40	21049
Mercury	tonne	42	184648	18	99467	17	63865
Molybdenum and Scrap	tonne	119	182537	365	342257	305	521412
Nickel and Alloys Incl. Scrap	tonne	2937	4147078	5893	9407073	6885	16097003
Nickel and Alloys	tonne	2269	3763280	4199	8103812	4996	13841599
Nickel Waste and Scrap	tonne	668	383798	1694	1303261	1889	2255404
Other Rare Metals Nes	tonne	++	366	3	16304	43	8798
Pig and Cost Iron (Incl. Speigeliesen)	tonne	1123792	30155194	1250907	49495194	672227	36969622
Platinium Alloys and Related Metals	kg	616	3535012	1194	4795081	1328	769761
Platinum (powder, Unwrought and Others)	kg	507	552422	869	917208	1191	457116
Other Metals Of Platinum Group	kg	109	2982590	325	3877873	137	312645
Platinium - Clad Base /precious Metal	kg	700	50	70	6	3	9
Preciuos Metals / Metals Clad With Preciuos Metals	tonne	3827	13371985	3045	12713613	3187	11668802
Selenium	tonne	40	43423	39	81781	184	295421
Silicon	tonne	159	23239	365	119140	322	92247
Silver	tonne	615	33934966	89	3633631	130	5737293
Silver Clad Base Metals	kg	6026	23892	2979	14664	2861	13326
Tantalum and Scrap	tonne	5	55163	6	80552	++	577
Tantalum Alloys Unwrought	tonne	5	54121	3	40332	++	460
Tantalum & Scrap	tonne	++	1042	3	40220	++	117
Tellurium	tonne	++	37	++	17	2	197
Tin and Alloys Incl. Scrap	tonne	750	784385	1191	1494894	797	975946
Tin and Alloys	tonne	570	731861	721	1432470	361	914572
Tin and Alloys : Worked	tonne	178	51368	469	62201	436	61221
Tin (scrap)	tonne	2	1156	1	223	++	153
Titanium and Alloys (incl. Waste and Scrap)	tonne	253	443579	131	386027	252	576880
Tungsten and Alloys Incl. Scrap	kg	292331	835275	1209171	2600160	1117211	2746384
Zinc and Alloys Incl. Scrap	tonne	300018	55103971	283204	74950497	354217	106078261
Zinc and Alloys	tonne	299936	55094321	283200	74949996	354216	106078016
Zinc (scrap)	tonne	82	9650	4	501	1	245
Zirconium and Scrap	tonne	++	24791	3	25189	--	--

Source: DGCIS, Kolkata
P: Provisional
++: Negligible; --: Nil
***: Quantity not additive*
NA: Data not available

Table 5: Exports of Metals and Alloys for the period 2020-21 to 2022-23 (By Principal Metals and Alloys)

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value in 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
All Metals & Alloys	**2072220863**	**100.00**	**3474571089**	**100.00**	**2859079114**	**100.00**	**-17.71**
Iron and Steel	1225105321	59.12	2034353812	58.55	1532329704	53.60	-24.68
Aluminium and Alloys Incl. Scrap	427759670	20.64	791688112	22.79	709309716	24.81	-10.41
Ferroalloys	127735114	6.16	271246477	7.81	269482234	9.43	-0.65
Copper and Alloys (incl. Brass and Bronze)	102064524	4.93	171342596	4.93	108765921	3.80	-36.52
Zinc and Alloys Incl. Scrap	55103971	2.66	74950497	2.16	106078261	3.71	41.53
Lead and Alloys Incl. Scrap	25845466	1.25	40542449	1.17	38752553	1.36	-4.41
Pig and Cost Iron (incl. Speigeliesen)	30155194	1.46	49495194	1.42	36969622	1.29	-25.31
Nickel and Alloys Incl. Scrap	4147078	0.20	9407073	0.27	16097003	0.56	71.12
Gold (non-monetory and Monetory):total	18895717	0.91	463986	0.01	11920184	0.42	2469.08
Preciuos Metals / Metals Clad With Preciuos Metals	13371985	0.65	12713613	0.37	11668802	0.41	-8.22
Silver	33934966	1.64	3633631	0.10	5737293	0.20	57.89
Tungsten and Alloys Incl. Scrap	835275	0.04	2600160	0.07	2746384	0.10	5.62
Cobalt and Alloys (incl Waste and Scrap)	364327	0.02	895452	0.03	2216211	0.08	147.50
Antimony Alloys and Scrap	932922	0.05	1507988	0.04	1554406	0.05	3.08
Magnesium and Scrap	143710	0.01	1314210	0.04	1400550	0.05	6.57
Tin and Alloys Incl. Scrap	784385	0.04	1494894	0.04	975946	0.03	-34.71
Platinium Alloys and Related Metals	3535012	0.17	4795081	0.14	769761	0.03	-83.95
Titanium and Alloys (incl. Waste and Scrap)	443579	0.02	386027	0.01	576880	0.02	49.44
Manganese and Alloys (incl Waste and Scrap)	375616	0.02	631089	0.02	539489	0.02	-14.51
Molybdenum and Scrap	182537	0.01	342257	0.01	521412	0.02	52.35
Other metals and alloys	504494	0.02	766491	0.02	666782	0.02	-13.01

Source: DGCIS ,Kolkata
P: Provisional

Table 6: Exports of Metals and Alloys for the period 2020-21 to 2022-23 (By Principal Countries)

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
All Countries	**2072220863**	**100.00**	**3474571089**	**100.00**	**2859079114**	**100.00**	**-17.71**
USA	181147665	8.74	374045858	10.77	422469111	14.78	12.95
Italy	88655244	4.28	217854671	6.27	205619781	7.19	-5.62
UAE	94721649	4.57	185822430	5.35	155279468	5.43	-16.44
Korea, Rep. of	117726820	5.68	199604000	5.74	133320009	4.66	-33.21
Netherlands	29377804	1.42	83882891	2.41	126300771	4.42	50.57
China	282137796	13.62	299643455	8.62	97443184	3.41	-67.48

Table- 6 (Concld.)

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
Malaysia	125849163	6.07	50737053	1.46	95658276	3.35	88.54
Nepal	86311070	4.17	123997053	3.57	94734349	3.31	-23.60
Belgium	50892573	2.46	131252203	3.78	92825630	3.25	-29.28
Turkey	27009450	1.30	160402261	4.62	91448993	3.20	-42.99
Saudi Arabia	34252627	1.65	49642855	1.43	84794739	2.97	70.81
Mexico	22986274	1.11	57676583	1.66	84567356	2.96	46.62
Vietnam	89994420	4.34	141424098	4.07	78962395	2.76	-44.17
Germany	42938548	2.07	72966621	2.10	72544356	2.54	-0.58
Bangladesh	41676869	2.01	67615713	1.95	62808696	2.20	-7.11
UK	67194772	3.24	77293537	2.22	62688080	2.19	-18.90
Indonesia	34626189	1.67	63237913	1.82	57153149	2.00	-9.62
Japan	29959601	1.45	61037039	1.76	56302498	1.97	-7.76
Spain	32978681	1.59	72721171	2.09	55417572	1.94	-23.79
Thailand	42712830	2.06	65156296	1.88	49130953	1.72	-24.60
Canada	31322349	1.51	38532307	1.11	42402179	1.48	10.04
Taiwan	46133098	2.23	74803461	2.15	41975466	1.47	-43.89
Singapore	37943474	1.83	51480652	1.48	41477188	1.45	-19.43
Oman	25806700	1.25	28359778	0.82	30691421	1.07	8.22
Australia	21192418	1.02	30801483	0.89	28968492	1.01	-5.95
Brazil	24931404	1.20	38966104	1.12	26669666	0.93	-31.56
Poland	15982508	0.77	42308074	1.22	23036638	0.81	-45.55
Egypt	12579893	0.61	43658472	1.26	22992741	0.80	-47.33
France	14999110	0.72	19783705	0.57	20962979	0.73	5.96
Kenya	15616109	0.75	26360428	0.76	19919385	0.70	-24.43
Qatar	15262845	0.74	26722441	0.77	18125709	0.63	-32.17
Greece	13470442	0.65	43757201	1.26	18066850	0.63	-58.71
Russia	13891831	0.67	22118352	0.64	17212513	0.60	-22.18
South Africa	11756736	0.57	31172657	0.90	13926528	0.49	-55.32
Croatia	460888	0.02	22237881	0.64	12512694	0.44	-43.73
Other countries	247721013	11.95	377494392	10.86	300669299	10.52	-20.35

P: Provisional
Source: DGCIS, Kolkata

Value of exports of selected mineral-based products at 4,68,492 crore in the year 2022-23 registered an increase of 37.93% as compared to that of 3,39,645 crore in the previous year. Exports of selected mineral-based products during 2020-21 to 2022-23 are furnished in Table-7.

Table 7: Exports of Selected Mineral based Products for the period 2020-21 to 2022-23

(Value in ₹ '000)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
All Item		**	**1630698738**	**	**3396458165**	**	**4684929273**
Aluminium Fluoride	tonne	2045	187158	984	24720	391	50222
Asbestos Cement Products	tonne	89833	1444464	116492	1876220	134657	2460411
Asbestos Fibre Products	tonne	41739	5548536	49044	6902347	42269	6866139
Bleaching Powder	tonne	21509	734237	30919	931596	28840	1014781
Boric Acid	tonne	1952	160749	1384	176162	3456	414727
Briquets of Coke , Semi-coke ff Coal	tonne	51	728	272	2410	398	1202

Table- 7 (Concld.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Calcium Carbide	tonne	129	11213	787	97371	735	84151
Caustic Soda	tonne	275516	6028001	343042	13196705	458237	24294052
Cement	**tonne**	**2806874**	**8761533**	**1901076**	**6187851**	**670528**	**3281107**
Cement (portl and Grey)	tonne	1528080	4528743	995557	3314929	455037	2038722
Cement (portland White)	tonne	18384	179863	18285	177863	14590	160360
Cement Clinker	tonne	1094051	3410629	734859	1972316	4019	24046
Cement (others)	tonne	166359	642298	152375	722743	196882	1057979
Cryolite and Chiolite	tonne	149	8467	126	12127	29	4274
Graphite (artificial)	tonne	21744	2820004	28218	4090984	29522	4136910
Graphite Bricks and Shapes	tonne	515	8408	59	4099	231	7097
Graphite Crucibles	tonne	416	28081	397	49894	--	--
Hydroflouric Acid	tonne	1931	164258	1325	132129	824	113899
Manganese Oxide	**tonne**	**29116**	**1357914**	**21148**	**986863**	**20784**	**1270422**
Manganese Dioxide	tonne	4476	227849	5297	258822	3395	250032
Manganese Oxides(other than Mn Dioxide)	tonne	24640	1130065	15851	728041	17389	1020390
Petroleum Products: Total*	000' tonne	56769	1571680000	62755	3318010000	61015	4587290000
Non-ferrous Ash and Residues	**tonne**	**319494**	**514364**	**278914**	**2224341**	**333837**	**3841934**
Non-ferrous Ash and Residues	tonne	317963	491875	276905	2172866	332980	3813521
Non-ferrous Base Metals Scrap	tonne	1531	22489	2009	51475	857	28413
Other Refractory Manufactures	tonne	64780	6895845	551138	8958764	289712	8549440
Phosphatic Fertilisers	tonne	385	15631	428	16776	1815	52272
Phosphoric Acid	tonne	460	50475	9187	1228169	3762	672208
Phosphorus (emememtal)	tonne	583	246040	627	362922	671	552440
Potash Fertilisers	tonne	26583	673799	5877	209314	5347	237161
Potasium Nitrate	tonne	827	165914	917	187910	936	251715
Refractory Bricks	tonne	291949	13735641	830258	13283270	844982	17751765
Silicon Carbide Crucibles	tonne	3728	624851	30137	888930	4926	861075
Slag (Dross Etc. From Iron and Steel Exc. Granulated)	tonne	152818	951045	289895	2753273	457908	3998236
Soda Ash	tonne	149930	2376038	250630	5373921	204198	6945863
Sodium Nitrate	tonne	272	10289	427	25774	343	36512
Sodium Nitrite	tonne	15629	727353	17044	1001187	18964	1868789
Sulphur Sublimed Precipitated and Colladial	**tonne**	**15756**	**1777105**	**17607**	**1941916**	**14515**	**2059103**
Sulphur (colloidal)	tonne	++	9	++	9	++	312
Sulphur Precipitated	tonne	2	543	++	16	++	5961
Sulphur Sublimed	tonne	15754	1776553	17607	1941891	14515	2052830
Titanium Oxide and **Dioxide Total**	**tonne**	**28419**	**2990597**	**48003**	**5320220**	**35393**	**5961366**
Titanium Dioxide	tonne	6481	1152120	6049	1538174	4930	1276988
Titanium Oxides (other Than Titanium Dioxides	tonne	21938	1838477	41954	3782046	30463	4684378

Source: DGCIS, Kolkata
P: Provisional
**Source: Ministry of Petroleum & Natural Gas Basic Statistics*
++: Negligible; --: Nil
***: Quantity not additive*

IMPORTS

Ores & Minerals:

During the year 2022-23 the value of imports (including re-imports) of ores and minerals is ₹ 21,63,599 crore. The import value which had increased from ₹ 7,91,320 crore in 2020-21 to ₹ 15,51,380 crore in 2021-22, increased to ₹ 21,63,599 crore in 2022-23. The value of mineral imports showed an increase of 39.46% in 2022-23 as compared to that in the previous year.

Petroleum (crude) continued to be the largest constituent item with a share of 60.21% in the total value of mineral imports in 2022-23. Next in order of share was Coal (Except Lignite) with the contribution of 17.73% followed by Diamond 9.60% and Natural Gas 6.34%. The combined share of these four minerals was 93.40% in 2021-22 as against 93.82% in the previous year.

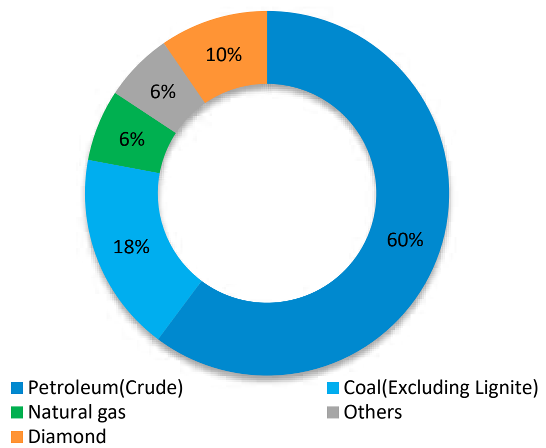
The value of imports of some ores & minerals in 2022-23 has increased as in the cases of Precious metal ores & concentrates (209.11%), Emerald (cut and uncut) (95.24%), Precious And Semi-precious Stones (cut and uncut): Total (77.93%), coke (68.29%), Coal (ex Lignite) (67.65%), as compared to that in the previous year. However imports of all the ores & minerals registered positive growth over previous year.

During 2022-23, ores and minerals were imported from various countries. Bulk of ores & minerals having share more than 1% to total value were imported from 17 countries. These 17 countries, accounted for about 88.06% of the total value of ores & minerals imported in 2022-23. Russia occupied the top position in 2022-23 in terms of imports value and accounted for 13.90% of the total mineral imports. Next in the order was Iraq with 12.43% share followed by UAE (11.64%), Saudi Arabia (10.80%), USA (7.86%), Australia (5.97%), Indonesia (5.92%), Qatar (3.83%), Kuwait (2.99%), and Nigeria (2.36%), the individual share of remaining countries was less than Two percent.

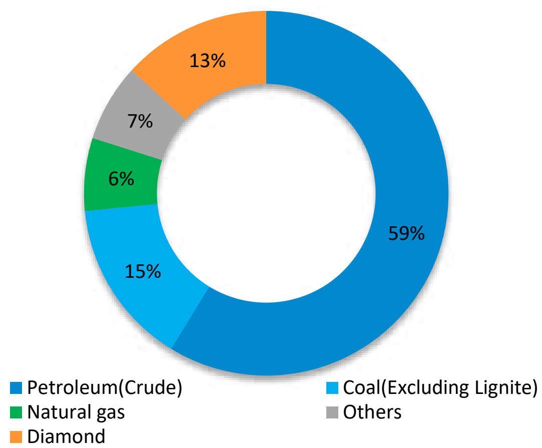
Countrywise analysis of value of imports of ores and minerals in 2022-23 revealed that imports value from Recpublic of Korea reported increase of about 31 times (2975%), Spain by over 9 times (804.49%), Russia by over 8 times (699.35%).

The other countries which recorded significant increase in the value of imports of ores and minerals during the year were Turkey (246.44%), Libya (203.59%), Indonesia (123%), and Singapore (103.27%). However, imports value showed an increment in respect of Other Countries (3.09%). (Tables - 8 to 10)

Value of Imports of Ores & Minerals 2021-22 and 2022-23 (By Principal Ores & Minerals)



Total Import of Ores & Minerals ₹ 21,63,599 crore in 2022-23



Total Import of Ores & Minerals ₹ 15,51,380 crore in 2021-22

Table 8: Imports of Ores & Minerals for the period 2020-21 to 2022-23

(Value in ₹ '000)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
All Minerals		**	**7913202918**	**	**15513800326**	**	**21635991450**
Abrasive (natural)	tonne	3221	55212	3718	78311	1994	65016
Alabaster	tonne	826	27872	1572	59681	2388	113198
Alumina	tonne	2334786	57491719	2549567	82447635	2407867	89152924
and alusite	tonne	15217	428831	10419	344730	14168	599795
Antimony Ores and Conc.	tonne	5977	1072406	4555	1499919	6460	2708869
Arsenic Sulphide (natural)	tonne	4	570	18	2119	12	448
Asbestos	**tonne**	**308506**	**11851124**	**437511**	**16631390**	**404154**	**22940349**
Asbestos (chrysotile)	tonne	308100	11840174	436977	16613219	403772	22920593

Table- 8 (Cont.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Asbestos (others)	tonne	406	10950	534	18171	382	19756
Ball Clay	tonne	65828	765439	93855	1134427	34761	715449
Barytes	tonne	11691	313860	16577	523859	14241	476940
Bauxite	tonne	3034041	13709540	3009079	18963241	3596098	23423723
Bentonneite	tonne	90933	1019395	142010	2131123	119280	1861091
Borax	**tonne**	**194448**	**6337254**	**223368**	**7973967**	**198719**	**10161598**
Natural Borate	tonne	83207	2113660	101337	2910832	70532	2894632
Sodium Borate	tonne	101477	3557620	111210	4188993	116698	6018930
Borax:other Borates	tonne	9764	665974	10821	874142	11489	1248036
Building and Monumental Stones NES	tonne	16327	360034	44482	422105	545687	926601
Calcite	tonne	67643	374975	41688	290721	55362	381332
Chalk	tonne	66	2661	64	2197	41	2191
Chromite	**tonne**	**156211**	**2257733**	**245710**	**4232459**	**111291**	**2969916**
Chrome Ore Conc.	tonne	4013	93937	4987	126819	7911	215038
Chrome Ore Lumps	tonne	78845	1148209	110544	1809263	19019	575665
Chrome Ore Others	tonne	73353	1015587	130179	2296377	84361	2179213
Clay (Others)	tonne	12562	241521	14245	279441	7152	355004
Coal(Ex Lignite)	000' tonnes	215260	1160506410	208636	2288189160	237678	3836139804
Coal:Lignite	000' tonnes	1	5746	1	9495	2	19282
Cobalt Ores and Conc.	tonne	++	325	1	6917	++	1766
Coke	tonne	2463036	44821773	2501153	81047701	3639296	136398611
Copper Ores and Conc.	tonne	415136	59071579	1018934	223814328	1178921	273744293
Corundum (Natural)	tonne	1	79	++	10	++	9
Diamond		**	**1283511854**	**	**2056382187**	**	**2077695939**
Diamond (Industrial)	ct	8725537	4362112	16457278	10785779	20011091	16783936
Diamond (mostly Cut)		**	1277251339	**	2042729864	**	2057858821
Diamond Powder	000' ct	839962	1898403	1238216	2866544	1166631	3053182
Diatomite	tonne	7099	212766	1787	94373	3722	243082
Dolomite	tonne	3505151	5075300	5510404	9682992	5672340	9944292
Earth Clay	tonne	3	450	2	247	--	--
Emerald (cut and **Uncut)**		**	**7997796**	**	**16560915**	**	**32333990**
Emerald (cut)	000' ct	9842	1357766	3174	2553209	2654	9054590
Emerald (uncut)	tonne	49	6640030	58	14007706	64	23279400
Felspar (cut and **uncut)**		**	**8094**	**	**22005**	**	**43069**
Felspar (cut)	000' ct	883	4353	774	8386	1104	31621
Felspar (uncut)	tonne	1	3741	37	13619	64	11448
Felspar (natural)	tonne	13187	78978	2795	54485	2107	52870
Fire Clay	tonne	2326	100595	898	58418	1137	61115
Flint	tonne	9209	85170	8611	83205	7874	82200
Fluorspar	tonne	220573	6090596	286224	7792038	310173	11509548
Garnet (Cut and **Uncut)**		**	**97335**	**	**183591**	**	**303072**
Garnet (cut)	000' ct	1437	32565	1299	42311	1102	90487
Garnet (uncut)	tonne	11	64770	23	141280	52	212585
Garnet(abrasive)	tonne	345	14712	140	1789	30	929
Granite	**tonne**	**37304**	**1320021**	**35032**	**1279464**	**38427**	**1660364**
Granite (cut Blocks/slabes)	tonne	7071	175377	5980	176076	7939	259235
Granite (polished Blocks/tiles)	tonne	1501	51776	733	22736	1238	42361

Table- 8 (Cont.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Granite(crude Or Roughly Trimmed)	tonne	25874	829212	26944	891720	26722	991401
Granite (others)	tonne	2858	263656	1375	188932	2528	367367
Graphite(natural)	tonne	40153	1808218	54047	2651642	45994	2939533
Gypsum	tonne	4762012	7372934	5632758	11823817	6128694	13798597
Iron Ore	**000' tonnes**	**766**	**8445221**	**6683**	**35389345**	**1790**	**15947473**
Iron Ore Conc: Non Agglomated	000' tonnes	154	1484523	1446	9469224	1316	13603285
Iron Ore Fines	000' tonnes	++	852	4075	15630812	337	943068
Iron Ore Lumps	000' tonnes	166	1800782	927	8903226	131	1262348
Iron Ore Pellates	000' tonnes	379	4612581	170	874034	--	--
Iron Ore Pyrites	000' tonnes	67	546483	65	512049	6	138772
Kaolin	tonne	237144	4431804	223127	5048415	220124	7423589
Kieselguhr	tonne	10	1543	++	64	6	520
Kyanite	tonne	1238	42080	1668	53418	1354	63110
Lead Ores and Conc.	tonne	5473	325104	5325	255224	5558	294381
Limestone	tonne	22797801	32911759	27582767	49014650	29736036	62593636
Magnesite	**tonne**	**364577**	**7657838**	**510898**	**13106490**	**502837**	**15431256**
Magnesia (fused)	tonne	25215	1135547	42306	2614441	47972	3095460
Magnesite (calcined)	tonne	59514	919930	44231	940743	48967	1109909
Magnesite (not Calcined)	tonne	57993	159537	136894	317688	27279	140613
Magnesite:dead-burnt Magnesia	tonne	133034	3360002	170744	5340576	179510	6135407
Magnesium Oxide	tonne	63442	1402374	67331	2067467	63286	2443589
Magnesite (other)	tonne	25379	680448	49392	1825575	135823	2506278
Manganese Ore	**tonne**	**4058590**	**55242138**	**6500149**	**96424799**	**4641809**	**82621009**
Manganese Ore (30% Or More But Below 35% Mn)	tonne	449497	3789163	929453	9970098	189188	2136109
Manganese Ore (35% Or More But Below 46% Mn)	tonne	2942210	39070738	4464163	69812534	3784313	69173601
Manganese Ore (46% Or More Mn)	tonne	182048	3156903	185816	3797474	47028	1042963
Manganese Ore (ferruginous,10 % Or More But Below 30%)	tonne	168371	1218726	307008	2929378	180387	1667126
Manganese Ore (others)	tonne	316464	8006608	613709	9915315	440893	8601210
Marble	**tonne**	**645253**	**12032307**	**1073654**	**21110673**	**1453668**	**29835923**
Marble (dresssed)	tonne	623229	10660272	1038849	18724997	1410696	26642956
Marble (others)	tonne	22024	1372035	34805	2385676	42972	3192967
Mica	**tonne**	**2987**	**1252020**	**3338**	**1319896**	**4068**	**1594113**
Mica (unmanufactured)	**tonne**	**1273**	**140981**	**1569**	**157461**	**2030**	**184553**
Mica (blocks)	tonne	56	15557	79	12727	301	16600
Mica (powder)	tonne	542	75765	508	61955	607	70281
Mica (splittings)	tonne	515	43414	981	82548	1122	97608
Mica (waste and Scrap)	tonne	160	6245	1	231	++	64
Mica (worked)	**tonne**	**1714**	**1111039**	**1769**	**1162435**	**2038**	**1409560**
Mica (bricks)	tonne	++	406	++	43	--	--

Table- 8 (Cont.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Mica (cond. Films, Plates, Cuts Nes)	tonne	53	55589	4	6768	++	1439
Mica (sheets and Strips)	tonne	101	20939	238	49539	306	71974
Mica (washers and Discs)	tonne	++	55	++	542	++	949
Mica Worked (others)	tonne	1560	1034050	1527	1105543	1732	1335198
Molybdenum Ores and Conc.	tonne	9177	8848441	9114	15470962	10436	23316669
Natural Gas	tonne	25054872	583289424	23417029	1005206968	19852386	1372095889
Nickel Ores and Conc.	tonne	37	6404	106	16165	20	369
Niobium Or Tantalum Ores and Conc.	tonne	2	489	2	488	1	242
Ochre	**tonne**	**391**	**82224**	**648**	**149495**	**438**	**153565**
Ochre: Earth Colours	tonne	228	18018	309	45117	73	7637
Ochre:yellow Ochre	tonne	7	6308	9	6219	6	4221
Persian Red	tonne	--	--	3	473	++	75
Red Oxide	tonne	156	57898	327	97686	359	141632
Petroleum (crude)	000' tonnes	188182	4396561618	220034	9139168005	236665	13027071596
Precious and Semi-precious Stones (cut and Uncut):total		**	47935435	**	128825205	**	229220056
Precious and Semi Precious Stones (uncut)	tonne	2024	6847282	4323	10225806	5791	10919741
Precious and **Semi Precious Stones Cut**	**000' ct**	**432603**	**41088153**	**383623**	**118599399**	**736129**	**218300315**
Preciuos Metal Ores and Concentrates	kg	10743	48509	799178	2376644	2541828	7346355
Quartz and **Quartzite**	**tonne**	**1098**	**50333**	**7792**	**211384**	**5854**	**306024**
Quartz (natural)	tonne	206	6940	1049	28661	1515	39142
Quartzite (natural)	tonne	892	43393	6743	182723	4339	266882
Rock Phosphate	tonne	7781423	53709109	9659818	104667349	9091591	151370002
Salt (Other Than Common Salt)	tonne	98042	645494	69549	512396	98986	908453
Sand (excl. Metal Bearing)	tonne	57812	400291	5121	348319	5717	319717
Sandstonnee	tonne	16	480	130	2691	28	1709
Silica Sand	tonne	21356	238740	57095	527973	162087	747250
Sillimanite	tonne	606	11571	801	13972	58	3424
Slate	tonne	49	3784	109	5741	83	6744
Steatite	**tonne**	**5332**	**344649**	**9978**	**407255**	**10395**	**545770**
Steatite Blocks	tonne	--	--	2	246	++	5
Steatite Lumps	tonne	156	501	641	2117	489	1961
Steatite Powder and Others	tonne	5176	344148	9335	404892	9906	543804
Sulphur (exc. Sublimed Precipited and Colloidal)	tonne	1463291	10948268	1895211	35362092	1337789	26766634
Tin Ores and Conc.	tonne	2	899	++	299	++	366
Titanium Ores and **Conc.**	**tonne**	**78747**	**3440562**	**111653**	**5292058**	**68000**	**4969119**
Titanium Ores and Conc. (ileminite)	tonne	43894	907344	77003	2326341	32126	1398364
Titanium Ores and Conc.(rutile)	tonne	29562	2224774	22960	2479934	19468	2774144
Titanium Ores and Conc.(others)	tonne	5291	308444	11690	485783	16406	796611
Tripoli Earth	tonne	--	--	19	1174	++	2
Tungsten Ores and Conc.	tonne	121	9104	151	14800	423	142414
Vanadium Ores and Conc.	tonne	999	77967	5869	436744	3661	209238

Table- 8 (Cont.)

Ores & Minerals	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Vermiculite	tonne	696	17234	1096	25520	2292	73873
Witherite	tonne	++	10	--	--	--	--
Wollastonneite	tonne	24049	370375	30625	675667	41436	877192
Zinc Ores and Conc.	tonne	804	9530	720	24772	1041	39415
Zirconium Ores and Conc.	tonne	68675	6993378	94839	11260337	82831	15163201
Other Minerals Nes	tonne	544580	2325905	678649	4316773	1154993	4704343

Source: DGCIS, Kolkata
P: Provisional
++: Negligible; --: Nil
***: Quantity not additive*

Table 9: Value of Imports of Ores & Minerals for the period 2020-21 to 2022-23 (By Principal Minerals)

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
All Minerals	**7913202918**	**100.00**	**15513800326**	**100.00**	**21635991450**	**100.00**	**39.46**
Petroleum (crude)	4396561618	55.56	9139168005	58.91	13027071596	60.21	42.54
Coal(ex Lignite)	1160506410	14.67	2288189160	14.75	3836139804	17.73	67.65
Diamond	1283511854	16.22	2056382187	13.26	2077695939	9.60	1.04
Natural Gas	583289424	7.37	1005206968	6.48	1372095889	6.34	36.50
Copper Ores And Conc.	59071579	0.75	223814328	1.44	273744293	1.27	22.31
Precious And Semiprecious Stones (cut And Uncut):total	47935435	0.61	128825205	0.83	229220056	1.06	77.93
Rock Phosphate	53709109	0.68	104667349	0.67	151370002	0.70	44.62
Coke	44821773	0.57	81047701	0.52	136398611	0.63	68.29
Alumina	57491719	0.73	82447635	0.53	89152924	0.41	8.13
Manganese Ore	55242138	0.70	96424799	0.62	82621009	0.38	-14.32
Limestonnee	32911759	0.42	49014650	0.32	62593636	0.29	27.70
Emerald (cut And Uncut)	7997796	0.10	16560915	0.11	32333990	0.15	95.24
Marble	12032307	0.15	21110673	0.14	29835923	0.14	41.33
Sulphur (exc. Sublimed Precipited And Colloidal)	10948268	0.14	35362092	0.23	26766634	0.12	-24.31
Bauxite	13709540	0.17	18963241	0.12	23423723	0.11	23.52
Molybdenum Ores And Conc.	8848441	0.11	15470962	0.10	23316669	0.11	50.71
Asbestos	11851124	0.15	16631390	0.11	22940349	0.11	37.93
Iron Ore	8445221	0.11	35389345	0.23	15947473	0.07	-54.94
Magnesite	7657838	0.10	13106490	0.08	15431256	0.07	17.74
Zirconium Ores And Conc.	6993378	0.09	11260337	0.07	15163201	0.07	34.66
Gypsum	7372934	0.09	11823817	0.08	13798597	0.06	16.70
Fluorspar	6090596	0.08	7792038	0.05	11509548	0.05	47.71
Borax	6337254	0.08	7973967	0.05	10161598	0.05	27.43
Dolomite	5075300	0.06	9682992	0.06	9944292	0.05	2.70
Kaolin	4431804	0.06	5048415	0.03	7423589	0.03	47.05
Preciuos Metal Ores And Concentrates	48509	0.00	2376644	0.02	7346355	0.03	209.11
Titanium Ores And Conc.	3440562	0.04	5292058	0.03	4969119	0.02	-6.10
Chromite	2257733	0.03	4232459	0.03	2969916	0.01	-29.83
Graphite(natural)	1808218	0.02	2651642	0.02	2939533	0.01	10.86

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
Antimony Ores And Conc.	1072406	0.01	1499919	0.01	2708869	0.01	80.60
Bentonneite	1019395	0.01	2131123	0.01	1861091	0.01	-12.67
Granite	1320021	0.02	1279464	0.01	1660364	0.01	29.77
Mica	1252020	0.02	1319896	0.01	1594113	0.01	20.78
Other Minerals	8139435	0.10	11652460	0.08	13841489	0.06	18.79

P: Provisional
Source: DGCIS, Kolkata

Table 10: Value of Imports of Ores & Minerals for the period 2020-21 to 2022-23 (By Principal Countries)

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
All Countries	**7913202918**	**100.00**	**15513800326**	**100.00**	**21635991450**	**100.00**	**39.46**
Russia	176807689	2.23	376212689	2.43	3007260310	13.90	699.35
Iraq	951898110	12.03	2266196177	14.61	2688547525	12.43	18.64
UAE	1017894598	12.86	1843987354	11.89	2517375323	11.64	36.52
Saudi Arabia	798697210	10.09	1721278315	11.10	2337429207	10.80	35.80
USA	836948848	10.58	1586164944	10.22	1701028287	7.86	7.24
Australia	491512945	6.21	1076064677	6.94	1290848582	5.97	19.96
Indonesia	395918292	5.00	574654486	3.70	1281466158	5.92	123.00
Qatar	309014143	3.91	527094184	3.40	828373534	3.83	57.16
Kuwait	231464773	2.93	596318462	3.84	646652875	2.99	8.44
Nigeria	409344897	5.17	747501535	4.82	510151563	2.36	-31.75
South Africa	241002978	3.05	405469645	2.61	390549161	1.81	-3.68
Belgium	264518200	3.34	438749857	2.83	382648203	1.77	-12.79
Hong Kong	217688153	2.75	250330723	1.61	368641126	1.70	47.26
Oman	128077798	1.62	335925209	2.17	311181460	1.44	-7.37
Angola	137782628	1.74	203521139	1.31	289007940	1.34	42.00
Singapore	39441256	0.50	134462362	0.87	273326497	1.26	103.27
Mexico	146551950	1.85	255035385	1.64	228561889	1.06	-10.38
Turkey	38261935	0.48	52303565	0.34	181198262	0.84	246.44
Brazil	74961113	0.95	198682221	1.28	176038572	0.81	-11.40
Congo P Rep	16347508	0.21	96191250	0.62	160451789	0.74	66.80
Colombia	69861350	0.88	175537868	1.13	150465046	0.70	-14.28
Mozambique	25000891	0.32	77575867	0.50	147779460	0.68	90.50
Malaysia	74447498	0.94	92681696	0.60	118938570	0.55	28.33
Canada	55949686	0.71	75916712	0.49	99409305	0.46	30.95
Algeria	25776167	0.33	54931611	0.35	98898468	0.46	80.04
Egypt	78132837	0.99	164988147	1.06	93102654	0.43	-43.57
Chile	32458431	0.41	74894353	0.48	82674865	0.38	10.39
China	19704470	0.25	68099047	0.44	74238385	0.34	9.02
Israel	50015508	0.63	110568654	0.71	67546512	0.31	-38.91
Spain	2974588	0.04	7371814	0.05	66677514	0.31	804.49
Ecuador	17501977	0.22	64408792	0.42	62215821	0.29	-3.40
Thailand	24462173	0.31	52204049	0.34	60153244	0.28	15.23
Jordan	21341424	0.27	43889310	0.28	60035964	0.28	36.79
Korea Rep. of	3852646	0.05	1949796	0.01	59956324	0.28	2975.00

Ores & Minerals	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
Libya	3928806	0.05	18450824	0.12	56014309	0.26	203.59
Other countries	**483659442**	**6.11**	**744187607**	**4.80**	**767146746**	**3.55**	**3.09**

P: Provisional
Source: DGCIS, Kolkata

Metals & Alloys:

The value of imports (including re-imports) of metals & alloys stands at ₹ 6,68,213 crore in the year 2022-23. The import value which had increased from ₹ 4,35,611 crore in 2020-21 to ₹ 6,26,927 crore in 2021-22, increased to ₹ 6,68,213 crore in 2022-23. The value of metal imports showed an increase of 6.59% in 2022-23 as compared to the previous year.

In terms of value of imports, Gold Non-monetary & monetary (total) has the largest share of 41.97%, Iron & Steel 25.47%, Copper & Alloys (Incl. Brass & Bronze) 9.08%, Aluminum and Alloys Incl. Scrap 8.42% , and Silver 6.32%. The individual share of remaining metals was less than Two percent of the total value of metals & alloys.

The value of imports of the metals & alloys that showed significant growth which included Preciuos Metals / Metals Clad With Precious Metals at 274.07%, Platinium Alloys and Related Metals 227.16%, Pig and Cast Iron (incl. Speigeliesen) 97.16%, and Silver 72.72% in 2022-23 as compared to the previous year. On the other hand, during 2022-23, the value of imports of metals and alloys that showed a declining trend as compared to the previous year were mainly in the case of Ferroalloys (20.51%), Gold (non-monetory and Monetory): Total (18.49%), Other Rare Metals NES (15.65%).

India imported metals & alloys from various countries in 2022-23. Bulk of the metals and alloys having share of more than 1% of the total value were imported from 23 countries which accounted for 86.24% of the total value of metals & alloys imported in 2022-23. Switzerland occupied the top position with a share of 15.55% of the total value of metal imports in 2022-23 followed by China in second place with a share of 8.30%.The countries next in order were UAE in third place with a share of 7.92%, USA 6.13% followed by UK at the 5th place with share of 5.49% and South Africa at 6th place with 5.47%. The other countries with share more than 4% included Republic of Korea (4.87%), Japan (4.32 %) and Bolivia (3.04%). The remaining countries are those with a share less than three percent.

During the year under review, imports in terms of value from Uganda increased manifold by 531.88% and for many other countries imports value rose up more than 100%, for instance, Turkey (189.86%) and Poland (132.77%).The other countries which recorded significant positive growth in imports included UK (89.21%), USA (83.47%), and Qatar (67.28%), as compared to the previous year. On the other hand, the value of imports of metals & alloys showed a declining trend in the case of many countries prominent among them were Dominican Republic (46.54%), Guinea (44.75%) and Argentina (33.62%). Imports of selected mineral-based products during 2020-21 to 2022-23 are furnished in Table-14. Value of imports of selected mineral- based products at ₹ 2,69,946 crore in the year 2022-23 registered an increase of 26% as compared to that of ₹ 2,13,229 crore in the previous year (Table 11 to 14).

Table 11: Imports of Metals and Alloys for the period 2020-21 to 2022-23

(Value in ₹ '000)

Metals and Alloys	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
All Metals & Alloys		**	**4356107118**	**	**6269271863**	**	**6682127007**
Aluminium and Alloys Incl. Scrap	tonne	2060227	299126164	2334438	452887747	2542127	562908946
Antimony Alloys and Scrap	tonne	1319	591363	1173	998247	1579	1548561
Bismuth and Scrap	tonne	277	135511	286	189060	NA	NA
Boron	tonne	++	1899	++	2818	++	6094
Cadmium (incl. Waste and Scrap)	tonne	8249	1338734	6787	1218010	--	--
Chromium and Alloys	tonne	1329	786755	1451	925819	1443	1419432
Cobalt and Alloys (incl Waste and Scrap)	**tonne**	**802**	**2898721**	**1130**	**5852552**	**1186**	**7612854**
Cobalt And Alloys	tonne	802	2898714	1128	5850055	1184	7611201
Cobalt And Scrap	tonne	++	7	2	2497	2	1653
Copper (cement Copper Precipitated)	tonne	39	5489	281	8758	1039	7114

Table- 11 (Cont.)

Metals and Alloys	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Copper and Alloys (incl. Brass and Bronze)	**tonne**	**744819**	**341717156**	**823597**	**526294673**	**943404**	**606646258**
Brass And Bronze	tonne	19468	11486251	20218	15778525	21873	17402991
Copper And Alloys	tonne	496358	261483027	553443	392177470	650824	456985846
Brass And Bronze (scrap)	tonne	138389	40285631	133181	65116768	134801	66231070
Copper (scrap)	tonne	90604	28462247	116755	53221910	135906	66026351
Ferroalloys	**tonne**	**421980**	**55319083**	**608617**	**123345004**	**398067**	**98050366**
Ferroalloys: Charge-chrome	tonne	14004	741433	8832	769273	1494	151335
Ferro Silico-chrome	tonne	--	--	100	12778	262	31057
Ferro Silico-manganese	tonne	10497	546336	26676	2741398	32779	2785678
Ferro-boron	tonne	1238	197093	1046	215732	2008	609479
Ferro-chrome	tonne	39002	4897369	44631	8360932	32307	7573631
Ferro-cobalt	tonne	++	1402	--	--	++	1467
Ferromanganese	tonne	66089	4785976	40881	7059207	29021	4753503
Ferro-molybdenum	tonne	2883	3115738	2558	6140376	4498	12093687
Ferro-nickel	tonne	79737	16875880	249315	55890205	65680	20467621
Ferro-niobium	tonne	3026	5857814	3982	8642844	5245	12336415
Ferro-phosphorous	tonne	2006	55172	3746	148545	3507	136457
Ferro-silico-magnesium	tonne	2765	289625	4299	631424	6048	1051977
Ferro-silicon	tonne	194439	16370102	212256	28265119	205830	30855315
Ferro-titanium	tonne	462	109565	731	300529	564	252271
Ferro-tungsten	tonne	13	23282	2	4892	33	71825
Ferro-vanadium	tonne	480	613762	900	1806932	1211	2795214
Ferro-zirconium	tonne	374	51237	522	96181	658	162218
Ferro-alloys (others)	tonne	4965	787297	8140	2258637	6922	1921216
Gold (non-monetory And Monetory):total	kg	651238	2542884698	879010	3440928249	678299	2804792414
Gold-monetory	kg	--	--	--	--	1	2321
Gold-nonmonetory	kg	651238	2542884698	879010	3440928249	678298	2804790093
Gold,non-monetory, Powder	kg	++	51	++	5	1	70
Gold,non-monetory:other Semimanufacturedforms	kg	1864	7902576	10521	45336972	5895	26615750
Gold,non-monetory, Other Unwrought Forms	kg	649374	2534982071	868489	3395591272	672402	2778174273
Gold-clad Metals/base Metales Nes	tonne	++	1694	++	52	++	19
Iron And Steel		**	826381853	**	1159500736	**	1702246642
Iron And Steel (finished Steel Inc. Cr Sheet)	tonne	3123084	281364644	3186329	400431501	3980055	546607218
Iron And Steel (semi-finished Steel Incl. Stl Ingo)	tonne	1848059	97340310	1504120	116884064	2932868	265021615
Iron And Steel (sponge Iron)	tonne	68343	1315159	37451	1088387	304299	9750521
Iron And Steel (steel Wire)	tonne	151105	15473255	149312	21164209	149052	22150739
Iron And Steel Material	tonne	385727	21247947	526903	46871076	432675	41995521
Iron And Steel(stainless Steel)	tonne	39876	7480309	32950	7510586	36862	10000540
Iron And Steel: Alloy Steel (Granules)	tonne	17284	1015659	18629	1463023	18666	1586757
Iron And Steel: Alloy Steel (Powder)	tonne	2596	590464	3450	911990	3473	1042530
Iron And Steel (scrap)	tonne	5393385	213404783	4976246	323514680	10375501	542058265
Iron And Steel (other Finished Steel, Nes)	tonne	139913303	31358265	501617	2119643	355515	2355133

Table- 11 (Concld.)

Metals and Alloys	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Iron and Steel (other Finished Steel, Nes)	tonne	675529	155791058	904150	237541577	923470	259677803
Lead and Alloys Incl. Scrap	tonne	314954	45882809	303573	52969860	350294	62709661
Lead and Alloys	tonne	245841	36498550	225448	40056256	269596	49768026
Lead (Scrap)	tonne	69113	9384259	78125	12913604	80698	12941635
Magnesium and Scrap	tonne	25841	4604195	28845	10442217	32696	12691108
Manganese and Alloys (incl Waste and Scrap)	tonne	37247	4933243	40463	12752665	46715	10775920
Manganese and Alloys:(wrought and Unwrought)	tonne	36890	4838565	39842	12402477	46341	10452221
Manganese and Alloys Nes	tonne	357	94678	621	350188	374	323699
Mercury	tonne	112	456185	93	417082	100	375260
Molybdenum and Scrap	tonne	430	1540722	554	2453374	413	2415813
Nickel and Alloys Incl. Scrap	tonne	56536	55125443	51519	79427347	48896	104926707
Nickel and Alloys	tonne	53248	53022663	48437	77416339	45782	102235427
Nickel (scrap)	tonne	3288	2102780	3082	2011008	3114	2691280
Other Rare Metals Nes	tonne	212	520361	1836	1160126	527	978594
Pig and Cost Iron (incl. Speigeliesen)	tonne	36920	3368526	43732	4890464	152200	9641932
Platinium Alloys and Related Metals	kg	10719	38332024	9603	37563471	31498	122892033
Platinum (powder, Unwrought and Others)	kg	5184	11561645	6020	14641574	25040	101387439
Other Metals Of Platinum Group	kg	5535	26770379	3583	22921897	6458	21504594
Platinium - Clad Base /precious Metal	kg	73	42046	178	72575	7665	17093
Preciuos Metals / Metals Clad With Preciuos Metals	tonne	328	5267483	320	2723812	711	10188846
Selenium	tonne	701	681519	508	712159	387	689860
Silicon	tonne	64800	8323238	77220	17371458	73832	17980477
Silver	tonne	1484	59602766	4422	244542763	8156	422370924
Silver Clad Base Metals	kg	500	7518	4862	22436	1342	26471
Tantalum and Scrap	tonne	1	92405	412	184858	2	35354
Tantalum Alloys Unwrought	tonne	1	92405	5	99544	2	35354
Tantalum & Scrap	tonne	--	--	407	85314	--	--
Tellurium	tonne	2	21250	3	18935	2	20915
Tin and Alloys Incl. Scrap	tonne	10797	14848133	10809	28696669	13792	32096144
Tin and Alloys	tonne	10382	14585191	10333	28331809	13507	31791629
Tin and Alloys : Worked	tonne	415	262942	476	364860	265	285379
Tin (scrap)	tonne	--	--	--	--	20	19136
Titanium and Alloys(incl. Waste and Scrap)	tonne	8875	5480218	9369	7998954	9970	10442098
Tungsten and Alloys Incl. Scrap	kg	326673	1451447	364880	1805805	422270	2478727
Zinc and Alloys Incl. Scrap	tonne	189197	34313169	227424	50722547	279972	73134370
Zinc and Alloys	tonne	139769	27338160	148376	36587059	188566	54320346
Zinc (scrap)	tonne	49428	6975009	79048	14135488	91406	18814024
Zirconium and Scrap	tonne	3	23298	45	170561	--	--

Source: DGCIS, Kolkata
P: Provisional
++: Negligible; --: Nil
***: Quantity not additive*
NA: Data not available

Table 12: Value of Imports of Metals and Alloys for the period 2020-21 to 2022-23 (By Principal Metals And Alloys)

Metals and Alloys	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
All Metals & Alloys	**4356107118**	**100.00**	**6269271863**	**100.00**	**6682127007**	**100.00**	**6.59**
Gold (non-monetory And Monetory):total	2542884698	58.38	3440928249	54.89	2804792414	41.97	-18.49
Iron And Steel	826381853	18.97	1159500736	18.49	1702246642	25.47	46.81
Copper And Alloys (incl. Brass And Bronze)	341717156	7.84	526294673	8.39	606646258	9.08	15.27
Aluminium And Alloys Incl. Scrap	299126164	6.87	452887747	7.22	562908946	8.42	24.29
Silver	59602766	1.37	244542763	3.90	422370924	6.32	72.72
Platinium Alloys And Related Metals	38332024	0.88	37563471	0.60	122892033	1.84	227.16
Nickel And Alloys Incl. Scrap	55125443	1.27	79427347	1.27	104926707	1.57	32.10
Ferroalloys	55319083	1.27	123345004	1.97	98050366	1.47	-20.51
Zinc And Alloys Incl. Scrap	34313169	0.79	50722547	0.81	73134370	1.09	44.19
Lead And Alloys Incl. Scrap	45882809	1.05	52969860	0.84	62709661	0.94	18.39
Tin And Alloys Incl. Scrap	14848133	0.34	28696669	0.46	32096144	0.48	11.85
Silicon	8323238	0.19	17371458	0.28	17980477	0.27	3.51
Magnesium And Scrap	4604195	0.11	10442217	0.17	12691108	0.19	21.54
Manganese And Alloys (incl Waste And Scrap)	4933243	0.11	12752665	0.20	10775920	0.16	-15.50
Titanium And Alloys(incl. Waste And Scrap)	5480218	0.13	7998954	0.13	10442098	0.16	30.54
Preciuos Metals / Metals Clad With Preciuos Metals	5267483	0.12	2723812	0.04	10188846	0.15	274.07
Pig And Cost Iron (incl. Speigeliesen)	3368526	0.08	4890464	0.08	9641932	0.14	97.16
Cobalt And Alloys(incl Waste And Scrap)	2898721	0.07	5852552	0.09	7612854	0.11	30.08
Tungsten And Alloys Incl. Scrap	1451447	0.03	1805805	0.03	2478727	0.04	37.26
Molybdenum And Scrap	1540722	0.04	2453374	0.04	2415813	0.04	-1.53
Antimony Alloys And Scrap	591363	0.01	998247	0.02	1548561	0.02	55.13
Chromium And Alloys	786755	0.02	925819	0.01	1419432	0.02	53.32
Other Rare Metals Nes	520361	0.01	1160126	0.02	978594	0.01	-15.65
Selenium	681519	0.02	712159	0.01	689860	0.01	-3.13
Mercury	456185	0.01	417082	0.01	375260	0.01	-10.03
Other metals and alloys	1669844	0.04	1888063	0.03	113060	0.00	-94.01

P: Provisional
Source: DGCIS, Kolkata

Table 13: Value of Imports of Metals and Alloys for the period 2020-21 to 2022-23 (By Principal Countries)

Country name	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
All Countries	**4356107118**	**100.00**	**6269271863**	**100.00**	**6682127007**	**100.00**	**6.59**
Switzerland	1201797774	27.59	1564907587	24.96	1038775716	15.55	-33.62
China	253099822	5.81	376977637	6.01	554878817	8.30	47.19
UAE	411090037	9.44	591002469	9.43	529496819	7.92	-10.41
USA	199853317	4.59	223363766	3.56	409804493	6.13	83.47
UK	110728782	2.54	194002191	3.09	367076891	5.49	89.21
South Africa	246653484	5.66	319969889	5.10	365349540	5.47	14.18
Korea, Rep. of	191626385	4.40	288127635	4.60	325647044	4.87	13.02
Japan	162204785	3.72	206886097	3.30	288912090	4.32	39.65
Bolivia	85111551	1.95	153988602	2.46	203266092	3.04	32.00
Tanzania	42337240	0.97	125279262	2.00	174978416	2.62	39.67
Indonesia	40875240	0.94	120637568	1.92	163916943	2.45	35.88
Peru	111217188	2.55	173847784	2.77	144158791	2.16	-17.08
Hong Kong	87314320	2.00	137895844	2.20	143067417	2.14	3.75
Singapore	146390033	3.36	144120534	2.30	141954049	2.12	-1.50
Guinea	105674630	2.43	248657333	3.97	137392312	2.06	-44.75
Ghana	67204084	1.54	80349443	1.28	115546373	1.73	43.80
Australia	72900094	1.67	89268691	1.42	108905732	1.63	22.00
Germany	65525774	1.50	99569459	1.59	101575120	1.52	2.01
Vietnam	51232884	1.18	61267425	0.98	101437423	1.52	65.57
Malaysia	71177450	1.63	82123026	1.31	100738577	1.51	22.67
Thailand	58326516	1.34	76221571	1.22	94211839	1.41	23.60
Saudi Arabia	32755487	0.75	57540914	0.92	80950013	1.21	40.68
Brazil	29317748	0.67	62749799	1.00	70850817	1.06	12.91
Netherlands	31735149	0.73	51389965	0.82	60737124	0.91	18.19
Colombia	28940987	0.66	43209967	0.69	56344834	0.84	30.40
Russia	35261589	0.81	53611438	0.86	50398242	0.75	-5.99
Belgium	32504807	0.75	38751219	0.62	46682953	0.70	20.47
Italy	27524684	0.63	36599369	0.58	41721391	0.62	13.99
Turkey	6699718	0.15	13065202	0.21	37870789	0.57	189.86
Uganda	10143	0.00	5755028	0.09	36364762	0.54	531.88
Taiwan	19372549	0.44	30777560	0.49	35511353	0.53	15.38
Canada	17870630	0.41	25339341	0.40	33467591	0.50	32.08
Sweden	13913307	0.32	20452695	0.33	30363505	0.45	48.46
Kuwait	9608378	0.22	19575783	0.31	26480393	0.40	35.27
Mozambique	8684725	0.20	19997140	0.32	25344796	0.38	26.74
France	20627600	0.47	23510746	0.38	25243768	0.38	7.37
Dominic Rep	18134943	0.42	46650133	0.74	24938353	0.37	-46.54
Poland	6136396	0.14	9357051	0.15	21780826	0.33	132.77
Qatar	6927078	0.16	12575431	0.20	21036390	0.31	67.28
Argentina	23981232	0.55	35261734	0.56	20857250	0.31	-40.85
Norway	11517093	0.26	13486755	0.22	20582451	0.31	52.61
Bahrain	11511478	0.26	16546742	0.26	20467683	0.31	23.70
Mexico	18982225	0.44	14967523	0.24	17892754	0.27	19.54

Table- 13 (Concld.)

Country name	2020-21		2021-22		2022-23 (P)		% change in total value 2022-23 over 2021-22
	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	Value (₹ '000)	% share in total value	
Spain	8791657	0.20	14121787	0.23	17549605	0.26	24.27
Bhutan	9282769	0.21	19066273	0.30	17087237	0.26	-10.38
Philippines	14087147	0.32	13993333	0.22	16255644	0.24	16.17
Oman	6779524	0.16	8395067	0.13	15759302	0.24	87.72
Other Countries	122806685	2.82	204060055	3.25	198496687	2.97	-2.73

P: Provisional
Source: DGCIS, Kolkata

Table 14: Imports of Selected Mineral- Based Products for the period 2020-21 to 2022-23

Metals and Alloys	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
All Item		**	**1392000442**	**	**2132299235**	**	**2699467376**
Aluminium Fluoride	tonne	61225	4805867	74348	5287781	55141	5621747
Asbestos Cement Products	tonne	19306	466845	20721	590388	24267	638296
Asbestos Fibre Products	tonne	2309	2750723	3353	3130952	2838	3237762
Bleaching Powder	tonne	34	5524	31	6228	17	5096
Boric Acid	tonne	6897	313194	7412	378403	5478	409638
Briquets Of Coke , Semi-coke Of Coal	tonne	++	222	108	3681	2	204
Calcium Carbide	tonne	32665	1774852	22008	1576090	22133	1715011
Caustic Soda	tonne	248057	5549454	203275	7734743	135822	7422730
Cement	tonne	2350442	9302473	2028180	9220479	1798578	9063366
Cement (portland Grey)	tonne	393659	1851543	345549	1635014	196614	1094540
Cement (portland White)	tonne	174241	1321486	187661	1473250	212205	2027762
Cement Clinker	tonne	1491411	4061781	1211789	3928839	1165979	4121143
Cement (others)	tonne	291131	2067663	283181	2183376	223780	1819921
Cryolite and Chiolite	tonne	6338	174382	4167	152877	1747	121744
Graphite (artificial)	tonne	54327	5422418	75657	8125841	82721	12008937
Graphite Bricks and Shapes	tonne	5430	21390	200053	23733	1017	13039
Graphite Crucibles	tonne	906	50672	296	38483	--	--
Hydroflouric Acid	tonne	2095	177923	1122	133130	3729	440788
Manganese Oxide	tonne	25687	1565080	29224	2103412	19809	2056547
Manganese Dioxide	tonne	12996	1016479	11268	1267664	7522	1207803
Manganese Oxides(otr Than Mn Dioxide)	tonne	12691	548601	17956	835748	12287	848744
Petroleum Products: Total*	000' tonne	43248	1094300000	39017	1768350000	44598	2158540000
Non-ferrous Ash and Residues#	tonne	66023	7976670	68776	10876447	102886	11588866
Other Refractory Manufactures &	tonne	131311	4122283	529721	5908835	1140369	6360129
Phosphatic Fertilisers	tonne	++	51	++	245	90	1938
Phosphoric Acid	tonne	2514246	124688967	6442448	186191658	2697479	289035035
Phosphorus (elemental)	tonne	42551	8199312	52577	17336452	42176	19536933
Potash Fertilisers	tonne	5250814	94059271	3020152	77176503	2563414	120342931
Potasium Nitrate	tonne	58	7553	153	16481	524	59500
Refractory Bricks	tonne	265070	10879704	14632269	12745613	11943527	24402335
Silicon Carbide Crucibles	tonne	386	70638	918	135424	1237	82534
Slag(Dross Etc. From Iron and Steel Exc. Granulated)	tonne	84962	592855	94710	540217	91819	527830

Table- 14 (Concld.)

Metals and Alloys	Unit	2020-21		2021-22		2022-23 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Soda Ash	tonne	719730	11480417	563139	9700159	577480	19535859
Sodium Nitrate	tonne	1281	36525	1207	39664	2193	162404
Sodium Nitrite	tonne	11053	434032	13368	744245	10395	736934
Sulphur Sublimed Precipitated and Colladial	tonne	862	191861	959	335922	1036	290426
Sulphur (colloidal)	tonne	39	8477	27	10666	27	10921
Sulphur Precipitated	tonne	9	1568	39	6196	252	40331
Sulphur Sublimed	tonne	814	181816	893	319060	757	239174
Titanium Oxide and Dioxide Total	tonne	13514	2579284	15233	3695149	18654	5508817
Titanium Dioxide	tonne	13389	2510726	15135	3623000	18503	5392495
Titanium Oxides (other Than Titanium Dioxides)	tonne	125	68558	98	72149	151	116322

Source: DGCIS, Kolkata
P: Provisional
++: Negligible; --: Nil
***: Quantity not additive*
**Source: Ministry of Petroleum & Natural Gas Basic Statistics*
#: Iincludes non ferrous ash & residues and non ferrous base metals scrap
&: Includes other refractory manufactures and goods of siliceous fossil metals/earths

10 . State reviews

Summary

The mineral production (excluding atomic minerals and Minor Minerals) in India increase by 5.8% (as per index of mineral production base year 2011-12) during 2022-23 as compared to the previous year.

Mineral production (Fuel, Metallic, Non-metallic and Minor minerals) was reported from 31 states, union territories during the year 2022-23. The state value of MCDR mineral was reported at ₹ 1,96,591 crore. The major part of the value of MCDR mineral production was confined to eight states namely Odisha, Rajasthan, Chhattisgarh, Karnataka, Andhra Pradesh, Telangana, Madhya Pradesh and Maharashtra (Table-1).

The total number of reporting mines (excluding fuel, atomic and minor minerals) at all India level were 1,408 in 2022-23. Out of these, 287 were from Madhya Pradesh, 175 from Gujarat, 134 from Karnataka, 120 from Odisha, 117 from Chhattisgarh, 116 from Andhra Pradesh, 98 from Rajasthan and 89 from Maharashtra. Remaining mines were reported from other states (Table-2).

Mineral wise reserves/ resources in the country as on 01.04.2020 are furnished in Table-3.

Table - 1 : Value* of Mineral Production, 2020-21 to 2022-23

(By States & Union Territory)

(Value ₹ '000)

State / Union Territory	2020-21	2021-22	2022-23(p)
India	**1597481344**	**2129892982**	**1965907190**
Andaman Nicobar Island	221700	177328	209964
Andhra Pradesh	130994104	137541496	138586085
Arunachal Pradesh	397944	416302	558770
Assam	783615	853962	807178
Bihar	43021892	43068330	43053880
Chhattisgarh	153480094	245384020	194328212
Goa	1157858	296446	476694
Gujarat	54458025	47039706	84543882
Haryana	10509672	6528368	6528368
Himachal Pradesh	4191870	4422399	4483730
Jammu & Kashmir	1937922	4630470	6462437
Jharkhand	30845510	58088511	58552207

Table- 1 (Concld.)

(Value ₹ '000)

State / Union Territory	2020-21	2021-22	2022-23(p)
Karnataka	127485054	200317967	141694807
Kerala	16486191	34112169	38987694
Ladakh	756538	769885	65469
Madhya Pradesh	63585432	96543530	90890478
Maharashtra	74869659	74123221	89644019
Manipur	2866	2866	2866
Meghalaya	3148601	4227742	5047705
Mizoram	1071304	1572600	2576746
Nagaland	1774	1774	1774
Odish	303806246	626891395	504059730
Punjab	2546800	1749900	510956
Rajasthan	308261370	301784255	334391109
Sikkim	18787	18787	18787
Tamil Nadu	8511562	9471345	10305529
Telangana	177329636	113277727	92663408
Tripura	46688	43089	67791
Uttar Pradesh	57036657	56992498	56817414
Uttarakhand	2205004	1781713	1806320
West Bengal	18310969	57763181	57763181

** Excluding the minerals declared as prescribed substances under the Atomic Energy Act, 1962 and fuel minerals.*

Table - 2 : Number of Reporting Mines*, 2020-21 to 2022-23

(By States)

State / Union Territory	2020-21	2021-22	2022-23(p)
Grand Total	**1353**	**1323**	**1408**
Andhra Pradesh	110	114	116
Assam	2	2	3
Bihar	1	1	1
Chhattisgarh	102	109	117
Goa	42	35	30
Gujarat	154	139	175
Himachal Pradesh	23	23	24
Jammu & Kashmir	19	10	19
Jharkhand	46	47	46
Karnataka	141	132	134
Kerala	1	1	1
Madhya Pradesh	241	263	287
Maharashtra	72	74	89
Meghalaya	19	16	18
Odish	154	129	120
Rajasthan	88	93	98
Tamil Nadu	98	94	87
Telangana	36	38	39
Uttar Pradesh	2	2	3
Uttarakhand	2	1	1

** Excluding atomic minerals, fuel minerals and minor minerals.*

Table – 3: Reserves/Resources of Minerals as on 1.4.2020: India

Mineral	Unit	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
Minaral	000 tonnes	0	126050	126050
Antimony				
Ore	tonne	7503	11180	18683
Metal	tonne	75	179.92	254.92
Apatite	tonne	29395		21110299
Asbestos	tonne	0	22908067	22908067
Bauxite	000 tonnes	646493	4311754	4958248
Borax	tonne	0	74204	74204
Chromite	000 tonnes	78535	253150	331685
Cobalt (Ore)	million tonnes	0	44.91	44.91
Copper				
Ore	000 tonnes	163891	1496979	1660870
Metal	000 tonnes	2161.57	10035.52	12197.09
Diamond	carat	847559	30876432	31723991
Diatomite	000 tonnes	0	2885	2885
Emerald	kilogram	0	55869	55869
Fluorite	tonne	404241	20588239	20992480
Garnet	tonne	8590472	47416654	56007126
Gold				
Ore				
(Primary)	tonnes	23728100	494506270	518234370
Metal				
(Primary)	tonnes	92.76	514.5	607.26
Ore				
(Placer)	tonnes	0	26121000	26121000
Metal				
(Placer)	tonnes	0	5.86	5.86
Graphite	tonne	8563411	203060176	211623587
Iron Ore				
(Haematite)	000 tonnes	6209034	17848870	24057905
Iron Ore				
(Magnetite)	000 tonnes	202823	11024791	11227614
Kyanite	tonne	846865	104835455	105682321
Lead & Zinc				
Ore	000 tonnes	103275	663222	766497
Lead Metal	000 tonnes	1900.19	10969.8	12869.99
Zinc Metal	000 tonnes	7438.05	25732.32	33170.37
Lead+Zinc				
Metal	000 tonnes	0	143.13	143.13
Limestone	000 tonnes	19028470	208560789	227589259
Magnesite	000 tonnes	66070	393047	459118
Manganese				
Ore	000 tonnes	75041	428583	503624
Marl	tonne	68145000	31053477	99198477
Molybdenum				
Ore	tonne	0	27203398	27203398
Contained MoS_2 tonne	0		16890.56	16890.56
Nickel Ore	million tonnes	0	189	189

Table- 3 (Concld.)

Mineral	Unit	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
Perlite	000 tonnes	0	2406	2406
Platinum Group				
of Metals	tonnes of metal			
(PGM)	contained	0	20.92	20.92
Potash	million tonnes	0	23091	23091
Pyrite	000 tonnes	0	1674401	1674401
Rare-Earth				
Elements(REE)	tonne	0	459727.49	459727.49
Rock Phosphate	tonne	30876093	280377392	311253485
Rock Salt	000 tonnes	3860	8920	12780
Ruby	kilogram	0	5349	5349
Sapphire	kilogram	0	450	450
Sillimanite	tonne	8262300	64005091	72267391
Silver				
Ore	tonne	170446020	398197732	568643752
Metal	tonne	7707.07	22560.84	30267.91
Sulphur				
(Native)	000 tonnes	0	210	210
Tin				
Ore	tonne	2101	83720794	83722895
Metal	tonne	973.99	102782.91	103756.9
Titanium	tonne	15998625	411108526	427107150
Tungsten				
Ore	tonne	0	89432464	89432464
Contained				
WO_3	tonne	0	144650.07	144650.07
Vanadium				
Ore	tonne	0	24633855	24633855
Contained				
V_2O_5	tonne	0	64594.01	64594.01
Vermiculite	tonne	1590996	765227	2356223
Wollastonite	tonne	2680978	22427488	25108466
Zircon	tonne	669466	1674435	2343901

Andhra Pradesh

Mineral Resources

Andhra Pradesh is the sole producer of apatite. The State is the leading producer of barytes, ball clay, dolomite, garnet (abrasive), laterite, limestone, quartz, quartzite, silica sand and vermiculite. It accounts for 92% barytes, 40% calcite, 41% mica, 31% each kyanite & garnet, 19% titanium minerals, 16% bauxite, 15% dolomite, 13% sillimanite and 12% each vermiculite & limestone resources of the country. Andhra Pradesh is endowed with the internationally known black, pink, blue and multicoloured varieties of granites. Krishna- Godavari basin areas in this State have emerged as new promising are as for hydrocarbons, especially natural gas.

Important minerals occurring in Andhra Pradesh are: **apatite** in Visakhapatnam district; **asbestos** in Cuddapah district; **ball clay** in West Godavari district; **barytes** in Anantapur, Cuddapah, Krishna, Kurnool, Nellore & Prakasam districts; **calcite in** Anantapur, Cuddapah, Kurnool & Visakhapatnam districts; **china clay** in Anantapur, Chittoor, Cuddapah, East Godavari, West Godavari, Guntur, Kurnool, Nellore & Visakhapatnam districts; **coal** in Godavari Valley Coalfield; **corundum** in Anantapur districts; **dolomite** in Anantapur & Kurnool districts; **felspar** in Anantapur, Cuddapah, West Godavari, Nellore & Vizianagaram districts; **fireclay** in Chittoor, Cuddapah, East Godavari, West Godavari, Kurnool & Srikakulam districts; **garnet** in East Godavari, Nellore & Srikakulam districts; **granite** in Anantapur, Chittoor, Cuddapah, Guntur, Krishna, Nellore, Prakasam, Srikakulam & Vizianagaram districts; **iron ore (haematite)** in Anantapur, Cuddapah, Guntur, Krishna, Kurnool & Nellore districts; **iron ore (magnetite)** in Prakasam district; lead-**zinc in** Cuddapah, Guntur & Prakasam districts; **limestone** in Anantapur, Cuddapah, East Godavari, West Godavari, Guntur, Krishna, Kurnool, Nellore, Srikakulam, Visakhapatnam & Vizianagaram districts; **manganese ore** in Srikakulam & Vizianagaram districts; **mica** in Nellore & Visakhapatnam district; **ochre** in Anantapur & Cuddapah, West Godavari, Guntur, Kurnool & Visakhapatnam districts; **pyrophyllite** in Anantapur, Chittoor & Cuddapah districts; **quartz/silica sand** in Anantapur, Chittoor, Cuddapah, West Godavari, Guntur, Krishna, Kurnool, Nellore, Prakasam, Srikakulam, Visakhapatnam & Vizianagaram districts; **quartzite** in Kurnool, Srikakulam, Visakhapatnam & Vizianagaram districts; **talc/soapstone/steatite** in Anantapur, Chittoor, Cuddapah & Kurnool districts & **vermiculite** in Nellore & Visakhapatnam districts. **Petroleum & natural** gas deposits of importance are located in the onshore and offshore areas of Krishna-Godavari basin of the State.

Other minerals that occur in the State are **bauxite** in East Godavari & Visakhapatnam districts; **chromite** in

Krishna district; **copper** in Guntur, Kurnool & Prakasam districts; **diamond** in Anantapur, Krishna & Kurnool districts; **gold** in Anantapur, Chittoor & Kurnool districts; **graphite** in East Godavari, West Godavari, Srikakulam, Visakhapatnam & Vizianagaram districts; **gypsum** in Guntur, Nellore & Prakasam districts; **kyanite** in Nellore & Prakasam districts; **magnesite** in Cuddapah district; **pyrite** in Kurnool district; **sillimanite** in West Godavari & Srikakulam district; **silver** in Guntur district; **titanium minerals** in East Godavari, Krishna, Nellore, Srikakulam & Visakhapatnam districts; and **tungsten** in East Godavari district (Tables-1 & 2).

Exploration & Development

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

Production

Many important minerals are produced in Andhra Pradesh. The principal minerals produced in the state were Natural Gas (ut.), Petroleum (crude), Iron Ore, Manganese Ore, Limestone, Vermiculite etc. The value of minor minerals' production was estimated at ₹ 12,532 crore for the year 2022-23. The number of reporting mines in the State was 116 in the year 2022-23 in case of MCDR minerals (Table-3).

Table –1: Reserves/Resources of Minerals as on 01.04.2020: Andhra Pradesh

Mineral	Unit	Reserves				Remaining Resources								Total Resources
		Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
		STD 111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
Apatite	Tonne	27715	-	1680	29395	-	-	-	-	-	200163	-	200163	229558
Asbestos	Tonne	-	-	-	-	684839	39126	16553	-	1541	55936	-	797995	797995
Bauxite	000' Tonnes	-	-	-	-	-	-	-	188971	138120	288176	-	615267	615267
Chromite	000' Tonnes	-	-	-	-	-	-	-	-	-	#	-	#	#
Copper														
Ore	000' Tonnes	-	-	-	-	686	-	105	-	5791	1000	-	7582	7582
Metal	000' Tonnes	-	-	-	-	6.88	-	1.05	-	97.45	8.32	-	113.7	113.7
Diamond	Carat	-	-	-	-	-	-	-	200483	1524317	98155	-	1822955	1822955
Garnet	Tonne	-	-	-	-	1196087	237025	1359988	18	8800000	5674011	-	17267129	17267129
Gold														
Ore (Primary)	Tonne	3221400	-	36700	3258100	2485133	1857500	1548115	291000	55000	6236150	-	12472898	15730998
Metal (Primary)	Tonne	5.24	-	0.06	5.3	11.87	3.99	4.92	1.08	0.17	19.84	-	41.87	47.17
Graphite	Tonne	-	-	-	-	-	-	1135	0	1122	1136018	-	1138275	1138275
Iron Ore (Haematite)	000' Tonnes	32893	-	11851	44744	42461	68382	66330	377	5863	144374	23085	350872	395616
Iron Ore (Magnetite)	000' Tonnes	-	-	-	-	114210	-	-	13800	1266666	68527	9180	1472383	1472383
Kyanite	Tonne	-	-	-	-	-	-	399	-	-	32003829	-	32004228	32004228
Lead-Zinc Ore														
Ore	000' Tonnes	-	-	-	-	-	-	-	1000	4159	17530	-	22689	22689
Lead metal	000' Tonnes	-	-	-	-	-	-	-	28.7	119.53	688.65	-	836.88	836.88
Zinc metal	000' Tonnes	-	-	-	-	-	-	-	12.4	43.57	7.19	-	63.16	63.16
Limestone	000' Tonnes	2815170	2133	439387	3256690	1302360	404217	1164592	115264	2129536	18066740	3399422	26582132	29838822
Magnesite	000' Tonnes	-	-	-	-	-	-	-	-	-	80	-	80	80
Manganese Ore	000' Tonnes	6848	1006	234	8088	1000	718	1990	465	10730	6838	15	21756	29844
Pyrite	000' Tonnes	-	-	-	-	-	-	-	-	-	880	-	880	880
Sillimanite	Tonne	1451556	0	218469	1670025	-	11070	462830	-	7430300	1491539	-	9395739	11065764

Table-1 Concld.

Mineral	Unit	Reserves				Remaining Resources								Total Resources
		Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
		STD 111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
Silver														
Ore	Tonne	-	-	-	-	-	-	16950000	-	-	-	-	16950000	16950000
Metal	Tonne	-	-	-	-	-	-	128.13	-	-	-	-	128.13	128.13
Titanium	Tonne	-	-	-	-	-	31365	-	-	-	76702509	-	76733874	76733874
Tungsten														
Ore	Tonne	-	-	-	-	-	-	-	3640000	4700800	5952500	509000	14802300	14802300
Contained WO_3	Tonne	-	-	-	-	-	-	-	5096	6574.64	8273.65	318.28	20262.57	20262.57
Vermiculite	Tonne	45305	-	28888	74193	7349	917	5850	9800	5127	88865	-	117908	192101

Figures rounded off
 # Negligible

Table – 2: Reserves/Resources of Coal as on 1.4.2023: Andhra Pradesh

(In Million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total/Godavari Valley	1025	2369	778	4172

Source: Coal Directory of India, 2022-23.

Table – 3 : Mineral Production in Andhra Pradesh, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹'000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**110**		**130994104**	**114**		**137541496**	**116**		**138586085**
Natural Gas (ut.)	m c m	-	827	-	-	809	-	-	710	-
Petroleum (crude)	'000t	-	195	-	-	202	-	-	236	-
Gold Ore	t	-	-	-	-	856	-	-	31028	-
Gold*	kg	1	-	-	1	-	-	1	++	32
Iron Ore	'000t	14	349	260233	15	319	237855	13	185	125683
Manganese Ore	t	24	250255	848621	20	204002	1115138	19	213790	1377386
Limestone	'000t	68	41148	8685149	74	50278	10865618	79	52848	11760096
Vermiculite	t	3	750	469	4	2370	1481	4	2303	1484
Minor Minerals@		-	-	121199632	-	-	125321404	-	-	125321404

Note : The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
** Only labour reported. ++ negligible*
@ Figures for earlier years have been repeated as estimates because of non-receipt of data for the year 2022-23

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the principal mineral-based industries in the Organised Sector in the State are provided in Table-4.

Table – 4 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Asbestos/Cement sheets	
Hyderabad Industries Ltd, Ibrahimpatnam, Distt. Krishna	3000
Ramco Industries, Ibrahimpatnam, Distt. Krishna	NA
Cement	
ACC Ltd, (formerly, Encore cement), Vishakhapatnam (G)	300
Andhra Cements Ltd, (Visaka Cement Works), Durga Nagar, Distt. Visakhapatnam (G)	540
Andhra Cements Ltd, Durga Cement Works, Dachepalli, Distt. Guntur	2310
Anjani Portland Cement Ltd, Chintalapalem, Mellacheruvu	1925
Bharthi Cement Corp. Pvt. Ltd, Nallingayapalli, Distt. Cuddapha	5000
Bhavya Cement, Thangeda, Distt. Guntur	1400
BMM Cement Ltd, Gudipadu, Yediki	950
Dalmia Cement (Bharat) Ltd, Cuddapha	4060
2600 (Clincker)	
Deccan Cement Ltd, Ravipahad, Nareducherla	1800
Deccan Cement Ltd, Ravipahad, Palakeedu Nalgonda	1800
Greygold Cement Ltd, Hyderabad	91
Himadri Cement Ltd, Vedadri, Jaggyyapet	247.5
India Cements Ltd, Chilamkur, Distt. Cuddapha	1460
India Cements Ltd, Malkapur, Tandur	2900
India Cements Ltd, Vishnupuram Work, Wadapally, Mariyalaguda	3500
India Cements Ltd, Yeraguntla, Distt. Cuddapha	1000
	540(Clincker)
My home Industries Pvt. Ltd, Mellacheruvu, Nalgonda	3200
UltraTech Cements Ltd, Jaypee Balaji Cement, Budawada, Distt. Krishna	5000
JSW Cement Ltd, Nandyal, Distt. Kurnool	4800

Table- 4 (Cont.)

Industry/plant	Capacity ('000 tpy)
JSW Cement Ltd, Bilakalagudur, Gadivemula	4800
KCP Ltd, Macherla, Distt. Guntur	825
KCP Ltd, Muktyala, Distt. Krishna	1860
KCP Ltd, Muktyala, Jaggayyapeta Unit II	3520
Kakatiya Cement Sugar and Industries Ltd,	297
Dondapadu, Melacheruvu	
My Home Cement Industries Ltd, Mulakapalli, Distt. Visakhapatnam (G).	2000
NCL Industries Ltd, Kondapalli, Distt. Krishna (G).	990
Orient Cement Ltd, Devapur, Kasipet.	5000
Panyam Cements & Mineral Industries Ltd, Cement Nagar, Distt. Kurnool.	1000
Parashakti Cement, Jettipalem, Distt. Guntur.,	1260
Penna Cement Industries Ltd, Talaricheruvu,,	2200
Penna Cement Industries Ltd, Boyareddypalli,	2000
Penna Cement Industries Ltd, Ganeshpahad	1200
Prism Cement Ltd, Kotapadu, Kolimigundla.	4800
Rain Commodities Ltd, (Rain Cements), Boincheruvupalli, Peapully, Distt. Kurnool	2770
Rain Cements, Ltd, Ramapuram, Mellacheruvu	1500
Ramco Cement Ltd, (formerly, Madras Cements), Jayantipuram, K.S. Rajanagar, Distt. Krishna.	3650
Ramco Cement Ltd, Vizag Grinding Unit, Distt. Visakhapatnam.	950
Shree Jayajothi (Subs. of Myhome Cement Ind.) Yanakandala, Distt. Kurnool.	3200
Shri Chakra Cements Ltd, Alamada, Distt. Vizianagaram (G).	260
Shri Chakra Cements Ltd, Narsimhapuri, Distt. Guntur.	310
Sagar Cements Bayyavaram, Distt. Visakhapatnam (G)	200
Sagar Cements, Mattampally	2350
Sagar Cement Ltd, BMM Cement Anantapur,	1000
UltraTech Cements Ltd, (APCW), Tadipatri, Distt. Anantapur.	9000
Zuari Cement, Krishnanagar, Yerranguntala, Distt. Cuddapha.	3800
Zuari Cement, Ltd, Sitapuram Dondapadu Mellacheruvu	1200
Chemical	
Andhra Sugars Ltd, Saggonda, Distt. West Godavari.	400 TPD (caustic soda) 99 (H_2SO_4)
Shree Rayalseema Alkalies &	156.95 (Total)
Allied Chem. Ltd, Gondiparla, Distt. Kurnool.	69.5 (caustic soda) 49.8 (Cl)
24.7 (HCl)	
23.1 (KOH)	
Shree Rayalseema High Strength Hypo Ltd, Gondiparla	14.85 (bleaching powder) 49.5 (H_2SO_4) ,
Distt. Kurnool.	15 (Oleum)
Ceramic	
Sentini Ceramica Pvt. Ltd, Kanukollu, Distt. Krishna (JV with H R Johnson (I) Ltd)	58 mill. sq.m
Spartek Ceramics India Ltd, Narsingapuram, Distt. Chittoor.	NA
Kajaria Ceramics Ltd, Vijayawada.	2.9 (mill. sq m)
Electrode	
Indus Elctrode Gundlapalli,	0.90
Maddiapdumandal.	
Magnarc Elcetrodes Pvt. Ltd, Pendurthy.	1.8

Table- 4 (Cont.)

Industry/plant	Capacity ('000 tpy)
Fertilizer	
Agri Green Fertilizers & Chemicals Pvt. Ltd, Cuddapah	30 (SSP) .
Bhaskar Fertiliser (P) Ltd, Anantapur	45 (SSP)
Coromandel International Ltd, Visakhapatnam	1300 (NP/ NPKs).
Coromandel International Ltd, Kakinada, Distt. East Godavari	1925 (DAP) .
GDS Chemicals & Fert. Pvt. Ltd, Anakapalli, Visakhapatnam	36 (SSP)
K. P. R. Fertilizers Ltd, Biccavolu,	11300 (SSP
Godavari	
Krishna Industrial Corpn. Ltd, Nidadavole,	45 (SSP)
Distt. West Godavari.	33.5 (H_2 SO_4)
Nagarjuna Fertilizers & Chemicals Ltd,t Kakinada, Distt. East Godavari (Unit I & II)	1500 (Urea)
NG Fertilizers & Chemicals Pvt. Ltd, Kodurupadu, Distt. Krishna	200 (SSP)
Prathyusha Chems and Fertilisers Ltd, Parwada, Visakhapatnam	100 (SSP)
Subhodaya Chemicals Ltd, Gauripatnam, Distt. West Godavar	42.9 (SSP) i
Pesticides	
Jayalakshmi Fertilizers,	2000
Tanuku, Distt. West Godavari	
Glass	
Triveni Glass Ltd, Kondagudem, Distt. West Godavari	10 (mill. sq. m)
Iron & Steel	
Visakhapatnam Steel Plant,	8856 (sinter)
Visakhapatnam	3400 (pig iron) 6300 (crude/liquid steel)
Sponge Iron	
Amoda Iron and Steel Pvt. Ltd,	60
Jayanthipuram, Jaggayyapet Mandal, Aggayyapet	
Apple Industries Ltd,	150
Dhiral, Anantapur	
Maa Mahamaya Industries Ltd,	112
Vizianagaram	
Pushpit Steel Pvt. Ltd,	86.4
Merlapaka,Yerpendu, Chittor	
SLV Steels and alloys Pvt. Ltd,	60
Anantapur	
Sri Sai Sindhu Industries Ltd,	52.5
Tadpatri	
Steel exchange India Ltd,	250
Srirampuram,Visakhapatnam	
Sree Rayalseema Green Steloy Ltd,	36
Gooty, Distt. Anantapur	
Pig Iron	
Rishrtriya Ispat Nigam Ltd, Vishakhapatanam, Andhra Pradesh	6300
Sathavahana Ispat Ltd, Haresamudram,	210

Table- 4 (Concld.)

Industry/plant	Capacity ('000 tpy)
Distt. Anantapur	
Pellets	
Essar Steel Ltd, Visakhapatnam	8000
Ferroalloys	
Berry Alloys Ltd, Kothavalasa,	40 (Fe-Mn)
Distt. Vizianagaram	32 (Si-Mn)
Deccan Ferro alloys (P) Ltd, Pendurthi,	30 (Si-Mn)
Visakhapatnam	10(Fe-Mn)
FACOR Alloys Ltd, Shreeramnagar, Distt. Vizianagaram	90.3
Jindal Stainless (Hisar) Ltd,	40
Kothavalasa, Distt. Vizianagaram	
Maithan Alloy Ltd,	120
Atchutapuram	
Hira Elector Smelters Ltd,	NA
Bobbili, Distt. Vizianagaram	
Nava Bharat Ventures Ltd,	125
Paloncha	
Rhodium Ferro-alloy Pvt. Ltd,	8
Gollapuram	
Siri Smelters & Energy Pvt. Ltd,	8.5
Bobbili	
Petroleum Refinery	
HPCL, Vizag	8300
ONGC, Tatipaka, Distt. East Godavari	66

Note: Data, not readily available for fertilizer and cement Industries on respective website. Therefore, data is sourced from Indian Fertilizer Scenario, FAI Statistics, and Survey of Cement Industry & Directory, respectively.

Arunachal Pradesh

Mineral Resources

The most important mineral resource of the State is petroleum & natural gas and its chief occurrence is reported in Ningru and Dam Duma areas. These hydrocarbon deposits are located in the Assam Arakan Fold Belt (AAFB) and Upper Assam basin in the State. The State also reports resources of coal in Namchick Namphuk and Miaobum Coalfields; copper in East Kameng district, dolomite in West Kameng district; fuller's earth in Tirap district; graphite in Lohit, East Siang and Upper Subansiri districts; limestone in Dibang Valley, Lohit, East Siang and Upper Subansiri districts and quartzite in West Kameng district (Tables-1 and 2).

Exploration & Development

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

Production

Natural gas (ut.) and petroleum (crude) were the important mineral items produced in Arunachal Pradesh. The value of minor minerals' production was estimated at ₹ 56 crore for the year 2022-23 (Table-3).

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020 : Arunachal Pradesh

Mineral	Unit	Total Reserves (A)	Remaining Reserves				Total resources
			Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	(A+B)
Copper							
Ore	'000 tonnes	-	-	-	10	10	10
Metal	'000 tonnes	-	-	-	0 .02	0.02	0.02
Graphite	tonne	-	-	3200000	73118257	76318257	76318257
Limestone	'000 tonnes	-	49220	433575	1	482796	482796

Figures rounded off.

Table – 2 : Reserves/Resources of Coal as on 1.4.2022: Arunachal Pradesh

(In milllion tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**31**	**40**	**19**	**90**
Namchik-Namphuk	31	40	13	84
Miao Bum	–	–	6	6

Source: Coal Directory of India, 2022-23.

Table – 3 : Mineral Production in Arunachal Pradesh, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**-**	**-**	**397944**	**-**	**-**	**416302**	**-**	**-**	**558770**
Natural Gas (ut.)	m c m	-	56	-	-	58	-	-	53	-
Petroleum (crude)	'000t	-	54	-	-	48	-	-	47	-
Minor Minerals		-	-	397944	-	-	416302	-	-	558770

$ Excludes the value of Fuel minerals.

Assam

Mineral Resources

C**oal, petroleum & natural gas, limestone, fuller's** earth, sillimanite and minor minerals are the chief mineral resources of the State. **Coal** occurs in Mikirs Hills, Dilli-Jeypore, Makum and Singrimari coalfields. **Coal** extracted from the State is friable and contains high sulphur. **Petroleum & natural gas** occurs in Digboi oilfields, Lakhimpur district and at Moran Rudrasagar oilfields in Sivasagar district located in Assam Arakan Fold Belt (AAFB), Upper Assam and Assam basins. **Limestone** occurs in Karbi Anglong, North Cachar Hills and Nowgaon districts. Besides, **china clay** occurs in Karbi Anglong and North Lakhimpur districts; **fireclay** in Dibrugarh, Karbi Anglong, North Cachar Hills & North Lakhimpur districts; **fuller's earth** in Nalbari district; **granite** in Goalpara, Kamrup & Karbi Anglong districts, **iron ore (haematite)** in Kokrajhar district; **iron ore (magnetite)** in Dhubri, Goalpara & Kokrajhar districts; **quartz/silica sand** in Nowgaon district; and **sillimanite** in Karbi Anglong & Nowgaon districts. The reserves / resources of **coal** and **mineral**s are furnished in (Tables-1 and 2).

Exploration & Development

The Exploration & Development details for the state of Assam during the year 2022-23 are covered under the Exploration & Development review-2023.

Production

Coal, Natural gas (ut.), Petroleum (crude), Limestone were the principal minerals produced in Assam in 2022-23. The value of minor minerals' production was estimated at ₹ 31 crore for the year 2022-23. There were 3 reporting mines in 2022-23 in Assam in case of MCDR minerals (Table-3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, as per the available information, the principal mineral-based industries in the organised sector in the State are furnished in Table-4.

Table – 1: Reserves/Resources of Coal as on 1.4.2023 : Assam

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**465**	**57**	**3**	**525**
Singrimari	-	14	-	14
Makum	432	21	-	453
Dilli-Jeypore	32	22	-	54
Mikir Hills	1	-	3	4

Source: Coal Directory of India 2022-23.

Table – 2 : Reserves/Resources of Minerals as on 1.4.2020 : Assam

(By Grades/States)

(In '000 tonnes)

Mineral	Unit	Reserves	Remaining resources	Total Resources
Iron Ore (Haematite)	'000 tonnes	-	30890	30890
Iron Ore (Magnetite)	'000 tonnes	-	15380	15380
Limestone	'000 tonnes	188130	1683540	1871670
Sillimanite	tonne	-	4604700	4604700

Figures rounded off

Table -3 : Mineral Production in Assam, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**2**		**783615**	**2**		**853962**	**3**		**807178**
Coal	'000t	-	36	-	-	28	-	-	200	-
Natural Gas (ut.)	m c m	-	2995	-	-	3371	-	-	3557	-
Petroleum (crude)	'000t	-	3902	-	-	3988	-	-	4164	-
Limestone	'000t	2	1552	469810	2	1681	540157	3	1522	493373
Sulphur #	t	-	6447	-	-	6545	-	-	7705	-
Minor Minerals @		-	-	313805	-	-	313805	-	-	313805

***Note**: The number of mines excludes Fuel and Minor minerals.*
$ Excludes the value of Fuel minerals.
 # Recovered as by-product from oil refinery.
@ Figures for earlier years have been repeated as estimates because of non-receipt of data.

Table – 4 : Principal Mineral-based Industries

Industry / Plant	Capacity ('000 tpy)
Asbestos Products	
Assam Roofing Ltd, Bonda, Distt. Kamrup.	58
Cement	
Barak Valley Cements Ltd, Jhoom basti, Badarpurghat, Distt. Karimganj.	330
Calcom Cement (Dalmia Subsidiary), Distt. Nagaon.	1720
CCI Ltd, Bokajan, Distt. Karbi Anglong.	200

Table- 4 (Concld.)

Industry / Plant	Capacity ('000 tpy)
Cement Manufacturing Co. Ltd, Chamata Pathar, P. O. Sonapur, Distt. Kamrup (G).	2000
Purbanchal Cement, Vill. Sarutari, Distt. Kamrup	360
Topcem Cement Gauripur Kamrup	660
Fertilizer	
Assam State Fertilizer & Chemicals Ltd,	33 (SSP)
Chandrapur, Distt. Kamrup	16.5
(H_2SO_4)	
Brahmaputra Valley Fertilizers Corpn. Ltd,	510
(Urea)	
Namrup (Namrup II & III), Distt. Dibrugarh.	45 (SSP)
Progressive Fertichem Pvt. Ltd,	
Topatoli, Kamrup.	
Iron & Steel	
Shri Ganapati Ispat Pvt Ltd, Tinsukia.	NA
Petroleum Refinery	
Indian Oil Corporation, Bongaigaon.	2350
Indian Oil Corporation, Moonmati, Guwahati.	1000
Indian Oil Corporation, Digboi.	650
NRL, Numaligarh, Golaghat.	3000

Note: Data, as not readily available for fertilizer and cement industries on respective websites, was taken from Indian Fertilizer Scenario, FAI Statistics, and Survey of Cement Industry & Directory, respectively.
As per Rule-45 of MCDR, 2017, a total of 36 companies are registered with IBM as given in https://ibm.gov.in/writereaddata/files/05102020114426ASSAMALL.pdf

Bihar

Mineral Resources

Bihar is the principal holder of country's pyrite resources and possesses 94% of pyrite resources. The important mineral occurrences in Bihar are coal in Rajmahal coalfield; limestone in Kaimur (Bhabhua), Munger & Rohtas districts; mica in Nawada district; quartz/silica sand in Bhagalpur, Jamui,Munger & Nalanda districts; quartzite in Lakhisarai,Munger & Nalanda districts; and talc/ soapstone/steatite inMunger district. Besides, occurrences of bauxite inMunger & Rohtas districts; china clay in Bhagalpur &Munger districts; felspar in Gaya, Jamui &Munger districts; fireclay in Bhagalpur & Purnea districts; gold in Jamui district; granite in Bhagalpur, Gaya, Jahanabad & Jamui districts; iron ore (haematite) in Bhagalpur district; iron ore (magnetite) in Gaya & Jamui districts; lead-zinc in Banka & Rohtas districts; and pyrites in Rohtas district have been reported (Tables -1& 2).

Exploration & Development

The Exploration & Development details for the state of Bihar during the year 2022-23 are covered under the Exploration & Development review-2023.

Production

Limestone is the only major mineral produced in Bihar. The value of minor minerals' production is estimated as ₹ 4,272 crore for the year 2022-23. There was a single reporting mine in Bihar for MCDR mineral which relates to limestone (Table-3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the principal mineral-based industries in the organised sector in the State with their total installed capacities are furnished in Table-4.

Table – 1 : Reserves/Resources of Coal as on 1.4.2022 : Bihar

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total/Rajmahal	**310**	**4080**	**48**	**4437**

Source: Coal Directory of India 2022-23.

Table – 2 : Reserves/Resources of Minerals as on 1.4.2020 : Bihar

(By Grades/States)

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Bauxite	'000 tonnes	-	4114	4114
Gold				
Ore	tonne	-	222884860	222884860
Metal	tonne	-	37.6	37.6
Iron Ore (haematite)	'000 tonnes	-	55	55
Iron Ore (magnetite)	'000 tonnes	-	49439	49439
Lead-Zinc Ore				
Ore	'000 tonnes	-	11435	11435
Lead metal	'000 tonnes	-	24	24
Zinc metal	'000 tonnes	-	38.75	38.75
Limestone	'000 tonnes	11807	994188	1005995
Potash	Million tonnes	-	230	230
Pyrite	'000 tonnes	-	1574561	1574561
Rare-Earth Elements	tonne	-	1459	1459

Figures rounded off

Table –3: Mineral Production in Bihar, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**1**		**43021892**	**1**		**43068330**	**1**		**43053880**
Limestone	'000t	1	1000	301961	1	987	348399	1	929	333949
Sulphur #	t	-	7135	-	-	8160	-	-	14652	-
Minor Minerals @		-	-	42719931	-	-	42719931	-	-	42719931

Note : The number of mines excludes minor minerals.
 # Recovered as by-product from oil refinery.
@ Figures for earlier years have been repeated as estimates because of non-receipt of data.

Table – 4 : Principal Mineral-based Industries

Asbestos Products	Capacity ('000 tpy)
Eco cement Durgawati Bhabhua	1000
Kalyanpur Cements Ltd, Banjari, Dist. Rohtas.	1000
Kanodia Cement Bhabhua Bangar Cement	1200
Shree Cement Ltd, Jasoia Aurangabad Grinding Unit, Aurangabad.	3600
Shree Cement Ltd, New Bihar Cement Plant, Aurangabad	2000
UltraTech Cement Plant, Patliputra	1900
Petroleum Refinery	
Indian Oil Corporation, Barauni.	6000

Note: Data, for fertilizer industries, has been taken from Indian Fertilizer Scenario, FAI Statistics,.

Chhattisgarh

Mineral Resources

Chhattisgarh is the sole producer of tin concentrates and moulding sand. It is one of the leading producers of coal, dolomite, bauxite and iron ore. The State accounts for about 36% tin ore, 20% iron ore (haematite), 18% coal, 11% dolomite and 4% each diamond & marble resources of the country. Important mineral occurrences in the State are bauxite in Bastar, Bilaspur, Dantewada, Jashpur, Kanker, Kawardha (Kabirdham), Korba, Raigarh & Sarguja districts; china clay in Durg & Rajnandgaon districts; coal in Korba, Raigarh & Sarguja districts; dolomite in Bastar, Bilaspur, Durg, Janjgir-Champa, Raigarh & Raipur districts; and iron ore (haematite) in Bastar district, Bailadila deposit in Dantewada district, Chhote Dongar deposit in Kanker district, Rowghat, Chargaon, Metabodeli & Hahaladdi deposits in Rajnandgaon district and Boria Tibbu deposits in Dalli-Rajhara area, Durg district. Bailadila-Rowghat hill ranges in the State are considered to be one of the biggest iron ore fields in India. Limestone occurs in Bastar, Bilaspur, Durg, Janjgir-Champa, Kawardha (Kabirdham), Raigarh, Raipur & Rajnandgaon districts; quartzite in Durg, Raipur, Rajnandgaon & Raigarh districts; and talc/soapstone/ steatite in Durg & Kanker districts.

Other minerals found in the State are corundum in Dantewada district; diamond and other gemstones in Raipur, Mahasamund & Dhamtari districts; fire clay in Bilaspur, Raigarh & Rajnandgaon districts; fluorite in Rajnandgaon district; garnet & marble in Bastar district; emerald & gold in Raipur district; granite in Bastar, Kanker & Raipur districts; quartz/ silica sand in Durg, Jashpur, Raigarh, Raipur & Rajnandgaon districts; and tin in Bastar & Dantewada districts (Table-1). The reserves/ resources of coal are furnished in Table-2.

Exploration & Development

The Exploration & Development details for the state of Chhattisgarh during the year 2022-23 are covered under the Exploration & Development review-2023.

Production

Coal, Bauxite, Iron Ore, Tin Conc., Limestone and Moulding Sand are the major minerals produced in Chhattisgarh. The value of minor minerals production was estimated at ₹ 1,033 crores for the year 2022-23. There were 117 reporting mines in 2022-23 for MCDR minerals (Table -3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the principal mineral-based industries in the organised sector in the State are furnished in Table - 4.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020: Chhattisgarh

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Bauxite	000' tonnes	23695	968860	992555
Diamond	carat	-	1304000	1304000
Fluorite	tonne	-	545455	545455
Garnet	tonne	-	28800	28800
Gold				
Ore (Primary)	tonne	-	4841033	4841033
Metal (Primary)	tonne	-	5.51	5.51
Graphite	tonne	5282	1330	6612
Iron Ore (Haematite)	000' tonnes	1593732	2998379	4592111
Iron Ore (Magnetite)	000' tonnes	75876	30045	105921
Limestone	000' tonnes	1486351	11724867	13211218
Tin				
Ore	tonne	2101	29795176	29797277
Metal	tonne	973.99	15909.58	16883.57

Figures rounded off.
 # Declared as minor mineral vide Gazette notification dated 10.02.2015.

Table – 2 : Reserves/Resources of Coal as on 1.4.2023 : Chhattisgarh

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**37236**	**42294**	**1244**	**80774**
Sohagpur	94	434	-	529
Sonhat	950	1983	2	2940
Jhilimili	228	39	-	267
Chirimiri	320	11	31	362
Bisrampur	2014	678	5	2698
East Bisrampur	-	165	-	165
Lakhanpur	456	3	-	459
Panchbahini	-	11	-	11
Hasdeo-Arand	2032	3273	223	5529
Sendurgarh	153	126	-	279
Korba	8769	4212	49	13030
Mand-Raigarh	20091	28289	847	49228
Tatapani-Ramkola	2128	3064	85	5278

Figures rounded off.
Source: Coal Directory of India, 2022-23.

Table -3 : Mineral Production in Chhattisgarh, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**102**		**153480094**	**109**		**245384020**	**117**		**194328212**
Coal	'000t		158410	-		154120	-		184895	-
Bauxite	t	14	716296	751459	13	968248	1079736	13	1056576	1252140
Iron Ore	'000t	21	36839	132201316	21	41333	222498723	21	42546	169935753
Tin Conc.	kg	5	16865	10413	6	26301	32619	4	45429	51850
Graphite (r.o.m.)	t	1	1701	2041	1*	-	-	1*	-	-
Limestone	'000t	57	40378	10139974	64	41889	11523823	75	44735	12753977
Moulding Sand	t	4	14363	4150	4	17583	5256	3	17260	5383
Minor Minerals		-	-	10370741	-	-	10243863	-	-	10329109

Note : The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
** Only labour reported.*

Table – 4 : Principal Mineral-based Industries

2018-19 to 2022-23

(In tonnes)

Industry/plant	Capacity
Aluminium	
Bharat Aluminium Co. Ltd (Unit I & II),	200 # (Alumina)
Korba.	570 (Aluminium)
(#Plants remained non-operational during the year).	
Cement	
ACC Ltd, Jamul, Distt Durg.	2400
Ambuja Cements Ltd, Bhatapara,	3500
Distt. Raipur.	
Bhilai Jaypee Cement Ltd, Bhilai, Distt Durg (G).	2200
Century Cement, Baikunth, Distt Raipur.	2100
Century Textile & Industires Ltd, Tandwa, Tilda	2400
Emami Ltd, Baloda Bazar, Distt Raipur	2500
	3200 (clinkar)
Emami Ltd, Risda Baloda Bazar, Distt Raipur	2500
Emami Cement Ltd, Risda Baloda Bazar	3000
J. K. Laxmi, Durg	2.7
J. K. Laxmi Cement Ltd, Malpurikhurd, khasadhe, Dhamdha	2400
Lafarge India Pvt. Ltd, Arasmeta,	1.8
Distt Janjgir-Champa.	
Lafarge India Pvt. Ltd, Sonadih, Distt Raipur	550
NUVOCO Vistas Co. Ltd	1000
Sonadih Cement Plant, Rasedi, Baloda Bazar	
Shree Cement, Baloda Bazar, Distt Raipur	3000
Shree Cement Ltd, Khapradih Simga,	3000
Balrampur.	
UltraTech Cement Ltd, Hirmi, Distt Raipur.	1900
UltraTech Cement Ltd, Rawan, Distt Raipur.	2500

Table- 4 (Cont.)

(In tonnes)

Industry/plant	Capacity
Chemical	
Indu Ragukul Food &	1.5 (Sodium Dicromate)
Chemical Pvt. Ltd,	2.7 (Sodium chromate)
Electrode Rajghatta, Kharsia	1.35 (Sodium sulphate)
Bhanpuri, Raipur Calcutta Electrode Pvt. Ltd,	7.4
Fertilizer	
BEC Fertilizers, Sirgitti, Distt Bilaspur	850000
Dharamsi Morarji Chemical Co. Ltd,	183 (SSP & H_2SO_4))
Kumhari, Distt. Durg.	66 (SSP)
Khaitan Chemicals & Fertilizers Ltd,	49.5 (H_2SO_4)
Distt Rajnandgaon.	
Iron & Steel	
Bhilai Steel Plant, Bhilai	6334 (Sinters)
	4700 (Pig iron)
	3925 (crude/liquid steel)
	30 (Refractory bricks)
Jindal Steel & Power Ltd, Raigarh	2500 (Sinters)
	1320 (Sponge iron)
	8600 (Crude/liquid
Jayaswal NECO Industries Ltd, Siltara, Distt Raipur.	650 (Pig iron)
	255 (Sponge iron)
	1200 (pellets)
	1200 (Steel)
Monnet Ispat & Energy Ltd, Naharpalli, Raigarh	962.3 (Sinters)
	612.5 (Pig iron)
	750 (MS billet)
	450 (TMT Bar)
Sarda Energy & Minerals Ltd, (formerly	600 (Pellets)
Raipur Alloys & Steel Ltd), IGC,	210 (Sponge iron)
Shri Bajrang Power & Ispat Ltd,	130 (Steel)
Borjhara, Distt Raipur.	1200 (pellets)
Sponge Iron	
A.P.I. Ispat & Power Tech. Pvt. Ltd,	210
Siltara Billets, Raipur	
Alliance Integrated Metallics Ltd,	500
Bemta, Distt Raipur.	
Anjani Steel Ltd, Ujalpur, Distt Raigarh	108
Arti Sponge & Power Ltd, Siltara, Distt Raipur	60
Ambika Ispat (I) Pvt Ltd, Tarainal, Distt Raigarh	30
Baldev Alloys Pvt. Ltd, Siltara, Raipur	30
Bhagavati Power & Steel Pvt Ltd,	60
Siltara, Distt Raipur	
B.S. Sponge Pvt Ltd, Taraimal, Raigarh	90
Crest Steel & Power Pvt. Ltd,	231
IGC Borai, Distt Durg	
Devi Iron & Power Pvt Ltd, Tandira, Distt Raipur	90

Table- 4 (Cont.)

(In tonnes)

Industry/plant	Capacity
Drolia Electro Steel Pvt Ltd, Siltara, Raipur	66
Euro Pratik Ispat Pvt Ltd, Charoda, Distt Raipur	30
Gravity Treksim Pvt Ltd, Siltara, Distt Raipur	30
Godavari Power & Ispat Ltd, Siltara,	495
Distt Raipur	2100 (pellets)
Gopal Sponge & Power Pvt Ltd, Siltara, Distt Raipur	30
Gitanjali Ispat & Power Pvt Ltd, Sirgititi, Distt Bilaspur	10
GR Sponge & Power Ltd, Siltara, Distt Raipur	72
Shree Hare Krishna Sponge Iron Ltd, Siltara, Distt Raipur	12000
Jai Shree Balaji Steel Pvt Ltd (HEG Ltd), Borai, Distt Durg	120 (Sponge iron)
Hi-Tech Power & Steel Ltd, Parsada, Distt Raipur	60
Khetan Sponge & Infrastructure Pvt. Ltd, Sarora, Distt Raipur	30
Maa Kali Alloys (Ind.) Pvt Ltd, Pali, Distt Raigarh	60
MSP Steel & Power Ltd, Raigarh	192
	900 (pellets)
Monnet Ispat & Energy Ltd, Hasaud, Raipur	300
	250 (Semi-finished Steel)
	150 (Finished Steel)
Monnet Ispat & Energy Ltd, Naharpalli, Raigarh	500
NR Sponge Pvt. Ltd, Raipur	90
Nalwa Steel & Power Ltd, Taraimal, Raigarh	198
Nakoda Ispat Ltd, Siltara, Raipur	171
Niros Ispat Pvt. Ltd, Hathkhoj, Bhilai	97.5
Nova Iron & Steel Ltd, Dagori, Bilaspur	150
Nutan Ispat & Power Ltd, Jaroda, Raipur	60
PD Industries Pvt. Ltd, Siltara, Raipur	60
Prakash Industries Ltd, Hathenewra, Janjgir-Champa	1000
Raigarh Ispat & Power Ltd, Delari, Distt Raigarh	60
Rameswaram Steel & Power Ltd, Gharghoda, Distt Raigarh	72
Real Ispat and Power Ltd, Borjhara, Raipur.	60
	460 (Finished Steel)
Sarda Energy & Minerals Ltd, Mandhar, Raipur	150
Hanumant Alloys (India) Pvt. Ltd, Hardikala, Distt Bilaspur	16.5
Shivalaya Ispat & Power Pvt Ltd, Guma, Distt Raipur	90
Shivshakti Steel Pvt. Ltd, Chakradharpur, Distt Raigarh	97.5
Shree Shyam Ispat (India) Pvt. Ltd, Taraimal, Raigarh	120

Table- 4 (Concld.)

(In tonnes)

Industry/plant	Capacity
Singhal Enterprises Pvt Ltd, Taraimal, Distt Raigarh	253.5
Singhal Energy Pvt. Ltd, Taraimal, Raigarh	60
Sree Nakoda Ispat Ltd, Siltara, Distt Raipur	66
Sunil Sponge Iron Ltd, Chiraipani, Distt Raigarh	60
Sunil Sponge Pvt. Ltd, Munrethi, Dharsiwa	60
Topworth Steel Pvt Ltd, Rasmada, Distt Durg	165
Trimula Sponge Iron Pvt Ltd, Siltara, Raipur	30
Vandana Global Ltd, Siltara, Distt Raipur	216
Vasvani Industries Ltd, Siltara, Distt Raipur	90
Vidhyan Minerals India Pvt. Ltd, Bilaspur	30
Ferro Alloys	
Alok Ferro Alloys Ltd, Urla, Raipur	18
Deepak Ferro Alloys Ltd, Urla, Distt Raipur	5
Indsil Energy & Electro Chemical Ltd,	19.2
Urla, Distt Raipur	
Hira Ferro alloys Ltd, Urla, Distt Raipur	61.5
Jindal Steel & Power Ltd, Kharsia, Distt Raigarh	36
Sarda Energy &	600 (Pellets)
Minerals Ltd, (merged Chhattisgarh	360 (Sponge Iron)
Electricity Co. Ltd)	410 (Finished Steel)
Siltara, Distt Raipur	150 (Silico & Ferro–manganese
Nav-chrome Ltd, Urla, Distt Raipur	50
Orion Ferroalloy Pvt. Ltd	8
Punjipathra, Gharghora	
V.A. Power & Steel Pvt. Ltd	8.1(Fe-Si)
Punjipathra, Gharghoda	
Manganese Oxide	
Vandana Allied Minerals and alloy	3.6
Bodegaon, Durg	
Refractory	
SAIL Refractory Unit (formerly Bharat	60
Refractories Ltd), Bhilai, Distt Durg	
Vishva Vishal Engineering Ltd, Bhilai, Distt Durg	8.2

(G); Grinding Unit

Note: Data, not readily available for fertilizer and cement industries on respective websites, is taken from Indian Fertilizer Scenario, FAI Statistics, and Survey of Cement Industry & Directory, respectively.

[#]plant remained unoperational during the year

Delhi

Mineral Resources

Kaolin deposits are found in an area west of Qutub Minar at Mehrauli, Masoodpur, Kusumpur and Mahipalpur. In addition, occurrences of fireclay and silica material known as Badarpur sand/quartzite have also been reported from Delhi (Table - 1).

Mineral-based Industry

The present status of each Mineral-based Industry is not readily available. However, the principal Mineral-based Industries in the Organised Sector with their total installed capacities are furnished in Table-2.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2015 : Delhi

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
China clay#	'000 tonnes	-	5289	5289
Fireclay#	'000 tonnes	-	64	64

Figures rounded off.
 # Declared as Minor Mineral vide Gazette Notification dated 10.02.2015.

Table – 2 : Principal Mineral-based Industries

Industry	No. of units	capacity (tpy)
Abrasive	1	120
Activated earth	1	3,600
Alum	1	35,500
Asbestos products	1	25,000
Bleaching powder	1	10,000
Caustic soda	1	15,080
Ceramic & stoneware pipes	2	18,500
S. R. Industries Electrode, Narela	1	1800
Refractory	2	39,000

Goa

Mineral Resources

Goa is well-known for its iron and manganese ores. Bauxite and laterite are the other minerals produced in the State. Iron and manganese ore belts extend from south-east to north-west of the state. Manganese ores are associated with iron ores and occur as pockets of various sizes in the form of concretionary pebbles in shales. Important iron ore and manganese ore deposits are located at Bicholim, Sanguem and Satari talukas. Bauxite occurs in the North and South Goa districts; kaolin reportedly occurs in South Goa district, while quartz/silica sand deposits occur in both North and South Goa districts (Table -1).

Production

Iron ore is the only major mineral produced in Goa. But the production of Iron ore & others major mineral was reported Nil. The value of minor mineral's production was estimated at ₹ 48 crore for the year 2022-23. There were 30 reporting mines in 2022-23 in case of MCDR minerals (Table-2).

Mineral-based Industry

The present status of each Mineral-based Industry is not readily available. However, the principal Mineral-based Industries in the Organised Sector in the state are provided in Table-3.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020 : Goa

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Bauxite	'000 tonnes	9613	58244	67857
Iron ore (Haematite)	'000 tonnes	117235	1080322	1197557
Iron ore (Magnetite)	'000 tonnes	4990	261345	266336
Manganese Ore	'000 tonnes	65	34436	34501

Figures rounded off.

Table-2: Mineral Production in Goa, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**42**		**1157858**	**35**		**296446**	**30**		**476694**
Iron Ore	'000t	40	1003	897737	33**	-	-	28**	94	-
Manganese Ore *	t	2	-	-	2	-	-	2	-	-
Minor Minerals		-	-	260121	-	-	296446	-	-	476694

Note : The number of mines excludes Minor minerals.
*** Only labour reported, production activity stopped by S.C. Order.*
** Only labour reported.*

Table – 3 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Fertilizer	
Zuari Industries Ltd, Zuarinagar, Distt South Goa	400000 (Urea) and 800000 (NP/NPKs)/(DAP)
Pellets	
Mandovi Pellets Ltd, Mandovi, Shiroda	NA
Chowgule & Co. Ltd	NA
Pig Iron	
Sesa Goa Ltd, Bicholim	625
Aparant Iron & Steel Pvt. Ltd, Sanguem	160
Vedanta Ltd, Amona, Bicholim	832 (Sinter)
Sponge Iron	
Ambey Metallic Ltd, Pissurlem, Sattari	36
Goa Sponge & Power Ltd, Santona	90
Shraddha Ispat Pvt. Ltd, Santona, Sanguem	72
Ferroalloys	
Karthik Alloys Ltd, Cuncalim	3.2

Note: Data, for fertilizer industries, is taken from Indian Fertilizer Scenario, FAI Statistics.

Gujarat

Mineral Resources

Gujarat is the sole producer of chalk and is the principal producer of clay (others), fluorite (graded), kaolin, silica sand, lignite, petroleum & natural gas and marl in the country. The State is the sole holder of the country's chalk, marl and perlite resources and possesses 66% fluorite, 28% diatomite, 25% bentonite, 18% granite, 12% wollastonite, 10% limestone and 9% bauxite resources.

The important mineral occurrences in the State are: bauxite in Amreli, Bhavnagar, Jamnagar, Junagadh, Kheda, Kachchh, Porbandar, Sabarkantha & Valsad districts; ball clay in Banaskantha, Bharuch, Kachchh & Patan districts; bentonite in Amreli, Bhavnagar, Jamnagar, Kachchh & Sabarkantha districts; china clay in Amreli, Banaskantha, Bhavnagar, Jamnagar, Junagadh, Kachchh, Mahesana & Sabarkantha districts; chalk in Porbandar district; diatomite in Bhavnagar district; dolomite in Bhavnagar & Vadodara districts; fireclay in Bharuch, Kachchh, Mahesana, Rajkot, Sabarkantha, Surat & Surendranagar districts; fluorite in Vadodara & Bharuch districts; gypsum in Bhavnagar, Jamnagar, Junagadh, Kachchh and Surendranagar districts; lignite in Bharuch, Bhavnagar, Kachchh & Surat districts; limestone in Amreli, Banaskantha, Bharuch, Bhavnagar, Jamnagar, Junagadh, Kheda, Kachchh, Panchmahals, Porbandar, Rajkot, Sabarkantha, Surat, Vadodara & Valsad districts; marl in Amreli, Junagadh & Porbandar districts; ochre in Banaskantha, Bhavnagar & Kachchh districts; perlite in Rajkot district; petroleum and natural gas in oil fields of Ankaleshwar, Kalol, Navgam, Balol & Cambay in Cambay onshore and offshore basins; quartz/silica sand in Bharuch, Bhavnagar, Dahod, Kheda, Kachchh, Panchmahals, Rajkot, Sabarkantha, Surat, Surendranagar, Vadodara & Valsad districts; and talc/soapstone/steatite in Sabarkantha district.

Other minerals that occur in the state are: apatite and rock phosphate in Panchmahals district; calcite in Amreli & Bharuch districts; copper ore in Banaskantha district; granite in Banaskantha, Mahesana & Sabarkantha districts; graphite in Panchmahals district; lead-zinc and marble in Banaskantha & Vadodara districts; manganese ore in Panchmahals & Vadodara districts; vermiculite in Vadodara district; and wollastonite in Banaskantha district. The lignite resources are located in Bharuch, Bhavnagar, Kachchh and Surat districts (Tables-1and 2).

Production

Lignite, Natural Gas, Petroleum (Crude), Bauxite, Limestone, etc. were reported from the State of Gujarat. The value of minor minerals' production was estimated as ₹ 7,634 crore for the year 2022-23. There were 175 reporting mines in 2022-23 in case of MCDR minerals (Table-3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the important Mineral-based Industries in the organized sector in the State are furnished in Table- 4.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020 : Gujarat

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Apatite	tonne	-	351000	351000
Bauxite	'000 tonnes	101230	295797	397027
Copper				
Ore	'000 tonnes	-	12613	12613
Metal	'000 tonnes	-	200.74	200.74
Diatomite	'000 tonnes	-	811	811
Fluorite	tonne	-	14355280	14355280
Graphite	tonne	-	3355805	3355805
Lead-Zinc Ore				
Ore	'000 tonnes	-	5682	5682
Lead metal	'000 tonnes	-	208.45	208.45
Zinc metal	'000 tonnes	-	261.4	261.4
Lead-Zinc metal	'000 tonnes	-	0.9	0.9
Limestone	'000 tonnes	903115	21929169	22832284
Manganese Ore	'000 tonnes	695	2180	2875
Marl	tonne	68145000	31053477	99198477
Perlite	'000 tonnes	-	2406	2406
Rare Earth Element	tonne	-	424000	424000
Rock Phosphate	tonne	-	314820	314820
Vermiculite	tonne	-	1960	1960
Wollastonite	tonne	-	1990000	1990000

Figures rounded off

Table – 2: Reserves/Resources of Lignite as on 1.4.2023: Gujarat

(In million tonnes)

District	Proved	Indicated	Inferred	Total
Total	**1278.65**	**283.7**	**1159.7**	**2722.05**
Kachchh	335.61	56.4	33.09	425.1
Bharuch	724.76	118.59	491.23	1334.58
Bhavnagar	–	–	299.17	299.17
Surat	218.28	108.71	336.21	663.2

Source: Coal Directory of India 2022-23.

Table - 3 : Mineral Production in Gujarat, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**154**		**54458025**	**139**		**47039706**	**175**		**84543882**
Lignite	'000t	-	10813	-	-	13331	-	-	12313	-
Natural Gas (ut.)	m c m	-	1138	-	-	1017	-	-	923	-
Petroleum (crude)	'000t	-	4651	-	-	4627	-	-	4850	-
Bauxite	t	63	1497716	1198490	59	2018462	1692854	78	1667048	1495852
Fluorite (graded)	t	-	-	-	-	-	-	2	100	575
Limestone	'000t	91	22227	5080904	80	23250	5212323	95	22853	6528265
Marl%	t	-	1300333	243556	-	900560	133211	-	875309	177911
Sulphur#	t	-	82450	-	-	117588	-	-	146401	-

Table- 3 (Concld.)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
Minor Minerals		-	-	47935075	-	-	40001318	-	-	76341279

Note : The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
% Associate with Limestone
 # Recovered as by-product from oil refinery.

Table – 4 : Principal Mineral-based Industries

2018-19 to 2022-23

Industry/plant	Capacity ('000 tpy)
Abrasives	
Bombay Mineral Limited, Jam Khambhalia	86.4 (Abrasive Grain)
Carborandum Universal Ltd, Okha, Distt Jamnagar.	NA
Carborandum Universal Ltd, Bhatia, Distt Jamnagar	NA
Flexo-Plast Abrasives, Ahmedabad	NA
Orient Abrasive Ltd, Porbandar	75 (Abrasive Grain)
	150 (Calcined Bauxite)
	30 (Castable Refractory)
Asbestos Products	
Ramco Industries Ltd, Singura, Distt Kachchh.	72
Sanghi Industries Ltd, Sanghipuram, Distt Kachchh.	36
U.P. Asbestos Ltd, Valsad.	36
Cement	
Ambuja Cements Ltd, Ambuja Nagar, Distt Junagadh.	5700
Ambuja Cement Ltd, Magdalla, Distt Surat (G).	1560
Mehta Group Gujarat Sidhee Cement, Sidheegram, Sutrapada Distt Junagadh.	1200
Mehta Group Saurashtra Cement Ltd, Porbandar, Distt Junagadh.	1500
Saurashtra Cement Ltd, Ranavav Porbandar,	3063
Hi Bond Cement, Gondal.	1200
J.K. Laxmi, Kalol, Distt Ganghinagar (G).	1000
J.K. Laxmi, Surat	1350
Sanghi Industries Ltd, Sanghipuram, Distt Kachchh.	4000
Shree Digvijay Cement Co. Ltd, Digvijaygram, Sikka Distt Jamnagar.	1200 (43 Gr.)
	1200 (53. Gr.)
	1200 (PPC)
	1200 (Oil well cement)
	1200 (Sulphate Resisting P.C.)
Tata Chemicals Ltd, Mithapur, Distt Jamnagar.	500
UltraTech Cement Co. Ltd, Pipavav, Distt Amreli.	6400
UltraTech Cement Ltd, (Narmada Cement), Jafrabad, Distt Amreli.	1450
UltraTech Cement Ltd, (Gujarat Cement), Kovaya, Babarkot, Rajula Jafrabad,	6400
UltraTech Cement (formerly a unit of JCCL), Sewagram, Abdasa, Distt Kachchh.	2400
UltraTech Cement (formerly a unit of JCCL), Wanakbori, Distt Kheda (G).	2400
UltraTech Cement Ltd, Magdalla (G).	750
Sparta Cements & Infra Ltd. Bhuj	1000
Vadraj Cement, Mora, Surat	6000
Ceramic	
Unifrax India, Lakhtar	7.5 (Ceramic fiber product)

Table- 4 (Cont.)

Industry/plant	Capacity ('000 tpy)
Orient Glazes Ltd, OGPL, Kheda Unit Radhu	35.53
Chemical	
Baroda Rayon Corpn. Ltd, Surat.	15000 (yarn)
	21600 (H2SO4)
	2.2 (sodium sulphate)
Century Chemicals, Nava Nanga, Distt Jamnagar.	108 (refined salt)
Gujarat Alkalies & Chemicals Ltd, Baroda.	14.9 (caustic soda)
Gujarat Alkalies & Chemicals Ltd, Dahej, Distt. Bharuch.	242.6 (caustic Soda)
	151.4 (Cl)
	33.408 (phosphoric acid)
GHCL Limited, Sutrapada.	1100 (Soda Ash)
	71 (Sodium bicarbonate)
Indian Rayon Industries Ltd,	21 (yarn)
Veraval, Distt Junagadh.	35.7 (H2SO4)
	10 (carbon disulphide)
	9.3 (sodium sulphate)
	91.3 (caustic soda)
Kamadhenu Nutrients Pvt.ltd. Panoli,Ankleshwar	10.8 (Dicalcium phosphate)
Kohler India Corp. Pvt. Ltd, Jhagadia,Talodara	15.02 (2Pc B)
	8.29 (lav)
	2.25 (Pedestal)
	4.73 (tank)
Navin Fluorine Industries Ltd, Surat.	22 (HF)
Nirma Cement Ltd, Ranavav	421.2 (Soda ash)
Nirma Soda Ash Plant	1008 (Soda Ash Light)
Kalatalav, Bhavnagar	648 (Soda Dense)
	144 (Refined Sodium Bicarbonate)
	Vaccun Salt (864)
Saurashtra Chemicals Ltd, Porbandar, Distt Porbandar	365 (soda ash)
	20.4 (caustic soda)
	26.4 (refined bicarbonate)
Shree Sulphurics Pvt. Ltd, Ankleshwar, Distt Bharuch.	58 (H2SO4)
	12 (chloro-sulphuric acid)
Tata Chemicals Ltd, Mithapur, Distt Jamnagar. Copper Smelter	875 (soda ash)
Hindalco Industries Ltd,	500 (copper smelting)
Birla Copper, Dahej, Distt Bharuch.	1670 (H2SO4)
	15 tonnes (Au)
	150 tonnes (Ag)
HCL, Gujarat Copper Project, Jhagadia, Distt. Bharuch.	50 (electrolytic copper)
	20 (copper anodes)
Electrode	
Power Electrode Varaval Shapar, Kotda Sangani	0.6
Fertilizer	
Aarti Fertilizers, Vapi, Valsad	132 (SSP)
Coromandel International Ltd (Formerly	100 (SSP)
Liberty Phosphate Ltd), Nandesari, Vododara	367 (urea)
GSFC, Vadodara	108 (DAP)
	200 (complex)
	196 (AS)
GSFC, Sikka (Sikka - I & II), Jamnagar	326 (DAP)

Table- 4 (Cont.)

Industry/plant	Capacity ('000 tpy)
GNFC, Bharuch	636.9 (urea)
	142.5 (complex)
Hindalco Industries Ltd, Dahej, Distt Bharuch	400 (DAP/complex)
IFFCO Ltd, Kandla, Distt. Kachchh	2420
IFFCO Ltd, Kalol, Distt. Gandhinagar	602 (urea)
Khaitan Chemicals & Fertilizers Ltd, Dahej, Bharuch	200 (SSP)
KRIBHCO Ltd, Hazira, Distt. Surat	2195 (urea)
Narmada Agro Chemicals Pvt. Ltd, Mangrol, Junagadh	33000 (SSP)
Narmada Bio-chem Pvt. Ltd, Kalyangadh, Ahmedabad	196000 (SSP)
Nirma Ltd, Moraiya, Ahmedabad	100 (SSP)
Sona Phosphates Ltd, Sarigam, Valsad	15 (SSP)
T J Agro Fertilizers Pvt. Ltd, Navsari	22 (SSP)
Foundry	
Steelcast Ltd, Ruvapuri Road, Bhavnagar	30
Intolcast Pvt. Ltd, 16, 17 & 19 Ankur Industrial Complex, Rajkot Gundal Road Shaper, Rajkot	2.4 (steel casting)
Intricast Pvt. Ltd, 25/28 Galaxy	1.08 (steel casting)
Industrial Estate, Rajkot Gundal Road	
Shaper, Rajkot	
Invac Cast Pvt. Ltd, 444, 453 & 455 Nana Fofadia Road Bamangam, Vadodara	2.4 (steel casting)
Gujarat Intuxt Ltd.184/P, Rajkot Gundal Road Shaper, Rajkot	1.8 (steel casting)
Iron & Steel	
Essar Steel Ltd, Hazira, Distt Surat	6700 (sponge iron)
	10000 (crude/liquid steel)
Jindal Saw Ltd, Samaghogha, Mundra	900 (Sinter)
	580 (Pig Iron)
Ferroalloys	
Baroda Ferro Alloys Ltd, Panchmahals.	3.5
Essel Mining & Industries Ltd, Vapi, Distt Valsad.	9
Electro Ferro Alloys Ltd, Ahmedabad.	0.3
Sponge Iron	
Electrotherm India Pvt. Ltd, Samakhalli, Distt Kachchh	75
Gallant Metal Ltd, Samakhialli, Distt Kachchh	225000
Global Hi-Tech Industries Ltd, Bhuj, Distt Kachchh	105
Welspun Steel Ltd, Versamedi, Anjar	144
Glass	
Alembic Glass Industries Ltd, Baroda.	35
Bhagwati Glass Containers Ltd, Kalol.	8.7
Bharat Glass Tube Ltd, Bharuch.	7.2
Gobind Glass & Industries Ltd, Kadi.	NA
Gopal Glass Works Ltd, Budasan, Distt Mahesana.	40.6
Gujarat Borosil Ltd, Govali, Distt. Bharuch.	62.5
Piramal Glass Ltd, Jambusar.	355 (tpd)
Piramal Glass Ltd, Kosamba.	340 (tpd)
Haldyn Glass (Gujarat) Ltd, Padra, Vadodara.	320 TPD
Prestige Glass Industries Pvt Ltd, Vagra.	11.5
Petroleum Refinery	
IOCL, Koyali.	13700
RPL, Jamnagar	33000
RPL, Jamnagar (SEZ).	27000

Table- 4 (Concld.)

Industry/plant	Capacity ('000 tpy)
Essar Oil Ltd, Vadinar.	20000
Refractory	
Calders India Refractorie Ltd, Bhayati Jambudiya, Wankaner	42
Lilanand Magnesite Pvt. Ltd, Dharmpur, Ranavav	10.8
Synthetic Gas	
Reliance Industries Ltd, JG-DTA Gasification Area, Kunalus Lalpur	13122.48
Calcined Bauxite	
Birla VXL Ltd, Porbandar	36
Bombay Minerals Ltd, Jamkhambhaliya	96
Gujarat Credo Mineral Industries Ltd,	500 (dry beneficiated)
Naredi, Abdasa	10 (processed bauxite)
Saurashtra Calcine Bauxite & Allied Industries Ltd, Bhatia	39
Shri Natraj Ceramics & Chemical Industries Ltd, Khambhaliya	24

G: Grinding Unit

Data, not readily available for fertilizer and cement industries on respective websites, is taken from Indian Fertilizer Scenario, FAI Statistics, and Survey of Cement Industry & Directory, respectively.

Haryana

Mineral Resources

The State is the principal holder of country's resources of slate (85%), tin ore (64%), quartz-silica sand (42%) and quartzite (53%). The principal minerals that are found to occur in Haryana are china clay in Faridabad, Gurgaon & Rewari districts; limestone in Ambala, Bhiwani, Mahendragarh & Panchkula districts; quartz/silica sand in Bhiwani, Faridabad, Gurgaon & Mahendragarh districts; quartzite in Faridabad & Gurgaon districts; and slate in Mahendragarh & Gurgaon districts. Other minerals, such as, barytes, calcite, felspar & marble occur in Mahendragarh district; copper in Bhiwani & Mahendragarh districts; dolomite in Ambala & Mahendragarh districts; granite in Bhiwani district; and tin & tungsten mineralisations in Tosham area of Bhiwani district have also been reported (Table-1).

Production

Sulphur was the main mineral item reporting production in the state of Haryana. The value of minor minerals' production was estimated at ₹ 653 crore for the year 2022-23 (Table-2).

Mineral-based Industry

The present status of each Mineral-based Industry is not readily available. However, the important large and medium-scale Mineral-based Industries in the Organised Sector in the State are furnished in (Table-3).

Table – 1: Reserves/Resources of Minerals as on 1.4.2020: Haryana

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Copper				
Ore	'000 tonnes	-	53816	53816
Metal	'000 tonnes	-	179.01	179.01
Limestone	'00 tonnes	-	74677	74677
Tin				
Ore	tonne	-	53910000	53910000
Metal	tonne	-	86220.6	86220.6
Tungsten				
Ore	tonne	-	2230000	2230000
Contained WO_3	tonne	-	3568	3568

Figures rounded off.

Table - 2 : Mineral Production in Haryana, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**-**		**10509672**	**-**		**6528368**	**-**		**6528368**
Sulphur #	t	-	138025	-	-	178740	-	-	157228	-
Minor Minerals @		-	-	10509672	-	-	6528368	-	-	6528368

 # Recovered as by-product from fertilizer plant.
@ Figures for earlier years have been repeated as estimates because of non-receipt of data.

Table - 3: Principal Mineral-based Industries

Industry/plant	Capacity ('000tpy)
Asbestos Products	
Hyderabad Industries Ltd, Ballabgarh.	2160 MT
Cement	
Shree Cement (formerly, unit of Jaypee Cement), Panipat (G).	1500
J K Cement Ltd, Jharli, Distt Jhajjar (G).	1500
J K Laxmi, Bijitpur, Distt Jhajjar (G).	1300
UltraTech Cement, Panipat (G).	2000
UltraTech Cement, Jhajjar (G).	2250
Ceramic/Sanitaryware	
Hindustan Sanitaryware & Industries Ltd, Bahadurgarh.	14
SPL Ltd, Bahadurgarh.	35000 (sq m/day)
Somany Ceramics Ltd, Kassur, Distt Jhajjar.	10.4 (Mill sq m)
Chemical	
Oriental Carbon & Chemicals Ltd, Dharuhera, Distt Rewari.	28500
Bhalla Chemical Works Pvt Ltd,Ballabgarh.	10 (Zirconium derivaties) 5 (Zirconium silicate opacifiers)
Saint Gobain Gyproc India Ltd (formerly India Gypsum Ltd), Jind.	NA
S. B. Zircon Pvt. Ltd. Sikri, Ballabhgarh	3 (Zirconium opacifiers)
Varun Electrode Pvt Ltd, Panipat.	3.6
Electrode	
Devay Udyog, Charkhi Dadri	0.4
Fertilizer	
NFL, Gohana Road, Panipat.	511.5 (Urea) 8.70 (S)
Kisan Phosphates Pvt. Ltd, Gawar, Hisar.	132 (SSP)
Nitin Chemicals & Fertilizers Ltd, Rukri, Ambala.	20 (SSP)
Iron & Steel	
Jindal Stainless Ltd, Hisar.	780 (stainless steel)
Ferroalloys	
Haryana Ferro Alloys Ltd,	2.5
Glass	
Haryana Sheet Glass Ltd, Sevli, Distt Sonipat.	89.5
Hindustan National Glass & Industries Ltd, Ballabgarh.	690 TPD
Petroleum Refinery	
IOCL, Panipat.	15000
Refractory	
Bhaskar Refractories & SW Pipes (P) Ltd, Amar Nagar.	12

Note: Data, not readily available for Fertilizer and Cement Industries on respective websites, is taken from Indian Fertilizer Scenario,FAI Statistics and Survey of Cement Industry & Directory, respectively. G: Grinding Unit

Himachal Pradesh

Mineral Resources

The State is the sole holder of country's antimony ore and rock salt resources. Limestone and shale are the important minerals produced in the State. Barytes occurs in Sirmaur district; limestone in Bilaspur, Chamba, Kangra, Kulu, Mandi, Shimla, Sirmaur & Solan districts; and rock salt in Mandi district. Other minerals that occur in the State are antimony in Lahaul & Spiti districts; gypsum in Chamba, Sirmaur and Solan districts; magnesite in Chamba district; pyrite in Shimla district; and quartz, quartzite & silica sand in Una district Table - 1.

Production

Limestone and Salt (rock) were the principle minerals reporting production in the state. The value of minor minerals' production was estimated at ₹ 178 crore for the year 2022-23. There were 24 reporting mines in Himachal Pradesh in 2022-23 (Table-2).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the principal mineral-based industries in the Organised Sector in the State are furnished in Table - 3.

Table – 1: Reserves/Resources of Minerals as on 1.4.2020: Himachal Pradesh

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Antimony				
Ore	tonne	-	10588	10588
Metal	tonne	-	174	174
Limestone	'000 tonnes	1022012	5597134	6619146
Magnesite	'000 tonnes	-	298	298
Pyrite	'000 tonnes	-	2560	2560
Rocksalt	'000 tonnes	3860	8920	12780

Figures rounded off.

Table – 2 : Mineral Production in Himachal Pradesh, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**23**		**4191870**	**23**		**4422399**	**24**		**4483730**
Limestone	'000t	22	12018	2618878	22	13810	2983883	23	11839	2692145
Salt (rock)	t	1	486	14156	1	286	712	1	1002	10725
Minor Minerals@	-	-	-	1558836	-	-	1437804	-	-	1780860

Note : The number of mines excludes Minor minerals.
@ Figures for earlier years have been repeated as estimates because of non-receipt of data.

Table - 3: Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
ACC Ltd, Gagal (Gaggal I & II), Distt Bilaspur	4640
	3000 (Clincker)
Ambuja Cement, Suli, P.O. Darlaghat, Distt Solan	1600Cement & 2600 (Clincker)
Ambuja Cement, Nalagarh, Distt Solan	1500
Asian Concretes and Cements Pvt Ltd, Bir Palsi, Distt Solan	1300
CCI Ltd, Rajban, Distt Sirmaur	198
Ultra Tech Cement Ltd, Bagga, Distt Solan	2540 Cement & 2970(Clincker)
UltraTech Cement Ltd, (Blending & Grinding), Bagheri Solan	2000

Note: Data, not readily available for cement industries on respective websites, is taken from Survey of Cement Industry & Directory

Jammu & Kashmir

Mineral Resources

Jammu & Kashmir is the sole holder of country's borax, sapphire and sulphur (native) resources and possesses 30% graphite, 23% marble and 14% of gypsum. Coal, gypsum and limestone are the important minerals produced in the State. Coal occurs in Kupwara district; gypsum in Baramulla & Doda districts; limestone in Anantnag, Baramulla, Kathua, Leh, Poonch, Pulwama, Rajauri, Srinagar & Udhampur districts; and magnesite in Leh & Udhampur districts.

Other minerals that occur in the State are bauxite & china clay in Udhampur district; Bentonite in Jammu district; borax & sulphur in Leh district; Diaspore in Rajouri & Udhampur districts; graphite in Baramulla district; lignite & marble in Kupwara district; quartz & silica sand in Anantnag, Doda & Udhampur districts; quartzite in Anantnag district; and sapphire in Doda district (Tables - 1 and 2).

Production

Coal and Limestone were the principle mineral items reporting production in the state. The value of minor mineral's production was estimated to be ₹ 616 crore for the year 2022-23(P). There were 19 reporting mines in 2022-23 in case of MCDR of minerals (Table-3).

Mineral-based Industry

Jammu & Kashmir Cements Ltd, a State Government Undertaking, operates a cement plant of 4.00 lakh tpy capacity at Khrew in Pulwama district and 1.00 lakh tpy capacity at Samba Jammu. The Company also owns a small cement plant of 20,000 tpy capacity located at Wuyan in Srinagar district, besides two other tiny cement plants that have a total capacity of 5,20,000 tpy. Khyber Indus. (P) Ltd operates a cement plant of 3, 30,000 tpy in the State. The State also has a 1,800 tpy capacity unit that manufactures ceramic and refractory products in Kathua District. A 3,000 tpy capacity calcium carbide plant is situated at Pulwama District. J. K. Minerals Ltd has a plant of 30,000 tpy of DBM and 75,000 tpy plant of sized magnesite at Chipprian deposit near village Panthal in Udhampur district in the State (Table-4).

Table –1: Reserves/Resources of Minerals as on 1.4.2020 (P) : Jammu & Kashmir

Mineral	Unit	Reserves				Remaining Resources								Total Resources (A+B)
		Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
		STD 111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Bauxite	'000 tonnes	0	0	0	0	0	0	0	1323	182	1220	0	2725	2725
Borax	tonne	0	0	0	0	0	0	0	0	0	0	74204	74204	74204
Graphite	tonne	0	0	0	0	0	0	0	0	0	1059520	61681035	62740555	62740555
Limestone	'000 tonnes	156757	15852	12881	185490	122422	45566	58608	67456	26704	1703261	218054	2242071	2427561
Magnesite	'000 tonnes	0	0	0	0	3210	740	0	0	0	150	45	4145	4145
Sapphire	Kilogram	0	0	0	0	0	0	0	0	0	450	0	450	450
Sulphur (Native)	000 tonnes	0	0	0	0	0	0	0	0	0	210	0	210	210

Figures rounded off

Table –2: Reserves/Resources of Lignite as on 01.04.2023

(In million tonnes)

District	Proved	Indicated	Inferred	Total
Total	**–**	**20.25**	**7.3**	**27.55**
Kupwara	–	20.25	7.3	27.55

Source: Coal directory of India, 2022-23

Table – 3: Mineral Production in Jammu & Kashmir, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**19**		**1937922**	**10**		**4630470**	**19**		**6462437**
Coal	'000t	-	10	-	-	11	-	-	10	-
Limestone	'000t	18	1175	300656	10	1156	286892	19	1238	298346
Magnesite	t	1*	-	-	-	-	-	-	-	-
Minor Minerals		-	-	1637266	-	-	4343578	-	-	6164091

Note : The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
** Only labour reported.*

Table – 4: Principal Mineral-based Industries

(In tonnes)

Industry/plant	Capacity
Jammu & Kashmir Cement Ltd, Khrew, Pulwama	400
Jammu & Kashmir Cement Ltd, Samba Jammu.	100
Jammu & Kashmir Cement Ltd, Wuyan Srinagar.	200
Khyber Indus (P) Ltd	330
Ceramic & Refractory Product, Kathua.	1.8
Calcium Carbide Plant, Pulwama	3
J. K. Mineral Ltd, Chipprian,	30 (DBM)
Panthal, Udhampur	75 (Magnesite)
Nayyar Electrode Pvt. Ltd, Barri Brahmana	4.45

Jharkhand

Mineral Resources

Jharkhand is one of the major mineral producing States. It is the sole producer of flint stone in the country and is one of the leading producers of coal, gold, graphite, bauxite, iron ore & limestone. Uranium ore is mined and processed by Uranium Corporation of India Ltd (UCIL) for supply as fuel to the country's nuclear power reactors through six underground mines, one opencast mine, and two processing plants. Jharkhand has the sole resources of emerald mineral. It accounts for about 31% rock phosphate, 23% iron ore (haematite), 30% apatite, 14% andalusite, 20% cobalt ore, 20% copper ore, 9% each granite (dimension stone) & graphite and 5% silver ore resources of the country.

Important minerals that occur in the State are bauxite in Dumka, Gumla, Latehar, Lohardaga & Palamu districts; china clay in Dumka, Hazaribagh, Lohardaga, East & West Singhbhum, Sahebganj & Ranchi districts; coal in Bokaro, Deoghar, Dhanbad, Giridih, Godda, Hazaribagh, Palamau, Pakur & Ranchi districts; copper in Hazaribagh & East Singhbhum districts; dolomite in Garhwa & Palamu districts; felspar in Deoghar, Dhanbad, Dumka, Giridih, Hazaribagh, Jamtara, Koderma, Latehar, Palamu & Ranchi districts; fireclay in Dhanbad, Dumka, Giridih, Godda, Hazaribagh, Latehar, Palamu, Ranchi & West Singhbhum districts; gold in East Singhbhum district; graphite in Palamu district; iron ore (haematite) in West Singhbhum district; iron ore (magnetite) in Gumla, Hazaribagh, Latehar, Palamu & East Singhbhum districts; kyanite in Saraikela-Kharsawan & West Singhbhum districts; limestone in Bokaro, Dhanbad, Garhwa, Giridih, Hazaribagh, Palamu, Ranchi, East & West Singhbhum districts; manganese ore in East & West Singhbhum districts; mica in Giridih and Koderma districts; ochre in West Singhbhum district; dunite/pyroxenite in East Singhbhum district; quartz/silica sand in Deoghar, Dhanbad, Dumka, Giridih, Godda, Hazaribagh, Jamtara, Koderma, Latehar, Palamu, Ranchi, Sahebganj, Saraikela-Kharsawan & West Singhbhum districts; and quartzite in East & West Singhbhum districts.

Other minerals that occur in the State are andalusite and rock phosphate in Palamu district; apatite, chromite, cobalt, nickel, gold & silver in East Singhbhum district; asbestos in East & West Singhbhum districts; barytes in Palamu & East Singhbhum districts; bentonite in Pakur & Sahebganj districts; garnet in Hazaribagh district; granite in Deogarh, Dhanbad, Dumka, Giridih, Godda, Gumla, Hazaribagh, Koderma, Lohardaga, Palamu, Ranchi & East Singhbhum districts; sillimanite in Hazaribagh district; talc/steatite/soapstone in Giridih, Koderma, Palamu, East & West Singhbhum districts; pyrophyllite in Saraikela-Kharaswan district; titanium minerals in Ranchi and East Singhbhum districts; and vermiculite in Giridih & Hazaribagh districts (Table-1). The reserve/resources of coal and the various coalfields located in Jharkhand are furnished in Table – 2.

Production

Coal is the principal mineral item reporting production in the state. The other important minerals produced are Bauxite, Copper Ore & Concentrate, Iron Ore, Graphite (r.o.m.), etc. The value of minor minerals' production was estimated at ₹ 40 crore for the year 2022-23. There were 46 reporting mines in 2022-23 in case of MCDR of minerals. (Table – 3)

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the principal large and medium-scale mineral-based industries in the organised sector in the State are given in Table - 4.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020: Jharkhand

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Andalusite	'000 tonnes	-	11800	11800
Apatite	tonne	-	7270000	7270000
Asbestos	tonne	-	154893	154893
Bauxite	000 tonnes	39972	249272	289244
Chromite	000 tonnes	-	736	736
Cobalt	Million tonnes	-	9	9
Copper				
Ore	000 tonnes	9150	242313	251463
Metal	000 tonnes	107.45	2672.21	2779.66
Emerald	Kilogram	-	55869	55869
Garnet	tonne	-	110071	110071
Gold				
Ore (Primary)	tonne	-	10076527	10076527
Metal (Primary)	tonne	-	15.43	15.43
Graphite	tonne	2604079	17402288	20006367
Iron Ore (Heamatite)	000 tonnes	534677	4175469	4710146
Iron Ore (Magnetite)	000 tonnes	-	10667	10667
Kyanite	tonne	331193	7943367	8274560
Limestone	000 tonnes	10687	610078	620765
Manganese Ore	000 tonnes	1059	13691	14749
Nickel	Million tonnes	-	9	9
Potash	Million tonnes	-	152	152
Rare-earth Elements	tonne	-	4	4
Rock Phosphate	tonne	-	107370000	107370000
Sillimanite	tonne	-	83000	83000
Silver				
Ore	tonne	-	23840000	23840000
Metal	tonne	-	5.22	5.22
Titanium	tonne	-	26603767	26603767
Vermiculite	tonne	-	30048	30048

Figures rounded off.

Table – 2 : Reserves/Resources of Coal as on 1.4.2023: Jharkhand

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**5574 9**	**2699 4**	**509 5**	**8783 8**
Raniganj	1594	445	-	2039
Jharia	17735	1798	-	19533
East Bokaro	3977	3553	762	8292
West Bokaro	3923	1279	17	5218
Ramgarh	937	912	58	1906
North Karanpura	11774	6173	1865	19812
South Karanpura	6045	1267	1083	8394
Aurangabad	352	2142	503	2997
Hutar	191	27	32	250
Daltonganj	84	60	-	144
Deogarh	326	74	-	400
Rajmahal	8811	9267	774	18852

Source: Coal Directory of India, 2022-23

Table - 3 : Mineral Production in Jharkhand, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**46**	**-**	**30845510**	**47**	**-**	**58088511**	**46**	**-**	**58552207**
Coal	'000t	-	123428	-	-	130106	-	-	156483	-
Natural Gas (ut.) +	m c m	-	2	-	-	4	-	-	10	-
Bauxite	t	19	1497472	1607332	19	1808750	2352953	21	2214879	3145924
Copper Ore	t	-	41772	-	-	25834	-	-	53375	-
Copper Conc.	t	2	1208	23707	2	-	-	2	-	-
Gold Ore	t	-	2859	-	-	3682	-	-	8809	-
Gold	kg	1	11	53310	1	12	56268	1	22	119607
Iron Ore	'000t	17	21434	28520399	17	24728	55168902	14	23091	54869828
Graphite (r.o.m.)	t	3	5962	6069	4	54	59	2	12163	10616
Kyanite	t	-	-	-	1	2785	5152	1	2071	3832
Limestone	'000t	4	324	233245	3	72	103729	5	3	952
Minor Minerals @	t	-	-	401448	-	-	401448	-	-	401448

Note : The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
+ Coal-bed Methane
@ Figures for earlier years have been repeated as estimates because of non-receipt of data.

Table – 4 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Alumina Hindalco Industries Ltd, Muri.	450 KTPA
Asbestos Products	
Hyderabad Industries Ltd, Jasidih, Distt. Deogarh.	72
Cement	
ACC Ltd, Chaibasa, Distt. Singhbhum.	1200
ACC Ltd, Sindri, Distt. Dhanbad (G).	2500
Bokaro Cement Plant (formerly JV of Jaypee Cement & SAIL), Bokaro (G).	2100
Lafarge, Jojobera, Distt. Singhbhum.	4600
Burnpur Cement Patratu Ramgarh	300
Ceramic	
Maithan Ceramics Pvt. Ltd, Dhanbad.	80
Chemicals	
Bihar Caustic & Chemicals Ltd, Garhwa Road, Distt. Palamu.	92.75 (caustic soda lye)
Copper Smelter	
HCL, ICC, Ghatsila, Distt. Singhbhum (East).	19 (refined copper)
	20.5 (copper smelting)
	18.5 (copper cathode)
	84 (fabricated wire bar)
	54(H_2SO_4), 390 t ($NiSO_4$)
	480 kg ($CuSO_4$)
	14.6 kg (selenium)
	9868 kg (Ag), 698 kg (Au)
Foundry	
Grind chem, Adityapur	15 (Foundry fluxes)
Jharkhand Grid chem Pvt. Ltd, Adityapur, Gamharia	25 (Foundry fluxes)

Note: Data, not readily available for cement industries on respective websites, is taken from Survey of Cement Industry & Directory

Karnataka

Mineral Resources

Karnataka has the distinction of being the principal Gold producing State in the country. The State is the sole producer of felsite and one of the leading producers of Iron ore, Chromite, Dolomite, Dunite, Kyanite and Shale. Karnataka hosts the country's 79% Vanadium ore, 69% Iron ore (magnetite), 65% Corundum, 41% Tungsten ore, 36% Asbestos, 25% Limestone, 20% Gold ore (primary), 20% Granite (dimension stone), 25% Manganese ore, 17% Dunite, 12% Kyanite and 7% PGMs resources.

The important mineral-occurrence found in the State are bauxite in Belagavi, Chikkamagaluru, Uttara & Dakshina Kannada and Udupi districts; china clay in Bengaluru, Belagavi, Ballari, Bidar, Chikkamagaluru, Dharwad, Gadag, Hassan, Haveri, Kolar, Uttara & Dakshina Kannada, Shivamogga & Tumakuru districts; chromite in Chikkamagaluru, Hassan & Mysuru districts; dolomite in Bagalkot, Belagavi, Vijayapura, Chitradurga, Mysuru, Uttara Kannada and Tumakuru districts; dunite/pyroxenite in Chikkamagaluru, Hassan and Mysuru districts; feldspar in Bengaluru, Belagavi, Chitradurga & Hassan districts; fireclay in Bengaluru, Chitradurga, Dharwad, Hassan, Kolar, Shivamogga & Tumakuru districts; Gold in Chitradurga, Dharwad, Gadag, Kalaburagi, Hassan, Haveri, Kolar, Raichur & Tumakuru districts; Iron ore (haematite) in Bagalkot, Ballari, Vijayapura, Chikkamagaluru, Chitradurga, Dharwad, Gadag, Uttara Kannada, Shivamogga & Tumakuru districts; Iron ore (magnetite) in Chikkamagaluru, Hassan, Uttara & Dakshina Kannada and Shivamogga districts; kyanite in Chikkamagaluru, Chitradurga, Coorg, Mandya, Mysuru, Shivamogga & Dakshina Kannada districts; Limestone in Bagalkot, Belagavi, Ballari, Vijayapura, Chikkamagaluru, Chitradurga, Davangere, Gadag, Kalaburagi, Hassan, Mysuru, Uttara & Dakshina Kannada, Shivamogga, Tumakuru & Udupi districts; magnesite in Coorg, Mandya & Mysuru districts; manganese ore in Belagavi, Ballari, Chikkamagaluru, Chitradurga, Davangere, Uttara Kannada, Shivamogga & Tumakuru districts; ochre in Ballari and Bidar districts; quartz/silica sand in Bagalkot, Bengaluru, Belagavi, Ballari, Chikkamagaluru, Chitradurga, Davangere, Dharwad, Gadag, Kalaburagi, Hassan, Haveri, Kolar, Koppal, Mandya, Mysuru, Uttara & Dakshina Kannada, Raichur, Shivamogga, Tumakuru & Udupi districts; Quartzite in Belagavi district; & talc/steatite/soapstone in Ballari, Chikkamagaluru, Chitradurga, Hassan, Mandya, Mysuru, Raichur & Tumakuru districts.

Other minerals that occur in the state are asbestos in Chikkamagaluru, Hassan, Mandya, Mysuru and Shivamogga districts; barytes & pyrite in Chitradurga district; calcite in Belagavi, Vijayapura & Mysuru districts; copper in Chikkamagaluru, Chitradurga, Kalaburagi, Hassan, Uttara Kannada, Raichur & Shivamogga districts; corundum in Bengaluru, Ballari, Chitradurga, Kodagu, Hassan, Mandya, Mysuru & Tumakuru districts; fuller's earth in Belagavi & Kalaburagi districts; granite in Bagalkot, Bengaluru, Bellari, Vijayapura, Chamrajanagar, Chikkamagaluru, Chitradurga, Kodagu, Dharwad, Gadag, Kalaburagi, Hassan, Kolar, Koppal, Mandya, Mysuru, Uttara & Dakshina Kannada, Raichur, Tumakuru & Udupi districts; graphite in Kolar & Mysuru districts; gypsum in Kalaburagi district; molybdenum in Kolar & Raichur districts; nickel in Uttara Kannada district; Platinum Group of Metals in Davangere district; sillimanite in Hassan, Mysuru & Dakshina Kannada districts; silver in Chitradurga & Raichur districts; titanium minerals in Hassan, Uttara Kannada & Shivamogga districts; tungsten in Gadag, Kolar & Raichur districts; vanadium in Hassan, Uttara Kannada & Shivamogga districts; and vermiculite in Hassan, Mandya & Mysuru districts (Table-1).

Production

Gold ore and bullion (metal), Iron Ore, Manganese ore, Limestone, and Magnesite are the important minerals produced in Karnataka State. The value of minor minerals' production was estimated at ₹ 746 crore for the year 2022-23. There were 134 reporting mines in 2022-23 in case of MCDR of minerals (Table-2).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the important mineral-based industries in organised sector in the State are given in Table-3.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020: Karnataka

Mineral	Unit	Reserves				Remaining Resources								Total Resources (A+B)
		Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
		STD 111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Asbestos	tonne	0	0	0	0	0	0	0	0	2441037	5841420	0	8282457	8282457
Bauxite	'000 tonnes	126	194	4887	5207	2468	864	88	82	2220	35520	0	41242	46449
Chromite	'000 tonnes	176	0	323	499	474	378	54	0	20	392	0	1317	1817
Copper														
Ore	'000 tonnes	0	0	0	0	867	1301	3114	1750	6833	27634	0	41499	41499
Metal	'000 tonnes	0	0	0	0	0	0	15.28	22	65.77	142.81	0	245.86	245.86
Gold														
Ore (Primary)	tonne	17050000	3420000	0	20470000	2013000	1964000	174000	4304968	46495718	21773820	5813000	82538506	103008506
Metal (Primary)	tonne	74.02	13.44	0	87.46	5.06	5.12	0.64	14.13	44.17	48.91	45.68	163.71	251.17
Graphite	tonne	0	0	0	0	203673	30600	48821	0	41605	667933	0	992632	992632
Iron Ore(Heamatite)	'000 tonnes	897256	39779	106177	1043212	330334	46621	84816	592180	62882	504234	171714	1792781	2835992
Iron Ore(Magnetite)	'000 tonnes	133	185	0	318	120131	0	18375	1498957	479372	5345018	340000	7801853	7802171
Kyanite	tonne	181600	0	0	181600	230660	15930	119368	386247	1610502	10628753	0	12991460	13173060
Limestone	'000 tonnes	1766001	2013	503208	2271221	584131	522239	778646	1776165	15091800	35135248	11008	53899236	56170457
Magnesite	'000 tonnes	997	30	0	1027	802	247	270	88	10	2834	264	4516	5543
Manganese Ore	'000 tonnes	15363	0	101	15464	14723	2373	9604	18700	7306	55471	329	108508	123972
Molybdenum														
Ore	tonne	0	0	0	0	0	0	0	0	0	1320900	0	1320900	1320900
Contained MoS_2	tonne	0	0	0	0	0	0	0	0	0	1718.7	0	1718.7	1718.7
Nickel Ore	Million tonnes	0	0	0	0	0	0	0	0	0	0.23	0	0.23	0.23
Pt. Group Of Metals	tonne	0	0	0	0	0	0	0	0	0	0	1.5	1.5	1.5
Pyrite	'000 tonnes	0	0	0	0	0	0	0	0	0	3000	0	3000	3000
Rare-earth Elements	tonne	0	0	0	0	0	0	0	0	0	3350	384	3734	3734
Sillimanite	tonne	0	0	0	0	0	0	0	0	0	982725	0	982725	982725
Silver														
Ore	tonne	17480000	4640000	0	22120000	0	0	69462	0	1490000	2254150	0	3813612	25933612

Mineral	Unit	Reserves				Remaining Resources								Total Resources (A+B)
		Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
		STD 111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Metal	tonne	4.43	1	0	5.43	0	0	0.48	0	0.39	3.42	0	4.29	9.72
Titanium	tonne	0	0	0	0	0	0	0	0	0	13862094	0	13862094	13862094
Tungsten														
Ore	tonne	0	0	0	0	0	0	0	15361152	11805499	172921	9338246	36677818	36677818
Contained WO_3	tonne	0	0	0	0	0	0	0	2915	1775	142	1403	6235	6235
Vanadium														
Ore	tonne	0	0	0	0	0	500000	4000000	0	0	14884430	0	19384430	19384430
Contained V_2O_5	tonne	0	0	0	0	0	700	5600	0	0	43197.55	0	49497.55	49497.55
Vermiculite	tonne	0	0	0	0	28000	50520	15500	0	1562	66658	0	162240	162240

Figures rounded off

Table –2: Mineral Production in Karnataka, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**141**		**127485054**	**132**		**200317967**	**134**		**141694807**
Chromite	t	2	-	-	2	-	-	-	-	-
Gold Ore	t	-	434810	-	-	470456	-	-	593677	-
Gold	kg	3	1116	5422160	4	1395	6704750	4	1411	7535031
Iron Ore	'000t	65	34500	94390860	56	40333	160324539	54	39821	116250944
Manganese Ore	t	9	371045	2359787	8	380004	3167390	10	344731	2553838
Silver #	kg	-	120	7244	-	143	11503	-	148	9299
Graphite (r.o.m.)*	t	2	-	-	2	-	-	1	-	-
Kyanite	t	1	3780	7397	1	5075	9084	1	360	644
Limestone	'000t	54	33188	6095069	54	39395	7893558	58	38942	7817554
Limeshell	t	-	-	-	1	100	231	2	250	658
Magnesite	t	4	6611	39237	3	7057	51412	3	8197	64413
Vermiculite*	t	1	-	-	1	-	-	1	-	-
Minor Minerals		-	-	19163300	-	-	22155500	-	-	7462426

Note : The number of mines excludes minor minerals.
 # Recovered at Raichur & Tumkur during refining of gold.
** Only labour reported.*

Table – 3 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Abrasives	
Grindwell Norton Ltd, Bengaluru.	NA
Alumina	
Hindalco Industries Ltd, Belagavi	350 (alumina)
	40(paste)
	0.090(Vanadium)
Cement	
ACC Ltd, Wadi (Wadi & Wadi New), Distt. Kalaburagi	5450
ACC Ltd, Kudithini, Ballari (G).	1100
ACC Ltd, Thondebhavi, Distt. Chikaballapur (G).	1660
Bagalkot Cement Industries Ltd, Distt. Bagalkot.	600
Chettinad Cement, Kallur, Distt. Kalaburagi.	2500
Dalmia Cement, Yadwad, Distt. Belagavi	4000
	2600(Clinker)
Heidelberg Cement India Ltd, (Formerly Mysore Cements Ltd) Ammasandra, Distt. Tumakuru.	510
J. K. Cement Ltd, Muddapur, Distt. Bagalkot	3000
JSW Cement, Vijaynagar, Distt. Ballari.	3200
Kesoram Industries, Vasavadatta Cement, Sedam, Distt. Kalaburagi	8565(OPC)
	8565(PPC)
Kalaburagi Cement Pvt Ltd (formerly Viratsagar) Gulbargha, Distt. Kalaburagi	2750
Kalaburagi Cement Pvt Ltd Karchikhed, Chincholi	3500
	2750 (Clinker)
Orient Cement Ltd.Itagi, Chittapur	3000
Ramco Cement Ltd, Mathodu, Distt. Chitradurga.	290

Table- 4 (Cont.)

Industry/plant	Capacity ('000 tpy)
Shree Cement Ltd.Benekanahalli, Kodla Sedam, Kalaburagi	3000
Ultratech Cement, Raj Shree Cement, Malkhed, Distt. Kalaburagi.	6100
Ultratech Cement, Ginigera, Distt. Koppal [(G)].	1300
Orient Cement Chittapur, Kalaburagi	3000
Ceramic	
Ceramic Products Ltd, Khanapur, Distt. Belagavi.	NA
H&R Johnson (India) Ltd, Hubballi.	47.72
Murudeshwar Ceramics Ltd, Dharwad.	8.4 mill.sqm
The Mysore Spongware Pipes Potteries Ltd, Solandavanahalli, Bengaluru.	NA
Chemical	
Solaris Chem Tech Industries Ltd,	59.4 (caustic
Bhinga, Distt. Uttara Kannada.	soda), 52.3 (Cl),
	133.7 (HCl)
	24.0 (H_3PO_4)
Magnesium & aallied Product Hurugalavadi , Mandya	3 (Magnesium
	Carbonate)
	1.875 (Magnesium Oxide)
Shivam Minerals , Honaga Belgaum	4.6(Magnesium
	Carbonate)
	4.6 (Magnesium Oxide)
K. P. R. Fertilizers Ltd Halvarthi, Koppal.	60 (SSP)
Mangalore Chemical & Fertilizers Ltd, Panambur, Mangaluru.	379.5 (Urea)
	260 (DAP)
	40 (Complex)
Tungabhadra Fertilizers & Chemicals Ltd, Munirabad, Koppal.	45 (SSP)
Iron & Steel	**12100 (pig iron)**
JSW Steel Ltd, Tornagallu Sandur Distt. Ballari	9200 (pellets)
	12000 (crude/liquid steel)
	12950 (sinter)
	4618(Coke)
Visvesvaraya Iron & Steel Ltd,	205 (pig iron)
Bhadravati, Distt. Shivamogga.	118(crude/liquid steel)
4.8 (refractory bricks)	
Sunvik Steels Pvt. Ltd,	60 (sponge iron)
Jodidevarahally, Distt. Tumakuru.	60 (TMT bar)
	36(-------)
Pellets	
BMM Ispat, Danapur, Distt. Ballari.	2400 (pellets)
KIOCL, Mangaluru	3500 (pellets)
	6700 (conc.)
Minera Steel & Power Pvt. ltd., Sandur	600
SLR Metalliks Ltd. Narayan	343.2(Sinter)
Devera Kera Hagari Bommanahalli	
Xindia Steel, Koppal.	800 (pellets)
Pig Iron	
Uni-Metal Ispat Ltd, Ballari.	75
Kalyani Ferrous Ind. Ltd, Koppal	500(Sinter)
	289.6
Kirloskar Ferrous Industries Ltd, Bevinahalli, Distt. Koppal.	500 (Sinter)
	720

Table- 4 (Concld.)

Industry/plant	Capacity ('000 tpy)
Mukund limited, Ginigera, Kopopal	500 (Sinter)
	410.3
Sponge Iron	
Agrawal Sponge & Energy (P) Ltd, Kuduthini, Distt. Ballari.	90
Balakundi Premium Steels Pvt. Ltd, Halakundi, Distt. Ballari.	34
Bellary Ispat (P) Ltd, Halakundi Distt. Ballari.	52.5
Ballary Steel & Alloys Ltd, Ballari.	60
Benaka Sponge Iron Pvt. Ltd, Belagal, Distt. Ballari.	84
BMM Ispat Ltd., Danapur	600
	2400 (pellet)
BRU Industries, Anekal Taluk	1.2 (cast Iron)
Dhruvdesh Metasteel Pvt. Ltd, Hirebaganal, Distt. Koppal.	72
Divya Jyoti Steel Ltd, Taranagar, Distt. Ballari.	30
Gayatri Metals Pvt Ltd, Belagal, Distt. Ballari.	5000
Hindustan Calcined Metal Pvt. Ltd., Janekunnte, Ballari	60
Jairaj Ispat Limited Belagal village	60
Haryana Steel and Power, Shanthigrama, Distt. Hassan.	35
Hare Krishna Metallics Pvt Ltd, Hire Baganal, Distt. Koppal.	144
Hospet Ispat Pvt. Ltd,	60
Allanagar Bagnal Road, Distt. Koppal.	
Hothur Ispat Pvt. Ltd, Veniveerpur, Distt. Ballari.	300 TPD
Minera Steel & Power Pvt. Ltd, Yerabanahally, Distt. Ballari.	120
M.S.Metals & Steels PVT. Ltd. Hirebagnal Koppal	105
	109.5(TMT Bars)
Noble Distillaries & Powers Ltd,	200 TPD
PGM Ferro Steel Pvt. Ltd, Hariganadani, Distt. Ballari.	60
Popuri Steels Ltd, Halakundi, Distt. Ballari.	30
Padmawati Ferrous Metal, Chikantpur Sandur, Ballari.	150
Rayon Steel Pvt Ltd, Veniverapur, Distt. Ballari.	60
Rengineni Steel Pvt. Ltd, Halakundi, Distt. Ballari.	25.5
Shree Venkteshwara Sponge & Power Ltd, Halakundi, Distt. Ballari.	60
Yashshvi Steel & Alloys Ltd, Halakundi, Distt. Ballari.	30
Ferro Alloys	
Ani Smelters Yaradakatla, Hariyur	1.5
Dandeli Steel & Ferro Alloys Ltd, Dandeli.	6
Padmawati Ferrous Metal, Chikantpur, Ballari	30
	5 (Ferro - manganese)
	5 (Silico-manganse)
	2 (Ferro-silicon)
Sandur Manganese & Iron Ore Ltd, Mariyammanahalli Hospet	36 (SiMn)
Refractories	
T. S.Ranganath & Company, Keshavapurahuliyar, Chikkanayakanahalli	1.0 (Clay tiles & Block)
S.R. Chemicals & Ferro Alloys Ltd, Honaga, Distt. Belagavi.	0.3
Thermit Alloys Pvt. Ltd, Shivamogga.	1.2
Petroleum Refinery	
MRPL, Mangaluru.	15000

G; Grinding Unit
Note: Data for fertilizer and cement industries is taken from Indian Fertilizer Scenario, FAI Statistics, and Survey of Cement Industry & Directory, respectively.

Kerala

Mineral Resources

Kerala is well-known for its deposits of excellent quality china clay and beach sands containing valuable minerals like ilmenite, rutile, sillimanite, zircon, garnet, leucoxene and monazite. The State is the principal producer of limeshell and sillimanite. The State also accounts for 23% china clay and 10% sillimanite of the country's resources. As per AMDER of the Department of Atomic Energy, Kerala state accounts for 144.02 million tonnes of ilmenite, 7.83 million tonnes of rutile and 7.96 million tonnes of zircon resources.

Important mineral occurrences in the State are: bauxite in Kannur, Kasaragod, Kollam & Thiruvananthapuram districts; china clay in Alappuzha, Ernakulam, Kannur, Kasaragod, Kollam, Kottayam, Palakkad, Thiruvananthapuram & Thrissur districts; limestone in Alappuzha, Ernakulam, Kannur, Kollam, Kottayam, Kozhikode, Malappuram, Palakkad & Thrissur districts; quartz/silica sand in Alappuzha, Kasargod, Thiruvananthapuram & Wayanad districts; sillimanite in Kollam & Thiruvananthapuram districts; and titanium minerals in Kasaragod, Kollam, Pathanamthitta & Thiruvananthapuram districts.

Other minerals that occur in the State are fire clay in Alappuzha, Ernakulam, Kannur & Kollam districts; garnet in Kollam & Thiruvananthapuram districts; gold in Malappuram & Palakkad districts; granite in Palakkad & Thiruvananthapuram districts; graphite in Ernakulam, Idukki, Kollam, Kottayam & Thiruvananthapuram districts; iron ore (magnetite) in Kozhikode & Malappuram districts; kyanite in Kollam & Thiruvanantha-puram districts; lignite in Kannur districts; magnesite in Palakkad district; and steatite in Kannur & Wayanad districts (Tables - 1&2).

Production

Limestone is the only important minerals produced in Kerala State. The value of minor minerals' production was estimated as ₹ 3867 crores for the year 2022-23. There was only one reporting mine in 2022-23 in case of MCDR minerals (Table -3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the important mineral-based industries in organised sector in the State are given in Table - 4.

Table – 1: Reserves/Resources of Minerals as on 1.4.2020 (P) : Kerala

Mineral	Unit	Reserves				Remaining Resources								Total Resources (A+B)
		Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
		STD 111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Bauxite	'000 tonnes	0	0	0	0	29	0	24	2037	14637	2722	0	19449	19449
Garnet	tonne	0	0	0	0	0	0	45797	100874	0	52190	0	198861	198861
Gold														
Ore (Primary)	tonne	0	0	0	0	0	0	0	462280	96180	0	0	558460	558460
Metal (Primary)	tonne	0	0	0	0	0	0	0	0.17	0.03	0	0	0.2	0.2
Ore (Placer)	tonne	0	0	0	0	0	0	0	0	2552000	23569000	0	26121000	26121000
Metal (Placer)	tonne	0	0	0	0	0	0	0	0	2.29	3.57	0	5.86	5.86
Graphite	tonne	0	0	15443	15443	0	8376	0	0	1088550	322606	0	1419532	1434975
Iron Ore(Magnetite)	'000 tonnes	0	0	0	0	0	0	0	0	59912	23523	0	83435	83435
Kyanite	tonne	0	0	0	0	0	0	0	174733	0	10000	0	184733	184733
Limestone	'000 tonnes	10475	0	65	10540	123286	103	0	21161	2888	36622	0	184059	194599
Magnesite	'000 tonnes	0	0	0	0	0	0	0	2	0	38	0	40	40
Pt. Group Of Metals	tonne	0	0	0	0	0	0	0	0	0	0.18	0	0.18	0.18
Sillimanite	tonne	553000	0	0	553000	432713	0	0	2564254	0	3369200	0	6366167	6919167
Titanium	tonne	2370712	0	0	2370712	10597943	0	0	0	19961000	87048716	0	117607659	119978371
Zircon	tonne	156509	0	0	156509	400650	0	0	123426	0	716279	0	1240355	1396864

Figures rounded off

Table –2 : Reserves/Resources of Lignite as on 1.4.2023 : Kerala

(In million tonnes)

District	Proved	Indicated	Inferred	Total
Total/Kannur	**–**	**–**	**9.65**	**9.65**

Source: Coal Directory of India, 2022-23.

Table–3 : Mineral Production in Kerala, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value[$]	No. of mines	Quantity	Value	No. of mines	Quantity	Value
All Minerals		**1**		**16486191**	**1**		**34112169**	**1**		**38987694**
Limestone	'000t	1	376	331191	1	379	370969	1	347	318457
Sulphur [#]	t	-	142166	-	-	182352	-	-	182398	-
Minor Minerals		-	-	16155000	-	-	33741200	-	-	38669237

Note : The number of mines excludes minor minerals.
 # Recovered as by-product from oil refinery.

Table – 4 : Principal Mineral-based Industries

2018-19 to 2022-23

Industry/plant	Capacity ('000 tpy)
Abrasives	
Carborandum Universal Ltd, Ernakulam	NA
Carborandum Universal Ltd, Thrissur	NA
Carborandum Universal Ltd, Pattanamthitta	NA
Asbestos Products	
Hyderabad Industries Ltd (formerly, Malabar Building Products Ltd) Mulagunnathukavu, Diat. Thrissur	84
Cement	
J K Tex Coats Nadama, Kanayannur	0.030 (Cerastone)
	0.025 (Rock tiles)
	0.35 (Others)
Malabar Cements, Walayar, Distt. Palakkad	660
Malabar Cement, Cherthala, Distt. Alappuzha (G)	200
The Travancore Cements Ltd, Nattakom, Distt. Kottayam	81
Ceramic	
Kerala Ceramics Ltd, Kundara, Distt. Kollam	18000
Tata Ceramics, Kozhikode	NA
FACR-RCF Building Product Ltd (FRBL), Kochi.	NA
Chemical	
Tecil Chemicals and Hydro Power Ltd, Chingavanam, Distt. Kottayam	30 (calcium carbide)
	2 (acetylene black)
	7.5 (ferrosilicon)
Cochin Minerals and Rutile Ltd, Kadungalloor, Alwaye	50 (Synthetic Rutile)
	82.5 (Ferrous cloride)
	30 (Ferric cloride)
	8 (Recovered Tio_2)
	6 (Recovered Upgraded Ilmenite)
Electrode	
Super Electrode, Patlla	0.6

Industry/plant	Capacity ('000 tpy)
Synthetic Rutile	
CMRL, Edayar, Distt. Ernakulam	50
KMML, Chavara, Distt. Kollam	50
TiO_2 Pigment	
TTPL, Kochuveli, Distt. Thiruvananthapuram	1.8
KMML, Chavara, Distt. Kollam	40
Fertilizer	
FACT Ltd, Udyogmandal, Distt. Ernakulam	148.5 (Complex)
	225 (AS)
FACT Ltd, Ambalamedu (Cochin II), Distt. Ernakulam	485 (NP/NPKs)
Ferro-alloys	
INDSIL Electrosmelts Ltd, Pallatheri, Distt. Palakkad.	14
The Silcal Metallurgic Ltd, Wayalur.	3.6
Foundry	
HMT Machine Tools Ltd, Bengaluru.	1500
Glass	
Excel Glass Ltd, Pathirapally, Distt. Alappuzha.	72
Lead-Zinc	
BZL Zinc Ltd, Binanipuram. (Edayar Zinc Ltd)	38 (Zn ingot)
	0.08 (Cd ingot)
	50 (H_2SO_4)
Petroleum Refinery	
BPCL, Kochi.	12400

Note:Data for Fertilizer Industries is taken from Indian Fertilizer Scenario, FAI Statistics.

Madhya Pradesh

Mineral Resources

Madhya Pradesh is the only diamond producing State in the country and is the leading producer of copper conc., diaspore, pyrophyllite, manganese ore, limestone and clay (others). The State accounts for the country's 90% diamond, 74% diaspore, 55% laterite, 48% pyrophyllite, 41% molybdenum, 27% dolomite, 19% copper ore, 18% fireclay, 12% manganese and 8% rock phosphate ore resources.

Important mineral occurrences in the State are: bauxite in Balaghat, Guna, Jabalpur, Katni, Mandla, Rewa, Satna, Shahdol, Shivpuri, Sidhi & Vidisha districts; calcite in Barwani, Jhabua, Khandwa & Khargone districts; china clay in Betul, Chhatarpur, Chhindwara, Gwalior, Hoshangabad, Jabalpur, Khargone, Narsinghpur, Raisen, Satna, Shahdol & Sidhi districts; copper in Balaghat, Betul & Jabalpur districts; coal in Betul, Shahdol & Sidhi districts; diamond in Panna district; diaspore & pyrophyllite in Chhatarpur, Shivpuri & Tikamgarh districts; dolomite in Balaghat, Chhindwara, Damoh, Dewas, Harda, Hoshangabad, Jabalpur, Jhabua, Katni, Mandla, Narsinghpur, Sagar & Seoni districts; fireclay in Betul, Chhindwara, Jabalpur, Katni, Narsinghpur, Panna, Sagar, Shahdol & Sidhi districts; iron ore (haematite) in Betul, Gwalior, Jabalpur & Katni districts; limestone in Balaghat, Chhindwara, Damoh, Dhar, Hoshangabad, Jabalpur, Jhabua, Khargone, Katni, Mandsaur, Morena, Narsinghpur, Neemach, Rewa, Sagar, Satna, Sehore, Shahdol & Sidhi districts; manganese ore in Balaghat and Jhabua districts; ochre in Dhar, Gwalior, Jabalpur, Katni, Mandla, Rewa, Satna, Shahdol & Umaria districts; pyrophyllite in Chhatarpur, Sagar, Shivpuri & Tikamgarh districts; quartz/silica sand in Balaghat, Dewas, Dhar, Jabalpur, Khandwa, Khargone, Morena, Rewa & Shahdol districts; talc/steatite/soapstone in Dhar, Jabalpur, Jhabua, Katni, Narsinghpur & Sagar districts and vermiculite in Jhabua district.

Other minerals that occur in the State are: barytes in Dewas, Dhar, Shivpuri, Sidhi & Tikamgarh districts; calcareous shales (used in slate pencil) in Mandsaur district; felspar in Jabalpur & Shahdol districts; fuller's earth in Mandla district; gold in Jabalpur & Sidhi districts; granite in Betul, Chhatarpur, Chhindwara, Datia, Jhabua, Panna, Seoni & Shivpuri districts; graphite in Betul & Sidhi districts; gypsum in Shahdol district; lead-zinc in Betul district; molybdenum in Balaghat district; potash in Panna district; quartzite in Sehore district; rock phosphate in Chhatarpur, Jhabua & Sagar districts; and sillimanite in Sidhi district (Table - 1). The reserves/resources of coal along with various coalfields in Madhya Pradesh are furnished in Table - 2.

Production

Madhya Pradesh is the sole producer state of diamond. Apart from this, coal, bauxite, copper ore & concentrate, iron ore, manganese ore, phosphorite and limestone are the principal minerals produced in Madhya Pradesh State. The value of minor minerals' production was estimated at ₹ 5,728 crore for the year 2022-23. There were 287 reporting mines in 2022-23 in case of MCDR of minerals. The details of mineral production in the State are shown in Table - 3.

Mineral-based Industry

The present status of each Mineral-based Industry is not readily available. However, the important large and medium-scale mineral-based industries in the Organised Sector in the State are furnished in Table-4.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020: Madhya Pradesh

Mineral	Unit	Reserves	Remaining resources	Total Resources
Antimony				
Ore	tonne	7503	592	8095
Metal	tonne	75	5.92	80.92
Bauxite	'000 tonnes	18564	167695	186259
Copper				
Ore	'000 tonnes	120353	266312	386665
Metal	'000 tonnes	1571.04	2095.82	3666.86
Diamond	carat	847559	27749477	28597036
Gold				
Ore (Primary)	tonne	-	7692934	7692934
Metal (Primary)	tonne	-	8.25	8.25
Graphite	tonne	-	12640000	12640000
Iron Ore (Haematite)	'000 tonnes	54129	302870	356999
Lead-Zinc				
Ore	'000 tonnes	-	19067	19067
Lead Metal	'000 tonnes	-	36.29	36.29
Zinc Metal	'000 tonnes	-	470.53	470.53
Limestone	'000 tonnes	1692431	7960747	9653178
Manganese Ore	'000 tonnes	19558	40499	60057
Molybdenum				
Ore	tonne	-	8000000	8000000
Contained MoS_2	tonne	-	5020	5020
Potash	Million tonnes	-	1244	1244
Rock Phosphate	tonne	9031093	49425938	58457031
Sillimanite	tonne	-	101600	101600
Silver				
Ore	tonne	-	3216000	3216000
Metal	tonne	-	159.86	159.86
Vermiculite	tonne	-	329	329

Figures rounded off

Table – 2 : Reserves/Resources of Coal as on 1.4.2021 : Madhya Pradesh

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**15279**	**12457**	**4482**	**32219**
Johilla	185	263	33	481
Umaria	178	4	-	181
Pench-Kanhan	2112	923	1903	4938
Pathakhera	291	88	68	447
Gurgunda	-	85	53	138
Mohpani	8	-	-	8
Sohagpur	3484	5071	278	8833
Singrauli	9021	6024	2147	17192

Source: Coal Directory of India, 2022-23

Table 3: Mineral Production in Madhya Pradesh, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**241**		**63585432**	**263**		**96543530**	**287**		**90890478**
Coal	'000t	-	132531	-	-	137975	-	-	146029	-
Natural Gas (ut.) +	m c m	-	334	-	-	290	-	-	264	-
Bauxite	t	21	632385	479818	18	608848	486524	23	601911	598061
Copper Ore	t	-	2239152	-	-	2442459	-	-	2165042	-
Copper Conc.	t	1	64920	5137695	1	65914	5560337	1	63860	6423658
Iron Ore	'000t	21	4094	2146870	23	7375	4727826	26	4354	2509988
Manganese Ore	t	47	934548	5684482	46	845351	6842478	50	855874	7491347
Phosphorite	t	5	97880	92007	6	113730	111393	6	444985	482205
Diamond	crt	2	13917	147696	3	266	18051	3	388	61473
Limestone	'000t	144	46099	12879609	166	49807	15833338	178	50591	16041163
Minor Minerals		-	-	37017255	-	-	62963583	-	-	57282583

Note : The number of mines excludes fuel mineral & minor minerals.
** Excludes the value of fuel minerals.*
+ Coal Bed Methane

Table – 4 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Aluminium/Alumina	
Hindalco Industries Ltd, Mahan	360 (Aluminium)
Aluminium, Bargwan, Distt Singrauli	
Asbestos Products	
Everest Building Products Ltd, Kymore	NA
Kalani Industries Pvt. Ltd, Pitampur, Dhar	NA
Ramco Industries Ltd, Maksi, Distt Shajapur	NA
Calcined Lime	
Rekha Harlalka, Jukehi, Maihar	11
Padampani Tripathi, Mamalime Industries	9.6
Rajarwara, Katni	
Cement	
ACC Ltd, Kymore, Distt Katni	2720
Bhilai Jaypee Cement Ltd, Babupur, Satna	1300
Birla Corpn. Ltd, (Satna Cement Works &	2200
Birla Vikas Cement), Satna	
Birla Coorporation Ltd, (Erstwhile Reliance	3000
Cement Pvt. Ltd, Maihar, Distt Satna	
Century Textiles & Ind. Ltd, Maihar Cement,	4200
Maihar (unit I&II), Distt Satna	
Heidelberg Cement (I) Ltd, Narsingarh,	2000
Distt Damoh	
Jaiprakash Power Ventures, Singrauli (G)	2000
Jaypee Rewa Cement Plant, Distt Rewa	2500
Jaypee Bela Cement Plant, Distt Rewa	2600
KJS Cement, Rajnagar, Distt Satna	2200
Prism Cement Ltd, (Unit I & II), Satna	6600

Table- 4 (Cont.)

Industry/plant	Capacity ('000 tpy)
Satguru Cement Pvt. Ltd, Ghursal, Gandhawani	95
UltraTech Cement Ltd, Sidhee	2300
UltraTech Cement, Dhar Cement Plant,	3500
Tonki, Temarni sounul, Golpura Manawar	
UltraTech Cement, Vikram Cement Plant,	4500 (OPC)
Khor, Distt Neemuch	4500 (PPC)
UltraTech Cement Ltd, Majhigawan,	3000
Rampur Naikin	
Ceramic	
Roca Bathroom Products Ltd, Dewas	NA
Govind Tiles Pvt. Ltd, Garra, Distt Balaghat	NA
Calcined lime	
Som lime work, Jukehi, Katni	21.6
Jai Mata lime Industries Pathra, Katni	15.2
Dharampal Industries Pathra, Katni	6
Sampuran Singh Saluja Patra, Katni	6.07
Fertilizer	
Agro Phos. (India) Ltd, Dewas	45 (SSP)
Arihant Ferts. & Chems. India Ltd,	66 (SSP)
Kanawati, Neemuch	
Basant Agro Tech (India) Ltd, Jawad, Neemuch	45 (SSP)
Coromandel International Ltd, (Formerly,	100 (SSP)
Liberty Urvarak Ltd,), Nirmani Khargone	
Indra Industries Ltd, (Formerly, Swastik Ferts &	66 (SSP)
Chems Ltd,), Indore, Dhar	
KMN Chemicals & Fertilizers Ltd,	60 (SSP)
Diwanganj, Raisen	
Khaitan Chemical & Fertilizers Ltd,	400 (SSP)
Nimrani, Distt Khargone	115.5 (H_2SO_4)
NFL, Vijaipur (Unit I & II), Distt Guna	2066.1 (Urea)
Krishna Phoschem Ltd, Meghnagar, Jhabua	120 (SSP)
Madhya Bharat Agro Products Ltd, Rajoa, Sagar	60 (SSP)
Madhya Bharat Phosphate Pvt. Ltd, (Unit I),	132 (SSP)
Diwanganj, Sanchi, Raisen	
Madhya Bharat Phosphate Pvt. Ltd, (Unit II),	165 (SSP)
Meghnagar, Jhabua	
Mexican Agro Chemical Ltd, (Formerly, Asha	60 (SSP)
Phosphates Ltd,), Jaggakhedi, Mandsaur	
Mukteswar Fertilizers Ltd, Narayankhedi, Ujjain.	60 (SSP)
Rama Phosphates Ltd, Indore	250 (SSP)
	102 (H_2SO_4)
Suman Phosphates and Chemicals Ltd, Indore	330 (SSP)
Varun Fertilizers Pvt. Ltd, Dewas	100 (SSP)
Ferroalloys	
Crescent Alloys Pvt. Ltd, Seoni	4.5
Jalan Ispat Castings Ltd, Meghnagar, Distt Jhabua	12
MOIL Ferro Manganese Plant, Bharveli,	10
Distt Balaghat	
Petroleum Refinery	
Bharat Oman Refineries Ltd, Bina, Distt Sagar	6000

Table- 4 (Concld.)

Industry/plant	Capacity ('000 tpy)
Refractory	
ACC Refractories, Katni	65
Calderys India Refractories Limited	78
Katni Refractory Works, Katni	30 (Binder)
Murwara	9 (Grout)
Mahakoshal Refractories Pvt. Ltd, Katni	61.09
Mahakoshal Refractories Pvt. Ltd, Gudri, Bohariband	31
Premier Refractories India Pvt. Ltd, Katni.	50

G; Grinding Unit

Note: Data not readily available on respective websites, therefore taken from IMYB2022.

Maharashtra

Mineral Resources

Maharashtra is the sole producer of fluorite (graded) and the principal producer of bauxite, kyanite, manganese ore, quartzite and sand (others). The principal mineral-bearing belts in Maharashtra are Vidarbha area in the east and Konkan area in the west. Important mineral occurrences are: bauxite in Kolhapur, Raigad, Ratnagiri, Satara, Sindhudurg & Thane districts; china clay in Amravati, Bhandara, Chandrapur, Nagpur, Sindhudurg & Thane districts; chromite in Bhandara, Chandrapur, Nagpur & Sindhudurg districts; coal in Nagpur, Chandrapur & Yavatmal districts; dolomite in Chandrapur, Nagpur & Yavatmal districts; fireclay in Amravati, Chandrapur, Nagpur & Ratnagiri districts; fluorite & shale in Chandrapur district; iron ore (haematite) in Chandrapur, Gadchiroli & Sindhudurg districts; iron ore (magnetite) in Gondia district; kyanite in Bhandara & Nagpur districts; laterite in Kolhapur district; limestone in Ahmednagar, Chandrapur, Dhule, Gadchiroli, Nagpur, Nanded, Pune, Sangli & Yavatmal districts; manganese ore in Bhandara, Nagpur & Ratnagiri districts; corundum & pyrophyllite in Bhandara district; quartz & silica sand in Bhandara, Chandrapur, Gadchiroli, Gondia, Kolhapur, Nagpur, Ratnagiri & Sindhudurg districts; quartzite in Gondia & Nagpur districts; and sillimanite in Chandrapur district.

Other minerals that occur in the State are: barytes in Chandrapur & Gadchiroli districts; copper in Bhandara, Chandrapur, Gadchiroli & Nagpur districts; felspar in Sindhudurg district; gold in Bhandara & Nagpur districts; granite in Bhandara, Chandrapur, Dhule, Gadchiroli, Nagpur, Nanded, Nashik, Sindhudurg & Thane districts; graphite & mica in Sindhudurg district; lead-zinc & tungsten in Nagpur district; marble in Bhandara & Nagpur districts; ochre in Chandrapur & Nagpur districts; silver & vanadium in Bhandara district; steatite in Bhandara, Ratnagiri & Sindhudurg districts; and titanium minerals in Gondia & Ratnagiri districts (Table-1). As per the AMD of the Department of Atomic Energy, India, Maharashtra state accounted for 5.50 million tonnes of ilmenite resources and 0.01 million tonnes of rutile resources. The coal reserves and resources along with the various coalfields located in the State are shown in Table-2.

Production

Coal, Bauxite, Iron Ore, Manganese Ore, Fluorite, Kyanite, Sillimanite and Limestone are the principal minerals produced in Maharashtra State. The value of minor mineral's production was estimated at ₹ 5,607 crores for the year 2022-23. There were 89 reporting mines in 2022-23 in case of MCDR minerals. The details of mineral production in the state are shown in Tabl-3.

Mineral-based Industry

The present status of each Mineral-based Industry is not readily available. However, the important mineral-based industries in the Organised Sector in the State are given in Table-4.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020: Maharashtra

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Bauxite	'000 tonnes	38472	193958	232430
Chromite	'000 tonnes	5	533	538
Copper				
Ore	'000 tonnes	-	17755	17755
Metal	'000 tonnes	-	158.08	158.08
Fluorite	tonne	386142	100000	486142
Gold				
Ore (Primary)	tonne	-	1627000	1627000
Metal (Primary)	tonne	-	3.64	3.64
Graphite	tonne	-	1160000	1160000
Iron ore (Haematite)	'000 tonne	15241	286304	301544
Iron ore (Magnetite)	'000 tonne	578	1210	1788
Kyanite	tonne	332389	3063615	3396004
Lead-zinc				
Ore	'000 tonnes	-	9272	9272
Zinc metal	'000 tonnes	-	589.67	589.67
Limestone	'000 tonne	701349	3107044	3808392
Manganese ore	'000 tonne	17733	41303	59036
Rare Earth Elements	tonne	-	2090	2090
Sillimanite	tonne	181748	30580	212328
Silver				
Ore	tonne	-	235000	235000
Metal	tonne	-	0.23	0.23
Titanium	tonne	303551	3980786	4284337
Tungsten				
Ore	tonne	-	10122250	10122250
Contained WO_3	tonne	-	18590.72	18590.72
Vanadium				
Ore	tonne	-	384630	384630
Contained V_2O_5	tonne	-	1538.52	1538.52

Figures rounded off

Table – 2 : Reserves/Resources of Coal as on 1.4.2023 : Maharashtra

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**8065**	**3425**	**1847**	**13336**
Wardha Valley	5009	1891	1441	8340
Kamptee	2046	938	107	3091
Umrer Makardhokra	308	–	161	469
Nand Bander	691	596	118	1405
Bokhara	10	–	20	30

Source: Coal Directory of India, 2022-23.

Table -3: Mineral Production in Maharashtra, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**72**		**74869659**	**74**		**74123221**	**89**		**89644019**
Coal	'000t	-	47435	-	-	56528	-	-	63620	-
Bauxite	t	12	471068	332108	12	640345	387799	19	899528	578068
Iron Ore	'000t	11	1249	1732866	11	1984	6653399	11	6110	20675345
Manganese Ore	t	27	646513	6485961	28	732018	8425784	29	751104	8382578
Fluorite (graded)	t	1	1052	8018	1	1237	9430	1	910	5192
Kyanite	t	3	1145	1854	3	1460	3031	3	334	843
Sillimanite	t	1	11110	13987	%	3432	8283	%	1437	4249
Limestone	'000t	17	13943	3476065	19	15758	3884495	26	16655	3927677
Sulphur #	t	-	41375	-	-	53165	-	-	46283	-
Minor Minerals		-	-	62818800	-	-	54751000	-	-	56070067

Note : The number of mines excludes fuel mineral & minor minerals.
** Excludes the value of fuel minerals.*
% Associate with Kyanite
 # Recovered as by-product from oil refinery.

Table – 4 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Abrasives	
Grindwell Norton Ltd, Mora, Uraon, Raigad	NA
Aluminium products	
Hindalco, Recycling Plant, Taloja	50
Hindalco, Mouda, Distt. Nagpur	30 (rolling mill)
	14 (conductor rod)
Asbestos Products	
Everest Building Products Ltd, Mulund	NA
Hyderabad Industries Ltd, Musarane	60
Newkem Products Corp, Mumbai	9.9
Swastik Industries, Pune	NA
Cement	
ACC Ltd, Ghugus, Distt. Chandrapur	3800
Ambuja Cement Ltd, (Maratha Cement Works), Upparwahi, Chandrapur	4750
India Cement, Vaijnath, Parli, Distt Beed (G)	1100
JSW Cement, Dolvi, Distt. Raigad	"1000 (slag cement)"
"Manikgarh Cement, (I) Korpana, Distt. Chandrapur"	2000
"Manikgarh Cement, (II) Korpana, Distt. Chandrapur"	4000
Murli Industries Ltd, Naranda, Distt. Chandrapur.	3000
Orient Cement, Jalgaon (G)	2000
Birla Corpn. Ltd, Butibori, Distt. Nagpur (G)	500
UltraTech Cement, Hotgi, Distt. Solapur (G)	4000
UltraTech Cement Ltd, Awarpur,	6000
Distt. Chandrapur	4500 (Clinker)
"UltraTech Cement Ltd, Ratnagiri Works (G), Distt. Ratnagiri"	480
UltraTech Cement Ltd, Nagpur	2000

Industry/plant	Capacity ('000 tpy)
Zuari Cement, Solapur	1200
Ceramics	
H & R Johnson (India) Ltd, Pen	154.8
"Joglekar Refractory & Ceramics Pvt. Ltd, Rabale, Distt. Thane."	364.8
Jyoti Ceramic Industries Pvt. Ltd,	0.16 (Ref. coating)
Satpur	1.0 (Ceramic Product)
NITCO Tiles Ltd, Raigad	66 lakh (sq. m)
Chemicals	
Borax Morarji Ltd, Ambarnath	25 (borax)
	8 (boric acid)
Century Rayon, Shahad, Distt. Thane	25 (rayon yarn)
	20 (caustic soda)
Foseco India Ltd, Sanswadi	15 (foundry
	chemicals)
Gargi Huttenes Albertus Pvt.Ltd, Kukshet, Navi Mumbai	12 (Foundary Chemical)
National Peroxide Ltd, Kalyan,	1.4 (sodium
Distt Thane.	per borate)
Star Earth Minerals Pvt. Ltd,	0.6 (zirconium basic
Tanjola, Panvel	carbonet)
"Sudarshan Chemical Ind. Ltd, Roha, Distt Raigad"	5.2 (pigments)
Tecil Chemical & Hydro Power Ltd,	30
Mumbai.	(calcium carbide)
Zirconium Chemicals Pvt. Ltd,	0.3
Taloja, Distt. Raigad	(zirconium salt)
Copper Wire Rods	
HCL, Copper Project, Taloja	60
Electrode	
GEE Ltd, Thane.	4.02 (Mill. m)
Weldfast Electrode Pvt. Ltd, Nagpur	15.9
Weldstrong Electrode Pvt. Ltd,	0.9
Butibori, Higna Nagpur	0.15 (Welding flux)
Electrolytic Manganese Dioxide	
MOIL, Dongri Buzurg, Distt. Bhandara	1
Fertilizers	
Balaji Fertilisers Pvt. Ltd, Nanded	20 (SSP)
"Basant Agro Tech (India) Ltd, Barshi Takli, Akola"	120 (SSP)
Basant Agro Tech (India) Ltd, Jalgaon.	132 (SSP)
"BEC Fertilizer (Unit of Bhilai Engg. Corpn. Ltd), Gunjakheda, Wardha"	66 (SSP)
"Bharat Agri Fert & Realty Ltd, Kharivali, Thane"	132 (SSP)
"Coromandel International Ltd, (Formerly, Liberty Phosphate Ltd), Pali, Raigad"	66 (SSP)
"Deepak Fertilizers & Petrochemical Corporation Ltd, Taloja"	230 (ANP)
"Rama Krishi Rasayan (A division of Rama Phosphates Ltd), Loni Kalbhor, Pune"	132 (SSP)
"Shiva Global Agro Industries Ltd, (Formerly, Shiva Fertilizers Ltd), Nanded"	120 (SSP)

Industry/plant	Capacity ('000 tpy)
"Shri Bhavani Mishra Fertilizers Pvt. Ltd, Vazirabad, Nanded"	30 (SSP)
"Shree Pushkar Chems & Fertiliser Ltd, Lote Porshuram, Khed, Ratnagiri"	100 (SSP)
"Zuari Fertilizers and Chemicals Ltd, Mahad, Distt. Raigad"	216 (SSP)
RCF, Trombay	330 (Urea)
	690 (Complex)
RCF, Thal, Distt. Raigad	2000 (Urea)
Pesticides	
Hindustan Insecticides Ltd, Rasaini, Distt. Raigad	13.2
Paint	
Jespco, Irechwara, Miraj	8 (Zircon Paint)
Glass	
Ace Glass Containers Ltd, Pimpri, Distt. Nashik	NA
"Empire Industries Ltd, (Vitrum Glass), Vikroli, Mumbai"	37.5
"Hindustan National Glass & Industries Ltd, Nashik"	320 TPD
Iron & Steel	
JSW Ispat Steel Ltd, Dolvi, Raigad	5400 (Sinter)
	1600 (Sponge iron)
	5040 (Crude/Liquid steel)
	3500 (pig iron)
Lloyds Steel Ltd, Wardha	600 (HRC)
	350 (CRC)
	250 (GPC)
Indian Seamless Steel & Alloys Ltd,	450 (seamless tubes)
Jejuri, Distt. Pune	350 (alloy &
	carbon steel)
Sunflag Iron & Steel Co. Ltd,	262 (sponge iron)
Warrthy, Mohadi	250 (Pig iron)
	250 (sinter)
	505 (Finished steel)
Uttam Galva Metallics Ltd,	886.95 (Sinter)
Bhugaon,Wardha	525 (pig iron)
Lime	
Hetendra Lime Products, Rajur, Wani	5.5
Swastic Lime Factory, Rajur, Wani	5.5
Swastic Mineral & Lime Industries, Rajur,Wani	5.5
Pellet	
Amba River Coke Ltd, Dolvi, Pen	4000
Pig Iron	
Ispat Metallics India Ltd, Dolvi, Raigad.	2000
Lint Export Pvt. Ltd, Chincholi, Mohol	0.25
"Tata Metaliks Ltd, (Usha Ispat Ltd, Redi), Distt Sindhudurg."	300
Sona Alloys Pvt. Ltd, Satara.	314
Usha Ispat Ltd, Redi.	300
Uttam Galva Metallics Ltd,	225
Bhugaon, Wardha	389.95 (Sinter)
Gopani Iron Ore Ltd, Chandrapur.	144

Industry/plant	Capacity ('000 tpy)
	75 (Semi-Finished Steel)
Lloyds Metals & Engineers, Ghugus, Chandrapur.	300
JSW Steel Salav Ltd,	900
"Welspun Max Steel Ltd, (formerly Vikram Ispat), Distt. Raigad"	
Ferroalloys	
"Chandrapur Ferro Alloys Plant (SAIL), (formerly Maharashtra Elektrosmelt Ltd), Chandrapur."	100
Minex Metallurgical Co. Ltd, Nimji, Kalmeshwar	0.250 (Fe-Ti)
Natural Sugar & Allied Industries Ltd,	16.5 (Si-Mn)
Sai Nagar, Ranjani, Distt. Osmanabad	16.5 (H. C.Si-Mn)
SRC Chemical Pvt. Ltd, Borieandi, Daund, Pune	6
Welspun Maxsteel Ltd, Salav, Raigad.	90
Refractory	
ACE Refractories, Nagpur.	60
NECO Ceramics	NA
Ceraflux India Pvt. Ltd,	2.7 (Ref. Die releasing Agent)
Gokul Shirgaon, Kholapur	2.7 (Ref. Coating)
Calderys India Refractories Limited	58 (castable)
Nagpur Refractory Works, Ruikhairi, Butibori, Nagpur	
Joglekar Refractories Pvt. Ltd,	4.8 (Ramming Mass)
Rabale, Navi Mumbai	0.54 (Chrome Ore +60)
	0.15 (Chrome Ore -60)
Petroleum Refinery	
BPCL, Mumbai.	12000
HPCL, Mumbai.	7500

(G) : Grinding units.

Note: Data not readily available for fertilizer and cement industries on their respective websites. Therefore, the data have been taken from Indian Fertilizer Scenario, FAI Statistics and Survey of Cement Industry & Directory, respectively.

Manipur

Mineral Resources

Important mineral occurences in the State are chromite and limestone. Total resources of the chromite and limestone in the State are 6.66 million tonnes and 46 million tonnes respectively (Table-1).

Production

No mineral production (except minor minerals) was reported from Manipur in 2022-23. The value of minor minerals' production was estimated at ₹ 29 lakh for the year 2022-23.

Table –1: Reserves/Resources of Minerals as on 1.4.2020: Manipur

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Chromite	000 tonnes	-	6657	6657
Limestone	000 tonnes	-	46053	46053

Figures rounded off

Meghalaya

Mineral Resources

Coal and limestone are the only major minerals mined in the State. Coal occurs in Mikir Hills, Khasi Hills, Jaintia Hills and Garo Hills districts. Resources of limestone occur in West Garo Hills, East Khasi Hills, West Khasi Hills and Jaintia Hills districts. Other mineral occurrences are apatite in Jaintia Hills district; china clay in East Garo Hills & West Garo Hills, Jaintia Hills & East Khasi Hills districts; copper, lead-zinc, silver & titanium minerals in East Khasi Hills district; feldspar & rock phosphate in East Garo Hills & Jaintia Hills districts; fireclay in East Khasi Hills & West Garo Hills districts; granite in West Khasi Hills district; iron ore (magnetite) in East Garo Hills district; quartz & silica sand in East Garo Hills, West Garo Hills & East Khasi Hills districts; and sillimanite in West Khasi Hills district (Table -1). The various coalfields and their reserves/resources in the State are furnished in Table-2.

Production

Limestone was the important mineral produced in Meghalaya during the year 2022-23. The value of minor minerals' production was estimated at Rs. 94 crore for the year 2022-23.There were 18 reporting mines in 2022-23 in the state for limestone. (Table-3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the important mineral-based industries in the organised sector in the State are furnished in Table - 4.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020: Meghalaya

Mineral	Unit	Reserves				Remaining Resources								Total Resources (A+B)
		Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
		STD 111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Apatite	tonne	0	0	0	0	0	0	0	0	0	1300000	0	1300000	1300000
Bauxite	'000 tonnes	0	0	0	0	0	0	0	0	0	4300	0	4300	4300
Copper														
Ore	'000 tonnes	0	0	0	0	0	0	0	0	880	0	0	880	880
Metal	'000 tonnes	0	0	0	0	0	0	0	0	9	0	0	9	9
Iron Ore(Heamatite)	'000 tonnes	0	0	0	0	0	0	0	0	0	225	0	225	225
Iron Ore(Magnetite)	'000 tonnes	0	0	0	0	0	0	0	0	0	3380	0	3380	3380
Lead-Zinc Ore														
Ore	'000 tonnes	0	0	0	0	0	0	0	0	880	0	0	880	880
Lead metal	'000 tonnes	0	0	0	0	0	0	0	0	16.5	0	0	16.5	16.5
Zinc metal	'000 tonnes	0	0	0	0	0	0	0	0	14	0	0	14	14
Limestone	'000 tonnes	133298	50979	66766	251043	57639	104791	16452	697286	4167752	17819716	720309	23583945	23834988
Rock Phosphate	tonne	0	0	0	0	0	0	0	0	0	1311035	0	1311035	1311035
Sillimanite	tonne	14400	0	68112	82512	0	0	0	0	0	55807	0	55807	138319
Silver														
Ore	tonne	0	0	0	0	0	0	0	0	880000	0	0	880000	880000
Metal	tonne	0	0	0	0	0	0	0	0	19.8	0	0	19.8	19.8
Titanium	tonne	0	0	0	0	0	0	0	0	3345000	0	0	3345000	3345000

Figures rounded off

Table – 2 : Reserves/Resources of Coal as on 1.4.2023 : Meghalaya

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**89**	**17**	**471**	**576**
West Darangiri	65	–	60	125
East Darangiri	–	–	34	34
Balphakram-Pendenguru	–	–	107	107
Siju	–	–	125	125
Langrin	10	17	106	133
Mawlong Shelia	2	–	4	6
Khasi Hills	–	–	10	10
Bapung	11	–	23	34
Jayantia Hills	–	–	2	2

Source: Coal Directory of India, 2022-23.

Table –3 : Mineral Production in Meghalaya, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value	No. of mines	Quantity	Value
All Minerals		**19**		**3148601**	**16**		**4227742**	**18**		**5047705**
Limestone	'000t	19	6029	2689713	16	6399	2974757	18	8112	4110595
Minor Minerals		-	-	458888	-	-	1252985	-	-	937110

Note : The number of mines excludes minor minerals.

Table – 4 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Cement	
Adhunik Cement (Subsidiary of Dalmia Cement),Distt Jaintia Hills	1500
Amrit Cement Industries Ltd, Khleriat, Distt Jaintia Hills	3000
Cement Manufacture Co. Ltd, Lumshnong,Distt Jaintia Hills	792
DCBL Meghalaya Cements Ltd, Thangskai, Narpuh Distt Jaintia Hills	1500
Green Valley Industries, Nongsning, Jowai,Distt Jaintia Hills.	1000
JUD Cement Ltd, Norpuh, Distt Jaintia Hills	500
Mawmluh Cherra Cements Ltd, Cherrapunjee, Distt East Khasi Hills	185
Meghalaya Cements Ltd, Thangskai, Distt Jaintia Hills	860
Megha Technical & Engineering (P) (MTEPL),Lumshnong, Distt Jaintia Hills	700
Hills Cement, Jaintia Hills	1000
RNB Cement, East Khasi	400
Ferroalloys	
Jaintia Ferro Alloys Pvt. Ltd, Byrnihat.	6
Maithan Alloys Ltd, Ribhoi	15 MVA
Maithan Alloys Ltd, RajaBagan	28
Nalari Ferro alloys Pvt Ltd, Norbhog	11
Khasi alloys Pvt. Ltd, EPIP Meghalaya	4.1
Iron & Steel	
Jai Kamakhya Alloy Pvt. Ltd	815 tpd

Source: Data from respective websites of cement industries as well as Survey of Cement Industry & Directory.

Mizoram & Nagaland

Mizoram

Mineral Resources

Occurrences of lignite, sandstone and pyrites are reported from the State. Major deposits of economic importance have not been reported so far in the State.

Production

No mineral production (except minor minerals) was reported from Mizoram during 2022-23. The value of minor minerals' production was estimated at ₹ 258 crore for the year 2022-23

Nagaland

Mineral Resources

Important mineral occurrences in the State are: coal in Borjan, Jhanzi-Disai, Tiesang and Tiru Valley Coalfields; iron ore (magnetite), cobalt, dunite and nickeliferous chromite in Tuensang district and limestone in Phek and Tuensang districts (Table-1). The various coalfields and their reserves/resources are furnished in Table-2.

Production

No mineral production (except minor minerals) was reported from Nagaland during 2022-23. The value of minor minerals' production was estimated at ₹ 18 lakh for the year 2022-23.

Table – 1: Reserves/Resources of Minerals as on 01-04-2020: Nagaland

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Chromite	Tonnes	-	3200	3200
Cobalt	Million Tonnes	-	5	5
Copper Ore	Tonnes	-	2000	2000
Metal	Tonnes	-	15	15
Iron Ore (Magnetite)	Tonnes	-	5280	5280
Limestone	Tonnes	-	1752200	745875
Nickel Ore	Million Tonnes	-	5	5

Table – 2 : Reserves/Resources of Coal as on 1.4.2021 : Nagaland

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Nagaland	**8.76**	**21.83**	**415.83**	**446.42**
Borjan	6	–	5	11
Jhanzi-Disai	2	22	109	133
Tiensang	1	–	2	3
Tiru Valley	–	–	7	7
DGM	–	–	293	293

Source: Coal Directory of India, 2020-21.

Odisha

Mineral Resources

Odisha is the leading producer of chromite, garnet (abrasive), bauxite, manganese ore, iron ore, sillimanite, quartzite and dolomite. The State hosts the country's sole resources of ruby. It accounts for the country's 96% chromite, 93% nickel ore, 90% PGM metal, 69% cobalt ore, 51% bauxite, 44% manganese, 34% iron ore (haematite), 25% sillimanite, 24% fireclay, 23% pyrophyllite, 20% vanadium ore, 17% mica, and 10% dolomite resources. As per AMD of the Department of Atomic Energy, Odisha, accounted for 150.62 million tonnes of rutile resources.

Important minerals that occur in the State are: bauxite in Balangir, Kalahandi, Kandhamal, Kendujhar, Koraput, Malkangiri, Rayagada & Sundargarh districts; china clay in Bargarh, Boudh, Balangir, Kendujhar, Koraput, Mayurbhanj, Sambalpur & Sundargarh districts; and chromite in Balasore, Cuttack, Dhenkanal, Jajpur & Kendujhar districts. Chromite deposits of Sukinda and Nuasahi ultramafic belt constitute 95% of the country's chromite resources. Besides, coal occurs in Ib river valley and Talcher coalfield, Dhenkanal district; dolomite in Bargarh, Kendujhar, Koraput, Sambalpur & Sundargarh districts; dunite/pyroxenite in Kendujhar and Sundargarh districts; fireclay in Angul, Cuttack, Dhenkanal, Jharsuguda, Khurda, Puri, Sambalpur & Sundargarh districts; garnet in Ganjam, Kalahandi & Sambalpur districts; graphite in Bargarh, Boudh, Balangir, Kalahandi, Koraput, Nuapada & Rayagada districts; iron ore (haematite) in Dhenkanal, Jajpur, Kendujhar, Koraput, Mayurbhanj, Sambalpur & Sundargarh districts; iron ore (magnetite) in Mayurbhanj district; limestone in Bargarh, Koraput, Malkangiri, Nuapada, Sambalpur & Sundargarh districts; manganese ore in Balangir, Kendujhar, Koraput, Rayagada, Sambalpur & Sundargarh districts; Pyrophyllite in Kendujhar district; quartz/silica sand in Boudh, Balangir, Kalahandi, Sambalpur & Sundargarh districts; quartzite in Balangir, Dhenkanal, Jajpur, Jharsugada, Kendujhar, Mayurbhanj, Sambalpur & Sundargarh districts; sillimanite in Ganjam & Sambalpur districts; talc/steatite/soapstone in Mayurbhanj, Sundargarh & Sambalpur districts; titanium minerals in Dhenkanal, Ganjam, Jajpur & Mayurbhanj districts; and zircon in Ganjam district.

Other minerals that occur in the State are asbestos in Kendujhar district; cobalt in Cuttack & Jajpur districts; copper in Mayurbhanj & Sambalpur districts; granite in Angul, Boudh, Balangir, Cuttack, Deogarh, Dhenkanal, Ganjam, Kendujhar, Khurda, Koraput, Mayurbhanj, Nuapada, Rayagada & Sambalpur districts; lead in Sargipalli area, Sundargarh district; mica in Sonepur district and nickel in Cuttack, Kendujhar & Mayurbhanj districts. Occurrences of ruby and emerald are reported from Balangir and Kalahandi districts, respectively. Platinum Group of Metals occur in Kendujhar district; silver in Sundargarh district; tin in Koraput & Malkangiri districts; and vanadiferous magnetite occurs in Balasore & Mayurbhanj districts (Table-1). The various coalfields along with their reserves/resources are given in Table - 2.

Table –1: Reserves/Resources of Minerals as on 1.4.2020: Odisha

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Asbestos	tonnes	-	56700	56700
Bauxite	'000 tonnes	409740	1647284	2057024
Chromite	'000 tonnes	78031	240237	318269
Cobalt	Million tonnes	-	31	31
Copper Ore	'000 tonnes	-	11991	11991
Metal	'000 tonnes	-	97.03	97.03
Garnet	tonnes	8330046	1177318	9507364
Graphite	tonnes	2838414	17142707	19981121
Iron Ore (Hematite)	'000 tonnes	2798749	6610582	9409331
Iron Ore (Magnetite)	'000 tonnes	-	242	242
Lead-Zinc Ore	'000 tonnes	-	1750	1750
Lead Metal	'000 tonnes	-	76.96	76.96
Limestone	'000 tonnes	468580	1727424	2196004
Manganese Ore	'000 tonnes	11470	160058	171528
Nickel Ore	Million tonnes	-	175	175
Pt. Group of Metals	tonnes	-	14.2	14.2
Silver Ore	tonnes	-	1749500	1749500
Metal	tonnes	-	64.91	64.91
Tin Ore	tonnes	-	15618	15618
Metal	tonnes	-	652.73	652.73
Titanium	tonnes	12654141	53019062	65673203
Vanadium Ore	tonnes	-	4864795	4864795
Metal	tonnes	-	13557.94	13557.94
Zircon	tonnes	476672	390247	866919

Figures rounded off.

Table –2: Reserves/Resources of Coal as on 1.4.2023: Odisha

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**52046**	**37536**	**4936**	**94519**
Ib-River	17506	20096	2228	39830
Talcher	34540	17440	2708	54689

Source: Coal Directory of India, 2022-23.

Production

The important minerals produced in the state were Coal, Bauxite, Chromite, Iron Ore, Manganese Ore, Graphite and Limestone etc. during 2022-23. The value of minor minerals' production was estimated at ₹ 115 crore for the year 2022-23. The number of reporting mines in 2022-23 was 120 in case of MCDR minerals (Table-3).

Table -3: Mineral Production in Odisha, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**154**		**303806246**	**129**		**626891395**	**120**		**504059730**
Coal	'000t	-	154151	-	-	185068	-	-	218981	-
Bauxite	t	5	15565611	12424241	6	16449396	19284303	6	17403320	20814951
Chromite	t	22	2830413	21862796	18	3785625	47969167	18	3560267	48045941
Iron Ore	'000t	82	104485	262035370	69	136792	553095800	65	140431	428633112
Manganese Ore	t	29	482915	1948077	21	512591	2429734	15	644218	2999142
Graphite (r.o.m.)	t	6	17697	46633	6	26620	69216	6	23346	97664
Iolite	kg	3	16	73	3	27	191	3*	-	-
Limestone	'000t	7	7186	2118507	6	7059	2574534	7	6551	2320890
Sulphur #	t	-	209387	-	-	207831	-	-	228518	-
Minor Minerals		-	-	3370549	-	-	1468450	-	-	1148030

Note: The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
 # Recovered as by-product from oil refinery.

Table – 4 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Aluminium/Alumina	
Hindalco Industries Ltd, Hirakud	215 (aluminium)
Hindalco Industries Ltd, Aditya Aluminium, Lapanga, Distt. Sambalpur	360 (aluminium)
NALCO, Damanjodi, Dist. Koraput	2275 (alumina)
NALCO, Angul	460 (aluminium)
Utkal Alumina International Limited, Rayagada	1500 (alumina)
Vedanta Aluminium Ltd, Lanjigarh, Dist. Kalahandi	2000 (alumina)
Vedanta Aluminium Ltd, Lanjigarh, Dist. Kalahandi	1500 (Venadium)
Vedanta Aluminium Ltd, Jharsuguda, Dist. Sambalpur	1750 (aluminium)
Asbestos Products	
UAL Industries Ltd, Korian, Dist. Dhenkanal	NA
Konark Cement & Asbestors Industries Ltd, Bhubaneswar	NA
Cement	
ACC Ltd, Bargarh Cement Ltd, Bargarh	2140
Ultra-Tech Cement Ltd, Jharsuguda (G)	2600
OCL India Ltd, Rajgangpur, Distt. Sundargarh	4000
	1064 (Refractory)
	2900 (Clinker)
OCL India Ltd, Kapilas (G), Cuttack	1350
Toshali Cements Pvt Ltd, Ampavalli, Distt. Koraput	200
Ceramics	
Prabhu Ceramics & Minerals Pvt Ltd, Majhipali, rengali, Sambalpur	24 (Acidic Ramming Mass)
	9.6 (EBT Filling Mass)
Chemical	
Arrow Minerals & Metals Pvt. Ltd, Vejidihi, Banspal	1.8 (Manganese Oxide)
	2.25 (Manganese dioxide powder)
Chrome Concentrate	
K L Resources Pvt. Ltd,	74.7

Punjab

Mineral Resources

Minerals reported to occur in the State are quartz and silica sand in Hoshiarpur district; and quartzite in Hoshiarpur & Ropar (Rupnagar) districts (Table - 1).

Production

Production of minor minerals was only reported in the state. The value of minor minerals' production was estimated at ₹ 51 crores for the year 2022-23.

Mineral-based Industry

The present status of each Mineral-based Industry is not readily available. However, the important Mineral-based Industries in the Organized Sector in the State are furnished in Table-2.

Table –1: Reserves/Resources of Minerals as on 1.4.2020: Punjab

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Quartz/silica sand#	'000 tonnes	-	3927	3927
Quartzite#	'000 tonnes	-	81912	81912

 # Figures rounded off

 # Declared as Minor mineral vide Gazette notification dated 10.02.2015

Table – 2: Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Alloy Steel	
Antarctic Industries Ltd, Ludhiana	120
Cement	
Ambuja Cement, Ropar (Rupnagar) [(G)]	2500
Asian FCPL, Patiala	1500
Ambuja Cement, Bathinda [(G)]	1200
UltraTech Cement, Bathinda [(G)]	1750
Chemical	
Siel Chemical Complex, Charatrampur	74.3 (NaOH)
	65.8 (Cl)
	18 (bleaching powder)
	66.0 (HCl)
VTPL (Vardhaman Industries Ltd),	60
Distt Patiala, Fertilizer	
NFL, Nangal, Distt. Ropar (Rupnagar)	478.5 (Urea)
	22 (methanol)
NFL, Sibian Road, Distt. Bathinda	511.5 (Urea)
	8.7 (S)
Petroleum Refinery	
HPCL Mittal energy Ltd, Bathinda	9000
Sponge Iron	
Vallabh Steels Ltd, Sahnewal, Ludhiana	120

Note:
Data, not readily available for Fertilizer and Cement Industries on their respective website, hence it is taken from Indian Fertilizer Scenario, FAI Statistics and Survey of Cement Industry & Directory, respectively.

Rajasthan

Mineral Resources

Rajasthan is the richest state in terms of availability and variety of minerals in the country and produces about 50 different minerals along with minor minerals during 2022-23. Rajasthan is the sole producer of lead & zinc ores, selenite and wollastonite. Rajasthan was the sole producer of garnet (gem) till 2004-05. Almost entire production of silver in the country comes from Rajasthan. The State is a major producer of copper ore/conc., limestone, ochre, phosphorite/rock phosphate and talc/soapstone/steatite. The State is also an important producer of marble of various shades. Makrana area is the world famous center for marble mining.

The State possesses substantial share of the total resources of potash (94%), lead & zinc ore (89%), wollastonite (88%), silver ore (88%), gypsum (82%), ochre (81%), bentonite (75%), fuller's earth (74%), diatomite (72%), feldspar (66%), marble (63%), asbestos (61%), copper ore (54%), calcite (50%), talc/steatite/soapstone (49%), ball clay (38%), rock phosphate (31%), fluorite (29%), and tungsten (27%).

Important minerals that are found to occur in the State are: asbestos (amphibole) in Ajmer, Bhilwara, Dungarpur, Pali, Rajsamand & Udaipur districts; ball clay in Bikaner, Nagaur & Pali districts; barytes in Alwar, Bharatpur, Bhilwara, Bundi, Chittorgarh, Jalore, Pali, Rajsamand, Sikar & Udaipur districts; calcite in Ajmer, Alwar, Bhilwara, Jaipur, Jhunjhunu, Pali, Sikar, Sirohi & Udaipur districts; china clay in Ajmer, Barmer, Bharatpur, Bhilwara, Bikaner, Bundi, Chittorgarh, Dausa, Jaipur, Jaisalmer, Jhunjhunu, Kota, Nagaur, Pali, Sawai Madhopur & Udaipur districts; and copper in Khetri belt in Jhunjhunu district & Dariba in Alwar district. Deposits of copper are also reported at Ajmer, Bharatpur, Bhilwara, Bundi, Chittorgarh, Dausa, Dungarpur, Jaipur, Jhunjhunu, Pali, Rajsamand, Sikar, Sirohi and Udaipur districts. Occurrence of other minerals, namely, Dolomite in Ajmer, Alwar, Bhilwara, Chittorgarh, Dausa, Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Sikar & Udaipur districts; felspar in Ajmer, Alwar, Bhilwara, Jaipur, Pali, Rajsamand, Sikar, Tonk & Udaipur districts; fireclay in Alwar, Barmer, Bharatpur, Bhilwara, Bikaner, Dausa, Jaisalmer, Jhunjhunu & Sawai Madhopur districts; fluorspar in Ajmer, Dungarpur, Jalore, Jhunjhunu, Sikar, Sirohi & Udaipur districts; garnet in Ajmer, Bhilwara, Jhunjhunu, Sikar & Tonk districts; gypsum in Barmer, Bikaner, Churu, Sri Ganganagar, Hanumangarh, Jaisalmer, Jalore, Nagaur & Pali districts; iron ore (haematite) in Alwar, Dausa, Jaipur, Jhunjhunu, Sikar & Udaipur districts; iron ore (magnetite) in Bhilwara, Jhunjhunu & Sikar districts; and lead-zinc in Zawar in Udaipur district, Bamnia Kalan, Rajpura-Dariba in Rajsamand & Rampura/Agucha in Bhilwara district. Lead-zinc occurrences have also been reported from Ajmer, Chittorgarh, Pali and Sirohi districts. Lignite deposits are found to occur in Barmer, Bikaner, Jaisalmer, Jalore, Nagaur and Pali districts. Flux grade limestone occurs in Jodhpur and Nagaur districts and Chemical-grade limestone in Jodhpur, Nagaur and Alwar districts. Cement grade deposits of limestone are widespread in Ajmer, Alwar, Banswara, Bhilwara, Bikaner, Bundi, Chittorgarh, Churu, Dungarpur, Jaipur, Jaisalmer, Jodhpur, Jhunjhunu, Kota, Nagaur, Pali, Sawai Madhopur, Sikar, Sirohi and Udaipur districts. Magnesite in Ajmer, Dungarpur, Pali & Udaipur districts; marble in Ajmer, Alwar, Banswara, Bhilwara, Bundi, Chittorgarh, Dungarpur, Jaipur, Nagaur, Sikar, Sirohi & Udaipur districts; mica in Ajmer & Bhilwara districts; ochre in Baran, Bharatpur, Bhilwara, Bikaner, Chittorgarh, Jaipur, Sawai Madhopur & Udaipur districts; pyrite in Sikar district; pyrophyllite in Alwar, Bhilwara, Jhunjhunu, Rajsamand & Udaipur districts; quartz/silica sand in Ajmer, Alwar, Bharatpur, Bhilwara, Bikaner, Bundi, Chittorgarh, Dausa, Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Kota, Pali, Rajsamand, Sawai Madhopur, Sikar, Sirohi, Tonk & Udaipur districts; quartzite in Ajmer, Alwar, Jhunjhunu & Sawai Madhopur districts; rock phosphate in Alwar, Banswara, Jaipur, Jaisalmer & Udaipur districts; talc/steatite/ soapstone in Ajmer, Alwar, Banswara, Bharatpur, Bhilwara, Chittorgarh, Dausa, Dungarpur, Jaipur, Jhunjhunu, Karauli, Pali, Rajsamand, Sawai Madhopur, Sirohi, Tonk & Udaipur districts; vermiculite in Ajmer & Barmer districts; and wollastonite in Ajmer, Dungarpur, Pali, Sirohi & Udaipur districts.

Other important minerals that occur in the State are: apatite in Udaipur & Sikar districts; bauxite in Kota district; bentonite in Barmer, Jaisalmer & Jhalawar districts; corundum in Tonk district; diatomite in Barmer & Jaisalmer districts; emerald in Ajmer & Rajsamand districts; fuller's earth in Barmer, Bikaner & Jodhpur districts; gold in Banswara, Bhilwara, Dausa, Sirohi & Udaipur districts; granite in Ajmer, Alwar, Banswara, Barmer, Bhilwara, Chittorgarh, Jaipur, Jaisalmer, Jalore, Jhunjhunu, Jodhpur, Pali, Rajsamand, Sawai Madhopur, Sikar, Sirohi, Tonk & Udaipur districts; graphite in Ajmer, Alwar & Banswara districts; kyanite & sillimanite in Udaipur district; manganese ore in Banswara, Jaipur & Pali districts; potash in Jaisalmer & Nagaur districts; silver in Ajmer, Bhilwara, Jhunjhunu, Rajsamand, Sikar & Udaipur districts; and tungsten in Nagaur & Sirohi districts (Table -1). District-wise reserves/resources of lignite in the State are provided in Table-2.

Deposits of petroleum are located in the Bikaner-Nagaur and Barmer-Sanchore basin and those of natural gas in Jodhpur and Jaisalmer basins in the State.

Production

Production of different type of minerals has been reported from the state of Rajasthan during the year 2022-23. The value of minor minerals' production was estimated at ₹ 12,402 crore for the year 2022-23. The number of reporting mines in Rajasthan was 98 in the year 2022-23 in case of MCDR minerals (Table 3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the important mineral-based industries in the organized sector in the State are given in Table-4.

Table –1: Reserves/Resources of Minerals as on 1.4.2020: Rajasthan

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Apatite	tonne	-	1067521	1067521
Asbestos	tonne	-	13615710	13615710
Bauxite	'000 tonnes	-	528	528
Copper				
Ore	'000 tonnes	34388	833461	867849
Metal	'000 tonnes	483.08	4152.52	4635.6
Diatomite#	'000 tonnes	-	2074	2074
Fluorite	tonne	18099	5587504	5605603
Garnet	tonne	207888	842923	1050811
Gold				
Ore (Primary)	tonne	-	125913720	125913720
Metal				
(Primary)	tonne	-	234.56	234.56
Graphite	tonne	-	1913554	1913554
Iron ore				
(Haematite)	'000 tonnes	7314	28166	35480
(Magnetite)	'000 tonnes	121060	673866	794926
Kyanite	tonne	-	23703	23703
Lead-Zinc				
Ore	'000 tonnes	103275	581381	684656
Lead metal	'000 tonnes	1900.19	9431.73	11331.92
Zinc metal	'000 tonnes	7438.05	23827.97	31266.02

Table- 1 (Concld.)

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Lead-Zinc				
metal	'000 tonnes	-	142.23	142.23
Limestone	'000 tonnes	4804154	24157095	28961249
Magnesite	'000 tonnes	-	54091	54091
Manganese				
Ore	'000 tonnes	568	1790	2359
Potash	million tonnes	-	20572	20572
Pyrite	'000 tonnes	-	90876	90876
Rock				
Phosphate	tonne	21845000	72003769	93848769
Sillimanite	tonne	-	819	819
Silver				
Ore	tonne	148326020	342383997	490710017
Metal	tonne	7701.64	21940.57	29642.21
Tungsten				
Ore	tonne	-	23928294	23928294
Contained				
WO_3	tonne	-	93707.94	93707.94
Vermiculite	tonne	-	104125	104125
Wollastonite	tonne	2680978	20433955	23114933

Figures rounded off
Note: The proved and indicated balance recoverable reserves of crude oil and natural gas as on 1.4.2016 are 31.72 million tonnes and 35.66 billion c.u.m. respectively.

Table – 2: Reserves/resources of Lignite as on 1.4.2023: Rajasthan

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**1203.85**	**3108.55**	**2273.84**	**6586.24**
Bikaner	560.30	230.33	309.19	1099.82
Barmer	495.23	2509.46	1555.00	4559.69
Jaisalmer & Bikaner	-	-	11.47	11.47
Jaisalmer	-	-	70.44	70.44
Jaisalmer & Barmer	-	-	13.80	13.80
Jalore	-	-	76.08	76.08
Nagaur	148.32	368.26	219.17	735.75
Nagaur & Pali	-	0.50	18.69	19.19

Source: Coal Directory of India, 2022-23.

Table – 3: Mineral Production in Rajasthan, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**88**		**308261370**	**93**		**301784255**	**98**		**334391109**
Lignite	'000t	-	9056	-	-	10526	-	-	10197	-
Natural Gas (ut.)	m c m	-	2040	-	-	2619	-	-	2340	-
Petroleum(crude)	'000t	-	5891	-	-	5887	-	-	5074	-
Copper Ore	t	-	991991	-	-	1101339	-	-	1107920	-
Copper Conc.	t	2	42590	3371952	2	49399	5463975	2	48886	5014787
Iron Ore	'000t	9	1088	5106818	10	1235	5557564	10	1321	6283857

Table- 3 (Concld.)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
Lead & Zinc Ore	t	-	15455342	-	-	16338564	-	-	16744080	-
Lead Conc.	t	10	376923	18810483	10	368040	22025747	9	376666	24761930
Zinc Conc.	t	%	1513996	63127101	%	1594085	78727814	%	1670207	92306379
Manganese Ore	t	1	6940	20820	1	8008	25626	1	6437	22528
Silver **	kg	-	705676	42657180	-	647013	42115418	-	713620	43805077
Phosphorite	t	1	1357949	4602518	1	1281229	6536677	2	1533464	12422328
Fluorite(graded)	t	-	-	-	-	-	-	1	125	64
Garnet (abrasive)	t	7	7114	26378	5	8182	24660	5	9863	35815
Limestone	'000t	39	74266	19449722	41	87483	23336293	45	95051	25548161
Magnesite	t	-	-	-	1*	-	-	1	1	5
Selenite	t	3	402	602	4	716	902	3	328	443
Siliceous Earth	y	12	23823	14686	13	33898	22837	14	32070	17535
Wollastonite	t	4	103902	122210	5	108335	149156	5	110793	147258
Minor Minerals		-	-	150950900	-	-	117797586	-	-	124024942

Note: The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
% Number of mines covered under lead concentrates.
*** Recovered at Chanderiya Lead-Zinc Smelter of HZL (as by product) from lead concentrates produced in Rajasthan.*
** Only labour reported.*

Table – 4: Principal Mineral-based Industries

Industry/plant	Capacity ('000tpy)
Cement	
ACC Ltd, Lakheri, Distt Bundi	1500
Ambuja Cements Ltd, Rabriyawas, Distt Pali	3600
Binani Cement, Binanipuram, Distt Sirohi	4850
Binani Cement, Neem Ka Thana, Sikar (G)	1400
Birla Corporation Ltd, (Birla Cement Works &Chanderia Cement Works), Chittorgarh	4000
India Cements Ltd, Jhalo ka garha Garhi	1800
J.K. Cement, Nimbahera, Distt Chittorgarh	3250
J.K. Cement, Mangrol, Distt Chittorgarh	2500
J.K. Cement, Gotan, Distt Nagaur	500
J.K. White Cement Works, Gotan	610 (white Cement)
Merta, Distt Nagaur	500(white putty)
J.K. Laxmi Cement, Banas, Distt Sirohi	8700
NUVOCO Vistas (Lafarge) India Ltd, Nimbahera, Distt Chittorgarh	2600
Mangalam Cement (Mangalam Cement & Neer Shree Cement), Morak, Distt Kota	3250
Nirma Limited, Nimbol, Jaitaran	2280
Shree Cement Ltd, Beawar, Distt Ajmer	3000
Shree Cement Ltd, Andherideori, , Masuda, Ajmer	3600
Shree Cement Ltd, Ras, Distt Pali	3000
Shree Cement Ltd, Ras ,Jaitaran, Distt Pali	4000
Shree Cement Ltd, Kushkhera, Distt Alwar (G)	3500
Shree Cement Ltd, Suratgarh, Distt Sri Ganganagar (G)	1800
Shree Cement Ltd, Suratgarh, Rohi, Udaipur-Udasar, Distt Sri Ganganagar (G)	3600
Shree Cement Ltd, Jobner, Distt Jaipur (G)	1500
Shriram Cement Works, Kota	400
Trinetra Cement (Subsidiary of India Cement), Nokhala, Distt Banswara	1800

Table- 3 (Cont.)

Industry/plant	Capacity ('000tpy)
Udaipur Cement Works (Subsidiary of JKCL), Udyog Ltd,), Udaipur	1240
Ultra Tech Cement (Birla White Cement Division), Kharia Khangar, Bhopalgarh	680 (white cement)
	400 (putty)
Ultra Tech Cement Nathdwara	4850 (cement)
Binnani Cement Ltd,Amli,Pindwara	-
UltraTech Cement (Aditya I & II), Shambhupura, Distt Chittorgarh	8000
UltraTech Cement, Kotputali, Distt Jaipur	4000
Wonder Cement, Nimbahera, Distt Chittorgarh	8000
Chemical	
DCM Shriram Industries Ltd, Distt. Kota	9 (rayon/yarn)
	7.7 (sodium sulphate)
Modi Alkalies & Chemicals Ltd, Distt. Alwar	84.2 (caustic soda)
	50.3 (Cl), 39.6 (HCl)
Ceramics/Chemicals	
Bikaner Ceramics Pvt. Ltd, Bikaner	9 (insulators)
Kajaria Ceramics Ltd, Gailpur	6.5 (mill. sq m)
Kajaria Ceramics Ltd, Malootana	24.5 (mill. sq m)
Bhalla Chemical Works Pvt Ltd	10 (zirconium oxychloride & special zirconia)
Roca Bathroom Product Pvt Ltd, Alwar	12.9
Roca Bathroom Product Pvt Ltd, Alwar	2 mill. pc.
Fertilizer	
Adheeshaa Phosphate, Umarada, Udaipur	132 (SSP)
Arawali Phosphate Ltd, Umra, Udaipur	40 (SSP)
Arihant Phosphate & Fertlizers Ltd, Nimbaheda, Chittorgarh	66 (SSP)
Bohra Industries Ltd, Umra, Udaipur	200 (SSP)
Chambal Fertilizers & Chemicals Ltd, Gadepan, Kota	180 (SSP)
Coromandel Intermational Ltd, (Formerly) Liberty Phosphate Ltd), Jagpura, Kota	132 (SSP)
Devyani Phosphate Pvt. Ltd, Udaipur	60 (SSP)
Dharamsi Morarji Chemical Co. Ltd, Khemli, Udaipur	66 (SSP)
Gayatri Spinners Ltd, Hamirgarh, Bhilwara	30 (SSP)
Indian Phosphate Ltd, Umrada, Udaipur	130 (SSP)
Jagdamba Phosphate, Kota	132 (SSP)
Jubilant Agri and Consumer Products Ltd, Singhpur, Kapasan, Chittorgarh	264 (SSP)
Khaitan Chemical & Fertilizers Ltd, Dhinwa, Distt Chittorgarh	198 (SSP)
Mangalam Phosphates Ltd, Hamirgarh, Bhilwara	72 (SSP)
Ostwal Phoschem (India) Ltd, Hamirgarh, Bhilwara	132 (SSP)
Patel Phoschem (P) Ltd, Umarda, Udaipur	100 (SSP)
Prem Sakhi Fertx. Ltd, Lakadwas, Udaipur	66 (SSP)
Rama Phosphates Ltd, Umra, Udaipur	181 (SSP)
Sadhana Phosphates & Chems Ltd, Gudli, Udaipur	120 (SSP)
Shriram Fertilizers & Chemicals Ltd, Shriramnagar, Distt Kota	379.5 (Urea)
	113.8 (caustic soda)
	13.2 (bleaching powder)
	61.2 (HCl)
	61.2 (Cl)
Shri Ganapati Fertilizers Ltd, Kapasan, Chittorgarh	99 (SSP)
Shurvi Colour Chem Ltd, Madri, Udaipur	12 (SSP)
Plaster of Paris	
Abhishek Plaster Industries, Baramsar, Distt Hanumangarh	6.1

Table- 3 (Concld.)

Industry/plant	Capacity ('000tpy)
Agrawal Industries, Nohar, Distt Hanumangarh	6.3
Balaji Plaster Industries, Taranagar, Distt Churu	6
Balaji Industries, Taranagar, Distt Churu	6.5
Ganesh Plaster Industries, Taranagar, Distt Churu	6
Gil Brothers, Taranagar, Distt Churu	7.1
Hind Plaster Industries, Taranagar, Distt Churu	6
Jaishri Plaster Industries, Taranagar, Distt Churu	6.3
Jagdamba Plaster Industries, Rawatsav, Distt Hanumangarh	7
Coromandel International Ltd, (Formerly Liberty Phosphate Ltd), Jagpura, Kota	132 (SSP)
Devyani Phosphate Pvt. Ltd, Udaipur	60 (SSP)
Dharamsi Morarji Chemical Co. Ltd, Khemli, Udaipur	66 (SSP)
Jai Bhavani Plaster Industries, Baramsar, Distt Hanumangarh	6
Jai Sriram Plaster Industries, Taranagar, Distt Churu	7.1
M.G. Plaster Pvt Ltd, Taranagar, Distt Churu	6.2
Mahabir Plaster Industries, Taranagar, Distt Churu	6
Multani Industries, Nohar, Distt Hanumangarh	8.4
R.D. Plaster Industries, Nohar, Distt Hanumangarh.	8.4
R.N. Industries, Bikaner, Distt Bikaner	18
Shalimar Plaster & Chemical Industries, Sardarshahar, Distt Churu	14
Shri Lakshmi Gypsum, Chak, Distt Hanumangarh	6
Shriram Plaster, Taranagar, Distt Churu	6.3
SS Plaster Industries, Taranagar, Distt Churu	6
Shiv Bhakti Industries, Nohar, Distt. Hanumangarh	8.4
Tiger Plaster, Sardarshahar, Distt Churu	11
The Sardarshahar Plaster & Minerals, Sardarshahar, Distt Churu	19.4
Updesh Industries Ltd, Chak, Distt Hanumangarh	9
Pellet	
Jindal Saw Limited, Pur, Bilwara	1500
Power generation	
JSW Energy Barmer Ltd, Bhadresh.	1080 MW
Copper Smelters	
HCL, KCC, Jhunjhunu.	31 (Cu cathode)
Rajpura Dariba Lead & Zinc Mine Dariba, Rajsamand	76.827(Zinc Conc.)
	17.506(lead Conc.)
Lead & Zinc Smelters	
HZL Zinc Smelter, Debari, Distt Udaipur.	88 (Zn)
HZL Lead-zinc Smelter, Chanderiya, Distt Chittorgarh.	85 (Pb)
	525 (Zn)
	0.833 (Cd)*
	168 tonnes (Ag)
HZL, Dariba Smelting Complex, Dariba Distt Rajsamand.	100 (Pb)
	210 (Zn)

** Total for all smelters of HZL*
(G); Grinding Units
Note:
Data, not readily available for fertilizer and cement industries on respective websites, is taken from Indian Fertilizer Scenario, FAI Statistics and Survey of Cement Industry & Directory respectively.

Sikkim

Mineral Resources

The important mineral resources of the State are copper-lead-zinc and silver, reported in Bhotang, Rangpo and Dikchu in East Sikkim districts. Occurrences of other minerals reported in the State include dolomite, quartzite and talc/steatite/soapstone in West Sikkim district; limestone in North Sikkim district and marble in East Sikkim & North Sikkim districts (Table-1). The reserves/resources of coal and the coalfield located in Sikkim are reflected in Table-2.

Production

No mineral production (except minor minerals) was reported in 2022-23. The value of minor minerals' pro duction was estimated at ₹ 188 lakh for the year 2022-23.

Mineral-based Industry

SMC, a joint venture of Government of Sikkim and Government of India was established for the purpose of development of Bhotang polymetallic ore deposit at Rangpo. Sikkim's Mines & Geology Department had set up a pilot dimension rock cutting unit and pilot lime making unit to ascertain the feasibility of setting up of commercial lime plant and dimension rock cutting plant in the State. A ferro alloys plant, namely, Akshay Ispat & Ferro Alloys Ltd with an installed capacity of 6,000 tpy is located at Mamring, South Sikkim district. The present status of these industries is not available.

Table – 1: Reserves/Resources of Minerals as on 1-04-2020: Sikkim

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Copper				
Ore	'000 tonnes	-	958	958
Metal	'000 tonnes	-	21.47	21.47
Lead-Zinc		-	-	-
Ore	'000 tonnes	-	950	950
Lead metal	'000 tonnes	-	8.58	8.58
Zinc metal	'000 tonnes	-	20.07	20.07
Limestone	'000 tonnes	-	2380	2380
Silver				
Ore	tonnes	-	949623	949623
Metal	tonnes	-	56.69	56.69

Figures rounded off

Table – 2 : Reserves/Resources of Coal as on 1.4.2023 : Sikkim

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total/Rangit Valley	**-**	**58**	**43**	**101**

Source: Coal Directory of India, 2022-23

Tamil Nadu

Mineral Resources

Tamil Nadu is the leading holder of country's resources of vermiculite, molybdenum, dunite, rutile, garnet and ilmenite. The State accounts for the country's 79% vermiculite, 65% dunite, 48% garnet, 52% molybdenum, 25% sillimanite and 16% fire clay resources. As per AMD of the Department of Atomic Energy, Tamil Nadu accounted for 167.70 million tonnes of ilmenite resources and 7.85 million tonnes of rutile resources.

Important minerals that are found to occur in the State are: bauxite in Dindigul, Namakkal, Nilgiris & Salem districts; dunite/pyroxenite in Salem district; felspar in Coimbatore, Dindigul, Erode, Kanchipuram, Karur, Namakkal, Salem & Tiruchirapalli districts; fireclay in Cuddalore, Kanchipuram, Perambalur, Pudukottai, Sivaganga, Tiruvallur, Tiruchirapalli, Vellore & Villupuram districts; garnet in Ramanathapuram, Tiruchirapalli, Tiruvarur, Kanyakumari, Thanjavur & Tirunelveli districts; granite in Dharmapuri, Erode, Kanchipuram, Madurai, Salem, Tiruvannamalai, Tiruchirapalli, Tirunelveli, Vellore & Villupuram districts; graphite in Madurai, Ramanathapuram, Sivaganga & Vellore districts; and gypsum in Coimbatore, Perambalur, Ramanathapuram, Tiruchirapalli, Tirunelveli, Thoothukudi & Virudhunagar districts. Similarly, occurrences of minerals, such as, lignite deposits are located in Cuddalore, Ariyalur, Thanjavur, Thiruvarur, Nagapattinam, Ramnad, Sivaganga & Ramanathapuram districts; limestone in Coimbatore, Cuddalore, Dindigul, Kanchipuram, Karur, Madurai, Nagapattinam, Namakkal, Perambalur, Ramanathapuram, Salem, Tiruvallur, Tiruchirapalli, Tirunelveli, Vellore, Villupuram & Virudhunagar districts; magnesite in Coimbatore, Dharmapuri, Karur, Namakkal, Nilgiri, Salem, Tiruchirapalli, Tirunelveli & Vellore districts; quartz/silica sand in Chennai, Coimbatore, Cuddalore, Dharmapuri, Dindigul, Erode, Kanchipuram, Karur, Madurai, Namakkal, Periyar, Perambalur, Salem, Tiruvallur, Tiruvarur, Nagapattinam, Tiruchirapalli, Villupuram, Virudhunagar & Vellore districts; talc/steatite/soapstone in Coimbatore, Salem, Tiruchirapalli & Vellore districts; titanium minerals in Kanyakumari, Nagapattinam, Ramanathapuram, Tiruvallur, Tirunelveli & Thoothukudi districts; vermiculite in Dharmapuri, Tiruchirapalli & Vellore districts; and zircon in Kanyakumari district have been established.

Other minerals that occur in the State are: apatite in Dharmapuri & Vellore districts; barytes in Erode, Madurai, Perambalur, Tirunelveli & Vellore districts; bentonite in Chengai-Anna district; calcite in Salem district; china clay in Cuddalore, Dharmapuri, Kanchipuram, Nilgiris, Sivaganga, Tiruvallur, Tiruvannamalai, Tiruchirapalli & Villupuram districts; chromite in Coimbatore & Salem districts; copper, lead-zinc & silver in Villupuram district; corundum & gold in Dharmapuri district; dolomite in Salem & Tirunelveli districts; emerald in Coimbatore district; iron ore (magnetite) in Dharmapuri, Erode, Nilgiris, Salem, Tiruvannamalai, Tiruchirapalli & Villupuram districts; kyanite in Kanyakumari & Tirunelveli districts; molybdenum in Dharmapuri, Dindigul & Vellore districts; pyrite in Vellore district; sillimanite in Kanyakumari, Karur & Tirunelveli districts; tungsten in Madurai & Dindigul districts; and wollastonite in Dharmapuri & Tirunelveli districts (Table-1). District-wise reserves/resources of lignite are provided in Table-2.

In addition to the above, petroleum and natural gas deposits are found to be located in Cauvery basin area.

Production

The principal minerals produced in the state were Lignite, Natural Gas (utilised), Petroleum (crude), Limestone and Magnesite in 2022-23. The value of minor minerals' production was estimated at ₹ 226 crore for the year 2022-23. The number of reporting mines was 87 in 2022-23 in case of MCDR minerals (Table-3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the important mineral-based industries in organised sector in the State are given in Table -4.

Table – 1: Reserves/Resources of Minerals as on 1.4.2020: Tamil Nadu

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Apatite	tonne	-	240000	240000
Bauxite	'000 tonnes	-	24112	24112
Chromite	'000 tonnes	-	282	282
Copper				
Ore	'000 tonnes	-	790	790
Metal	'000 tonnes	-	3.81	3.81
Garnet	tonne	52538	25831356	25883894
Gold				
Ore	tonne	-	67000	67000
(Primary)				
Metal	tonne	-	1	1
(Primary)				
Graphite	tonne	3100193	6605086	9705279
Iron Ore	'000 tonnes	-	528901	528901
(Magnetite)				
Kyanite	tonne	1683	247829	249512
Lead-Zinc Ore				
Ore	'000 tonnes	-	790	790
Lead metal	'000 tonnes	-	7.74	7.74
Zinc metal	'000 tonnes	-	36.52	36.52
Limestone	'000 tonnes	547024	1577025	2124049
Magnesite	'000 tonnes	55084	100402	155486
Molybdenum				
Ore	tonne	-	17882498	17882498
Contained	tonne	-	10151.86	10151.86
M_OS_2				
Pt. Group	tonne	-	1.69	1.69
of Metals				
Pyrite	'000 tonnes	-	24	24
Sillimanite	tonne	134030	17218747	17352777
Silver				
Ore	tonne	-	790000	790000
Metal	tonne	-	42.55	42.55
Titanium	tonne	670221	113677284	114347505
Tungsten				
Ore	tonne	-	250000	250000

Table- 1(Concld.)

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Contained WO_3	tonne	-	50	50
Vermiculite	tonne	1516803	343051	1859854
Wollastonite	tonne	-	3533	3533
Zircon	tonne	36285	43833	80118

Figure rounded off.

Table – 2 : Reserves/Resources of Lignite as on 1.4.2023 : Tamil Nadu

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**5023**	**21885.00**	**10688**	**37596**
Cuddalore	4119	1429	1302	6850
Ariyalur	904	303	512	1719
Thanjavur & Thiruvarur	–	17203	3058	20261
Thiruvarur &Thanjavur	–	2351	222	2573
Thanjavur & Nagapattinam	–	359	927	1286
Thiruvarur & Nagapattinam	–	–	574	574
Ramanathapuram	–	169	3108	3277
Ramnad	–	71	965	1036
Ramanathapuram & Sivaganga	–	-	20	20

Source: Coal Directory of India, 2022-23

Table – 3: Mineral Production in Tamilnadu, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**98**		**8511562**	**94**		**9471345**	**87**		**10305529**
Lignite	'000t	-	18026	-	-	23635	-	-	21519	-
Natural Gas (ut.)	m c m	-	911	-	-	1067	-	-	1109	-
Petroleum(crude)	'000t	-	410	-	-	367	-	-	324	-
Garnet (abrasive) *	t	2	-	-	2	-	-	-	-	-
Graphite (r.o.m.)	t	1	10026	32404	1	36214	52872	1	54136	54201
Limestone	'000t	89	21144	5813723	85	21323	6505610	80	24545	7529571
Magnesite	t	5	43613	227494	5	81013	454667	5	62123	329344
Marl %	t	0	916081	173628	0	952921	193287	-	577180	129788
Vermiculite	t	1	510	1688	1	690	2284	1	-	-
Minor Minerals @		-	-	2262625	-	-	2262625	-	-	2262625

Note : The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
** Only labour reported.*
% Associate with Limestone
@ Figures for earlier years have been repeated as estimates because of non-receipt of data for the years 2021-22 & 2022-23.

Table – 4 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Abrasives	
Carborandum Universal Ltd, Chennai	NA
Cutfast Abrasives Tools Pvt. Ltd, Chennai	NA
Asbestos Products	
Hyderabad Industries Ltd, Kannigaiper	100
Ramco Industries Ltd, Arakkonam, Distt. Vellore	NA
Southern Asbestos Cement Ltd, Arrakonam, Distt. Vellore	NA
Tamil Nadu Asbestos, Alangulam, Distt. Virudhunagar	28.5
Cement	
ACC Ltd, Madukkarai, Distt.. Coimbatore	1000
Chettinad Cement Corpn. Ltd, Puliyar, Distt. Karur	1700
Chettinad Cement Corpn. Ltd, Karikalli, Distt. Dindigul	4500
Chettinad Cement Corpn. Ltd, Ariyalur	5500
Dalmia Cements, Dalmiapuram, Distt. Tiruchirapalli	3400
Dalmia Cements, Ariyalur	3000
Dhandhapani Cement Pvt. Ltd, Thathamangalam, Manachanallur	225
India Cements Ltd, Sankarnagar, Distt. Tirunelveli	2050
India Cements Ltd, Sankaridurg, Distt. Salem (G)	860
India Cements Ltd, Dalavoi, Distt. Ariyalur	2160
India Cements Ltd, Vallur, Distt. Chennai (G)	1100
India Cements Ltd, Panaiveedu, Thiruchengodu	1400
My Home Industries Ltd. Tuticor	1500
Ultra-Tech Cement Ltd, Reddipalayam, Distt. Ariyalur	1400
Ultra-Tech Cement Works (ARCW), Arakkonam (G)	1100
Ramco Cement (formerly Madras Cement), R.S. Raja Nagar, Distt. Virudhunagar	2000
Ramco Cement (formerly Madras Cement), Alathiyur Works, Distt. Ariyalur	3050
Ramco Cement (formerly Madras Cement), Ariyalur Plant, Govindpuram, Distt. Ariyalur	3500
Ramco Cement (formerly Madras Cement), Chengalpet Grinding Unit, Uthiramerur, Distt. Kanchipuram (G)	500
Ramco Cement (formerly Madras Cement), Valapady, Distt. Salem (G)	1600
Tamil Nadu Cements, Alangulam, Distt. Virudhunagar	290
Tamil Nadu Cements, Ariyalur, Distt. Ariyalur	500
Tamil Nadu News -print & Paper Ltd., Kagithapuram, Manmangalam	328.5
Vijay Cements Trichy	75
Zuari Cements Ltd, Chennai Grinding Unit, Attipattu, Tiruvallur (G)	900
Ceramics	
Carborandum Universal Ltd, Hosur	NA
Murugappa Morgan Thermal Ceramics Ltd, Ranipet, Distt. Vellore	5.44
Neycer India Ltd, Vadalur, Distt. Cuddalore	9
Roca Bathroom Product Pvt Ltd, Ranipet, Distt. Erode	12.6
Roca Bathroom Product Pvt Ltd, Perundurai, Distt. Vellore	24
Spartek Ltd, Chennai	NA
Copper Smelter	
Sterlite Industries (I) Ltd, Thoothukudi	400 (Cu smelting)
	205 (Cu cathode)
	90 (wire rods)
	1050 (H_2SO_4)

Table- 4 (Cont.)

Industry/plant	Capacity ('000 tpy)
Chemicals	
Tanfac Industries Ltd, Cuddalore	16.5 (anhydrous HF),
	16.5 (AlF_3)
	67.5 (H_2SO_4)
	14 (Hydrofluoric acid)
	3.4 (speciality fluorides)
Tuticorin Alkali Chemicals & Fertilizers Ltd, Thoothukudi	115 (soda ash)
	105 (A/Cl)
Vaiyapuri Shanthi Ferric alum, Sellipalayam, Namakal	3.4(Ferric alum)
Electrode	
AVR Electrodes, No1, SIDCO,Indl.Estate, Rajapalyam, Virudhnagar	250
Fertilizer	
Coimbatore Pioneer Fertilizer Ltd, Muthugoundanpudur, Distt. Coimbatore.	66 (SSP)
	30 (H_2SO_4)
	3 (oleum)
Coramandal International Ltd, (Formerly EID Parry), Ranipet, Distt. N. Arcot	132 (SSP)
	33 (H_2SO_4)
Coramandal International Ltd, Ennore, Distt. Thiruvallur.	330 (Complex)
Kothari Industrial Corp. Ltd, Ennore.	66 (SSP)
Madras Fertilizer Ltd, Manali, Distt. Thiruvallur.	486.8 (Urea)
	840 (NP/NPKs)
Greenstar Fertilizers Ltd, Guindy.	115 (SSP)
Southern Petrochemical Industries Corpn. Ltd, Thoothukudi.	620 (Urea)
Ferroalloy	
Electralloy Special Steel Casting Pvt. Ltd.	1.0 (alloy , Stainless steel casting)
Synthetic Rutile	
DCW Ltd, Sahupuram, Distt. Thoothukudi.	48
TiO_2 Pigment	
VVTi Pigments (P) Ltd, (formerly, Kilburn Chemicals), Distt. Thoothukudi	18
	36 (Ferrous Sulphate Heptahydrate)
Iron & Steel	
Salem Steel Plant (SAIL), Salem.	180 (Crude/Liquid steel)
JSW Steel Plant (acquired Southern Iron & Steel Co. Ltd), Salem.	1180 (sinter)
	1000 (pig iron)
	1000 (specialised alloy steel)
	18000 (Crude/Liquid steel)
Sponge Iron	
Akshara Industries Ltd, Eguvarpalayam, Distt. Thiruvallur.	100
Kaushik Steel Industries Ltd, Pappen Kuppam, Distt. Thiruvallur.	60
Agni Steels Pvt Ltd, Olappalayam Road, Ingur, Distt. Erode.	36
Refractory	
ABREF Pvt. Ltd, Gummidipoondi, Distt. Thiruvallur.	1.3
Sharda Ceramics Pvt. Ltd, Ambattur, Chennai.	9.9
Shri Natraj Ceramic & Chemical Industries Ltd, Dalmiapuram, Distt. Tiruchirapalli.	42
VRW Refractories, Vanagaram.	21.6
Zirconium Complex, Pazhakayal, Thoothukudi.	0.5 (Zr-Oxide)
	0.25 (Zr sponge)

Table- 4 (Concld.)

Industry/plant	Capacity ('000 tpy)
DBM & Calcined Magnesite	
SAIL Refractory Co. Ltd (formerly Burn Standard Co. Ltd), Salem.	13(calcined magnesite)
	61 (DBM)
	15 (refractory bricks)
	45(Dunite fracton)
Dalmia Magnesite Corpn., Chettichavadi, Distt. Salem.	72 (DBM)
Ramkrishna Magnesite Mines, Salem.	3 (calcined)
Tamil Nadu Magnesite Ltd, Kurumbapatty, Distt. Salem.	19.5(calcined magnesite)
	30(DBM)
Sri Pon Kumar Magnesite Ltd, Salem.	26.5 (DBM)
Silicon Carbide	
Carborandum Universal Ltd, Tiruvottiyur.	NA
Petroleum Refinery	
CPCL, Manali, Dist. Thiruvallur.	10500
CPCL, Narimanam.	w1000

Note: Data, not available for fertilizer and cement Industries on respective website, is taken from Indian Fertilizer Scenario, FAI Statistics, and Survey of Cement Industry & Directory, respectively.
(G): Grinding unit.

Telangana

Telangana is the 29th state of India, formed on the 2nd of June 2014 with ten districts, namely; Hyderabad, Adilabad, Khammam, Karimnagar, Mahbubnagar, Medak, Nalgonda, Nizamabad, Rangareddy and Warangal. Telangana is surrounded by Maharashtra and Chhattisgarh in the North, Karnataka in the West and Andhra Pradesh in the South and East directions.

Mineral Resources

Telangana is the leading producer of barytes, dolomite, feldspar, laterite, limestone, Quartz and Sand (others). It accounts for 47% kyanite, 29% corundum, 10% fuller's earth and 9% limestone resources of the country. Telangana is endowed with the internationally known black, pink, blue and multicolored varieties of granites.

Important minerals occurring in Telangana are: barytes in Khammam, district; china clay in Adilabad, Mahabubnagar, Nalgonda, Rangareddi and Warangal districts; coal in Adilabad, Karimnagar, Khammam and Warangal districts; corundum in Khammam district; dolomite in Khammam and Warangal districts; felspar in Hyderabad, Khammam, Mahabubnagar, Medak and Rangareddy districts; fireclay in Adilabad and Nalgonda districts; garnet in Khammam district; granite in Karimnagar, Khammam, Mahabubnagar, Medak, Nalgonda, Rangareddy and Warangal districts; iron ore (haematite) in Khammam district; iron ore (magnetite) in Adilabad and Warangal districts; limestone in Adilabad, Hyderabad, Karimnagar, Mahabubnagar, Nalgonda, Rangareddy, districts; manganese ore in Adilabad district; mica in Khammam districts; quartz/silica sand in Hyderabad, Khammam, Mahabubnagar, Medak, Nalgonda, Rangareddy and Warangal districts; and talc/soapstone/steatite in Khammam district. Other minerals that occur in the State are chromite, copper, graphite and kyanite in Khammam district; fuller's earth in Medak and Rangareddy districts; and marble in Khammam district (Tables - 1 and 2).

Production

Production of minerals like Coal, Manganese ore, Limestone etc. were reported from Telangana. The value of minor minerals' production was estimated at ₹ 8,694 crore for the year 2022-23. The number of reporting mines was 39 in 2022-23 in case of MCDR minerals (Table-3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the important mineral based industries in the organised sector in the State are given in Table-4.

Table – 1: Reserves/Resources of Minerals as on 1.4.2020: Telangana

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Chromite	'000 tonnes	-	186	186
Copper				
Ore	'000 tonnes	-	666	666
Metal	'000 tonnes	-	9.12	9.12
Garnet	tonne	-	1960196	1960196
Graphite	tonne	-	219455	219455
Iron ore				
(Haematite)	'000 tonnes	-	105627	105627
Iron ore				
(Magnetite)	'000 tonnes	-	87366	87366
Kyanite	tonne	-	48350000	48350000
Limestone	'000 tonnes	1214127	16438327	17652454
Manganese ore	'000 tonnes	342	4162	4503

Figures rounded off.

Table – 2: Reserves/Resources of Coal as on 1.4.2023 : Telangana

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total/Godavari Valley	**11257**	**8497**	**3433**	**23186**

Source: Coal Directory of India, 2022-23

Table – 3: Mineral Production in Telangana, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**36**		**177329636**	**38**		**113277727**	**39**		**92663408**
Coal	'000t	-	52603	-	-	67232	-	-	69637	-
Manganese Ore	t	6	11097	67713	8	10434	61676	7	10810	82811
Garnet (abrasive)	t	-	-	-	-	-	-	1	461	323
Limestone	'000t	30	24493	4904676	30	28499	5932307	31	27118	5636954
Minor Minerals		-	-	172357247	-	-	107283744	-	-	86943320

Note : The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.

Table – 4: Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Aluminium Foil	
Hindalco, Kollur, Medak	4
Asbestos Products	
Bhagyanagar Wood Plast Ltd, Nandikandi, Distt. Medak	60
Hyderabad Industries Ltd, Sanathnagar, Distt. Rangareddy	160
Hyderabad Industries Ltd, Thimmapur	230
J.J. Spun Pipe Industries, Arsapalli, Distt. Nizamabad	4.5
Visaka Industries Ltd, Medak	36
Bleaching Clay	
Ashapura Clay Tech. Ltd, Dharur, Distt. Rangareddy	20 (Fuller's earth granules)
	15 (Bentonite granules)

Table- 4 (Concld.)

Industry/plant	Capacity ('000 tpy)
Cement	
Anjani Portland Cements Ltd (Subs. of Chettinad Cement), Anjanipuram, Distt. Nalgonda	1200
CCI Ltd, Tandur, Distt. Rangareddy	1000
Bheema Cement, Nalgonda	900
Greygold Cement, Nalgonda	90
Deccan Cements Ltd, Bhavanipuram, Distt. Nalgonda	2300
India Cement Ltd, Malkapur, Distt. Rangareddy	2400
India Cement (Raasi Cements), Vishnupuram, Distt. Nalgonda	3500
Keerthi Industries Ltd, Mellacheruvu, Distt., Nalgonda	590
Kesoram Cement, Basantnagar, Distt. Karimnagar	6000
Mancherial Cement Co. (P) Ltd, Mancherial, Distt. Adilabad	330
My Home Cement Industries Ltd, Mellacheruruvu, Distt. Nalgonda	3300
NCL Industries Ltd, Simhapuri, Distt. Suryapet	2000
Orient Cement, Devapur, Distt. Adilabad	3000
Penna Cement Industries Ltd, Tandur, Distt. Rangareddy	2000
Penna Cement Industries Ltd, Ganeshpahad, Distt. Nalgonda	1200
Rain Commodities Ltd (Rain Cements), Ramapuram, Distt. Nalgonda	4000
Sagar Cements Ltd, Mattampally, Distt. Nalgonda	2650
Sri Lalita Cement, Mattampally, Distt. Nalgonda	1000
Zuari Cements Ltd (Sri Vishnu Cements Works), Dondapadu, Sitapuram, Distt. Nalgonda	1200
Ceramic/Sanitary ware	
Hindustan Sanitaryware & Industries Ltd, Bibinagar, Distt. Nalgonda	1.8
Montana International Ltd, Faralwadi, Distt. Medak	3.6
Restile Ceramics Ltd, Malkapur, Distt. Medak	1.4
Fertilizer	
Chemtech Fertilizers Ltd, Kazipalli, Medak	33 (SSP)
Sponge Iron	
Ashirwad Steels & Ind. Ltd, Veliminedu, Distt. Nalgonda	60
Anand Metallics & Power Pvt. Ltd, Kodi Cherla, Distt. Mahabubnagar	24
Binjusaria Sponge & Power Pvt. Ltd, Farooq Nagar, Distt. Mahabubnagar	30
Lakshmi Gayatri Iron & Steel, Kethepally, Distt. Nalgonda	60
NMDC (Sponge Iron Division), Paloncha, Khammam.	60
Reactive Metals of India Ltd, Appajipally, Distt. Mahabubnagar.	36.5
Sunder Steels Ltd, S.D. Road, Secunderabad.	36
Ferro-alloys	
Nav Bharat Ferro Ventures Ltd, Paloncha, Distt. Khammam.	125
Shree Raghvendra Ferro alloys Pvt Ltd, Nalgonda.	15
VBC Ferro Alloys Ltd, Rudraram, Distt. Medak.	48 (silico-manganese)
	32.4 (ferro-manganese)
Refractory	
MPR Refractories Ltd, Medak.	9.5
Raasi Refractories, Narketapally, Distt Nalgonda.	35

Note: Data, not readily available for fertilizer and cement Industries on respective websites, is therefore taken from FAI Statistics and Survey of Cement Industry & Directory, respectively

Tripura

Mineral Resources

Natural gas is the most important mineral resource in Tripura located in the Assam Arakan Fold Belt (AAFB) basin. Other minerals of significance found to occur in the State are glass sands, limestone, fireclay, plastic clay, shale and quartz-silica sand used particularly for building/construction purposes (Table-1).

Production

Natural gas (utilised) was important mineral item produced in Tripura during 2022-23. The value of minor minerals' production was estimated at ₹ 678 lakh for the year 2022-23 (Table-2).

Mineral-based Industry

A 3,000 tpy lime-pozzolana mixture factory has been in operation at Kumarghat in North Tripura district. A 150 tpy glazed pottery unit of Tripura Khadi and Village Industrial Board is also in operation at Anandnagar in Tripura (West) district. M/S DP Group has set up a cold Steel Rolling Plant at Bodhjungnagar Industrial Complex. The State Government is actively wooing Private Sector investment for establishment of gas-based industries. Besides, Private Sector's involvement in setting up of Ceramic tiles units and other mineral-based industries are also being actively pursued. Private participation in setting up plastic clay and glass sand industries is also under consideration by the State Government.

Table – 1: Reserves/Resources of Minerals as on 1.4.2015: Tripura

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Fireclay#	'000 tonnes	-	370	370
Quartz-silica sand#	'000 tonnes	-	490	490

Figures rounded off.
Note: The proved and indicated balance recoverable reserve of Petroleum crude and Natural gas in the State as on 01.04.2021 are 0.07 million tonnes and 29.18 billion cu. m, respectively.
 # Declared as Minor Mineral vide Gazette Notification dated 10.02.2015.

Table –2 : Mineral Production in Tripura, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals				**46688**			**43089**			**67791**
Natural Gas (ut.)	m c m		1634	-		1531	-		1675	-
Petroleum (crude)	'000t		-	-		3	-		3	-
Minor Minerals			-	46688		-	43089		-	67791

$ Excludes the value of fuel minerals.

Uttar Pradesh

Mineral Resources

The State is the principal holder of country's andalusite & diaspore resources and possesses 78% andalusite, 37% diaspore, 17% sillimanite and 10% pyrophyllite. Important minerals occurring in the State are: coal in Singrauli coalfields, Sonbhadra district; and diaspore & pyrophyllite in Hamirpur, Jhansi, Lalitpur and Mahoba districts. Naini area of Allahabad district has good resources of high quality silica sand, an important source of glass sand, that contains 98% SiO_2 and a very low proportion of Fe_2O_3. It is found at Shankargarh and Lohargarh in Allahabad district and also Bargarh in Banda district. Silica sand is also found in Aligarh and Chitrakoot districts.

Other minerals that occur in the State are andalusite & calcite in Mirzapur district; bauxite in Banda, Varanasi & Lalitpur districts; china clay & dolomite in Banda and Sonbhadra districts; felspar in Jhansi district; fireclay, limestone, potash & sillimanite in Sonbhadra district; ochre in Banda district; granite in Banda, Hamirpur, Lalitpur & Mahoba districts; iron ore (haematite) and rock phosphate in Lalitpur district (Table-1). The reserves/resources of coal along with details of coalfield are provided in Table-2.

Production

Coal, Limestone and Sulphur were the mineral items produced in Uttar Pradesh during 2022-23. The value of minor minerals' production was estimated at ₹ 5,614 crore for the year 2022-23. The number of reporting mines in Uttar Pradesh was 3 in 2022-23 in case of MCDR minerals (Table-3).

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, the important mineral-based industries in the Organised Sector in the State are furnished in Table - 4.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020: Uttar Pradesh

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Andalusite	'000 tonnes	-	114250	114250
Bauxite	'000 tonnes	-	18908	18908
Gold				
Ore (Primary)	tonne	-	13000000	13000000
Metal (Primary)	tonne	-	2.08	2.08
Iron ore (Haematite)	'000 tonnes	-	86330	86330
Limestone	'000 tonnes	3720	439723	443443
Potash	million tonnes	-	893	893
Platinum Group of metals	tonne	-	3.35	3.35
Rare Earth- Elements	tonne	-	2948	2948
Rock Phosphate	tonne	-	25773444	25773444
Sillimanite	tonne	-	11450000	11450000

Figures rounded off. *(P): Provisional*

Table –2 : Reserves/Resources of Coal as on 1.4.2023 : Uttar Pradesh

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total/Singrauli	884.04	177.76	–	1061.8

Source: Coal Directory of India, 2022-23.

Table - 3: Mineral Production in Uttar Pradesh, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**2**		**57036657**	**2**		**56992498**	**3**		**56817414**
Coal	'000t	-	17016	-	-	18073	-	-	20540	-
Limestone	'000t	2	2574	896096	2	2809	851937	3	2583	676853
Sulphur#	t	-	54234	-	-	60307	-	-	55411	-
Minor Minerals @		-	-	56140561	-	-	56140561	-	-	56140561

Note : The number of mines excludes fuel mineral & minor minerals.
$ Excludes the value of fuel minerals.
 # Recovered as by-product from oil refinery.
@ Figures for earlier years have been repeated as estimates because of non-receipt of data.

Table – 4 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Abrasives	
John Oakey and Mohan Ltd, Ghaziabad	NA
Micro Lapping Abrasive, Near Munni, Near Munni Devi Temple, Seohra, Dhampur	0.08(Abrasive powder)
Aluminium	
Hindalco Industries Ltd, Renukoot	700 (alumina)
	345 (aluminium)
Asbestos Product	
Asbestos Cement Ltd, Raibareli	NA
Uttar Pradesh Asbestos Product Ltd, Mohanlalganj, Lucknow	NA
Cement	
ACC Ltd, Tikaria, Distt Sultanpur (G)	3000
Ambuja Cement, Dadri, Gautam Budh Nagar (G)	1800
Raebareli Cement Works, Birla Corporation (G)	1300

Table- 4 (Concld.)

Industry/plant	Capacity ('000 tpy)
Heidelberg Cement (Diamond Cement), Madora, Jhansi (G)	2700
Jaypee Cement, Sadvakhurd (Blending Unit)	600
Kanodia Cement, Bulandsahar	330
Shree Cement, Sikandarabad (G), Bulandsahar	2000
The KCP Ltd., Dalla Cement Factory, Dalla Distt Sonebhadra	500
Jaypee Cement, Chunar Cement Factory, Chunar, Distt Mirzapur (G)	2500
Jaypee Cement, Tanda, Ayodhya, Distt Faizabad (G)	1000
Jaypee Cement, Churk Mirzapur (G)	1500
Birla Corp. Ltd.(Erstwhile Reliance Cement), Kundanganj, Distt Raebareli	2000
UltraTech Cement, Dadri (G)	1300
UltraTech Cement, Aligarh (G)	1300
UltraTech Cement Ltd. Ayodhya, Ambedkar Nagar	1000
UltraTech Cement Ltd. Bara , Allahabad	4000
UltraTech Cement Ltd. Dallakolta, Robertsonganj	500
Mangalam Cement, Aligarh (G)	750
Electrode	
Ankit Sangal, Sujroo, Muzaffernagar	0.85(electrode no 10)
	0.15(electrode no 8)
Fertilizer	
Asian Fertilizers Ltd, Deokahia, Gorakhpur	66 (SSP)
Coromandel International Ltd (Formerly Liberty Phosphate Ltd), Raebareli	132 (SSP)
Jubilant Agri and Consumer Products Ltd (Formerly Vam Organic Chemicsls Ltd), Bhartiagram, Gajraula	165 (SSP)
IFFCO, Phulpur (Unit I & II), Distt Allahabad	1697.8 (Urea)
IFFCO, Aonla (Unit I & II)	1999.8 (Urea)
Indo Gulf Fertilizer Ltd (a unit of Aditya Birla Nuva Ltd), Jagdishpur	1105.5 (Urea)
Kanpur Fertilizer & Cement, (formerly Duncan India Ltd), Kanpur	722 (Urea)
Khaitan Chemicals & Fertilizers Ltd, Goramachhia, Jhansi	132 (SSP)
Khaitan Chemicals & Fertilizers Ltd, Malwan, Fatehpur	115 (SSP)
KRIBHCO Shyam Fertilizer, Piprola Shahajahanpur	864.6 (Urea)
Madan Madhav Fertilizers & Chems Pvt. Ltd, Fetehgarh	24 (SSP)
Natraj Organics Ltd, Muzaffarnagar	60 (SSP)
Tata Chemicals Ltd, Babrala, Distt Badaun	1155 (Urea)
V. K. Phosphates Ltd, Bartara , Shahjahanpur	33 (SSP)
Natraj Organics Ltd, Muzaffarnagar	60 (SSP)
Tata Chemicals Ltd, Babrala, Distt Badaun	1155 (Urea)
V. K. Phosphates Ltd, Bartara , Shahjahanpur	33 (SSP)
Ferroalloys	
Hindustan Ferro Alloys, Hamirpur.	3.2
The India Thermit Corpn. Ltd, Kanpur.	0.3
Iron & Steel, Malvika Steel Ltd, Jagdishpur	511 (pig iron)
	600 (saleable steel)
Sponge Iron	
RLJ Concast Pvt.Ltd, Baragaon Chunar	60
S. A.Iron & Alloy Pvt.Ltd.Jeewanthpur, Mughalsarai	90
Petroleum Refinery, IOCL, Mathura.	8000

(G); Grinding Unit

Note: Data, not readily available for fertilizer and cement Industries on respective websites, is taken from Indian Fertilizer Scenario, FAI Statistics, and Survey of Cement Industry & Directory, respectively.

Uttarakhand

Mineral Resources

Important minerals found in the State are high-grade limestone in Almora, Bageshwar, Dehradun, Nainital, Pauri-Garhwal, Pithoragarh & Tehri-Garhwal districts; magnesite & steatite in Almora, Bageshwar, Chamoli & Pithoragarh districts; and tungsten in Almora district.

Other minerals that occur in the State are: asbestos in Chamoli district; barytes & marble in Dehradun district; copper in Almora, Dehradun & Pithoragarh districts; dolomite in Dehradun, Nainital & Tehri-Garhwal districts; graphite in Almora district; gypsum in Dehradun, Pauri-Garhwal & Tehri-Garhwal districts; lead-zinc & silver in Dehradun & Pithoragarh districts; and rock phosphate in Dehradun & Tehri-Garhwal districts (Table - 1).

Production

Magnesite was the only important mineral produced in Uttarakhand during 2022-23. The value of production of minor minerals was estimated at ₹ 173 crore for the year 2022-23. There was only one reporting mine in Uttarakhand and that of magnesite only (Table-2).

Mineral-based Industry

The present status of each Mineral-based Industry is not readily available. However, the important medium and large-scale mineral-based industries in the Organised Sector in the State are furnished in Table - 3.

Table –1: Reserves/Resources of Minerals as on 1.4.2020: Uttarakhand

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Asbestos	tonne	-	311	311
Copper				
Ore	'000 tonnes	-	4220	4220
Metal	'000 tonnes	-	60.04	60.04
Graphite	tonne		10700	10700
Lead-Zinc				
Ore	'000 tonnes	-	5620	5620
Lead metal	'000 tonnes	-	182.6	182.6
Zinc metal	'000 tonnes	-	266.83	266.83
Limestone	'000 tonnes	-	1575771	1575771
Magnesite	'000 tonnes	9959	229476	239434
Rock Phosphate	tonne	-	24178386	24178386
Silver				
Ore	tonne	-	3390000	3390000
Metal	tonne	-	138.59	138.59
Tungsten				
Ore	tonne	-	658000	658000
Contained WO_3	tonne	-	705	705

Figures rounded off *(P): Provisional*

Table - 2 : Mineral Production in Uttarakhand, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21			2021-22			2022-23(p)		
		No. of mines	Quantity	Value$	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
All Minerals		**2**		**2205004**	**1**		**1781713**	**1**		**1806320**
Magnesite	t	2	24437	47945	1	25427	48693	1	37205	73300
Minor Minerals @		-	-	2157059	-	-	1733020	-	-	1733020

Note : The number of mines excludes minor minerals.
@ Figures for earlier years have been repeated as estimates because of non-receipt of data for the year 2022-23.

Table – 3: Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Abrasives	
Tirupati Microns, Bhagwantpur, Kashipur, Udham Singh Nagar	0.15 (Abrasives Powder)
Cement	
The KCP Ltd, Distt Haridwar (G)	1100
Ambuja Cement, Roorkee, Distt Haridwar (G)	1000
Shree Cement, Roorkee, Distt Haridwar (G)	1800
Shree Cement, Laskar Grinding unit Akbarpur-OUD, Laskar	1800
DBM	
Almora Magnesite Ltd, Village-Matela Distt. Bageshwar	25 (DBM, calcined & semi calcined magnesite)
Minerals & Refractories. Haldwani Pithoragarh	
Ramesh Chandra Binjola, Kumaon Refractories, Narsingh Talla, Haldwani	9 (DBM, calcined magnesite)
Glass	
Hindustan National Glass & Industries Ltd, Rishikesh	4395 TPD

G: Grinding Unit

West Bengal

Mineral Resources

West Bengal is the principal holder of country's apatite resources. It is said to possess 57% apatite and 14% china clay resources of the country. Important minerals that occur in the State are: apatite in Purulia district; coal in Bardhaman, Bankura, Birbhum, Darjeeling, Jalpaiguri & Purulia districts; china clay in 24-Parganas, Bankura, Birbhum, Bardhaman, Hoogly, Midnapur & Purulia districts; and fireclay in Bankura, Birbhum, Bardhaman & Purulia districts.

Other minerals that occur in the State are barytes, copper, gold, kyanite, pyrite & titanium in Purulia district; dolomite in Jalpaiguri district; felspar in Bankura & Purulia districts; granite in Bankura, Birbhum & Purulia districts; lead- zinc in Darjeeling district; limestone in Bankura & Purulia districts; manganese ore & sillimanite in Midnapur district; quartz/ silica sand in Bankura, Hoogly & Purulia districts; and tungsten & vermiculite in Bankura district (Table-1). Reserves/ resources of coal and lignite along with details of coalfields/ districts are provided in Table-2 & Table -3.

Production

During the year 2022-23, production of Coal, Natural Gas (ut.) and Sulphur was reported from West Bengal.

The value of minor minerals' production was estimated at ₹ 5,776 crore for the year 2022-23. Mineral production in West Bengal from 2020-21 to 2022-23 is furnished in Table -4

Mineral-based Industry

The present status of each mineral-based industry is not readily available. However, important mineral-based industries located in the State with their total installed capacities are furnished in Table - 5.

Table – 1 : Reserves/Resources of Minerals as on 1.4.2020: West Bengal

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Apatite	tonne	-	10652220	10652220
Copper				
Ore	'000 tonnes	-	113	113
Metal	'000 tonnes	-	2.09	2.09
Gold				
Ore (Primary)	tonne		12833333	12833333
Metal (Primary)	tonne		0.65	0.65
Kyanite	tonne	-	26520	26520
Lead-Zinc		-		
Ore	'000 tonnes	-	3706	3706
Lead metal	'000 tonnes	-	140.07	140.07
Zinc metal	'000 tonnes	-	143.42	143.42
Limestone	'000 tonnes	-	44706	44706
Manganese ore	'000 tonnes	-	200	200
Pyrite	'000 tonnes	-	2500	2500
Sillimanite	tonne	-	1653000	1653000
Titanium	tonne	-	2279000	2279000
Tungsten				
Ore	tonne	-	763802	763802
Contained WO_3	tonne		1530.84	1530.84
Vermiculite	tonne	-	5566	5566

Figures rounded off.

Table – 2 : Reserves/Resources of Coal as on 1.4.2023: West Bengal

(In million tonnes)

Coalfield	Proved	Indicated	Inferred	Total
Total	**17459**	**12699**	**3775**	**33933**
Raniganj	17041	6519	2859	26419
Barjora	201	–	–	201
Birbhum	218	6179	901	7298
Darjeeling	–	–	15	15

Source: Coal Directory of India, 2022-23

Table –3 : Reserves/Resources of Lignite as on 1.4.2023: West Bengal

(In million tonnes)

District	Proved	Indicated	Inferred	Total
Total	**–**	**1.13**	**2.8**	**3.93**
Bardhaman Rakshitpur, Gaurangapur-Bankati	–	0.29	1.82	2.11
Birbhum Mahalla, Dhobbanpur & Djara	–	0.84	0.98	1.82

Source: Coal Directory of India, 2022-23

Table – 4 : Mineral Production in West Bengal, 2020-21 to 2022-23

(Excluding Atomic Minerals)

(Value in ₹ '000)

Mineral	Unit	2020-21		2021-22		2022-23(p)	
		Quantity	Value$	Quantity	Value$	Quantity	Value$
All Minerals			**18310969**		**57763181**		**57763181**
Coal	'000t	30463	-	29069	-	32796	-
Natural Gas (ut.) +	m c m	307	-	389	-	399	-
Sulphur #	t	56118	-	66170	-	87067	-
Minor Minerals @		-	18310969	-	57763181	-	57763181

Note: The number of mines excludes fuel and minor minerals.
$ Excluding the value of Fuel minerals. + Coal Bed Methane
 # Recovered as by-product from oil refinery.
@ Figures for earlier years have been repeated as estimates because of non-receipt of data.

Table – 5 : Principal Mineral-based Industries

Industry/plant	Capacity ('000 tpy)
Asbestos Products	
Everest Building Products Ltd, Kolkata	NA
Ramco Industries Ltd, Haratara,	NA
Distt Paschim Medinipur	
UAL Industries Ltd, Tungadhowa,	150
Distt Paschim Medinipur	
Abrasives	
Carborandum Universal Ltd, Gopalpur	NA
K.L.Thirani & Co. Ltd, Kolkata	NA
Satya Narayan Roller Floor Mill	MOG-303 0.35
Pvt. Ltd, Chandur Tarkeshwar	MOG-302 0.40
	MOG-M2 0.40
	MOG-220 0.20
	Fine-0.15
Cement	
ACC Ltd (Damodar Cement), Purulia (G)	750
Ambuja Cement Ltd, Sankrail, Distt Howrah (G)	2400
Ambuja Cement Ltd, Farakka,	1250
Distt Murshidabad (G)	
Birla Corporation Ltd (Durgapur Cement	2300
Works & Durga Hitech Cement), Durgapur (G)	
Burnpur Cement, Asansol, Distt Burdwan (G)	300
Century Textiles, Sonar Bangala Grinding	1500
Unit, Distt Murshidabad	
Emami Cement Ltd, Panagarh Burdwan	2000
Emami Cement Ltd, Kotagram, Ausgram-II	2000
JSW Cement, Salboni, P Medinipur	2400
Lafarge Cement Pvt. Ltd, Mejia (G)	1650
Maa Chandi Cement Bamunara Burdwan,	330
NUVOCO Vistas Corp. Ltd, Amdang, Bakura	1650
OCL India Ltd, , Bengal Work Mednapore	1350
Ramco Cement (formerly Madras Cement),	950
Kolaghat, Distt Purba Medinipur (G)	
Shristi Cement Mangalpur	360
Swasata Cement Ltd, Purulia	1500

Table- 5 (Cont.)

Industry/plant	Capacity ('000 tpy)
Ultra-Tech Cement Works, Dhankuri	1600
Hoogly, West Bengal	
Ultra-Tech Cement Ltd, WBCW (G) Burdwan	1400
Ceramics	
WBCDC Ltd, Kolkata	0.18
Chemical	
Hindustan Heavy Chemicals Ltd,	14.8 (caustic soda)
Khardah, Distt 24-Parganas	6 (Cl), 9.8 (HCl)
	4.5 (ferric alum)
	18.7 (H_2SO_4)
Alchrome Chemical	**1.2(sodium bicarbonate)**
Industries Kalyani, Kalyani	0.6(sodium sulphate)
Industrial Estate	
Electrodes	
GEE Ltd, Kandua	18
Graphite India Ltd, Kolkata	NA
Radix Arc Pvt. Ltd, Dangadighila	4
Shield Arc Equipment Pvt. Ltd, Raspunja	2.5
Fertilizer	
Tata Chemicals Ltd, Haldia	675 (DAP)
Tata Chemicals Ltd (Phosphatic Division),	160 (SSP)
Haldia, Medinipur	
Teesta Agro Industries Ltd, Rajganj, Jalpaiguri	165 (SSP)
Jay Shree Chemicals & Fertilizers,	132 (SSP)
Khardah, 24 Parganas	62.70 (H_2SO_4)
The Phosphate Company Ltd, Rishra,	112.8 (SSP)
Hoogly	
Sai Fertilizers Pvt. Ltd, Dewanmara,	132 (SSP)
W. Medinipur	
Flux	
Priyanka Tradelink Pvt. Ltd	0.6
Glass	
Hindustan National Glass &	680 TPD
Industries Ltd, Rishra	
Iron & Steel	
Durgapur Steel Plant, SAIL, Durgapur	3009 (sinter)
	2400 (pig iron)
	2200 (crude/liquid steel)
	13.0NH4So4
IISCO Steel Plant, SAIL, Burnpur,	2695(pig iron)
Distt Bardhaman	2500 (crude/liquid steel)
	3800 (sinter)
Alloy Steel Plant, SAIL, Durgapur	234 (crude/
	liquid steel)
Rohit Ferrotech Ltd, Bishnupur	100 (stainless steel)
	71.4 (ferroalloys)
Rashmi Metaliks Ltd, Gokulpur,	1800 (pellets)
West Midnipore	580 (sinter)
Pig Iron	
Electrosteel Castings Ltd, Khardah	250

Table- 5 (Cont.)

Industry/plant	Capacity ('000 tpy)
	365 (sinter)
Jai Balaji Industries Ltd, Banskopa	428.7
Distt Bardhaman	608 (sinter)
Kajaria Iron Castings Ltd, Durgapur.	110
	326 (sinter)
KIC Metallics Ltd, Raturia	336 (sinter)
Angadpur, Durgapur	165(pig iron)
Orissa Metallic Pvt. Ltd,	1370 (pellets)
Mathurakismat, Gokulpur	300 (pig iron)
Shyamraipur Pachmi medinipur	329.72 (sponge Iron)
Unit -I & Dhekia & Chaksonadhar	
Pachmi Medinipur Unit II	
Rashmi Metallics Ltd, Shyamraipur,	600 (sinter)
Gokulpur, Medinipur	900 (pellets)
	180 (pig iron)
Tata Metaliks Ltd, Kharagpur.	345
	528 (sinter)
Tata Metaliks Ltd, Gokulpur, Maheshpur	600
Neo Metalliks Ltd, Gopalpur, Durgapur	300 (Sinter)
	187.9
Sponge Iron	
Adhunik Corporation Ltd, Angadpur, Durgapur.	72
Ankit Metal & Power Limited Jorehira Chhatna	210
	600 (pellet)
Aryavrata Steel Pvt. Ltd, Lohamelya	36
Distt West Medinipur.	
C. P Sponge Iron Pvt. Ltd, Raturia Angadpur,	60
Industrial Area Durgapur	
C. P. Ispat Pvt. Ltd, G.T. Road Bhirigee	60
Divya Jyoti Sponge Pvt. Ltd, Nandanpur	60
Electrosteel Castings Limited, Haldia	60
Howrah Gasses Ltd, Raniganj, Distt Bardhaman.	60
Jai Balaji Sponge Ltd, Raniganj, Mangalpur	105
Distt Bardhaman. I	
Jai Balaji Sponge Ltd, Banskopa	120
Distt Bardhaman. IV	
Kunj Bihari Steel Pvt. Ltd, Jamuria Nandi	30
M. B. Sponge & Power Limited, Hijalgola Jamuria	60
Maithan Steel & Power Ltd, Bora, Bonra	60
Rashmi Ispat (Pvt.) Ltd, Jhargram	150
Distt W. Medinipur	
Rashmi Cement Ltd, Jetusole Jhargram	492.7
Distt W. Medinipur	33 (Ferroalloys)
Ravindra Enterprise Pvt. Ltd, Digha, Purulia	30
Rishabh Sponge Ltd, Barjora, Bankura	90
SRS Sponge Pvt. Ltd, Dantia Balrampur	15
Satyam Iron & Steel co. Pvt. Ltd, Asansol	60
Sen Ferro-alloys Pvt. Ltd, Dejudi	15
Shyam Sel Ltd, Dewabdighi, Burdwan	100
Shyam Steel Industries Ltd, Anandpur, Durgappur	79

Table- 5 (Concld.)

Industry/plant	Capacity ('000 tpy)
Sunil Sponge Iron Ltd, Kolkata	115
Ferroalloys	
Kartik Alloys Ltd, Durgapur	10.7
Bhaskar Shrachi Alloys Ltd, Durgapur	40
Corporate Ispat Alloys Ltd (Abhijit Group), Durgapur	74
Dimension Steel and Alloys Pvt. Ltd, Bakura	38
Gagan Ferro Tech. Ltd, Jamuria	138.6
Jai Balaji Industries Ltd, Durgapur (JBIL Group)	106
Jai Balaji Industries Ltd, Unit IV, Banskopa	76.5
Jai Balaji Industries Ltd, Mangalpur	30.1
Maithan Alloys Ltd, Kulti Bardhaman	94.6
Modern India Con-Cast Ltd, Bishnupur, Distt Bankura	75
Modern India Cone-Cost Ltd, Haldia	100
Nilkanth Ferro Ltd, Radhamadhavpur	39.9 (silico manganese)-
Rohit Ferro-Tech Ltd, Haldia	100.6
Shyam Ferro Alloys Ltd, Burdwan	100 (50 MVA)
Shyam Ferro Alloys Ltd, Durgapur	100 (50 MVA)
Shri Vasavi Industries Ltd, Bishnupur, Distt Bankura	45
Srinivasa Ferro Alloys Ltd, Durgapur, Distt Bardhaman	84.2
Shri Goyatri Minerals Pvt. Ltd, Bishnupur, Distt Bankura	24
Refractory	
Alcoa-ACC Industrial Chemicals Ltd, Kalatalahat	10
Barakar Refractories (P) Ltd, Barakar, Distt Bardhaman	3.6
Kero Rajendra Monolithics Ltd, Banjora	NA
National Refractories Prop. Snowtex Udyog Ltd, Salanpur	43.2
Saswat International Ltd, Kulti, Distt Bardhaman	NA
Vesuvius India Ltd, Kolkata	96.5
Coke Oven Batteries	
IISCO Burnpur Works, Burnpur, Distt Bardhaman	1084
Petroleum Refinery	
IOCL, Haldia	7500
TiO_2 Pigment	
Kolmak Chemicals Ltd, Kalyani, Distt Nadia	4.8

(G): Grinding units.
Note: Data, not readily available for fertilizer and cement Industries on respective websites, is taken from Indian Fertilizer Scenario, FAI Statistics, and Survey of Cement Industry & Directory.

Union Territories

ANDAMAN & NICOBAR ISLANDS

No mineral production (except minor minerals) was reported from Andaman & Nicobar Islands during 2022-23. The value of minor minerals' production was estimated at Rs. 21 crore for the year 2022-23.

Mineral-based Industry

The present status of each Mineral-based Industry is not readily available. The principal mineral-based industries in the Organised Sector in Andaman & Nicobar Islands are furnished in Table - 1 .

Table-1 : Principal Mineral-based Industries at Andaman & Nicobar Islands

Industry/plant	Capacity ('000 tpy)
Cement	
India Cement Ltd Andaman & Nicobar Islands	1650
Sponge Iron	
Gallantt Metal Limited Andaman & Nicobar Islands	225

CHANDIGARH

No production of major or minor mineral was reported from Chandigarh during 2022-23.

DADRA & NAGAR HAVELI

No production of major or minor mineral was reported from Dadra & Nagar Haveli during 2022-23.

The present status of each Mineral-based Industry is not readily available. However, principal mineral-based industries in the Organised Sector located in Dadra & Nagar Haveli are furnished in Table - 2.

DAMAN & DIU

No production of major or minor mineral was reported from Daman & Diu during 2022-23. Reserves/ Resources of mineral as on 1.04.2020 are furnished in Table-3.

LAKSHADWEEP

No production of major or minor mineral was reported from Lakshadweep during 2022-23.

PUDUCHERRY

No production of major or minor mineral was reported from Puducherry during 2022-23. Reserves/ Resources of mineral as on 01.04.2020 are furnished in Table-4. Reserves/ Resources of lignite as on 01.04.2023 are furnished in Table-5.

The present status of each Mineral-based Industry is not readily available. However, principal mineral-based industries in the Organized Sector located in Puducherry are furnished in Table-6.

Table – 2 : Principal Mineral-based Industries in Dadra & Nagar Haveli

Industry/plant	Capacity ('000 tpy)
Aluminium	
Hindalco Industries Ltd, Silvasa	
Asbestos Products	30 (Al foil)
Ramco Industries Ltd, Golanda, Silvasa	
Copper	NA
Sterlite Industries (India) Ltd,	
Chinchpada, Silvasa	180 (copper cathode)
Alloy	150 (CC copper rod)
Hindustan Alloys Mfg. Co Ltd, (HAMCO), Silvasa	
	3 (tin ingot)
	38 (Al alloy ingot)
	2.8 (Sn-Pb solder wire)

Table – 3 : Reserve/Resource of Mineral as on 1.4.2020 : Daman & Diu

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Limestone	'000 tonnes	-	128670	128670

Figures rounded off *(P): Provisional*

Table – 4 : Reserves/Resources of Minerals as on 1.4.2020 : Puducherry

Mineral	Unit	Reserves (A)	Remaining resources (B)	Total Resources (A+B)
Limestone	'000 tonnes	-	15732	15732

Figures rounded off *(P): Provisional*

Table – 5 : Reserves/Resources of Lignite as on 1.4.2023: Puducherry

(In million tonnes)

District	Proved	Indicated	Inferred	Total
Total/ Bahur & West of Bahur of Neyveli Lignite Field	–	405.61	11	416.61

Source: Coal Directory of India, 2022-23.

Table – 6 : Principal Mineral-based Industries in Puducherry

Industry/plant	Capacity ('000 tpy)
Ceramics	150
Regency Ceramics Ltd, Yanam.	24.2
H&R Johnson (India) Ltd, Karaikal.	
Ferroalloys	12.4
The Silcal Metallurgic Ltd.	3
VSK Ferro Alloys Ltd, Tuthipet.	12
Snam Alloys Pvt. Ltd, Kariamanikam.	
Iron & Steel	NA
Sumangala Steel (P) Ltd.	
Glass	350 TPD
Hindustan National Glass & Industries Ltd, Puducherry.	

Offshore Regions

The Government of India notified the Offshore Areas Minerals (Development & Regulation) Act, 2002 (OAMDR Act), No. 17 of 2003 in the Gazette of India, Extraordinary, Part-II, Section-1, dated 31.1.2003. The purpose of the Act is to provide for development and regulation of mineral resources in the territorial waters, continental shelf, exclusive economic zone and other maritime zones of India and to provide for matters connected therewith or incidental thereto. The Act is applicable to all minerals in offshore areas including minerals prescribed under Atomic Energy Act, 1962, but excludes oils and related hydrocarbons as there is separate legislation in force. The Act came into effect from 15.1.2010 vide S.O. 338 (E), dated 11.2.2010 as notified by the Central Government.

The Act makes it mandatory to undertake reconnaissance, exploration or production operation in the offshore areas in accordance with the prescribed terms and conditions for Reconnaissance Permit (RP), Exploration Licence (EL) or Production Lease (PL) granted under the Act and the rules made thereunder. The Act further states that availability of the areas for grant of RP, EL or PL shall be notified within six months from the commencement of the Act, and subsequently at such times as considered necessary. The Act empowers the Central Government to make rules for the purpose of the Act including terms and conditions under the RP, EL, PL, etc. The Rules, namely, the Offshore Areas Mineral Concession Rules, 2006 have been framed and notified on 3.11.2006 by G.S.R.691(E) published in the Gazette of India, Extraordinary, Part II, Section 3 (i), No. 539, dated 4.11.2006. The Rules came into effect on the date on which the Offshore Areas Mineral (Development and Regulation) Act, 2002 came into force, i.e, 15.1.2010.

As per S.O.1341(E) dated 7.6.2010, the Controller General, Indian Bureau of Mines had notified the mineral-bearing offshore blocks available for grant of Exploration Licence. As per the attached Schedule to the said Notification, there were 26 offshore areas available in offshore waters of Bay of Bengal and 37 offshore areas in the offshore waters of Arabian Sea for grant of Exploration Licence.

The orders for grant of exploration licences were issued by the Administering Authority on 05.04.2011 for the 62 exploration blocks (the bounding latitude and longitude of Block Nos. 3 & 32 falling in the Arabian Sea were same and therefore these were considered as a single block and granted as Block No. 3). Before execution of deed granting such licence, the grant of exploration licences in 62 blocks was challenged through the writ petition in the judicature of various High Courts. Due to interim orders passed by various Hon'ble High Courts on the writ petition and non-disposal of the said petition, the offshore exploration licences granted have not been executed. Besides, it was brought to the notice of the Administering Authority that some of the exploration blocks notified for grant of offshore exploration licences vide Notification dated 07.06.2010 overlapped with areas other than offshore area, to which the OAMDR Act did not apply.

The Central Government, vide S.O.19 (E) dated 06.01.2011, published in the Official Gazette, declared the extent of the Coastal Regulation Zone (CRZ) and also imposed certain restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ. The said statutory order also did state that CRZ shall apply to the water and the bed area between the Low Tide Line to the territorial water limit (12 Nm) in case of seas and has prohibited in the area so identified as CRZ, inter alia, the mining of sand, rocks and other substrata materials except those rare minerals not available outside the CRZ area. In the context of the said notification, all the 62 offshore blocks lie within the area identified as CRZ which attracts the prohibition of mining (operation undertaken for the purpose of winning any mineral).

The OAMDR Act provides that the holder of an exploration licence for offshore area shall have the exclusive right to a production lease for winning of a mineral. In view of the effect of the CRZ Notification dated 06.01.2011, the purpose of executing the 62 offshore exploration licences could not be realised as the applicants could not undertake operations for winning of minerals in spite of grant of Production Lease after successful completion of exploration operations.

Therefore, taking into consideration all the above stated facts, the Controller General, IBM and administering authority Offshore Areas Minerals (Development & Regulation) vide S.O.19 (E) dated 6th January, 2011, published in the Official Gazette, annulled the Notification issued vide S.O.1341(E) dated 7th June 2010 with effect that all subsequent actions undertaken for grant of the 62 exploration licences hereby would stand rescinded. As per S.O. 1523(E) dated 06.04.2018, the Additional Director General, National Mission Head-II, Geological Survey of India, has been notified as the "Administering Authority" for the purpose of the said Act by Clause (a) of Section (4) of the Offshore Area Mineral Development and Regulation Act, 2002 ,17 of 2003 and in supersession of the notification published in Gazette of India, Extraordinary Part II, Section 3, Sub-section (ii) vide S.O. 339(E) dated 11th February 2010.

The Government of India further signed 360 contracts under NELP (New Exploration and Licensing Policy) regime with National Oil Companies and Private (both Indian and foreign)/ Joint Venture companies. At present, 229 contracts are operational out of the total 602 contracts [(360 NELP, 139 (OALP), 103 (DSF Round) signed so far under various bidding rounds.

The awarded 254 blocks under NELP regime are at locations in inland (114), offshore shallow water (59) and deepwater (81) areas. As a result of exploratory activities, several unexplored and poorly explored areas, in particular, offshore and deepwater areas, have been appraised through geophysical surveys and exploratory drilling. Details of exploration block awarded/ relinquished/operational are provided in Table -1.

Table - 1: Details of Exploration Block Awarded (as on 01.04.2023)

(In million tonnes)

Round	No. of blocks awarded	No. of blocks relinquished	No. of blocks active	Present Area (Sq. Km)
NELP-I	24	21	3	231527
NELP-II	23	22	1	267883
NELP-III	23	19	4	204596
NELP-IV	20	17	3	192810
NELP-V	20	16	4	115180
NELP-VI	52	46	6	306426
NELP-VII	41	36	5	112947
NELP-VIII	32	31	1	52573
NELP-IX	19	12	7	26441
Total NELP	**254**	**220**	**34**	**1510383**
OALP-I	55	4	51	59283
OALP-II	14	-	14	29233
OALP-III	18	3	15	29765
OALP-IV	7	-	7	18510
OALP-V	11	-	11	19789
OALP-VI	21	-	21	35346
OALP-VII	8	-	8	15766
Total OALP	**134**	**7**	**127**	**207692**
DSF-I	30	11	19	777
DSF-II	24	5	19	3004
DSF-III	30	-	30	12395
TotalDSF	**84**	**16**	**68**	**16176**

Source: IPNG Statistics 2021-22, Minstry of petroleum and Natural Gas.

In order to explore and produce new sources of natural gas from coal-bearing areas, the Government had formulated a CBM Policy in 1997, wherein CBM being Natural Gas is explored and exploited under the provisions of OIL Fields (Regulation & Development) Act, 1948 (ORD Act 1948) and Petroleum & Natural Gas Rules, 1959 (P&NG Rules 1959) administered by Ministry of Petroleum & Natural Gas (MOP&NG). CBM policy was aimed to provide attractive fiscal and contractual framework for exploration and production of CBM which is an environment-friendly clean gas fuel similar to conventional natural gas. In order to harness CBM (Coal-bed Methane) potential in the country, CBM blocks were offered through international competitive bidding for exploration and production for the first time in the year 2001. Under the CBM policy till date, four rounds of CBM bidding have been implemented by MoP&NG, resulting in award of 33 CBM blocks [including 2 blocks on Nomination and 1 block through Foreign Investment Promotion Board (FIPB) route]. Till date, most CBM exploration and production activities in India are pursued by domestic Indian companies. These CBM blocks are in the States of Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu and West Bengal.

RESERVES/RESOURCES

As on 1.4.2023, balance recoverable reserves of crude oil were estimated at 669.5 million tonnes, out of which 410.5 million tonnes (61.3%) are in onshore and 258.9 million tonnes (38.7%) in offshore areas. ONGC (nomination) contributed with the largest share of 66.8% in reserves of crude oil followed by Pvt. Joint Ventures (Pvt/JVs) in Production Sharing Contract (PSC)/Revenue sharing contract (RSC) regime (22.3%) and OIL (nomination) (10.8%) during financial year 2022-23. The balance recoverable reserves of natural gas as on 01.04.2023 were placed at 1,141.7 billion cu. m, out of which 609.2 billion cu. m (53.4%) are in offshore and 532.5 billion cu. m (46.6%) in onshore areas. ONGC (Nomination) contributed with the largest share of 57.9% in natural gas reserves followed by Pvt/JVs (PSC+RSC) and OIL (Nomination) at 33.2% and 8.8%, respectively (Table-2).

Table – 2: Balance Recoverable Reserves of Crude Oil & Natural Gas in India including Offshore Areas (As on 01.04.2023)

(Crude oil in million tonnes; Natural gas in billion cu. m)

Area	Crude oil*	Natural gas*
India	**669.5**	**1141.7**
1. Onshore	410.5	532.5
2. Offshore	258.9	609.2
a) Western Offshore	218.4	346.8
b) Eastern Offshore	40.5	262.4

Source: Indian Petroleum and Natural Gas Statistics, 2022-23, Ministry of Petroleum and Natural Gas, Govt. of India

EXPLORATION ACTIVITIES

Conventional Hydrocarbon

ONGC, GSI and other Public & Private Sector companies continued their efforts in respect of exploration for hydrocarbon in offshore region, both shallow and deep water, during 2022-23.

Marine and Costal Survey

The Annual Programme of Marine & Coastal Survey (MCS) Division included multidisciplinary offshore survey and mineral exploration within the Exclusive Economic Zone (EEZ) of India including Territorial Waters (TW) and International Waters.

Multichannel seismic survey was carried out in the Laccadive basin to correlate the seabed geomorphic features with the crustal configuration within EEZ of West Coast, Arabian Sea. Economic placer minerals resources have been delineated off Kerala, Odisha, Andhra Pradesh and Tamil Nadu. Preliminary search for Polymetallic crusts and nodules were carried out in Lakshadweep and Andaman Sea based on previous reported occurrenc es. High Resolution Seabed Mapping and Exploration (HRSME) was carried out in the Laxmi basin and Ninety East ridge to detect possible mineral occurrences of Fe-Mn, metalliferous mud etc. Detailed mineral investigation for Phosphorites off Chennai was taken up to augment the resources of phosphorites in these areas. Search for hydrothermal mineralisation and Fe-Mn in Andaman Back Arc basin was carried out by HRSME. Shallow seismic survey in TW was taken up off Ratnagiri and Veravel to detect subsurface sequences of seabed. Multithematic contiguous zone mapping beyond TW was undertaken off Tamil Nadu Coasts to delineate placer minerals in these areas.

During FS: 2022-23, baseline geoscience data collection on systematic seabed mapping were carried out over an area of 71,627 sq. km. Preliminary mineral investigation over an area of 17,298 sq km and close grid mineral investigation to the tune of 662sq. km were also carried out in TW and EEZ of India for the augmentation of offshore mineral potentials in Indian EEZ.

Along with these, a total of 3,388 lkm of multichannel and shallow seismic surveys were also carried out as part of Baseline Geoscientific Data generation and to study the sub-surface disposition of sediment sequences in TW and contiguous zone and to identify the possible locales of offshore minerals through advance processing techniques. The marine geoscientific programme taken up during the period under review comprises 6 complete and 1 spill-over cruises onboard RV Samudra Ratnakar in deep waters. In shallow water domain, three cruises were undertaken by RV Samudra Kaustubh and seven cruises by RV Samudra Shaudhikama. Besides these, three coastal items using mechanized boat and two RP items were also taken up during the period. The programmes were undertaken under Eastern and Southern Regions and highlights of the work completed are given under the heads of the Regions. The list of cruises and coastal programmes taken up by M&CSD during FS: 2022-23 is given below.

1. R. V. SAMUDRA RATNAKAR

Baseline geoscientific data generation by Integrated geophysical surveys (multi-channel seismic, bathymetry, gravity, and magnetic) in parts of Laccadive Plateau and Basin to correlate the seabed geomorphic features, sub-seabed ridges with the crustal configuration within EEZ off West Coast, Arabian Sea SR (Cruise-SR-076). (FSP ID: M1AMCS-SMM/NC/SR/MCSD-WC-1/2022/40087):

The integrated studies of bathymetry, multichannel seismic, magnetic, and gravity identified five physiographic domains viz, Continental shelf, Continental slope and Lakshadweep basin, Western Lakshadweep slope, and the Abyssal plain from East to West. The flood basalt which acts as a base for the Tertiary sediments is observed in all the seismic profiles. The continental slope is marked by a series of topographic rises and terraces. Karwar seamount is one of the marginal highs identified in the survey area. This flat-top mount indicates aerial exposure and later subsidence. The Lakshadweep basin is apparently smooth, occasionally punctured with subsurface intrusive. Pratap ridge is one such intrusive feature that is observed in all the profiles of subsurface or submerged. From seismic data, two systems of faults were identified on either side of the Lakshadweep basin initiating rifting and relatively higher sinking in the eastern boundary suggesting a half-graben structure and initiation of separation between India and Madagascar along the western boundary of the Lakshadweep ridge indicated by presence of stakes of Seaward Dipping Reflectors (SDRs). The studies tend to consider the evolution of the Lakshadweep ridge and basin took place in a continental environment. The crustal structure derived from modelling of gravity magnetic data suggests necking or continental thin point (CTP) underneath the lower crust of the Lakshadweep basin. This new insight supports the concept of a stretched continental shelf.

Seabed mapping and generation of baseline data for search of ferromanganese encrustations in the Laxmi Basin, Arabian Sea (Cruise-SR-077) (FSP ID: M1AMCS-SMM/NC/SR/MCSD-WC-1/2022/40180):

The swath bathymetric data over 45,800 sq.km, identified major features like Laxmi Ridge (LR), Laxmi Basin, Panikkar Ridge (PR), Wadia Guyot (WG), Panikkar Seamount (PS), and Shelf margin along with other features like submarine channels, knolls, peaks, mounts, spur, escarpments etc. The sub-bottom profiler data shows type -IA, sharp continuous echos with no sub-bottom reflectance and type IIIA echos over WG, while PS has type 1B echos indicating a sedimentation sequence in the area. The Satellite Free-air gravity anomaly map shows that gravity values vary from -58.6 mGal to 50 mGal with a total variation of 108.6 mGal in the area. Low gravity values are noted over the southern part of the LR while some high values are over WG and PS. From magnetic anomaly data linear magnetic high values are noticed over PR and magnetic low is situated south of LR. Seabed samplings over the seamount yielded ferromanganese crust and volcanic rock fragments. The genetic discrimination diagram shows that these crusts are of hydrothermal origin. Based on geochemical data, the crust is enriched with Co (3,364ppm), Ni (2,083ppm), Pb (1,906ppm), and ΣREY (1,678ppm). Fe is highly fractionated in the Fe-Mn crusts from Wadia Guyot and the Mn/Fe ratio is below 1. All the analyzed samples occupied the hydrothermal to near hydrothermal fields in the ternary diagram.

Close grid mineral exploration for phosphorite in the East Coast Margin of India, off Point Calimere, Tamil Nadu (Block-1) (Cruise SR-083) (FSP ID: M1AMCS-MME/C/SR/MCSD-EC2/2022/40145):

Close grid mineral exploration for phosphorite in the East Coast Margin of India, off Point Calimere, Tamil Nadu was taken up in an area of 504 sq.km with the objective`(s) to a) delineate High Potential Area (HPA) for phosphorite and, b) to evaluate the resource potential of phosphorite in the phosphatic zone. Seabed samples collected using spade corer (56 no`s), vibro corer (25 no`s), gravity corer (26 no`s), grab sampler (02 no`s) and piston corer (02 no`s) in 2km x 2km grid pattern brought out the occurrence of phosphatic material as thin layers in sub-surface sediment starting from 10cm bsf to a maximum depth of 5.80m bsf. Phosphatic material occur as reworked forms of hard grounds, replaced carbonate reefs, phosphorite bioclasts, phosphatic sands, steinkerns, fish bones and fish teeth. The quantity of phosphorite material and the P_2O_5 content increase from shallower to deeper water depths. P_2O_5 content of the phosphatic material varies from 17.73% to 28.54% with an average content of 22.5%. The average REE and Uranium content in the phosphorites are 220ppm and 102ppm respectively. The quantity of phosphatic materials measured in 56 spade core samples varies from 80gm/location to 1.75kg/location with an average weight of 0.51 kg/location.

Seabed mapping and Generation of baseline data with search for possible mineral occurrences in Ninety East Ridge near Equator, Indian Ocean (Cruise-SR-080). (FSP Code: M1AMCS-MME/NC/SR/MCSD-WC-1/2022/40074):

An area of 24,370 sq. km was surveyed over Ninety East Ridge, Indian Ocean by High Resolution Seabed Mapping and Sampling to search for ferromanganese encrustations and to understand the palaeo-oceanographic conditions and mode of origin of the illustrious Ninety East Ridge. The Ninety-East Ridge exhibits a notable pattern of faulting and lineaments, suggesting the presence of a sequence of fault systems, potentially characterized by step faulting aligned in a northeast-southwest to east-northeast-west-southwest direction. The comprehensive analysis of gravity and magnetic data, in conjunction with bathymetric information, has unveiled nearly N-S linear trending fracture zones (89°E FZ and 90°E FZ) as one of the prominent structural elements within the surveyed region. The Ninety-East Ridge exhibits a substantial crustal thickness, measuring approximately 24 km. This measurement stands in stark contrast to the comparatively thinner average oceanic crust, estimated at around 12 km, as observed in the Central Indian and Wharton Basins. The analysis of the Sub-Bottom Profiler (SBP) data reveals that the ridge's summit comprises a firm, thinly sediment-covered substrate, indicating the presence of a hard bottom. Seabed sampling recovered a large block of ferromanganese crust from the south-west of the survey area weighing 20 kg. The chemical analysis shows that this Fe-Mn rock contains Nickel (Ni) and Cobalt (Co) of 4,111 ppm and 3,917 ppm respectively.

Preliminary mineral exploration for ferromanganese crust and nodules in the western flank extension of Cherbaniani and Byramgore Reefs, Lakshadweep Islands, Arabian Sea. (Cruise-SR-078) (FSP ID: IAMCS-PMIWEEZ/NC/SR/MCSD-WC-2/2022/44094):

Preliminary exploration for ferromanganese crust and nodules and preliminary assessment of polymetals (Co, Ni, and Zn, etc.) covering 2,500 sq.km between water depth 381 and 1,890 m has been carried out during the cruise. The seafloor in the survey area consists of three regional morphological set-ups, namely; coral reef mounts, flat top sea mounts (North Block), and volcanic arc/cones (Central Block). The sub-bottom studies identified five major echo types. Type I-A is a single reflector of flat topography, while Type III-B is an overlapping hyperbole with varying vertices. Free air gravity anomaly varies from -56.3 mGal to 41.3 mGal in the study area. The magnetic anomaly varies from 600 nT to 255.9 nT. Based on the ROV dives, the seafloor of the area can be classified as sediment covered by nodules (N-type), crust dominant floor (C1 type), crust partially covered by sediments (C2 type), crust covered by sediments with ripple marks (C3 type), and sediment dominant floor (S type) with or without ripple marks and high biological activity. The seabed is carpeted by sediments like silty sand, sandy silt, clayey silt, silty clay, and fine to medium sand along with Fe-Mn nodules/crust. Fe-Mn nodules were recovered from the northwestern part of Cherbaniani Reef. The biggest Fe-Mn encrustation recovered is over coralline limestone from the northwestern part of Cherbaniani Reef with dimensions 114 x 52 cm and layer thickness varies from 2.5 cm to 4 cm.

Preliminary search for hydrothermal mineralization and ferromanganese crust/ nodules/ encrustations in active spreading area in Andaman back-arc basin, Andaman Sea (Cruise—SR-081) (FSP-ID-IAMCS-PMIWEEZNCERMCSD-EC-12022/40282):

Project SR-081 was carried out for a preliminary search of hydrothermal sulphide mineralisation and ferromanganese crust/nodules/encrustations over an area of 11,500 sq km in the Andaman Back arc basin. High-resolution survey with MBES, SBP, Magnetic survey, and Gravity survey brought out surface and subsurface features. The western boundary of the area is bounded by a north-south oriented fault termed as West Andaman Fault (WAF). Two seamounts SM-1, SM-2, and a few minor volcanic mounds are aligned parallel to the WAF. Ridges on either flank of the spreading center are aligned parallel to the spreading center. Prominent magnetic anomalies are oriented parallel to the active spreading axis. The free air gravity anomaly value varies from -77.5 m Gal to 69.5 m Gal and has a general trend of NE-SE in the CAT region and N-S direction at the WAF region. Rocky materials were recovered from the exposed mounds. White and grey materials collected from the western flank of the spreading center are due to the hot spring activity in the area. Rocks such as basalt, dunite, gabbro, and radiolarian chert were recovered from the western flank of WAF. Electron probe Micro Analyser (EPMA) result shows the main sulphide minerals observed are pyrite, chalcopyrite, and galena. Scanning Electron Microscope (SEM) analysis shows significant values of Nb, Cu, Co, and Ni.

Preliminary investigation for fe-mn nodules/crust in the seamounts of northern part of Sewell Rise and invisible bank, Andaman Sea (Cruise SR-082) (FSP-ID-M1A/ MCS/ MME/NC/ER/MCSD-EC-I/2022/40454):

Cruise SR-082 was undertaken covering 2,850 sq.km as part of a four-year programme for Preliminary investigation for polymetals in the Fe-Mn crust/nodules in the northern part of the Sewell Rise and Invisible bank, Andaman Sea. From MBES data, different topographical features like prominent N-S trending ridge, well-developed gullies pattern, and deep ocean basin have been identified. From Sub-bottom profiler data, three different echo characters have been identified and grouped into two major classes (Type I-1, I-2, III-1). The bathymetry as well as Free Air (FA) gravity anomaly represents a gentle slope in the west and a steep slope in the east as cuesta shaped. The eastern slope is represented by the escarpment with rouged nature in the bathymetry map. The total magnetic variation observed in this region is about 423nT ranging from -432nT to -9nT. Based on the combined interpretation from the residual anomaly, analytic signal, and vertical derivative maps, the survey area can be divided into three distinct magnetic domain strips from the eastern to western zone of alternative high-low-high, magnetic domains based on the presence of a steep magnetic gradient running in the NW-SE direction. Rock samples collected through 26 ROV are mostly altered basalt chiefly consisting of plagioclase feldspar followed by both clino and ortho-pyroxene and opaque minerals. The basalt collected from the study area is clustered in trachy basalt and basaltic trachy- andesite filed of the TAS diagram by Middlemost (1994). Sediments are mainly calcareous ooze having a good amount of calcium carbonate, and a considerable amount of quartz and clay minerals. The clay minerals (phyllosilicate) include chlorite, smectite, and kaolinite.

2. R.V. SAMUDRA SHAUDHIKAMA

Close Grid Mineral exploration for Placer minerals in the Territorial Waters off Chavara, Kerala (Cruise SD-311). FSP ID: M1AMCS-MME/NC/SR/MCSD-WC-1/2022/40110:

Close Grid Mineral Exploration for Placer minerals over 60 sq.km in the territorial waters and contiguous zone off Chavara, Kerala within 42 m to 53 m isobaths was carried out. The slope of the seafloor is gentle with a gradient of 1:1,000, slope angle θ= 0.06° dipping in SW-NE direction. The shallow seismic survey has identified a subsurface sediment sequence designated as Unit-1 throughout the study area bounded by seafloor on the top and a prominent marker reflector/an erosional surface at the bottom. The unit has several para-sequences in the form of transgressive system tracts (TST), erosional-depositional layers separated by maximum flooding surface (MFS), transgressive surface (TS), and prominent marker reflector (R1) / erosional surface (ES) respectively. The occurrence of carbonaceous wood and peat in cores at different subsurface levels indicates swamp and marshy environment present along the coastal tracts in the past, subsequently inundated by the rising sea level. The total heavy mineral weight percentage (THM wt%) in the study area ranges from 0.57 to 5.94% with an average of 2.21%.

The THM and TEHM (Total Economic Heavy Mineral) resource estimated for 0 to 1 m sediment column is 1.66 and 1.46 million tonnes, respectively. For 1 to 2 m bsf, the THM and TEHM resource is 0.70 and 0.61 million tonnes, respectively. The THM and TEHM resource estimated for 2 to 3 m level is 0.17 and 0.15 million tonnes, respectively.

Preliminary assessment of placer mineral resources in the contiguous zone off Kodungallur, Central Kerala (Cruise-SD-312) (FSP ID: M1AMCS- MME/NC/SR/ MCSD-WC-1/2022/40092):

Preliminary assessment of placer mineral resources in the contiguous zone off Kodungallur, Central Kerala was taken with the objective of preparing of heavy mineral distribution map, demarcation of the potential area of heavy mineral resources around the Contiguous Zone off Kodungallur, Kerala and to study the sub-surface disposition of sediment sequences and its thickness. An area of 240 sq. km. area is covered with 2x2 km grid vibro core sampling with 150lkm of single bathymetry and shallow seismic survey. The water depth varies from 45m to 70m and the sea bed is gently dipping westerly. The maximum core length recovered is 3.60 and the minimum core recovered is 0.47m. The average core length is 1.51 and the cumulative core length is 97.03m. The total heavy mineral percentage in the area varies from 0.2 wt % to 5.6 Wt % with an average of 1.5%.

Detailed exploration of placer mineral resources in the inner shelf off Varkalai-Anjengo, Kerala, (Cruise-SD-313). (FSP ID: MIAMCS-MME /NC/SR/MCSD-WC-1/2022/40118):

An area of 50 sq. km was surveyed and studied in detail with the systematic seismic survey, bathymetric survey, and close grid seabed sampling with the collection of 83 vibro-core samples off Warkallai, Kerala to evaluate heavy mineral resources. As per the seismic survey, the main reflectors present in all the seismic sections are the seafloor, the erosional reflector/surface (ER), the inclined reflector (IR), and the reflector R2. The surface sediment types are coarse sand, medium sand, fine sand, and clayey sand. The Total Heavy Mineral wt % of 0- 0.5m level varies from 0.66% to 12.9% with an average of 4.168 % and the THM wt% decreases towards depth. Notably, the 0-0.5m level samples along the coastline between Varkalai and Nedumkanda exhibits higher THM values, ranging from 1.215% to 12.9%, with an average of 4.83%. Analytical results of 41 bulk sediments show that SiO_2 ranges from 74.84% to 92%, Fe_2O_3 ranges from 0.94% to 4.3%, TiO_2 ranges from 0.85% to 6.35% and Cr ranges from 176 ppm to 335 ppm. The Inducttively Coupled Plasma Mass Spectrometry (ICPMS) analysis data of 06 samples shows that the total REE concentrations in bulk sediments vary from 154 ppm to 1976 ppm, with an average of 689 ppm. Higher levels of Uranium (2.3 to 19.35 ppm), Th (18 ppm to 278 ppm), and Zr (218 ppm to 1414 ppm) are also present. The XRF results of 10 bulk HM samples indicate a range of element values: Fe_2O_3 varies from 19.65% to 28.63%, TiO_2 ranges from 32.73% to 46.17% (average 40.21%), Zr varies from 8,862 ppm to 17,902 ppm, averaging 12,150 ppm, and Vanadium shows anomalous values between 882 ppm and 1121 ppm, with an average of 986 ppm.

Parametric (Shallow Seismic) Survey in the gap area off Ratnagiri - Umargam Sector, Arabian Sea (Cruise-SD-314) (FSP ID: M1AMCS-APS/NC/SR/MCSD-WC-1/2022/40097):

Seismic and bathymetry data were collected from two blocks-Ratnagiri and off Umargam to study the seabed morphology and sub-surface sediment characteristics. In the Ratnagiri block, the seismic two-way time section revealed one horizontal reflector R1 and seven inclined reflectors IR-1 to IR-7 (relatively dipping reflectors with respect to Seafloor) and a strong highly acoustic impedance reflector marked as acoustic basement within the maximum probing depth of 341msec (TWT). This reflector R1 is marked as the Maximum flooding surface (MFS) and it is an indication of a transgressive phase and sedimentation above this surface is identified as transgressive system tracts (TST). Below the reflector R1, reworked generating multiple erosional surfaces (ES) have been identified. Within the erosional surfaces, some V and U-shaped channel-like features are also identified. In the Umargram block, the seismic two-way time section indicates at least four major reflectors are present in the region. Clinoforms in Unit-1 and Unit-2 are making onlap over the first (R1) and second interface (R2), which indicates the transgression phase of the sea. The thickness of Unit-1 varies between 0 to 27m while Unit-2 varies from 0 to 42m. Due to increasing pressure with depth, sediments of the underlying unit got stratified and gave an impression of bedded formation. Unit-3 lying beneath Unit-2 is compact sediments that had been deposited during the regressive phase of the sea, Clinoforms in Unit-3 are making toplap on the second interface (R2). Unit-4 may be the part of the Deccan trap which is exposed to the sea bottom.

Parametric (Shallow Seismic) Survey in the gap area off Valsad - Veraval Sector, Arabian Sea (Cruise-SD-315). (FSP ID: MIAMCS-APSNCSRMCSD-WC-1202240096):

A total of 1,102 lkm of seismic data has been collected from three blocks off Veraval- Valsad Sector with the objective of filling the gap areas between Valsad and Veraval off the West Coast, Arabian Sea under Baseline Geoscientific Data Generation. Two prominent reflectors R1 and R2 are observed in all transects of Block-08, off Valsad. Palaeo-channels are observed along transects L9 and L11. The underlying reflector R2 varies in thickness and overlaps near the shore probably indicating exposure to milliolitic limestone deposits in the area. There are several sediment sequences and a minimum of two unconformity surfaces delineated above and below the first multiple of the seabed. These unconformities may be related to the lowest glacial phases (peak of Dry Age) with the upper (shallower) one as LGM (20K years) and the lower one with around 150 K years. The seismic signature of these sequences between R1 and R4 suggests the presence of bioherms and older terrigenous materials.

Multi thematic mapping of Contiguous Zone beyond Territorial Waters off Kanyakumari, Tamil Nadu (Cruise SD-316) (FSP ID: IAMCS-SCWTEEZ/NC/SR/MCSD-WC-2/2022/40219):

As part of the annual programme of GSI, for the FS: 2022-23, Cruise SD-316, was taken up, with an objective to bring out the bathymetry, surface, and subsurface geology of the area. A bathymetric Survey of 200 lkms has been carried out along 7 coast perpendicular lines, at 5 km intervals. The water depth of the survey area varies from 38 m to 61 m. Minimum depth was noticed in the northeastern part of the area and a maximum depth is in the southwestern part of the area. Magnetic surveys were carried out along seven coast perpendicular transects in NNE-SSW to NNW-SSE direction while shallow seismic surveys were done along eight coast perpendicular transects in the same directions with a line interval of 5km and one coast parallel transect CL-1 in E-W direction. The total field magnetic anomaly varies from -422 nT to -76 nT. Shepherd's classification shows all 82 grab samples fall under the sand domain. Sand % varies from 72.48% to 98.58%. Total Heavy Minerals (THM%) varies from 0.2% to 6.1%. The heavies include mainly sillimanite, ilmenite, mica, zircon, and garnet. In general, the samples contain 70-75% of biogenic components which are constituted by benthic foraminifera, planktic foraminifera, bivalves, coiled and non-coiled pteropods, micro-gastropods, bryozoans, ostracods, coral and shell fragments, etc. $CaCO_3$ in the sea bed sediments varies from 58.83 to 85.68 wt.%.

Multi Thematic Mapping of Contiguous Zone beyond Territorial Water off Vijayapati Tamil Nadu ((Cruise SD-317) (FSP ID: IAMCS-SCWTEEZ/NC/SR/MCSD-WC-2/2022/40325)

An area of 700 km^2 has been mapped by bathymetric, shallow seismic and magnetic survey each with 160-line km. A total of 80 surface sediment samples were collected at an interval of 2 km. Ten numbers, of vibrocore samples were collected. The bathy metric data of the study area reveals a consistent local variation with high frequency indicating that the area is highly uneven and rugged. It shows a depth range of 30 to 48 meteres. The magnetic survey indicates a shallow basement represented by a broad magnetic anomaly of different amplitude and low frequency. The magnetic anomaly of the studied area is varied in amplitude with long wavelengths and indicates the undulation of the magnetic basement. The seismic survey revealed a sloping pattern of the sea bottom towards the sea, with a prominent top layer consisting of shell fragments and pebbles. Inclined reflections observed beneath this layer reveal the sediment deposition by the sea during different periods, contributing to the geological structure. Dipping reflectors with similar characteristics were also identified in the area, potentially resulting from time lag deposition and erosion events. The heavy mineral studies carried out in the study area reveal the presence of Ilmenite, garnet, zircon, sillimanite, rutile, monazite, leucoxene, and pyribole grains. The geochemical data of 80 nos. of grab samples shows that the samples are mostly carbonate-rich with few samples having SiO_2% varying from 10-16%. Sr values of the samples range from 1,557 to 1,905 ppm except sample no. G-04 has a low concentration of 1071 ppm and has the highest Cr value of 203 ppm. The Zn value varies from 100 ppm to 354 ppm. Sample G-80 shows a high value of Cu (631 ppm).

3. R. V. SAMUDRA KAUSTHUBH

Preliminary search for placer minerals in the Territorial Waters off Pentakota-Pudimadaka sector (off Revu-Polavaram-Ontimamidi), (north block) Andhra Pradesh, Bay of Bengal (Cruise No. ST-296), FSP ID IAMCS-PMIWEEZ/NC/SR/MCSD-EC-2/2022/40135:

To evaluate placer mineral resources, 98 lkm of single beam bathymetric survey and 58 vibrocore samples were collected at a grid of 3km x 2km from an area of 258 sq.km in the Territorial waters off Pentakota- Pudimadaka Sector (off Revu- Polavaram- Ontimamidi). The water depth of the survey area ranges from 12.19 m to 43.92 m. The bathymetric map shows increase in depth towards south east direction with steeper gradient between 30 to 34m contour. The sea floor is carpeted by sediments mostly sand, silty sand sandy silt and clayey silt and grain size decreasing towards the deeper side. Heavy mineral studies were carried out from 58 sample locations at 1 m interval. Total heavy mineral wt% for 0-1m ranges from 0.11wt% to 5.59 wt% with an average value of 2.01 wt%, 0.77 to 6.30 with an average 2.86 from 1 to 2 m level, 2 to 3 m level it ranges from 1.74 to 5.47% with an average 3.29 wt%, from 3 to 4 m it ranges from 0.13 to 3.39% with an average of 2.01 wt%. A total of 132 lkm shallow seismic survey reveals two major distinct units.

Detailed exploration of placer mineral resources in the inner shelf off Gopalpur- Rushikulya river mouth, Odisha Coast (Cruise-ST- 293). (FSP No: M1AMCS-MME/NC/ER/MCSD-EC-1/2022/40222):

Cruise ST-293 was undertaken to evaluate economic heavy mineral resources in the sediments, off Gopalpur-Chhatarpur, Odisha, and to estimate the resource of individual heavy mineral/metal/elemental in different levels below the seafloor. An area of 48 sq. km was covered by the Bathymetric Survey along 23 shore perpendicular lines spaced at 1 km line intervals and one cross line. The water depth in the area varies from 9.6 m to 22 m and isobath shows a trend parallel to the coastline. The seabed morphology is very smooth and gently sloping south-easterly. A total of 69 nos. vibrocores were collected at 1 km X 1 km grid. To meet the objective of the cruise, completed the core logging of the vibrocores and generated 306 subsamples for heavy mineral studies, 196 subsamples for sedimentological studies and 89 subsamples for geochemical studies. The subsamples for sedimentological and heavy mineral studies are at various stages of laboratory analysis while subsamples for geochemical studies were submitted to the chemical laboratory. Also, 36 core samples for (0-1 m, 1-2 m & 2-3 m) were selected from two blocks to make 6 composite samples and submitted to the IREL Research Centre, Kollam, Kerala for individual economic heavy mineral separation. The representative average THM value is 5.45% in the northern part of the study area, 5.56% in the central part, and 6.4% in the southern side. Ilmenite, garnet, sillimanite, monazite, zircon, rutile, pyroxene, amphibole, kyanite, and mica are the minerals identified and counted under the microscope.

Systematic magnetic survey within Territorial Waters in the shelf area off Ganga delta, West Bengal (Cruise-ST-294) (FSP-ID-M1AMCS-APS/NC/ER/MCSD-EC-1/2022/40237):

Systematic magnetic and bathymetric surveys were carried out onboard R.V. Samundra Kaustubh in the territorial waters in the shelf area off the Ganga delta, West Bengal Coast to generate baseline data on magnetic property and for interpretation of magnetic basement and structural/geological features. The survey area is located on the south-eastern coast of West Bengal and is a part of the Bengal Basin. The water depth in the survey area varies from 8 m to 45 m. The horst/graben seafloor morphology of this region generated as a result of the break-up of eastern Gondwanaland and subsequent spreading of the Indian Ocean floor has been well-reflected in alternate high/lows of integrated magnetic, gravity, and bathymetry profile maps. The Magnetic (TF) anomaly map shows an overall variation of 272 nT, varying from -276nT to -4nT over the studied area. The radial power spectrum of the magnetic data delineated 3.98km and 5.17 km corresponding to shallow and deeper interfaces. In 2D GM-SYS modeling of satellite gravity and magnetic data along the regional profile, the crustal thickness is observed to vary from 30-33 km over continental and transition zones. The thickness of the oceanic crust is estimated to be 12-14 km. The model study also revealed that a thick sediment layer of around 9–12 km exists below the water column, which corroborates well with published results.

4. BOAT SURVEY

Preliminary search for placer minerals in the nearshore area from Gollavooru to Burjupadu, north Andhra Pradesh coast (Item No. 138) (FSP code: M1AMCS-NSS/NC/SR/MCSD-EC-2/2022/40147):

Onshore sediment sampling (46 nos) and Manual Auger Core (MAC-5 nos) and the near shore area from 0 m to 10 m isobaths, off Gollavooru to Burjupadu, North Andhra Pradesh coast has been studied in detail to get a comprehensive knowledge on the spatial distribution and down core continuity of heavy minerals. Total 15 nos of profiles were carried by representing the whole area to understand morphology of the beaches. The main geomorphic domains observed in this area are shore, berm, dunes, stabilized dunes and soil cover from south to central part of the survey area. The bathymetric data reveals that the contours are aligned near parallel to the coast configuration varying in water depths from 01 to 11.3 m. The heavy mineral analyses of the shoreline seabed sediment samples, Grab, VC and MAC indicates that the bulk weight percentage of total heavy minerals vary from 0.3327 wt % to 73.2655 wt % with an average of 20.7252 wt %, 3.1563wt% (G/58) to 34.8244 wt% (G/31) with an average of 11.3906 wt%, 1.7566 wt% (MAC/4/1) to 35.6717 wt% (MAC/3/1) with an average of 12.6829wt% and 6.1730 wt% (VC/1/1) to 11.1649 wt% (VC/3/1) with an average of 8.0655 wt%.

Preliminary search for placer minerals in the nearshore area between Karaikal and Velankanni, Nagapattinam District, Tamil Nadu (Item-No.139); (FSP ID-M1AMCS-PMIWEEZ/ NC/SR/SU-TNP/2022/40112):

An area of 80 sq. km in a nearshore domain lying within 10 m water depth between the coastal stretches extending from Karaikal to Vellankanni of Nagapatinam District, Tamil Nadu was covered with systematic bathymetric survey and collection of seabed sediments in 2 km X 2 km grid pattern. Bathymetric contour map shows seabed dipping gently towards the east on the southern side and comparatively steeply dipping towards the east in the northern part of the investigation area. The THM concentration in the seabed sediment varies from 35.72 wt.% (G/10/0) to 0.26 wt.% with an average concentration of 11.34 wt.%. THM concentration in onshore sediment samples collected from pits varies from 39.32 wt.% to 6.25 wt.% with an average concentration of 24.25 wt.%. TEHM concentration in the seabed sediment varies from 34.05 wt.% to 2.49 wt.% with an average concentration of 9.92 wt.%. TEHM concentration in onshore sediment samples collected from pits varies from 36.36 wt.% to 5.27 wt.% with an average concentration of 22.08 wt.%. Maximum TEHM % is reported in the nearshore domain between 0 and 5 m water depth off Nagapattinam and it decreases towards the sea.

Occurrences and spatial distribution of Microplastic in the marine environment off Netravathi River mouth, Mangaluru within the TW off Karnataka (Item-No.143) (FSP ID: M1AMCS-RP-EEZ/NC/SR/MCSD-WC-1/2022/40046):

In this study, comprehensive assessment of the abundance, distribution, and sources of microplastics in the surface sediments of five selected locations along the Mangalore coast along 10/20/30/40-metre water depths were carried out. The study found both primary and secondary microplastics in the sediments at the sampling sites, indicating heavy pollution in the area. Among the samples collected, the highest microplastic abundance was observed in the beach sample with 3,740 particles per kilogram, while the lowest was in the offshore sample off

Thalapady, with 365 particles per kilogram. The overall mean abundance for the study area was 1,653.7 particles per kilogram. In beach samples, the highest and the lowest abundance are 3,740 particles/kg and 1,502.5 particles/kg, respectively with a mean of 2,465 particles per kilogram. In seabed sediments at a depth of 10 meters, the highest abundance and the lowest is 1,600 particles/kg and 365 particles/kg, respectively with a mean abundance of 842.5 particles per kilogram. Fibers, fragments, films, foams, and pellets were the microplastic types in the order of predominance, with fibers comprising around 94% of the total particles (1,6537.5 particles). The predominant presence of Polyethylene (PE) polymer suggests urban sources as the main contributors to microplastic pollution, with PE fibers commonly used in fishing and navigation. Sample B-03 shows elevated levels of foams, likely linked to its proximity to a major Fishing Harbour at Netravathi River mouth. Additionally, sample B-04 exhibited increased amounts of pellets and films, potentially influenced by tourist activities at Someshwar beach. Of concern is the significant 17-fold increase in microplastic abundance in Mangalore's sediments, rising from 96 particles/kg to 1,653.7 particles/kg. This indicates that pollution not only originates from the Netravathi River but also from anthropogenic sources, such as tourism. This alarming finding highlights the potential risks of microplastics to both human health and the ecosystem.

Metal & Alloys

11. Aluminium and Alumina

Aluminium Industry in India is strategically well-placed and is one of the largest producers in the world with discernible growth plans and prospects for the future. India's rich bauxite mineral base renders a competitive edge to the industry as compared to its counterparts globally. The Indian Aluminium Industry scaled lofty notches since the establishment of the first manufacturing company, namely, Indian Aluminium Company (INDAL) in 1938. In 2004, all business activities of INDAL have been merged subsequently with Hindalco Industries Limited (Hindalco). Four major primary producers, National Aluminium Co. Ltd, Hindalco Industries Ltd, Bharat Aluminium Co. Ltd and Vedanta Aluminium Ltd (VAL) are at the forefront in aluminium production. The primary producers have a strong presence in the sheet business and are enlarging their roles in the foil segment. The primary producers are also in the extrusion segment in which a large number of secondary manufacturers participate with fragmental capacities. The overall total annual installed capacity of aluminium plants in the country has decreased to 41.45 lakh tonnes from 41.65 lakh tonnes in previous year. The production of aluminium comes from the plants viz, Nalco, Hindalco, Balco, & Vedanta. Producer-wise capacity of aluminium is furnished in (Table-1). The installed capacity of alumina plants in the country was 74.75 lakh tpy. Producer-wise capacity of alumina is furnished in (Table-2).

Table – 1: Installed Capacity of Aluminium

(By Producers)

(In '000 tonnes)

Producer	Plant	Annual capacity
Total		**4145**
Public Sector		
National Aluminium Co. Ltd	Angul (Odisha)	460
Private Sector		
Bharat Aluminium Co. Ltd	Korba (CG) - I	
	Korba (CG)- II	590
Hindalco Industries Ltd	Aditya (Odisha)- 360	
	Hirakud (Odisha)- 216	1345
	Mahan (M.P) - 359	
	Renukoot(U.P) - 410	
Vedanta Aluminium Ltd	Jharsuguda-I (Odisha) - 500	1750
	Jharsuguda-II (Odisha) - 1250	

Source: *Information received from the companies/Annual Reports.*

(In '000 tonnes)

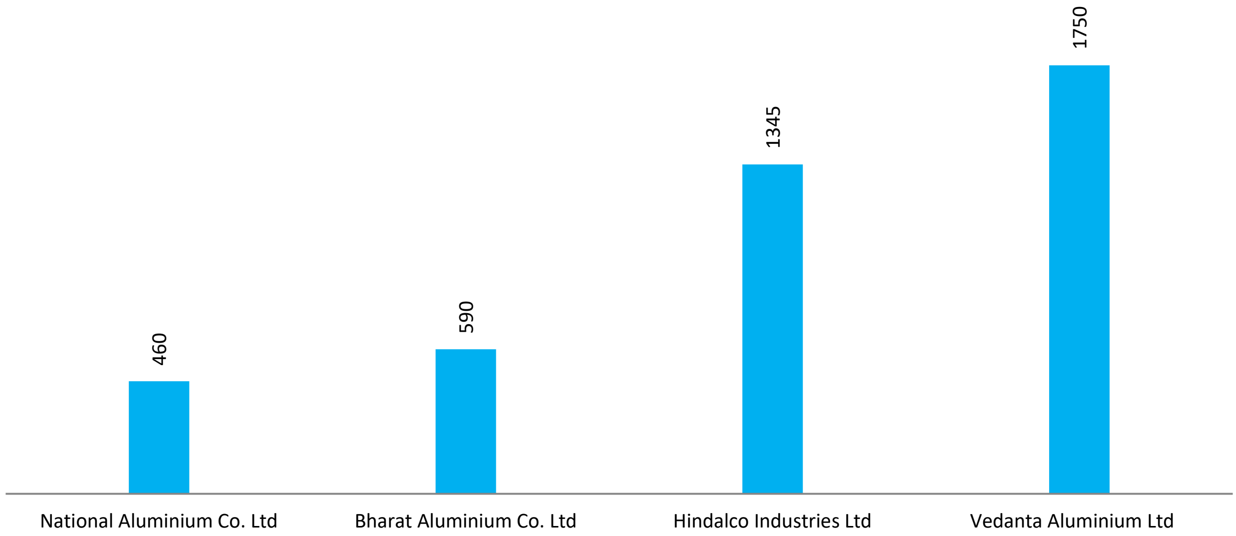


Fig 1: Company wise Installed Capacity of Aluminium

Table – 2: Installed Capacity of Alumina

(By Producers)

(In '000 tonnes)

Producer	Plant		Annual capacity
Total			7475
Public Sector			
National Aluminium Co. Ltd	Damanjodi (Odisha)		2275
Private Sector			
Bharat Aluminium Co. Ltd	Korba (Chhattisgarh)		200
Hindalco Industries Ltd	Renukoot (Uttar Pradesh)	700	3000
	Belagavi -	350	
	Muri (Jharkhand)	450	
	Utkal Alumina - (Odisha)	1500	
Vedanta Aluminium Co. Ltd	Lanjigarh (Odisha)		2000

Source: *Information received from the companies/Annual Reports.*

(In '000 tonnes)

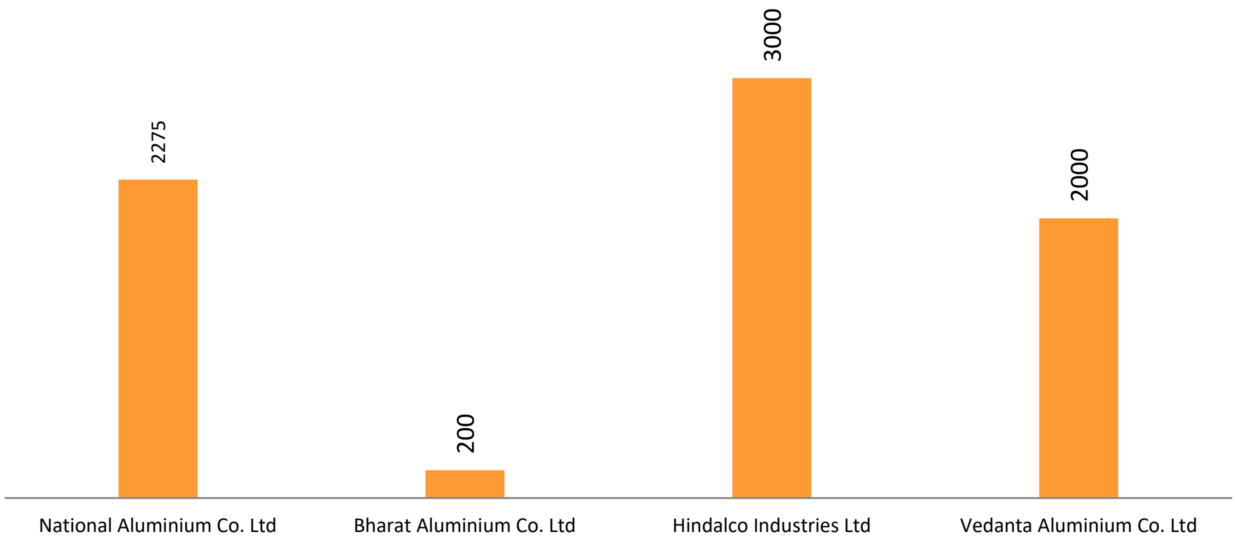


Fig 2: Company wise Installed Capacity of Alumina

PRODUCTION

Aluminium

The production of aluminium at 4066 thousand tonnes in 2022-23 registered an increase of 1.2% as compared to that in the previous year. Seven plants reported production of aluminium during the year. (Tables - 3 & 4).

Alumina

The production of alumina at 7,264 thousand tonnes in 2022-23 increased by 0.5% as compared to that in the previous year. Utkal Alumina was the leading producer of Alumina accounting for 32.15% of the total production during the the year under review. (Tables-5 & 6).

Table – 3: Production of Aluminium

2020-21 to 2022-23

(Quantity in tonnes; Value in ₹)

Year	Production	
	Quantity	Value
2020-21	3619237	415967702
2021-22	4016621	714320396
2022-23 (P)	4066459	809764986

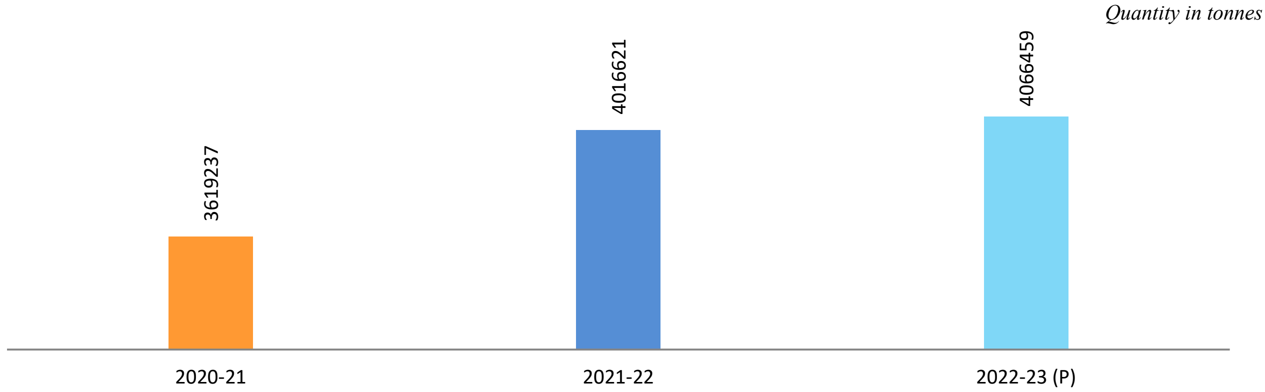


Fig 3: Production of Aluminium, 2020-21 to 2022-23

Table – 4: Production of Aluminium 2021-22 to 2022-23

(By Plants)

(In tonnes)

Producer	Plant	Production	
		2021-22	2022-23 (P)
National Aluminium, Co. Ltd	Angul	460020	459564
Hindalco Industries, Ltd	Aditya	365466	368058
	Hirakud	172071	175693
	Mahan	367168	368781
	Renukoot	389470	409047
Bharat Aluminium, Co. Ltd	Korba	580426	568549
Vedanta Aluminium, Ltd	Jharsuguda	1682000	1716767

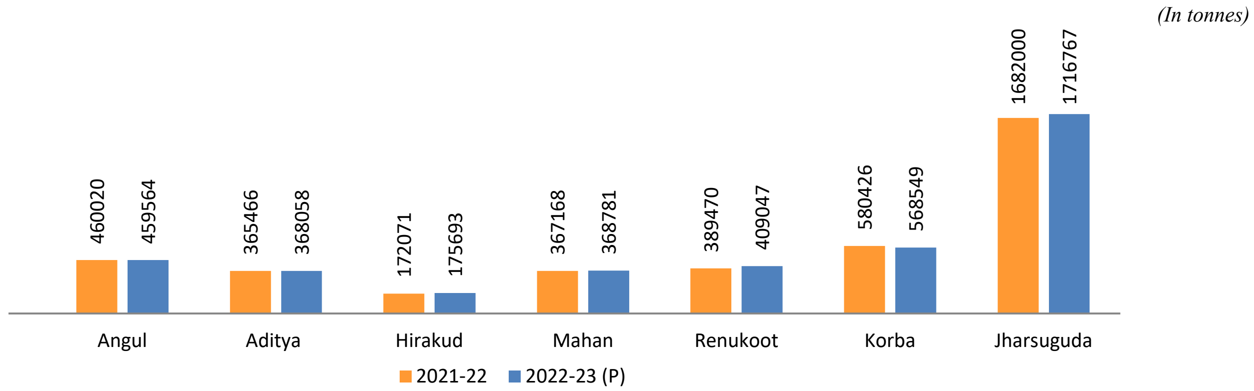


Fig 4: Plant wise Production of Aluminium 2021-22 to 2022-23

Table – 5: Production of Alumina (including Calcined alumina)

2020-21 to 2022-23

(Quantity in tonnes; Value in ₹ 000)

Year	Production	
	Quantity	Value
2020-21	6520842	118069838
2021-22	7229508	159576853
2022-23(P)	7264449	191159578

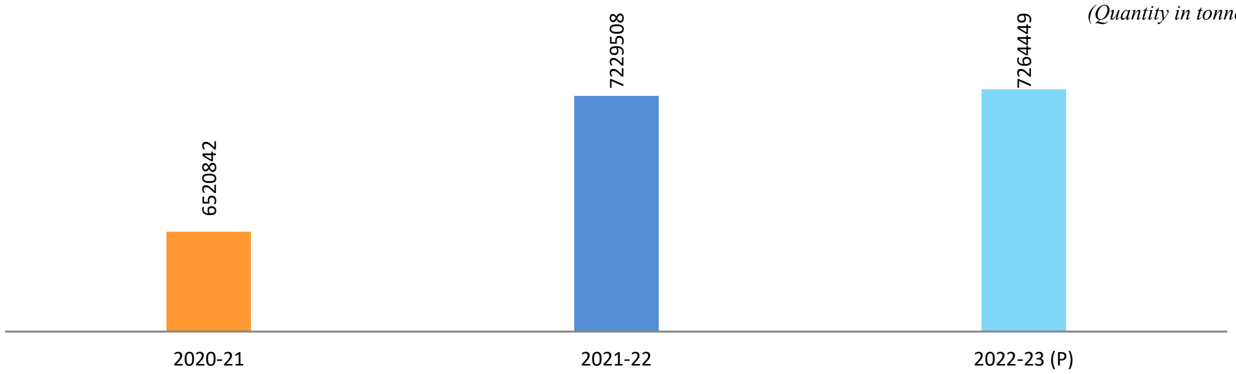


Fig 5 Production of Alumina (including Calcined alumina)2020-21 to 2022-23

Table – 6: Production of Alumina

2021-22 and 2022-23

(By Plants)

(In tonnes)

Producer	Plant	Production	
		2021-22	2022-23 (P)
National Aluminium, Co. Ltd	Damanjodi	2110000	2024000
Hindalco Industries, Ltd	Belgaum	307600	262400
	Muri	262373	272523
	Renukoot	559717	576782
	Utkal Alumina	2021908	2336000
Vedanta Aluminium, Ltd	Lanjigarh	1967910	1792744

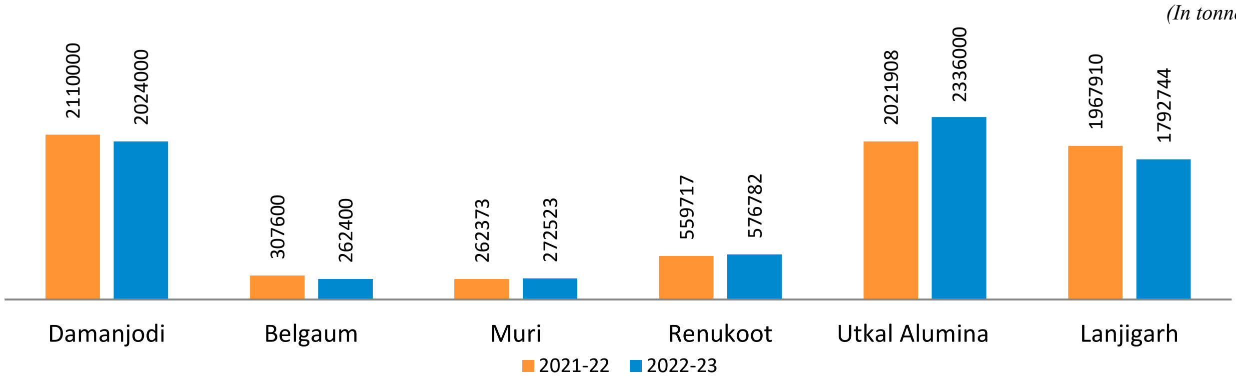


Fig 6: Plant wise Production of Alumina

INDUSTRY

Aluminium is the fastest growing non-ferrous metal in India and the same is evident by its growing and widespread use. Most of the Aluminium Smelter are located near their respective alumina refineries. Ten aluminium smelters are operated by four companies viz. Nalco, Balco, Hindalco & Vedanta. Nalco is the only company in the Public Sector with installed capacity of 4,60,000 tpy. Balco, earlier a Public Sector company, is now under Private Sector. The aluminium plants of Nalco and Balco have their alumina-aluminium complexes at Damanjodi-Angul (Odisha) and Korba (Chhattisgarh), respectively.

Nalco is one of the largest integrated Bauxite-Alumina-Aluminium- Power Complex in the country. The Company has 4,60,000 tpy, Aluminium Smelter at Angul and 22,75,000 tpy Alumina Refinery located at Damanjodi in Koraput, Odisha.

Hindalco Aluminium smelting operations are located at Renukoot (Uttar Pradesh), Aditya Aluminium (Odisha), Mahan Aluminium (Madhya Pradesh) and Hirakud (Odisha). Newly installed smelters at Aditya Aluminium and Mahan Aluminium have state-of-the-art AP36 technology. The Hindalco's total primary aluminium (metal) capacity has enhanced to around 13,45,000 tpy from earlier capacity of 5,62, 000 tpy. This increase was primarily on account of production from Mahan and Aditya smelter commissioned during the year 2014-15. In addition to aluminium, Renukoot Integrated Aluminium Complex also produces semi-fabricated products viz. conductor redraw rods, sheet, extrusion, etc. The Alupuram (Kerala) smelter is closed but extrusion unit currently operates at a capacity of 8,000 tpy.

Hindalco's plants are equipped with sophisticated rolling mills and finishing equipment. The plants are located at Hirakud (Odisha), Belur (West Bengal), Mouda (Maharashtra), Renukoot (Uttar Pradesh) & Taloja (Maharashtra). Hindalco's finished products include, alumina, primary aluminium in the form of ingots, billets & wire rods, value-added products, such as, rolled products, extrusion and foils. Hindalco is the largest manufacturer of entire range of Flat Rolled Products. Flat Rolled Products facilities at Hirakud (Odisha) and Mouda (Maharashtra) are being modernised to produce world class Can Body stock and Ultra Thin Gauge Foils, respectively. The Hirakud plant produces Flat Rolled Products (FRP), rolled products, extrusions products and wire rods. Hindalco has a conductor redraw capacity of 56,400 tpy at Renukoot plant and sheet rolling capacity of 2,05,000 tpy spread over at Renukoot (80,000 tpy), Belur (45,000 tpy), Taloja (50,000 tpy) and Mouda (30,000 tpy) plants. The Company also has two plants for aluminium extrusion with capacity of 31,000 tpy comprising units at Renukoot with 23,000 tpy capacity and Alupuram (Kerala) with 8,000 tpy capacity.

Hindalco's foil unit located at Silvasa (Dadra & Nagar Haveli) has an installed capacity of 30,000 tpy and produces foils with thickness varying from 9 microns to 200 microns. Kollur plant in Medak district (Andhra Pradesh) has capacity of 4,000 tpy and produces an array of high-quality foils, from cigarette and blister foil to lidding foil in thicknesses from 50 to 7 microns.

The overall Balco's smelter capacity augmented to 5,90,000 tpy with the commissioning of Korba-II smelter has capabilities to produce ingots, wire-rods billets, bushbars and rolled products. The Korba-I plant showed consistent production during the year. The Company has two power plants for commercial power generation of which one produces power for captive consumption, refining, smelting, fabrication, etc. and the other 1,200 MW power plant is under construction. The ramp up of BALCO-II smelter was completed during the year 2018. With the ramping up of the Jharsuguda-II smelter with capacity of 1.25 million tpy, the total smelter capacity of Vedanta in Odisha, has been enhanced to 1.75 million from 50,000 tpy capacity. MALCO is under care and maintenance by Vedanta since May, 2017. It generates 100 MW power from 4 units of 25 MW each through power plants located at Mettur (Tamil Nadu), and is one of the largest Private Sector power suppliers in Tamil Nadu. Jindal Aluminium Ltd (JAL) established its factory for manufacture of aluminium extrusion in the year 1968 at Bengaluru. JAL has 11 aluminium extrusion presses with an installed capacity of 1,20,000 tpy. The Company is the leader in aluminium extrusions, meeting country's about 30% demand.

JAL has taken a step forward by diversifying into Aluminium rolled products. Jindal commissioned the state-of-the-art Aluminium sheet and foil manufacturing facility with installed capacity of 40,000 tpy, at Dabaspet, Bengaluru, 35 km from the existing extrusion plant.

DEVELOPMENT & EXPANSION

National Aluminium Company Limited (NALCO): NALCO is in the process of setting up of 5th Stream expansion of its existing Alumina Refinery which would reportedly add 10.0 lakh tonnes to its existing installed capacity of 22.75 lakh tonnes per year (total capacity 32.75 lakh tonnes). This expansion would be based on improved Medium Pressure Digestion technology of M/s Rio Tinto Alcan International Limited (RTAIL).

Sourcing of bauxite for 5th Stream expansion of alumina refinery has been envisaged from Pottangi Bauxite Mines. The availability of bauxite from Pottangi Mines is expected beyond the scheduled commissioning of 5th Stream expansion. Hence, sourcing of bauxite from South Block of Panchpatmali Mines has been planned through setting up of a crushing & conveying system.

The Pottangi Bauxite mine (75 million tonnes) has been reserved by Government of India in favour of NALCO for meeting the bauxite requirement of 1 million tonnes alumina refinary under expansion. The mining plan has already been approved. The pre-project activities are underway. The mine is likely to be operational in the 4th quarter of financial year 2023-24.

Mining Lease of Utkal-D coal block has been granted by the Govt of Odisha over an area of 301.28 Ha and the lease is executed on 25.03.2021 thereafter Utkal coal block will be operationalised after obtaining of statutory clearances.

Nalco, a JV Company Mishra Dhatu Nigam Ltd (MIDHANI) named Utkarsha Aluminium Dhatu Nigam Ltd (UADNL) in August 2019 for establishment of 60,000 TPA for setting up of High End Aluminium Alloy Plant in JV mode for Defence, Aerospace & Automobile Sectors. The plant is expected to be commissioned by financial year 2024-25. The Company has formed JV with Neelachal Ispat Nigam Ltd (NINL) to set up a Coal Tar Distillation plant of 20,000 TPA based on the Coal Tar generated in NINL's Coke Oven Plant.

NALCO and Odisha Industrial Infrastructure Development Corporation (IDCO) have formed a JV Company for establishment of Angul Aluminium Park Pvt. Ltd (AAPPL) for promotion of downstream industries in the State of Odisha.

HINDALCO : In the field of aluminium, Hindalco operates in primary aluminium and downstream aluminium segments and is one of the world 's largest integrated aluminium producer. Hindalco's subsidiary Novalis with 61% recycling capability, is the largest aluminium recycler and producer of rolled aluminium products in the world. Hindalco launched India's first indigenous lightweight and eco-friendly aluminium bulker in India. This bulker saves up to 13,000 litres of fuel, generates 20 tonnes lower GHGs and is BS-VI compliant.

Hindalco is planning to expand its Aluminium downstream business with a focus on Value added product over the next 3-7 years. Products would cater to customised requirement for varied and complex applications of Aluminium. Hindalco to invest around ₹ 8,000-10,000 crore in expanding flat rolling capacity at Hirakud, new extrusion plant at Silvassa and in a greenfield site at Mundra with a recycling facility. The Hirakud plant capacity for flat rolled products is estimated to be 340 KTPA. The planned capacity of the extrusion plant at Silvassa is 34 KTPA, which would have three extrusion presses to service premium customers in building and construction, automobile and transport, electrical, consumer and industrial good sectors. In addition, the new extrusion and recycling unit at Mundra is awaiting land acquisition process and would have a capacity of 93 KTPA.

VEDANTA: Vedanta Aluminium Ltd (VAL) is the largest aluminium producer in India with a capacity of 1.75 million tonnes per annum. The aluminium smelting unit at Jharsuguda has come a long way to establish itself as the world's largest single-location smelter.With an already installed capacity of 1.75 mtpa, backed by two smelters – 0.5 million tonnes per annum and 1.25 million tonnes per annum (SEZ) and two power plants with a combined capacity of 3,615 MW, which is over 1.3 million tonnes per annum. It could be achieved further by scaling up to the production capability of the smelter and the refinery has been significantly enhanced in the last few years. With the ramp up of both smelters, production of aluminium has increased during the last couple of years. Similarly, production of Alumina has also increased due to debottlenecking of the refinery operations.The bauxite requirements for alumina refinery are met from captive mines, domestic source and imports.

BALCO operates through its plant at Korba in Chhattisgarh with a smelter capacity of 0.57million tonnes per annum and power generation capacity of 2,010 MW. The state-of-the-art alumina refinery at Lanjigarh feeds the aluminium smelters at Jharsuguda and BALCO and forms a crucial link in the value chain. It is one of the world's largest one-site integrated alumina refining complexes with a current capacity of 2 million tonnes per annum that can be ramped up to 5 million tonnes per annum.

USES & CONSUMPTION

Aluminum is the second most used metal in the world after steel. Aluminium is more environment-friendly than steel, plastic and other materials. The metal that made flying possible is sustainable, light and energy efficient. Aluminium has widespread uses throughout the economy and is equally important to both the industrial and consumer sectors. Aluminium is used in the Aerospace Industry as well as other industries requiring light metal. On the industrial side, aluminium is heavily used in electrical power transmission, machinery & equipment and construction. Aluminium usage in automobiles is rising and is expected to increase internationally. India's auto sector consumes about 4% aluminium. Over the past five years considerable progress has been made in aluminium-intensive vehicle production.

Housing, in particular, make heavy use of the lightweight material as a substitute for steel and wood in doors, windows and sidings. Aluminium is also used in a variety of retail products including cans, packaging, air conditioners, furniture and automobile. In addition, India has pioneered the replacement of copper by aluminium in power transmission & distribution which has enhanced the demand for aluminium. There are nearly 600 cable and conductor manufacturing units in the country, having a total capacity of about 4,00,000 tpy. The major end-use of aluminium is as rolled sheets, extrusions and foils. India Foils, Pennar Aluminium and Century Extrusions are the major players in the extrusion & foil market.

Key sectors to drive aluminium consumption in India are Auto, Power, Electronics, Railways, Aerospace & Defence Construction, Solar Energy and Aluminium packaging.

China was the largest producer as well as consumer during the year, contributing about 57% share of the world production (36.15 million tonnes) and 55% of the world consumption (35.71 million tonnes) of aluminium. The world excluding China is expected to see aluminium consumption growth of around 1% in the year 2019 from around 2% in the year 2018 due to likely moderation in demand from North America and Europe.

In India, the power, packaging, transport, construction, machinery and equipment sectors are key demand drivers of aluminium. The domestic imports of aluminium products, including scrap, are growing significantly, which is a major concern for the domestic aluminium producers. In advanced economies, aluminium is increasingly replacing wood and steel in Building Sector. Aluminium cans and containers are used extensively, world over. Aluminium is also the ideal packaging material for pharmaceuticals and processed foods.

In India, aluminium was consumed mainly in the Electrical sector (48%), followed by Automobile & Transport sector (15%), Construction (13%), Consumer Durables (7%), Machinery & Equipment (7%), Packaging (4%) and others (6%). In the Electrical sector, aluminium usage is in overhead conductor, and power cable used in generation, transmission and distribution of electricity. Aluminium is also used in switchboards, coil windings, capacitors, etc.

As per Technology Vision Document 2035, the per capita consumption of aluminium in India is among the lowest in the world with only 2.2 kg as compared to the world average of roughly 8 kg and with that of the developed nations which is 22-25 kg.

Alumina is produced from bauxite. About one tonne of alumina is produced from 3 to 3.5 tonnes of bauxite and about one tonne of aluminium is produced from about two tonnes of alumina.

RECYCLING

Aluminium is 100% recyclable and consumes 95% less and releases 95% less greenhouse gases as compared to primary aluminium and there is no loss of properties or quality during the recycling process. Products of aluminium, such as, UBC (Used Beverages Can), aluminium foils, plates and automotive components can be easily recycled, thereby, saving energy and reducing greenhouse emissions. Aluminium recycling process is less capital intensive than primary metal production as the process requires only 5% of energy, i.e.,13–15 thousand units of power for producing one tonne of aluminium through primary route. Recycling of aluminium saves about 6 kg of bauxite/kg and 14 kWh of electrical energy /kg of primary aluminium. Besides, it keeps the emission levels of greenhouse gases as low as 5% from the actual emission experienced during primary production. Further, recycling facilitates reduced stress on the use of bauxite and thereby preserving about six lakh tonnes of bauxite resources every year.

India's metal recycling rate is about 25%. Altogether the rise in aluminium production from old scrap has grown from one million tonnes in 1980 to 20 million tonnes in 2019. All the activity related to aluminium scrap recovery are limited to the Unorganised sectors, catering mostly to the utensil and casting industries. The proportion of recycled aluminium has been increasing over the years. It is expected that in the years to come, it will reach a figure of about 35–40% of total aluminium consumption. Currently, there is only one recycling unit of Hindalco in the Organised Sector at Taloja with 25,000 tonnes annual capacity. Although the plant at Taloja was facing challenges due to less availability of scrap, the production from the unit has improved and the plant is now operating at 80% of the rated capacity as against earlier capacity of 60%. Hindalco is planning to set up greenfield recycling unit at mundra with a capacity of 93 KTPA.

Most recycling units in India operate on outdated, or primitive technology which leads to high levels of pollution and energy consumption. This is an area that needs to be addressed by the Indian Aluminium Industry. Due recognition of recycling could encourage users of aluminium particularly in transport, housing, packaging and durable sectors to broaden the organised markets for the scrap generated.

WORLD REVIEW

World production of alumina was 141 million tonnes in 2022. China continued to be the leading producer with a share of about 58% which is followed by Australia (13%), Brazil (8%), India (5%) and Russia & UAE (2% each). World production of aluminum was at 67.20 million tonnes in 2022. China continued to be the leading producer with a share of about 59% which is followed by Russia, (6%), & Canada (3%). (Tables-7 & 8).

Table – 7: World Production of Alumina

(By Principal Countries)

In tonnes (Al_2O_3 content)

Country	2020	2021	2022
World: Total (rounded off)	**144800000**	**140500000**	**140800000**
China	73131946	77480000	81862000
Australia	20837142	20624088	19528493
Brazil	20368800	10992300	11200000
India[(a)]	6624500	7325000	7441000
Russia	2873000	3054000	3080000
UAE	1920000	2300000	2430000
Saudi Arabia	1782041	1879000	1745000
Ireland	1822368	1878000	1629000
Canada	1518000	1471000	1478000
Vietnam	1384706	1456068	1428503
Other countries	12520138	12030979	8959931

Source: BGS World Mineral Production, 2018-2022.
(a) Years ended 31st March following that stated

Table – 8: World Production of Aluminium (Primary)

(By Principal Countries)

In tonnes (metric)

Country	2020	2021	2022
World: Total (rounded off)	**65300000**	**67400000**	**67200000**
China	37080401	38502600	40214000
Russia	3638000	3640000	4014000
Canada	3154493	3157762	3026236
UAE	2520000	2540000	2720000
India*(d)	3619237	4016621	2322270
Bahrain	1548000	1561222	1600111
Australia	1582947	1558529	1494598
Norway	1330000	1419000	1393000
USA	1026617	907846	872300
Brazil	685100	771700	810900
other countries	9113297	9316252	8697977

Source: BGS World Mineral Production, 2018-2022.

FOREIGN TRADE

Exports

Export of alumina increased by 35% to 2014 thousand tonnes in 2022-23 from 1487 thousand tonnes in the previous year. Exports were mainly to UAE (34%), Oman (30%), Russia (14%) and UK (12%).

Export of aluminium and alloy Incl.Scrap decreased drastically by 17% to 2870 thousand tonnes from 3,454 thousand tonnes. Exports in 2022-23 were mainly to USA (8%), Korea, Rep. of (12%), Netherlands (10%), Malaysia (10%) (Tables-9 to 11).

Table– 9 : Exports of Alumina

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1487035**	**47334417**	**2014428**	**64237704**
UAE	745938	22936746	687641	22093403
Oman	244982	8394532	613138	18789515
Russia	-	-	289499	8261955
U K	31312	730576	246221	7348356
Taiwan	22700	941879	18145	1037353
China	133323	4018156	32978	1001625
Malaysia	95678	2864082	32266	966920
Georgia	-	-	31500	896270
Italy	2818	137344	13313	843262
Korea, Rep. of	18490	797254	13425	799168
Other countries	191794	6513848	36302	2199877

Figures rounded off

Table – 10: Exports of Aluminium and Alloys Incl. Scrap

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3454121**	**791688112**	**2870455**	**709309716**
USA	270434	82666048	244144	88115029
Korea	544473	113328421	345808	74170229
Netherlands	127039	32504416	3066866	68245571
Malaysia	94138	20084221	291396	63526272

Table- 10Cont.

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Mexico	146144	30200871	231688	52697568
Italy	158098	36801783	175170	40443317
Turkey	320151	66426511	121254	25695292
Japan	118441	23606891	114462	23347527
Vietnam	98908	21250923	103833	22824215
Bangladesh	57286	19003905	55726	20439941
Other countries	1519009	345814122	880288	229804755

Figures rounded off

Table – 11: Exports of Aluminium

(By Items)

Item	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All items	**3454121**	**791688112**	**2870455**	**709309716**
Aluminium & Alloys : Unwrought	2932260	622444035	2314182	504636153
Aluminium Alloys Unwrought	466857	107772630	226365	56610660
Aluminium Ingots	2462842	514076586	2067465	443904894
Aluminium Unwrought Nes	2561	594819	20352	4120599
Aluminium & Alloys : Worked	308958	80005080	293915	90407711
Aluminium & Alloys :Worked (Bars, Rods, Plates)	221750	52848855	195563	52365731
Aluminium & Alloys :Worked (Bars, Rods, Profiles)	65170	21514780	78506	32067202
Aluminium Worked (Bars, Rods, Profiles etc.)	22038	5641445	19846	5974778
Aluminium & Alloys, Worked, Nes	199044	86361195	248745	111184936
Aluminium & Scrap	9529	1604369	9609	1718635
Aluminium Powders & Flakes	4330	1273433	4004	1362281

Figures rounded off

Imports

Import of alumina decreased by 6% to 2407 thousand tonnes in 2022-23 from 2,549 thousand tonnes in the previous year. Imports were mainly from Indonesia (38%), Australia (27%), Vietnam (28%), China (3%) and Netherlands (1%).

Imports of aluminium & alloys including scrap also increased by 9% to 2542 thousand tonnes in 2022-23 from 2334 thousand tonnes in the previous year. The imports were mainly from USA (19%), China (13%), UAE (7%), UK (8%), and Saudi Arabia (6%).(Tables- 12 to 14).

Table – 12: Imports of Alumina

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**2549567**	**82447635**	**2407867**	**89152924**
Indonesia	654730	19029897	933578	32214885
Vietnam	682631	22554543	674076	23338494
Australia	957664	27069771	662736	22115636
China	92555	6313320	66267	5737210
Germany	7122	949584	5372	1109670
Saudi Arabia	43251	1488729	31500	1003743
Netherlands	25074	1428683	9744	918560
U S A	4302	823975	2708	729111
Japan	3412	379903	681	428159
Canada	3102	416853	4056	422020
Other countries	75724	1992377	17149	1135436

Figures rounded off

Table – 13: Imports of Aluminium Alloys Incl. Scrap

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**2334438**	**452887747**	**2542127**	**562908946**
China	250509	76342593	336026	112046665
USA	479644	72677925	488236	84316262
U A E	188607	36663829	195549	40787914
UK	179648	27522218	203966	33052532
Saudi Arabia	157267	29347969	161537	32560837
Thailand	53597	16521970	80191	28026278
Malaysia	79672	15939942	77480	19324115
Singapore	65593	11429472	79100	14940479
Baharain	54589	12034735	60427	14757195
Korea	58355	16508772	39532	13680619
Other countries	766957	137898322	820083	169416050

Figures rounded off

Table – 14: Imports of Aluminium

(By Countries)

Item	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All items	**2334438**	**452887747**	**2542127**	**562908946**
Aluminium & Alloys:Unwrought	213611	45666154	274056	63633827
Aluminium Alloys Unwrought	50835	10244963	62285	15331313
Aluminium Ingots	161124	35041224	210095	47912663
Aluminium Unwrought Nes	1652	339967	1676	389851
Aluminium & Alloys:Worked	390525	116853619	446845	154637499
Aluminium & Alloys:Worked (Bars,Rods,Plates)	126761	37013014	121399	44533141
Aluminium & Alloys:Worked (Bars,Rods,Profiles)	232931	71007555	282265	96630228
Aluminium Worked (Bars,Rods,Profiles Etc)	30833	8833050	43181	13474130
Aluminium & Alloys,Worked,Nes	65738	32363370	84325	46633490
Aluminium & Scrap	1662472	257308920	1734516	297172222
Aluminium Powders & Flakes	2092	695684	2385	831908

Figures rounded off

FUTURE OUTLOOK

Aluminum is one of the most abundant metals found in the Earth's crust. In terms of weight, it accounts for nearly 8% of the earth's crust. The wide availability and numerous properties of aluminum make it a widely used metal across the world. Aluminum is used in various applications such as packaging, household products, electronics, and transportation.

It possesses several properties such as high conductivity, ease of recycling, and corrosion resistance; however, aluminum carries drawbacks such as moderate tensile strength and moderate machine ability. This limits its direct usage in various end-user industries.

Aluminum is an ideal substitute for materials such as steel and iron, primarily due to its lower self-weight and high-strength properties. Prices of aluminum fluctuate primarily due to its application in several end-user industries.

Over the past few years, the metal has been used in combination with diverse alloying elements, including silicon, copper, magnesium, and zinc.

This combination helps in advancing the properties of aluminum, including high tensile strength, high fatigue strength, and high-temperature sustainability.

Alumina and Aluminium Market is expected to witness significant growth in the coming years, primarily driven by the growing demand for (Refractory, Metallurgy and Other). Based on the type, the market can be segmented into 6 (Metallurgical Grade, Refractory Grade, Grinding Grade, Cement Grade, Other). As per Research and Markets report the Aluminum Furniture Market is projected to reach USD 101.03 billion by 2030 from USD 63.13 billion in 2022, at a CAGR of 6.05% during the forecast period.

12. Antimony

Antimony is a strategic metal. The predominant ore of antimony is stibnite composed of antimony trisulphide, Sb_2S_3 (Sb 71.4%). The other important ores of antimony are jamesonite ($Pb_2Sb_2S_5$) and senarmonite/valentinite (Sb_2O_3). Antimony in its elemental form is a silvery white, brittle, fusible, crystalline solid that exhibits poor electrical and heat conductivity properties and vaporises at low temperatures. Antimony and some of its alloys exhibit unusual property of expansion on cooling. Commercial forms of antimony are generally traded in the form of ingots, broken pieces, granules or cast cake. Other forms are powder, shots and single crystals. Occurrence of antimony in the earth crust ranges from 0.2 to 0.5 parts per million. Antimony is geochemically categorised as a chalcophile, occurring with sulphur and associated with heavy metals, such as, lead, copper and silver.

RESERVES/RESOURCES

As per the NMI database based on UNFC system, as on 1.4.2020, the total reserves/ resources of antimony ore has been estimated at 18,683 thousand tonnes. The ore with metal content is placed at 255 thousandtonnes, Inferred category located in Lahaul & Spiti district, Himachal Pradesh (68%) and Madhya Pradesh (32%)(Table-1).

The stibnite and its decomposition products, cervantite and kermesite occur as veins, stringers and specks. Occurrences of antimony ores are also reported from the States of Andhra Pradesh, Jharkhand, Karnataka, Uttarakhand and Union Territory of Jammu & Kashmir.

Table – 1 : Reserves/Resources of Antimony as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total			
Ore	7503	11180	18683
Metal	75	179.92	254.92
By State			
Himachal Pradesh			
Ore	-	10588	10588
Metal	-	174	174
Madhya Pradesh			
Ore	7503	592	8095
Metals	75	5.92	80.92

USES

Antimony and its alloys find numerous applications in a wide range of high technology industries like electronic, space defence, photographic materials, electroplating, besides cosmetic, paint, plastics and textile industries. Traditionally, it is used in type metal in Printing Industry and other alloys. It is now used extensively worldwide to harden and increase the mechanical strength of lead, particularly in Battery Industry. Antimony trioxide is the most important of the antimony compounds and is primarily used in flame-retardant applications, including such markets, as children's clothing, toys as well as in manufacturing aircraft and automobile seat covers. Antimony sulphide is one of the ingredients used in safety matches. It is used in solar panels to improve stability of the solar performance of the glass upon exposure to UV radiations or sunlight and also as a decolourising and refining agent in Glass Industry. Antimony compounds also find use in pharmaceutical applications. It is also used in semiconductors for making infrared detectors, diodes & acoustic devices, and in plastic production as a heat stabiliser in PVC.

INDUSTRY

The metal is obtained commonly as a by-product in lead-zinc-silver smelting. As part of its R&D programme, HZL successfully implemented antimony dust treatment flow sheet at Ancillary Industry. Antimony dust at Pantnagar Metal Plant (PMP) was leached in controlled conditions to recover antimony as Potassium Antimony Tartarate (PAT) reagent which is used in Zinc Hydro plants purification section and enriched lead silver residue. Presently, there is no production of antimony in India. The entire requirement of antimony in the country is met through imports of its ore and concentrates. HZL is currently operating metal plant having 1,400 TPA antimony concentrate (by-product). The antimony slag is recovered as antimony trioxide with more than 95% purity, which is commercially accepted with high demand as flame retardant.

SUBSTITUTES

Combination of tin, calcium, copper, selenium, cadmium, strontium and sulphur is among the substitutes used as hardeners for lead used in batteries. Low maintenance batteries have started using calcium as additive to substitute antimony. Antimony can be replaced by organic compounds or hydrated aluminium oxide in flame-retardants and by tellurium and selenium in rubber manufacturing. Compounds of titanium, zinc, chromium, tin and zirconium are substituted for antimony chemicals in paints, pigments and enamels.

TECHNICAL POSSIBILITIES

Antimony products can be used as stabilisersin specialised plastics. Development of electric vehicles could lead to the use of high antimonial lead batteries because of their deep cycling characteristics. Antimony semiconductors have possible use in aircraft night vision systems and in space-based astronomy. Antimony has also been found to be used in the manufacture of DVDs.

RECYCLING

Traditionally, the bulk of secondary antimony has been recovered at secondary lead smelters as antimonial lead, most of which was generated and then consumed by the Lead-acid Battery Industry.

WORLD REVIEW

The world reserves of antimony were 1.8 million tonnes in terms of metal content. Antimony reserves are located mainly in China and Russia which contributes about 19% each of the total reserves followed by Bolivia (17%), Kyrgyzstan (14%), Australia (7%), (Table-2).

Table – 2 : World Reserves of Antimony

(By Principal Countries)

(In tonnes of metal content)

Country	Reserves
World : Total (rounded off)	1,800,000
China	350,000
Russia (recoverable)	350,000
Bolivia	310,000
Kyrgyzstan	260,000
Myanmar	140,000
Australia	(b)120,000
Turkey	100,000
Canada	78,000
Tajikistan	50,000
United States	(a)60,000
Pakistan	26,000
Mexico	18,000

Source: *USGS, Mineral Commodity Summaries, 2023*
(a) Company-reported probable reserves for the Stibnite Gold Project in Idaho.
(b) For Australia, Joint Ore Reserves committee-compliant reserves were 18000 tonnes.

The world mine production of antimony metal increased by 5% to 100,000 tonnes in 2022 as against 95,000 tonnes in the previous year. China with (39%) production was the main producer of antimony in the world followed by Tajikistan (24%), Russia (11%) and Turkey (10%) (Table-3).

China continued to be the leading antimony producing country in the world. The Chinese Government considered antimony to be one of the protected and strategic minerals, and therefore, strictly controlled the exploitation and production of antimony. In Oman, construction of an antimony smelter with 20,000 tonnes per year capacity of antimony metal and antimony oxide was initiated after acquisition of funds and other developmental proceedings put into place.

Table – 3 : World Mine Production of Antimony

(By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
World: Total (rounded off)	**121000**	**95000**	**100000**
China, Rep. of	60995	42622	*39000
Tajikistan	24000	24000	24000
Russia	17532	9000	11000
Turkey	2570	4210	10692
Iran[j]	5006	5000	5000
Bolivia	2629	3084	3453
Myanmar	3800	2300	3000
Australia[c]	3903	3380	2292
Mexico	136	413	632
Vietnam	312	268	252
Other countries	59	327	194

Source: BGS, World Mineral Production, 2018-22
(c) Years ended 30 June of that stated.
(j) Years ended 31 March following that stated

(In tonnes of metal content)

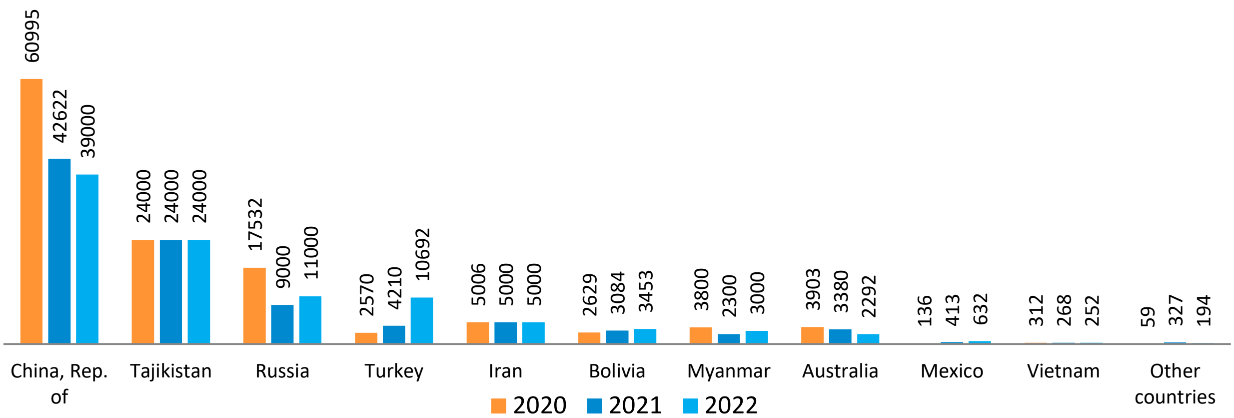


Fig 2: Country wise production of Antimony

FOREIGN TRADE

Exports

Exports of antimony ores & concentrates was nil for the years 2022-23 and 2021-22.Exports of antimony alloys and scrap decreased slightly by 11 % to 1590 tonnes in 2022-23 as against 1918 tonnes in the previous year. Exports were mainly to USA (85%), Italy (3%) and South Africa (3%). Exports of antimony (Unwrought) powders also decreased to 1588 tonnes in 2022-23 as against 1916 tonnesin 2021-22. Exports of antimonial lead were at 22852 tonnes in 2022-23 as compared to 22633 tonnes in 2021-22 (Tables- 4 to 7).

Table – 4 : Exports of Antimony (Unwrought) Powders

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1916**	**1507015**	**1588**	**1549664**
USA	1627	1271920	1363	1317864
Italy	-	-	50	50926
South Africa	35	27188	52	50502
Brazil	111	98654	37	35922
Spain	-	-	25	25753
Netherlands	1	1115	25	22350
Sri Lanka	6	6132	17	21867
Bangladesh	38	33305	10	10838
Nepal	2	2123	4	5008
Turkey	-	-	1	1474
Other Countries	96	66578	4	7160

Figures rounded off

Table – 5 : Exports of Antimony & Articles, NES

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**2**	**973**	**2**	**4742**
Germany	-	-	1	2660
Thailand	-	-	1	2054
USA	-	-	++	26
Azerbaijan	-	-	++	1
Korea, Rep. of	-	-	++	1
UAE	-	-	++	++
Nepal	1	662	-	-
Australia	1	259	-	-
Rwanda	++	22	-	-
Baharain	++	21	-	-
Other Countries	++	9	-	-

Figures rounded off

Table – 6: Exports of Antimony Alloys & Scrap

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1918**	**1507988**	**1590**	**1554406**
USA	1627	1271920	1363	1317890
Italy	-	-	50	50926
South Africa	35	27188	52	50502
Brazil	111	98654	37	35922
Spain	-	-	25	25753
Netherlands	1	1115	25	22350
Sri Lanka	6	6132	17	21867
Bangladesh	38	33314	10	10838
Nepal	3	2785	4	5008
Germany	-	-	1	2660
Other Countries	97	66880	6	10690

Figures rounded off

Table – 7 : Exports of Antimonial Lead

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**22633**	**4087251**	**22852**	**4426688**
Korea, Rep. of	8769	1602541	10230	2102614
UAE	4410	777971	5421	988087
Vietnam	3032	538127	2346	432230
Bangladesh	2280	400045	1943	354466
Japan	983	177169	1279	232131
Oman	647	110721	558	99354
Nepal	465	85049	362	70037
USA	268	51966	163	36543
Thailand	409	90888	152	34449
Turkey	202	36414	124	24182
Other Countries	1168	216360	274	52595

Figures rounded off

Imports

Imports of antimony ores and concentrates increased by 41% to 6460 tonnes in 2022-23 as compared to 4555 tonnes in the previous year. Imports were mainly from Canada (44%), China (30%), and Chile (10%). Imports of antimony alloys and scrap increased substantially by 34% to 1579 tonnes in 2022-23 from 1173 tonnes in the previous year. Imports of alloys and scrap were mainly from Oman (50%), China (18%) and Vietnam (16%). Imports of antimony (Unwrought) powders increased by 36% to 1579 tonnes in 2022-23 as compared to 1162 tonnes in the preceding year. Imports were mainly from Oman (50%), China (19%), Vietnam (16%) and Thailand (13%) (Tables-8 to 11).

Table – 8: Imports of Antimonial Lead

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**32305**	**5657916**	**56996**	**10271277**
Malaysia	13304	2289306	27433	4848198
Korea, Rep. of	8086	1472811	7245	1370061
UK	197	33824	6950	1188146
Singapore	6217	1087677	4553	822440
Luxembourg	319	58129	3706	664681
UAE	1188	218727	2904	558741

Table 8 Concld

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Saudi Arabia	1096	171853	1341	250884
Thailand	353	61923	622	118405
USA	-	-	562	104564
Greece	++	76	172	49969
Other Countries	1545	263590	1508	295188

Figures rounded off

In tonnes

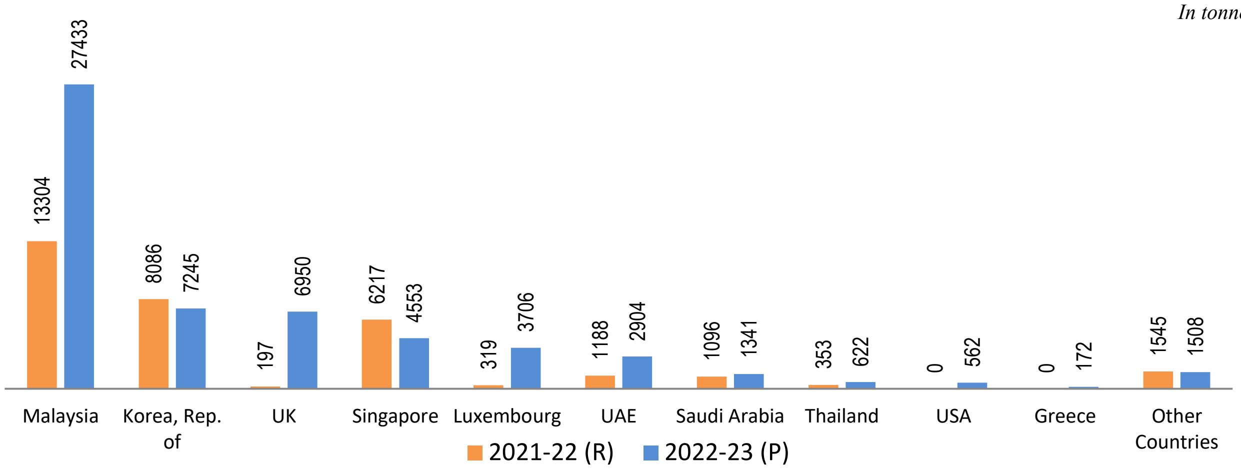


Fig: 3 Country wise Import of Antimony

Table – 9 : Imports of Antimony & Articles, NES

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**11**	**9341**	**++**	**741**
UK	++	379	++	452
Germany	-	-	++	128
USA	++	35	++	87
China, Rep. of	-	-	++	74
Vietnam	10	7739	-	-
Japan	1	1188	-	-

Figures rounded off

Table – 10 : Imports of Antimony (Unwrought), Powders

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1162**	**988906**	**1579**	**1547820**
Oman	420	377739	792	757119
China, Rep. of	402	328961	297	311585
Vietnam	155	118749	261	251297
Thailand	123	107106	214	210622
Hong Kong	-	-	15	16091
UK	15	14460	++	916
USA	++	3	++	155
Netherlands	23	22984	++	32
Belgium	-	-	++	3
Sweden	24	18904	-	-
Other Countries	-	-	-	-

Figures rounded off

Table – 11 : Imports of Antimony Alloys & Scrap

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1173**	**998247**	**1579**	**1548561**
Oman	420	377739	792	757119
China, Rep. of	402	328961	297	311659
Vietnam	165	126488	261	251297
Thailand	123	107106	214	210622
Hong Kong	-	-	15	16091
UK	15	14839	++	1368
USA	++	38	++	242
Germany	-	-	++	128
Netherlands	23	22984	++	32
Belgium	-	-	++	3
Other Countries	25	20092	++	++

Figures rounded off

FUTURE OUTLOOK

Antimony has been in a list of 30 critical minerals for India, released by Ministry of Mines, Government of India on 24.07.2023. The future growth in demand for antimony will be much dependent on the level of requirement from the Flame-retardant Sector which accounts for about 48% primary antimony consumption worldwide and for about 90% global antimony trioxide consumption.

In the Flame-retardant Sector, antimony trioxide is used as a synergist normally with bromine and chlorine. Currently, antimony-based catalysts account for around 90% usage worldwide in polyethylene terephthalate (PET) production.

A new chip, based on germanium-antimony-telluride was developed abroad for 'Phas e-change' Random Access Memory chips (PRAMS) which can process data faster than flash memory chips and unlike silicon are non-flammable. The chips have been commercialised and are expected to find applications in mobile phones and digital cameras. In contrast, antimony metal consumption in metallurgical and battery markets could show a declining trend. The recent research and development programmes initiated by lead-acid battery manufacturers have led to significant changes in lead-acid battery design that have yielded substantial performance improvement which is bound to make lead-acid batteries a better and viable option as compared to its counterparts. This would eventually result in reduced use of antimony in lead-acid batteries diminishing the prospect of use of antimony in Battery Markets. The world supplies of antimony are expected to rise to an extent sufficient enough to meet the prospective demand. However, as per USGS, global consumption of antimony is expected to increase owing to projected increase in the use of antimony in flame retardants, lead-acid batteries and plastics, primarily in Asia. Antimony is a versatile element with a range of industrial application, although its use has become more regulated due to concern about its environmental and health impacts.

13. Cadmium

Cadmium is a soft, bluish-white metal of low melting point which is present generally in zinc ore deposits as greenockite (CdS). The principal source of cadmium is zinc ore, sphalerite. Other sulphides and sulphosalts may also carry small amounts of the metal.

In India, cadmium is recovered as a by-product during zinc smelting and refining. The concentration of cadmium in sphalerite, the principal ore of zinc, ranges from 0.03 to 9.0 wt%.

INDUSTRY

The total annual installed capacity for recovering cadmium was 913 tpy of which HZL accounted for 833 tpy capacity. Binani Zinc Ltd (Edayar Zinc Ltd) reported the remaining 80 tpy capacity (Table 1). HZL produces cadmium of high quality in its zinc smelters which is casted in the form of pencils weighing from 250 g to 500 g. The purity is 99.95% Cd (max.) at Debari; 99.97% Cd (max.) at Vizag and 99.99% Cd (min.) at Chanderiya plants. HZL has plans to conduct R&D for production of high purity cadmium. High purity cadmium is typically used for nuclear shielding applications.

Table – 1 : Installed Capacity for Recovery of Cadmium

Unit	Location	Installed capacity (tpy)
Total		**913**
1. HZL, Debari Zinc Smelter	Debari, Distt. Udaipur, Rajasthan.	250
2. HZL,* Vizag Zinc Smelter	Visakhapatnam, Andhra Pradesh.	115
3. HZL, Chanderiya Lead-Zinc Smelter	Chanderiya, Distt. Chittorgarh, Rajasthan.	468
4. Binani Zinc Ltd** (Edayar Zinc Ltd)	Binanipuram, Distt. Ernakulam, Kerala.	80

** Operation suspended since 2002*
*** Operation suspended since April-2014*

USES

Cadmium is used to control the fissionable elements in nuclear reactors. Along with nickel, it is used in electrical storage/rechargeable batteries. Cadmium-based bearing alloys are used in high-speed internal combustion engines. Copper-cadmium alloys possess high strength, high conductivity and high resistance to abrasion, and therefore, the alloys are used in electric transmission wires. The main use of cadmium is in electroplating where it can be applied as a very thin coating to protect iron, steel, copper alloys and other metals and alloys from corrosion. Cadmium sulphide forms brilliant golden yellow, orange-red or reddish brown pigments used in paint, enamel, soap, rubber, glass and ceramic glazes. Some cadmium salts are also used in photographic films and in lithography. Cadmium coated products are preferred for a wide range of critical and safety-related applications in the aerospace, electrical, defence, mining, nuclear fission, television and offshore industries. Cadmium plating is used mainly in the aviation and aerospace industries to protect fastners exposed to hostile environments.

PRODUCTION

Production of cadmium is generally reported as a by-product of zinc smelting and is nil during both the year i.e. 2020-21 & 2021-22.The foreign market prices of cadmium are furnished in the General Review on "Prices".

Table – 2 : World Production of Cadmium

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World: Total (rounded)	**25800**	**26000**	**24400**
China	*10300	*10349	10000
Korea, Rep. of	*4500	*4500	*4500
Japan	1880	1900	1900
Canada[(a)]	1800	*1800	*1800
Kazakhstan	*1500	*1500	*1200
Mexico	978	1051	1174
Russia	*1300	*1400	*1000
Netherlands	*351	*854	*500
Uzbekistan	450	470	500
Norway	*340	*390	*400
Other countries	2353	1833	1249

Source: BGS World Mineral Production, 2018-22,
a) including cadmium sponge and/or secondary metal.

RECYCLING

National Waste and Recycling Associations (NWRAs) have been created around the world to promote the collection and recycling of all batteries, both from the general public and industrial consumers. Nickel-cadmium batteries which account for about three-fourths of the cadmium consumed are virtually 100 per cent recyclable once they have been collected. The recovery of cadmium from cadmium products through recycling not only ensures that cadmium be kept out of the waste stream and out of the environment, but also that there is consumption of this valuable natural resource as well. Exide Industries Ltd, India's largest manufacturer of lead-acid storage batteries and power storage solutions provider, has invested in building a battery recycling plant at Haldia (West Bengal) and has plans to expand its existing facility to manufacture Nickel-Cadmium batteries. The plant in Haldia will have a monthly capacity of 15,000 tonnes, making it the country's largest lead recycling facility. The project would give the company's recycling capacity a tremendous boost. It already operates two lead recycling plants near Pune and Bengaluru, which have a combined monthly capacity of 11,500 tonnes of recycled lead. The expansion project in Haldia is aimed at producing high-end Nickel-Cadmium batteries in technical collaboration with Furukawa of Japan. "These batteries find applications in bullet trains, metro rail and other critical installations. This plant will also produce lead-acid batteries".

As per JMK Research estimates, the lithium-ion battery market in India is expected to increase from 2.9 GWh in 2018 to about 132 GWh by 2030 (CAGR of 35.5%). Raasi Solar has announced plans to set up a 300MW plant focussing on lithium battery recycling along with battery assembling and cell manufacturing facility.

SUBSTITUTES

Suitable replacements of cadmium in all uses, especially in pigments and plating are being contemplated and enforced owing to the pollution hazards associated with the use of cadmium. Ni-Cd batteries, in some applications, are replaced with lead-acid, fuel cells lithium ion and nickel metal hydride batteries. However, higher costs of these substitutes restrict their uses. Cadmium in plating applications can be substituted by coatings of zinc or vapour-deposited aluminium. Cerium sulphide is used as a replacement for cadmium pigments mostly for plastics. Cadmium telluride (CdTe) flexible thin film solar cells are an alternative to traditional crystalline silicon solar cells and are suitable for commercial roof top applications and large-scale ground mounted utility systems. CdTe photovoltaic cells are potentially safe, environment-friendly application for cadmium. In India, cadmium is consumed in industries like paint, glass and chemical.

HEALTH AND SAFETY

Cadmium in all its chemical forms is considered highly toxic to living species as it does not decompose and if ingested through food, water and air it does not get excreted easily. It is both bioaccumulated and biomagnified. Ingested cadmium accumulates in liver, kidney, pancreas and thyroid. Excessive exposure to cadmium has been linked with respiratory insufficiency (via occupational exposure) and renal disturbance (via environmental and occupational exposure). Cadmium has also been implicated in the development of cancer of various types.

During the last decade, regulatory pressure to reduce or even eliminate the use of cadmium has gained momentum in many developed countries. The world recommended target guidelines for cadmium as a residual heavy metal below which no major risk is expected which could have significant or adverse impact on aquatic biota or human use is 0.1 mg/l. In the USA, Federal and State agencies regulate cadmium content in the environment. Cadmium present in CRT screens, printer inks, toners, etc. is known to cause health hazards affecting the kidneys and causing flue like symptoms and muscular pain. In India, the Silver Jewellery Industry is an important cadmium consuming industry. Silver mixed with cadmium is used in the making of silver jewellery.

WORLD REVIEW

Cadmium is generally recovered from zinc ores and concentrates. Sphalerite, the most economically significant zinc ore mineral, commonly contains minor amounts of cadmium, which shares certain similar chemical properties with zinc and often substitutes for zinc in the sphalerite crystal lattice. The cadmium mineral greenockite is frequently associated with weathered sphalerite and wurzite. Zinc-bearing coals of the Central United States and Carboniferous Age coals of other countries also contain large subeconomic resources of cadmium. Zinc-to-cadmium ratios in typical zinc ores range from 200:1to 400:1. Quantitative estimates of reserves are not available. Cadmium content of typical zinc ore averages about 0.03%.

The world production of cadmium was estimated at about 24,400 tonnes in 2022. China (40%), Rep. of Korea (18%) and Japan (7%), Canada (7%) & Kazakhstan (6%), and the remaining share was contributed by other countries. Quantitative estimates of reserves are not available. The cadmium content of typical zinc ores averages about 0.03%. Most of the world's primary cadmium is produced mainly in China, Republic of Korea, Japan, Canada, Kazakhstan, Mexico, Russia and Peru.

World's secondary cadmium production accounted for 20% of the total metal production. Most secondary metal is produced at NiCd battery recycling facilities in Asia, Europe and the United States. China, Belgium and Japan are by far the world's largest consumers of cadmium. The world production of cadmium during 2020 to 2022 by principal countries is furnished in Table-2.

FOREIGN TRADE

Exports

Exports of Cadmium was nil during 2022-23 as compared to 169 tonnes in the previous year. Similarly, exports of cadmium (including waste & scrap) also negligible during 2022-23 from that of 169 tonnes in the previous year.

Exports of cadmium & alloys was negligible during 2022-23 as against 123 tonnes in the previous year, while exports of cadmium & scrap was 149 tonnes in 2022-23 against negligible in 2021-22. Exports of cadmium unwrought and powders were negligible during 2022-23 as compared to 46 tonnes in the previous year. (Tables- 3 to 7).

Table – 3 Export of Cadmium

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**169**	**23129**	--	--
Bangladesh	168	22814	--	--
UAE	1	258	--	--
Saudi Arabia	++	30	--	--
Myanmar	++	16	--	--
Egypt	++	5	--	--
Kenya	++	4	--	--
Sri Lanka	++	2	--	--

Figures rounded off

Table – 4: Exports of Cadmium (Incl. Waste And Scrap)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**169**	**23278**	**++**	**152**
Maldives	--	--	++	151
Germany	--	--	++	1
Bangladesh	168	22863	--	--
UAE	1	294	--	--
Sudan	++	64	--	--
Saudi Arabia	++	30	--	--
Myanmar	++	16	--	--
Egypt	++	5	--	--
Kenya	++	4	--	--
Sri Lanka	++	2	--	--

Figures rounded off

Table –5: Export of Cadmium And Alloys & Alloys

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**123**	**16061**	**--**	**--**
Bangladesh	122	15886	--	--
UAE	1	166	--	--
Kenya	++	4	--	--
Egypt	++	3	--	--
Sri Lanka	++	2	--	--

Figures rounded off

Table – 6: Exports of Cadmium & Scrap

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**++**	**149**	**++**	**152**
Maldives	++	64	++	151
Germany	++	49	++	1
Sudan	++	36	-	-
Bangladesh	-	-	-	-
UAE	-	-	-	-

Table – 7: Exports of Cadmium:Unwrought, Powders

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**46**	**7068**	**--**	**--**
Bangladesh	46	6928	--	--
UAE	++	92	--	--
Saudi Arabia	++	30	--	--
Myanmar	++	16	--	--
Egypt	++	2	--	--
Turkey	3	603	-	-
Qatar	++	31	-	-
Jordan	++	8	-	-

Figures rounded off

Imports

The imports of cadmium was negligible in 2022-23 from 6374 tonnes in the previous year. Imports of cadmium (including waste & scrap) negligible tonnes in 2022-23 from 6787 tonnes in the year 2021-22 (Tables- 8 to 12).

Table – 8:Imports of Cadmium

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6374**	**1142118**	**--**	**--**
Korea, Rep. of	1423	254599	--	--
Japan	1201	213381	--	--
Russia	675	125033	--	--
China	363	75739	--	--
Belgium	435	71961	--	--
UAE	406	66511	--	--
Peru	240	40674	--	--
France	247	36807	--	--
Australia	180	31778	--	--
Bulgaria	152	29982	--	--
Other Countries	1052	195653	--	--

Figures rounded off

Table – 9: Imports of Cadmium (Incl. Waste & Scrap)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6787**	**1218010**	**--**	**--**
Korea, Rep. of	1683	306004	--	--
Japan	1201	213381	--	--
Russia	675	125033	--	--
Belgium	476	75876	--	--
China	363	75739	--	--
UAE	406	66511	--	--
Peru	280	47756	--	--
Australia	233	38453	--	--
France	247	36807	--	--
Bulgaria	152	29982	--	--
Other Countries	1071	202468	--	--

Figures rounded off

Table -10: Imports of Cadmium & Alloys

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1**	**5570**	**--**	**--**
China	1	5524	--	--
U K	++	26	--	--
U S A	++	13	--	--
Germany	++	7	--	--

Figures rounded off

Table – 11: Imports of Cadmium : Unwrought, Powders

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6373**	**1136548**	**--**	**--**
Korea, Rep. of	1423	254599	--	--
Japan	1201	213381	--	--
Russia	675	125033	--	--
Belgium	435	71961	--	--
China	362	70215	--	--
UAE	406	66511	--	--
Peru	240	40674	--	--
France	247	36807	--	--
Australia	180	31778	--	--
Bulgaria	152	29982	--	--
Other Countries	1052	196507	--	--

Figures rounded off

Table –12: Imports of Cadmium & Scrap Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**413**	**75892**	**--**	**--**
Korea, Rep. of	260	51405	--	--
Peru	40	7082	--	--
Australia	53	6675	--	--
Belgium	41	3915	--	--
USA	19	3487	--	--
Canada	++	3328	--	--
China	-		-	-

Figures rounded off

FUTURE OUTLOOK

The world cadmium market based on the world production of cadmium does indicate a fluctuating trend. While the primary cadmium supply is on decrease, there is a modest rise in production through recycling. Though cadmium consumption in various applications is clamoured with concerns over its toxicity and hazardous effect on human health and environment, the production of cadmium as a by-product will, however, continue as long as lead and zinc are produced.

The demand for cadmium is increasing owing to several new market opportunities for NiCd batteries, particularly, in industrial applications. NiCd battery had been favoured for use in less expensive consumer appliances and electronics owing to their cost advantage over other battery chemistries. During the past few years, lithium-ion batteries have significantly replaced NiCd batteries in some low-cost electronics and substitution is expected to continue as the manufacturing cost of lithium-ion batteries decreases and their electrical storage capacity increases.

NiCd batteries, however, are expected to continue to be used in certain industrial applications because of their superior reliabilility and stability compared with the other rechargeable battery technologies. NiCd batteries power some battery-powered electric vehicles and are also used in a limited number of hybrid electric vehicles. NiCd batteries are also used as buffers in transportable/renewable hybrid-power systems developed to generate electricity in remote locations and in underdeveloped regions. Industrial-sized NiCd batteries potentially could be used to store energy produced by certain on-grid solar or wind systems. Excess energy generated during periods of low electricity demand could be stored in batteries, from which it would later be dispatched during periods of high electricity demand. NiCd may be a favoured battery chemistry for this use owing to its stability in offshore and harsh weather environments. NiCd battery is used in electrical vehicles albeit in limited number in hybrid electrical vehicles and has been making important contribution to the development of the electric car market in Europe.

Cadium pigments and stabilisers are important additives in certain specialised plastic, glasses, ceramics and enamels which enable to achieve bright colours along with long service life, even in very demanding applications. It should also be emphasised that cadmium in these applications is in a chemically very stable, highly insoluble form and is embedded in the product matrix.

14. Cobalt

Cobalt is an important ferromagnetic strategic alloying metal having irreplaceable industrial applications. It is a chemical element with the symbol Co and atomic no. 27. Cobalt is associated mostly with copper, nickel and arsenic ores. Cobalt is extracted as a by-product of copper, nickel, zinc or precious metals. Lateritic/limonitic nickel ore usually is found to contain 0.08 to 0.15% Co along with 1.5 to 4% Ni in many parts of the world. In 2022, the Democratic Republic of Congo (DRC) was the world's leading producer of cobalt.

RESERVES/RESOURCES

Cobalt resources are predominantly associated with copper-cobalt ore, nickel-cobalt ore, arsenic-cobalt ore, and pyrite deposits. While independent cobalt minerals are rare, seabed manganese nodules emerge as a promising long-term resource for cobalt.

In India, cobalt deposits have been reported in the Singhbhum district of Jharkhand; the Kendujhar and Jajpur districts of Odisha; the Jhunjhunu district of Rajasthan; the Tuensang district of Nagaland; and the Jhabua and Hoshangabad districts of Madhya Pradesh. In the Sukinda area of the Jajpur district, Odisha, cobalt is found associated with nickeliferous limonite/laterite, and copper slags produced by HCL also present another potential source. Additionally, seabed polymetallic nodules, which contain an average of 0.3% cobalt along with other minerals, represent another source of cobalt.

According to NMI data based on the UNFC system, reserves/resources of cobalt in terms of ore as on 1.4.2020 have been estimated at 44.91 million tonnes under Remaining Resources category of which about 69%, i.e., 30.91 million tonnes are estimated in Odisha. The remaining 31% resources are in Jharkhand (9 million tonnes) and Nagaland (5 million tonnes). The reserves/resources of cobalt as per UNFC system are furnished below in Table-1.

Table – 1: Reserves/Resources of Cobalt Ore as on 1.4.2020

(By Grades/States)

(In million tonnes)

State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India	0	**44.91**	**44.91**
By States			
Jharkhand	0	9	9
Nagaland	0	5	5
Odisha	0	30.91	30.91

USES & CONSUMPTION

Batteries	• Cobalt is used as precursors (cobalt compounds) for cathodes in rechargeable batteries. Largest demand for cobalt has been from the Rechargeable Battery Industry • It was initially used in NiCd and NiMH cells, however, post the invention of the Lithium-ion battery, there was phenomenal growth in cobalt consumption in the Battery Sector (CRU).
Industry	• Cobalt is alloyed with aluminium and nickel to manufacture powerful magnets. Permanent magnets are used in wind turbines and electric motors for automobiles & aircraft. Cobalt powder finds an important application as a binder in the production of cemented tungsten carbides for heavy-duty and high-speed cutting tools. It is also used on bonded tools for Diamond Industry. • Cobalt application improves the coating/adhesive property of enamel in steel appliances and is used in manufacturing steel-belted tyres.
Superalloys/Alloys	• Cobalt-based superalloys normally contain 45% or more cobalt, while nickel and iron-based superalloys contain 8 to 20% cobalt. • Superalloys made of cobalt have improved strength and wear & c orrosion- r esistance characteristics at elevated temperatures. Another use of cobalt-based superalloys is in turbines for pipeline compressors and jet aircraft engine. • Hard-facing or cutting tools with cobalt alloys provide greater resistance to wear, heat, impact and corrosion.
Chemical Industry	• Cobalt oxide is used in chemical applications, such as, catalyst, dyes & pigments, paint driers/ adhesives and glass & ceramics. • Cobalt catalyst, mostly cobalt acetate is used in the manufacture of Terephthalic acid (TPA) and Dimethyl terephthalate (DMT). • Cobalt-molybdenum-alumina compound is used as catalyst in hydrogenation and for petroleum desulphurisation
Magnets	• Cobalt can retain ferromagnetic property up to a temperature of 1,100 ° C, highest for any metal. • It is used in the manufacturing of Alnico magnets, magnetic recording media, soft magnetic material, alloys for spacecraft, etc. • Cobalt is alloyed with aluminium and nickel to manufacture powerful magnets. Permanent magnets are used in wind turbines and electric motors for automobiles & aircraft.

MINING LEASE AND PRODUCTION

Currently, there are no working mining leases for cobalt in the country for production purpose. At the moment, India does not produce cobalt from primary cobalt. The demand for cobalt is usually met through imports. Refining capacity of cobalt in India is estimated at about 2,060 tonnes per year. Nicomet Industries Ltd., located in Cuncolim, Goa, and Rubamin Ltd., situated in Vadodara, Gujarat, were India's leading producers of cobalt cathodes and compounds. Installed capacity for cobalt metal and different cobalt salts at Nicomet is 1,000 tpy. Nicomet Industries Ltd., located in Mumbai, Maharashtra, produces nickel cathodes, sodium sulfate, and cobalt cathodes that meet LME-approved criteria under the NICO brand. Vedanta Group is also exploring ways to produce cobalt for batteries as the Group has become the latest entrant among companies that seeks to capitalise on the anticipated electric vehicle boom. According to reports, Sandvik Asia Ltd. recovers cobalt metal powder from trash cemented carbide at its pilot plant in Pune, Maharashtra. In addition, spent cobalt catalyst from plants producing DMT, TPA and oxo alcohols are also understood to be reprocessed by several small cobalt chemical processors. However, information on reprocessing of cobalt from scrap is not available. It is expected that recycled cobalt would continue to be used for domestic supply.

SUBSTITUTES

Cobalt is used in specialized applications and is challenging to substitute. Potential alternatives include barium or strontium ferrites, neodymium-iron-boron, or nickel-iron alloys in magnets; nickel, cermets, or ceramics in cutting and wear-resistant materials; nickel-based alloys or ceramics in jet engines; nickel in petroleum catalysts; rhodium in hydroformylation catalysts; and cerium, lead, manganese, iron, or vanadium in paints. Currently, about one-third of cobalt is replaced by cobalt-manganese-nickel in lithium-ion batteries. In some applications, substitution for cobalt would result in a loss in product performance. Other potential substitutes include cerium, iron, lead, manganese, or vanadium in paints; cobalt-iron-copper or iron-copper in diamond tools; copper-iron-manganese for curing unsaturated polyester resins; iron, iron-cobalt-nickel, nickel, cermets, or ceramics in cutting and wear-resistant materials; iron-phosphorus, manganese, nickel-cobalt-aluminum, or nickel-cobalt-manganese in lithium-ion batteries; nickel-based alloys or ceramics in jet engines; nickel in petroleum catalysts; and rhodium in hydroformylation catalysts.

RECYCLING

Recycling technologies for recovery of cobalt especially from waste Li-ion batteries have been an evolving process. The need for technologies which can recover valuable metals and the commercialisation of that technology by the industry is highly desirable. The technology related to "Recovery of cobalt from Li-ion batteries of mobile phones" developed by National Metallurgical Laboratory (NML), Jamshedpur, reportedly claims up to 95% recovery of pure cobalt from Li-ion batteries. Considering the need and significance of the problem related to energy materials like Ni and Co, CSIR-IMMT has developed suitable process flow sheets for the processing of secondary resources, such as, alloy scrap and spent catalyst to produce Ni/Co based precursor material that can be used for battery applications particularly in preparing electrodes of Li-ion batteries. In addition to this CSIR–IMMT has taken up another project from MIDHANI to produce high purity cobalt metal from impure cobalt hydroxide. The Mobility Mission held consultations with industry to develop battery recycling as a sustainable method for ensuring up to 95% recovery of critical minerals, such as, lithium, nickel, cobalt etc. from spent batteries, thereby ensuring regular supply of raw materials for battery maintenance.

TRADE POLICY

As per the ITC (HS), 2022 Scheduled Import Policy, imports of cobalt ores & concentrates under Heading No. 2605 and cobalt alloys and its products under Heading No. 8105 are allowed freely, except cobalt waste & scrap (ITC-HS Code No. 8105 3000) which is restricted.

WORLD REVIEW

The world cobalt reserves are estimated at 11 million tonnes of cobalt metal content. Cobalt reserves are mainly in the Democratic Republic of Congo which contributes (55%) to the total reserves followed by Australia (15%). Besides, major reserves are also located in Indonesia & Cuba (5% each) and Philippines, Russia & Canada (2% each). The world reserves of cobalt are provided in Table-2.

Table – 2 : World Reserves of Cobalt

(By Principal Countries)

(In tonnes of metal content)

Country	Reserves
World: Total (rounded off)	11,000,000
USA	69,000
Australia [(a)]	1,700,000
Canada	230,000
Democratic Republic of Congo	6,000,000
Cuba	500,000
Indonesia	500,000
Madagascar	100,000
New Caledonia	NA
Papua New Guniea	49,000
Philippines	260,000
Russia	250,000
Turkey	91,000
Other Countries	780,000

Source: USGS Mineral Commodity Summaries, 2024

(a) For Australia, Joint Ore Reserves Committee-compliant reserves were 6,10,000 tonnes.

The world mine production of cobalt in terms of metal content increased by 24% to 165 thousand tonnes in 2022 as compared to 133 thousand tonnes in the preceding year. The Democratic Republic of Congo (DRC) was the principal producer contributing about (70%) which is followed by Indonesia (6%), Russia (5%), Australia (4%), Cuba (3%) and Madagascar, Philippines, Canada & Papua New Guinea (2% each) (Table-3).

Table – 3 : World Mine Production of Cobalt

By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
World total	**127,000**	**133,000**	**165,000**
Congo, Democratic Republic of	86,591	93,144	115,371
Indonesia	1,000	2,100	9500
Russia	5,700	8,000	9,000
Australia	5,626	5,232	5,786
Cuba	5,500	4,400	4,200
Madagascar	833	2,111	3,428
Philippines	3,600	3,200	3,400
Canada	4,279	3,834	3,186
Papua New Guinea	2,941	2,953	2,987
New Caledonia	2,197	1,500	1750
Other Countries	8,828	6,585	6,396

Source: BGS, World Mineral Production, 2018-22

(In tonnes of metal Content)

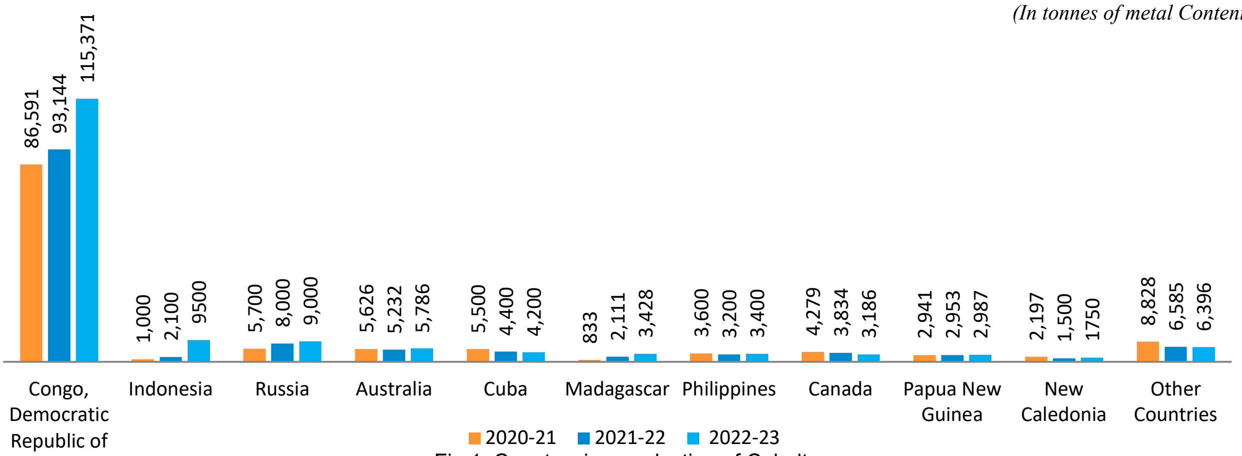


Fig 1: Countrywise production of Cobalt

FOREIGN TRADE

Exports

Cobalt ores & concentrates exports were nil during the last two years. Exports of cobalt and alloys including waste and scrap increased by 101% to 2,705 tonnes in 2022-23 from 1,340 tonnes in the previous year. Exports were mainly to Republic of Korea (59%), Philippines (15%) and Malaysia (9%) & Singapore (5%). Out of the total exports in 2022-23, exports of cobalt and alloys were at 2,219 tonnes and those of cobalt & scrap were at 486 tonnes. Similarly, during 2022-23 exports of cobalt powder were at 2,156 tonnes, cobalt (other articles) were at 36 tonnes and of cobalt unwrought at 27 tonnes (Tables-4 to 9).

Table -4 Export of Cobalt and Alloys(Inc waste and scrap)

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**1340**	**895452**	**2705**	**2216211**
Korea, Republic of	1179	550695	1608	1055839
Philippines	--	--	409	307576
Malaysia	--	--	237	251104
USA	19	56922	39	126911
Singapore	--	--	135	99988
UK	33	36648	45	80827
Belgium	32	105686	20	74289
Hong Kong	++	72	69	64575
Japan	++	668	63	54112
China	2	6783	36	31540
Other Countries	75	137978	44	69450

Table -5 Export of Cobalt and Alloys

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**1309**	**812402**	**2219**	**1821280**
Korea, Republic of	1179	550695	1464	985911
Philippines	--	--	409	307576
Malaysia	--	--	27	134039
Singapore	--	--	115	90516
Hong Kong	++	72	69	64575
USA	16	53145	18	51999
UK	29	31114	31	48907
China	2	6783	36	31540
Turkey	41	23427	41	30333
Japan	++	668	3	20284
Other Countries	42	146498	6	55600

Table-6 Export of Cobalt And Scrap

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**31**	**83050**	**486**	**394931**
Malaysia	--	--	210	117065
USA	3	3777	21	74912
Korea Republic of	--	--	144	69928
Belgium	21	70545	17	57792
Japan	--	--	60	33828
UK	4	5534	14	31920
Singapore	--	--	20	9472
Nepal	++	26	++	14
UAE	2	1687	--	--
Netherlands	1	1481	--	--

Table-7 Export of Cobalt Powders

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**1232**	**629350**	**2156**	**1536090**
Korea Republic of	1179	550039	1464	985111
Philippines	--	--	409	307576
Singapore	--	--	115	90516
Hong Kong	--	--	69	64575
Turkey	41	23427	41	30333
China	1	272	34	25612
Belgium	++	1243	3	16497
UK	++	97	21	14654
Russia	--	--	++	1216
UAE	10	50544	--	--
Other Countries	1	3728	--	--

Table-8 Export of Cobalt (Other Articles)

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**76**	**180381**	**36**	**149659**
USA	16	53118	18	51962
UK	29	31017	10	34253
Japan	++	668	3	20284
Germany	2	7482	1	7923
China	1	6511	2	5928
Switzerland	++	4581	1	5850
Israel	--	--	++	5514
Finland	1	8537	++	5452
France	1	10010	1	2797
Saudi Arabia	++	3295	++	2504
Other Countries	26	55162	++	7192

Table-9 Export of Cobalt Unwrought

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**1**	**2671**	**27**	**135531**
Malaysia	--	--	27	134039
Korea Republic of	++	650	++	793
Saudi Arabia	--	--	++	529
Taiwan	--	--	++	83
UAE	--	--	++	43
USA	++	17	++	37
Nepal	--	--	++	7
Belgium	1	1896	--	--
Switzerland	++	108	--	--

Imports

Imports of cobalt & alloys including waste and scrap increased about 5% to 1,186 tonnes in 2022-23 from 1130 tonnes in the previous year. Imports in 2022-23 were mainly from China & Belgium (22% each), USA (12%), UK (10%), and Japan (9%). Out of the total imports in 2022-23, imports of cobalt & alloys were at 1,184 tonnes and those of cobalt & scrap were negligible. Besides, imports of cobalt in the form of cobalt powder, other articles and unwrought cobalt were at 340 tonnes, 672 tonnes and 172 tonnes, respectively (Tables-10 to 16).

Table-10 Imports of Cobalt And Alloys(Incl Waste And Scrap)

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**1130**	**5852552**	**1186**	**7612854**
UK	80	938461	115	1653266
China	102	422343	262	1407052
USA	181	982003	143	1048116
Belgium	134	552752	261	890514
Japan	131	409178	102	447491
France	24	330325	13	382897
Norway	125	547533	73	378121
Germany	12	207270	9	309036
Netherlands	176	668410	33	180169
Morocco	--	--	40	175661
Other Countries	165	794277	135	740531

Table-11 Imports of Cobalt Powders

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**353**	**1490170**	**340**	**1846554**
Belgium	120	490617	109	586733
Japan	56	214086	52	281252
China	29	109629	49	230616
Turkey	15	54039	28	151881
Madagascar	++	++	21	137467
Netherlands	58	272167	21	123973
Finland	16	76963	13	78341
France	13	59330	11	69897
USA	18	75947	14	55266
South Africa	17	80086	11	54819
Other Countries	11	57306	11	76309

Table-12 Imports of Cobalt Other Articles

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**438**	**2933766**	**672**	**5044465**
UK	68	887078	104	1586285
USA	161	891777	124	967815
China	70	303765	135	867652
France	11	269757	2	312022
Belgium	14	62135	152	303776
Norway	--	--	53	302486
Germany	11	193151	7	291727
Morocco	--	--	40	175661
Singapore	11	73241	31	156311
Japan	37	57586	19	43945
Other Countries	55	195276	5	36785

Table-13 Imports of Cobalt Unwrought

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**337**	**1426119**	**172**	**720182**
China	3	8949	78	308784
UAE	86	421288	27	131139
Japan	38	137506	31	122294
Norway	125	547533	20	75635
Netherlands	65	220672	7	32994
USA	2	14279	5	25035
UK	4	18857	3	17305
Hong Kong	--	--	1	5353
France	++	1238	++	978
Canada	--	--	++	572
Other Countries	14	55797	++	93

Table-14 Imports of Cobalt And Alloys Total

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**1128**	**5850055**	**1184**	**7611201**
UK	80	938461	115	1653266
China	102	422343	262	1407052
USA	181	982003	143	1048116
Belgium	134	552752	261	890514
Japan	131	409178	102	447491
France	24	330325	13	382897
Norway	125	547533	73	378121
Germany	12	207270	9	309036
Netherlands	176	668410	33	180169
Morocco	--	--	40	175661
Other Countries	163	791780	133	738878

Table-15 Imports of Cobalt And Scrapl

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**2**	**2497**	**2**	**1653**
Saudi Arabia	--	--	2	1653
Bangladesh	2	2497	--	--

Table -16 Imports of Ores And Concs. Of Cobalt

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**1**	**6917**	**++**	**1766**
UK	1	6917	++	1766

FUTURE OUTLOOK

Cobalt is identified as critical mineral by Ministry of Mines , Govt. of India and Center for Social and Economic Progress (CSEP) study. Cobalt with their various forms are essential for the uses in green technologies like solar panels, wind turbines, batteries, and electric vehicles which are integral to the transition toward clean energy and a low-carbon economy. Also, it is used in Electric Vehicle, Batteries, glassware, ceramics, fuel manufacturing and Lubricant. Though, India does not have any primary cobalt resources. However, two possible secondary resources are nickel-bearing laterite deposits in Odisha and copper slag produced by HCL, which have been under R&D studies for commercial applications over the years. The cobalt refiners in India have catered to the market for chemical applications or where the cobalt metal or salt is dissolved and converted to cobalt oxide for cutting tools application. According to CRU, it was predicted that the demand for cobalt would increase by a staggering 68% from 2015 to 2025. In India, cobalt is expected to have significant uses in metallurgy because of the increased need for special alloys/superalloys, cutting tools, and as an alloy in permanent magnets. The demand for cobalt powder will keep increasing due to its widespread use in manufacturing bonded tools for the Diamond Industry.

When it comes to cobalt, the Indian Industry is relatively small, but it is steadily expanding in different areas, particularly in aerospace. The Aerospace Industry relies primarily on importing cobalt. Other sectors are experiencing steady growth, but they cannot match China's level of development. The overall usage may range from 70 to 80 tonnes at least, and up to 100 tonnes per month in cobalt content. Chemical industries primarily utilize cobalt sulfate.

The Battery Industry's rising demand for cobalt, particularly for personal electronics, has caused global yearly growth rates in cobalt consumption to surpass the growth rates for the global gross domestic product. Between 2018 and 2025, it was predicted that the rate would rise to 9.5%, primarily due to cobalt's utilization in rechargeable lithium-ion batteries for electric cars. For this, critical minerals, especially those with no known domestic resources, mineral-wise strategies are required to ensure robust access for India's manufacturing needs and climate change mitigation ambitions.

15. Copper

Copper is a soft, malleable, and ductile metal with very high thermal and electrical conductivity. Copper is one of the few metals that occurs in nature in directly usable metallic form (native metals) and is an important non-ferrous base metal having wide industrial applications, ranging from defence, space programme, railways, power cables, mint, telecommunication cables, etc. India is not self-sufficient in the production of copper ore. In addition to domestic production of ore and concentrates, India imports copper concentrates for its smelters. The domestic demand for copper and its alloys is met through domestic production, recycling of scrap and by imports.

Hindustan Copper Limited (HCL), a Public Sector Undertaking, is the only integrated Company in the country that is involved in mining & beneficiation of ore and is engaged in smelting, refining and casting of refined copper.

Hindalco Industries Ltd and Vedanta Limited are the major copper producers in the Private Sector that mainly rely on imported copper concentrates. These companies own copper mines in other countries.

RESERVES/ RESOURCES

The total reserves/resources of copper ore as on 1.4.2020 as per NMI database based on UNFC system are estimated at 1.66 billion tonnes. Of these, 163.89 million tonnes (9.87%) fall under 'Reserves category' while the balance 1.50 billion tonnes (90.13%) are placed under 'Remaining Resources' category. Gradewise, there are no reserves with 1.85% or more copper grade. However, 163.89 million tonnes reserves fall under 1% to below 1.85% Cu grade. Of the total ore resources 8.28 million tonnes (0.49%) comprise ore containing 1.85% Cu or more and 587 million tonnes (35.33%) resources fall under 1% to below 1.85% Cu grade. The total metal content out of the total copper resources is 12.20 million tonnes of which 2.16 million tonnes constitute reserves.

Largest reserves/resources of copper ore to the tune of 868 million tonnes (52.25%) are in the State of Rajasthan followed by Madhya Pradesh with 387 million tonnes (23.28%) and Jharkhand with 251 million tonnes (15.14%). Copper reserves/resources in Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Meghalaya, Nagaland, Odisha, Sikkim, Tamil Nadu, Telangana, Uttarakhand and West Bengal accounted for the remaining 9.33% of the total All India resources (Table-1).

Table - 1: Reserves/Resources of Copper as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

State	Total Reserves (A)	Total Remaining Resources (B)	Total Resources (A+B)
All India: Total			
Ore	163891	1496979	1660870
Metal	2161.57	10035.52	12197.09
By Grades			
Ore with 1.85% & Above Cu	-	8283	8283
Ore With 1.00 % to below 1.85 % Cu	163891	422903	586795
Ore with (+) 0.50% to below 1.00% Cu	-	797906	797906
Ore with (-) 0.50% Cu	-	267886	267886
Metal	2161.57	10035.52	12197.09
By States			
Andhra Pradesh			
Ore	-	7582	7582
Metal	-	113.7	113.7
Arunachal Pradesh			
Ore	-	10	10
Metal	-	0.02	0.02
Gujarat			
Ore	-	12613	12613
Metal	-	200.74	200.74
Haryana			
Ore	-	53816	53816
Metal	-	179.01	179.01
Jharkhand			
Ore	9150	242313	251463
Metal	107.45	2672.21	2779.66
Karnataka			
Ore	-	41499	41499
Metal		245.86	245.86
Madhya Pradesh			
Ore	120353	266312	386665
Metal	1571.04	2095.82	3666.86
Maharashtra			
Ore	-	17755	17755
Metal	-	158.08	158.08
Meghalaya			
Ore	-	880	880
Metal	-	9	9
Nagaland			
Ore	-	2000	2000
Metal	-	15	15
Odisha			
Ore	-	11991	11991
Metal	-	97.03	97.03
Rajasthan			
Ore	34388	833461	867849

Table- 1 (Concld.)

(In '000 tonnes)

State	Total Reserves (A)	Total Remaining Resources (B)	Total Resources (A+B)
Metal	483.08	4152.52	4635.6
Sikkim			
Ore	-	958	958
Metal	-	21.47	21.47
Tamil Nadu			
Ore	-	790	790
Metal	-	3.81	3.81
Telangana			
Ore	-	666	666
Metal	-	9.12	9.12
Uttarakhand			
Ore	-	4220	4220
Metal	-	60.04	60.04
West Bengal			
Ore	-	113	113
Metal	-	2.09	2.09

MINING LEASES AND PRODUCTION

As per Mineral Wise Summary of Mining Lease Distribution (Other than Atomic, Hydro Carbons Energy & Minor Minerals) as on 31/03/2023(P), copper ore has 9 no. of mining leases with 3916.85 hectare lease area.

Copper Ore and Concentrates

The production of copper ore at 3.33 million tonnes in 2022-23 decreased by 7% as compared to that in the previous year.

The metal content in the ore produced in 2022-23 works out to 27,728 tonnes as against 27,622 tonnes in previous year. During the year under review, 3.26 million tonnes of ore were treated for obtaining copper concentrates as against 3.60 million tonnes in previous year.

Production of copper concentrates at 1,12,746 tonnes in 2022-23 decreased by about 2% as compared to that in the previous year. Madhya Pradesh was the leading producer of copper concentrates, accounting for about 57% of the production during 2022-23, followed by Rajasthan (43%). The number of reporting mines was five in both the years, i.e., 2022-23 and 2021-22 (Tables- 2 to 6)

Table-2: Producer of Copper Concentrates, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
Hindustan Copper Ltd. Tamra Bhavan, 1, Ashutosh Choudhury Avenue, Kolkata - 700019	Madhya Pradesh Rajasthan	Balaghat Jhunjhunu

Table–3: Production of Copper Ore, 2021-22 and 2022-23

(By States)

(In tonnes)

Mineral	2021-22			2022-23 (p)		
	Ore Produced	Cu%	Metal Content	Ore Produced	Cu%	Metal Content
India	**3569632**	**0.77**	**27622**	**3326337**	**0.82**	**27728**
Jharkhand	25834	0.81	209	53375	0.88	471
Madhya Pradesh	2442459	0.74	18105	2165042	0.91	19702
Rajasthan	1101339	0.85	9308	1107920	0.68	7555

(p): Provisional

Table–4: Copper Ore treated, 2021-22 and 2022-23

(By States)

(In tonnes)

Mineral	2021-22			2022-23 (p)		
	Ore treated	Cu%	Metal Content	Ore treated	Cu%	Metal Content
India	**3604690**	**0.76**	**27545**	**3257190**	**2.35**	**76494**
Jharkhand	-	-	-	-	-	-
Madhya Pradesh	2486190	0.73	18149	2144220	0.83	17826
Rajasthan	1118500	0.84	9396	1112970	5.27	58668

(p): Provisional

Table–5: Production of Copper Concentrates, 2020-21 to 2022-23

(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**108718**	**8533354**	**115313**	**11024312**	**112746**	**11438445**
Jharkhand	1208	23707	-	-	-	-
Madhya Pradesh	64920	5137695	65914	5560337	63860	6423658
Rajasthan	42590	3371952	49399	5463975	48886	5014787

(p): Provisional .

(In tonnes)

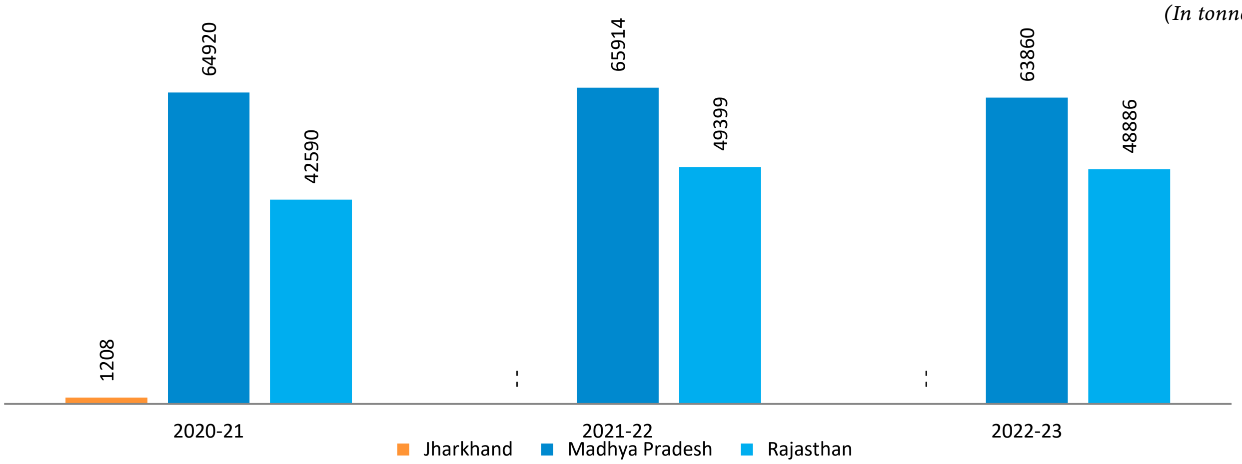


Fig. 1: Production of Copper Concentrates

Table–6: Production of Copper Concentrates, 2021-22 and 2022-23

(By Sectors/States/Districts)

(Quantity in tonnes; Value in ₹ '000)

State/District	No. of Mines	2021-22		No. of Mines	2022-23 (P)	
		Qty	Value		Production	Value
India	**5**	**115313**	**11024312**	**5**	**112746**	**11438445**
Public Sector	5	115313	11024312	5	112746	11438445
Jharkhand	**2**	**-**	**-**	**2**	**-**	**-**
Singhbhum (East)	2	-	-	2	-	-
Madhya Pradesh	**1**	**65914**	**5560337**	**1**	**63860**	**6423658**
Balaghat	1	65914	5560337	1	63860	6423658
Rajasthan	**2**	**49399**	**5463975**	**2**	**48886**	**5014787**
Jhunjhunu	2	49399	5463975	2	48886	5014787

(p): Provisional

Grade Analysis

During the year 2022-23, the average copper content in the ore produced was 0.82% Cu as against 0.77% in the previous year. All India average metal content of ore treated during the year 2022-23 works out to 2.35% Cu and 0.76% Cu for 2022-23 and 2021-22, respectively. The copper content in the ore treated varies from State to State. The average metal content in the concentrate produced works out to 22.47% Cu in 2022-23 as against 23.14% Cu in the previous year.

The average daily employment of labour in copper mines in 2022-23 was 3,722 as against 2,794 in the preceding year.

Copper Metal

Hindustan Copper Ltd produces copper metal from the ore produced at their captive mines. Vedanta Limited formerly known as Sterlite Industries (India) Ltd and Hindalco Industries Ltd produce copper metal from imported copper concentrates (Table-7).

Table-7 : Producers of Copper Metal,

Name and address of the Producer	Location of the plant	
	State	District
Hindustan Copper Ltd., Tamra Bhavan, 1, Ashutosh Chowdhury Avenue, Post Box No.10224, Kolkata-700019.	Jharkhand Maharashtra	Singhbhum(East) Raigad
Hindalco Industries Ltd., Century Bhawan, Dr. Annie Besant Road, Mumbai –400030, Maharashtra.	Gujarat	Bharuch
Vedanta Limited, Sesa Ghor, 20 EDC Complex, Patto, Panaji–403001, Goa.	Tamil Nadu Dadra & Nagar Haveli	Thoothukudi Chinchpada (Silvassa)

The production of copper blister was not reported in 2022-23 while copper continuous cast wire rods registered an increase of 20% in 2022-23 as compared to the previous year. The production of copper cathodes increased by 15%. Production of copper electrolytic wire bars was not reported for more than nine years (Tables-8 to 11). Prices of copper are furnished in the General Review on 'Prices'

Table–8: Production of Copper Metal, 2020-21 to 2022-23

(In tonnes)

Year	Copper blister	Copper cathodes Wirebars	Copper Electrolytic	Copper CCWR
2020-21	--	363609	--	341563
2021-22	--	483994	--	351464
2022-23(p)	--	554241	--	423283

(P): Provisional

Table–9: Production of Copper (Blister), 2020-21 and 2021-22

(By States/Plants)

(Quantity in tonnes; Value in ₹ '000)

State	Plant	2020-21		2021-22 (P)	
		Quantity	Value	Quantity	Value
India		**0**	**N.A.**	**0**	**N.A.**
Jharkhand	Surda ICC	0	N.A.	0	N.A.

(p): Provisional

Table–10: Production of Copper (CCWR), 2021-22 and 2022-23

(By States/Plants)

(Quantity in tonnes; Value in ₹ '000)

State	Plant	2020-21		2021-22 (P)	
		Quantity	Value	Quantity	Value
India		**351464**	**261303186**	**423282**	**304546760**
Gujarat	Hindalco	225017	168737600	267995	196596400
Maharashtra	HCL Taloja	0	0	0	0
Tamil Nadu	Vedanta Ltd	0	0	0	0
Dadar & Nagar Haveli	Vedanta Ltd	126447	92565586	155287	107950360

(P): Provisional

Table–11: Production of Copper (Cathodes), 2021-22 and 2022-23

(By States/Plants)

(Quantity in tonnes; Value in ₹ '000)

State	Plant	2020-21		2021-22 (P)	
		Quantity	Value	Quantity	Value
India		**483994**	**363507671**	**554242**	**390034135**
Gujarat	Hindalco	358889	27263400	407056	288340600
Jharkhand	Surda ICC	0	0	0	0
Tamil Nadu	Vedanta Ltd	0	0	0	0
Dadar & Nagar Haveli	Vedanta Ltd	125105	90875271	147186	101693535

(P): Provisional

MINING & MILLING

HCL's mines and plants are spread across five operating units, the Indian Copper Complex (ICC) at Ghatsila in Jharkhand, the Khetri Copper Complex (KCC) at Khetrinagar in Rajasthan, Malanjkhand Copper Project (MCP) at Malanjkhand in Madhya Pradesh, Taloja Copper Project (TCP) at Taloja in Maharashtra and Gujarat Copper Project (GCP) at Jhagadia in Gujarat. HCL operates four underground mines and one opencast mine, with a combined ore production capacity of about 3.5 million tonnes per year.

Hindustan Copper Ltd

Hindustan Copper Limited, established in 1967 is a Central Public Sector undertaking under the administrative control of Ministry of Mines, Government of India. The registered office of the Company is situated in Kolkata. The principal activities of the company are exploration, exploitation, mining of copper and copper ore including beneficiation of minerals, smelting and refining. The Comp any has c opper mine s & concentrator plants at Malanjkhand Copper Project (MCP) in Madhya Pradesh, Khetri Copper Complex (KCC) in Rajasthan and Indian Copper Complex (ICC), Ghatsila in Jharkhand. The Company has facilities of Smelter & Refinery plant at ICC and Gujarat Copper Project (GCP), Gujarat for production of copper cathode and thereafter conversion of cathode to Copper wire rod at Taloja Copper Project, Taloja (TCP), Maharashtra. The Company is primarily engaged in the business of mining and processing of copper ore, which has been grouped as a single segment in accordance with the 'Ind AS 108 - Operating Segments'. The Company is listed with BSE Ltd and National Stock Exchange of India Ltd.

HCL is targeting to enhance the ore production capacity to 12.20 MTPA by FY 2028-29. The status of different continuing mine expansion projects is as under:

1. Malanjkhand Mine (Madhya Pradesh)

The proposed expansion of MCP will augment the ore production capacity from 2.5 MTPA to 5.0 MTPA by developing an underground mine below contract for development of underground mine at MCP had ended on 28.12.2021. To complete the residual work of underground mine construction, a consultancy contract was entrusted on M/s MECON, a reputed CPSE Consultancy Organization, for estimation of value of residual work, preparation of NIT document and evaluation of tenders which have been divided in multiple parts (Mine Excavation at North Side, Mine Excavation at South Side, Shaft Furnishing, Men & Material Hoisting system, Crushing & Pumping system, Power system, Main Mechanical Ventilator) to complete the work in an efficient manner. Out of the above multiple parts, the contracts for completion of mine development work at North & South side have been awarded and started in FY 2022-23. For production of copper ore from underground mine at MCP, a contract for Development, Production Drilling and Ore Production had been awarded to M/s SMS Ltd led consortium in July, 2019. M/s SMS Ltd has started production of copper ore from stope since July, 2022 and majorly completed the mobilisation of production equipment at the site. Further, the Company has also awarded contract for construction of 3.00 MTPA Paste Fill Plant for back-filling the voids of Underground mine at MCP to the EPC contractor, M/s Shapoorji Pallonji and Company Private Ltd and the construction work has already commenced at the site.

2. Khetri & Kolihan Mine (Rajasthan)

The proposed expansion of mines at Western Sector would increase ore production capacity from existing 1.0 MTPA to 3.0 MTPA. Mine-wise status is as under:

a)Kolihan Mine: Shaft sinking and creation of ore handling facilities below 0 mRL (meter Reduced Level) has been under taken to augment the production capacity to 1.5 MTPA for which Environmental Clearance (EC) is already in place. The study report of Geophysical Exploration work, taken up in FY 2021-22, has shown possible extension of ore body upto -300mRL and the validation drilling is being carried out to confirm the prediction as well as for assessment of grade of ore as per standard practice. Based on outcome of the above, further activities like G2 level Exploration and Mine Planning will be taken up.

b) Khetri mine: Execution of the earlier awarded contract to augment ore production capacity at the mine from 0.5 MTPA to 1.5 MTPA through deepening of existing shafts and other related activities, could not be completed due to extremely bad ground/ fault zone encountered and as a result, the contract had to be terminated. To sustain the ore production from, another contract has been awar ded for conversion of track mining to trackless mining at 0mRL and below for which contract has been awarded and the work has already been commenced. For the Banwas deposit of Khetri Mine, the Company had during FY 2016-17 appointed contractual agency for ore production. The contractual agency has produced 3,75,689 tonnes of ore in FY 2022-23 and the target production is envisaged to be achieved by FY 2023-24.

3. Surda Mine (Jharkhand)

The plan envisages sinking of shaft, deepening of various winzes to increase production capacity

from 0.4 MTPA to 0.9 MTPA in Surda mine. The validity of Surda Mining Lease has been extended till 31.3.2040 by the Government of Jharkhand. Environmental Clearance (EC) was granted by the Ministry of Environment, Forest and Climate Change (MoEF&CC), Delhi for 0.9 MTPA ore production over 323.16 ha on 30.5.2022. Subsequently, during execution of Mining Lease deed, it was intimated by DMG, Ranchi on 29.8.2022 to submit amended EC over 388.68 ha. Accordingly, the EC amendment application was made and MoEF&CC, Delhi recommended the amendment subject to grant of Forest Clearance (FC) over balance 65.52 ha forest area within the mining lease.

The present status of forest clearance of Surda Mining Lease is that PCCF (Nodal), Forest Department, Government of Jharkhand has recommended the proposal for Stage-I forest clearance to the State Government of Jharkhand which is pending since 13.4.2023.

4. Re-opening of Closed Mines at Indian Copper Complex (ICC) Ghatsila (Jharkhand)

The Company has initiated action to re-open the closed mines, development of new underground mine at Singhbum Copper Belt of ICC namely, Kendadih and Rakha mines. Mine-wise status is given below:

a) Kendadih Mine:

Kendadih mine was reopened in December, 2017 with commissioning of winders after completion of dewatering of the mine. Production contract has been awarded on 6.7.2021. Development activities and ore production were started, but the performance of the contract was not at all satisfactory as a result the said contract has been terminated on 25.05.2023.

b) Rakha Mine: Rakha Mining Lease has expired on 28.8.2021 and Application for extension of lease for further period of 20 years beyond 28.8.2021 was submitted to the office of DC, Government of Jharkhand on 30.4.2020. In response to the application for extension of Rakha Mining Lease, Govt. of Jharkhand has intimated that it is under process/consideration as per Statute.

Simultaneously, for engagement of MDO (Mine Developer cum Operator) for re-opening and expansion of Rakha Copper Mine, development of a new underground mine at Chapri Block to produce 3 MTPA of ore and erection & commissioning of a matching capacity new Concentrator Plant at ICC, the Company has appointed Transaction Advisor for preparation of tender document and Mine Service Agreement (MSA). For selection of MDO, tendering action has been taken and web hosted in the platform of M/s MSTC. Pre-bid meeting has been conducted on 15.2.2023 wherein four prospective bidders participated. Tendering action is in process.

HCL hold around two-fifths of the copper ore reserves and resources in India with an average grade of 1.32%. As on 1.4.2022, HCL has reserves (proved & probable) of about 2.73 million tonnes in terms of copper metal and total reserves and resource of 6.18 million tonnes in terms of copper metal (i. e., 631.85 million tonnes of ore with average grade of 0.99% based on UNFC system). HCL is the only vertically integrated copper producer in the country which produces refined copper from its own mined ore.

SMELTING

Hindustan Copper Limited (HCL) was the sole producer of refined copper till 1995 and the focus was on vertical integration so that the entire quantity of ore produced in its mines was converted into copper cathode and ultimately, wire rod. After liberalisation of the economy, the copper segment of industry has transformed significantly. Currently, three major players dominate the Indian Copper Industry. Hindustan Copper Limited (HCL) in Public Sector combined with M/s Hindalco Industries Ltd and M/s Sterlite of Private Sector, have current total installed refined copper capacity of 10 lakh tonnes. Details regarding capacity of copper smelter are reflected in Table-12.

Table – 12 : Capacity of Copper Smelters

(Quantity in '000 tonnes)

Company/Location	Annual Capacity
TOTAL	1000
Hindustan Copper Ltd.	100
i) Khetri Copper Complex, Distt. Jhunjhunu, Rajasthan	31
ii) Indian Copper Complex, Distt. East Singhbhum, Ghatsila, Jharkhand	19
iii) Gujrat Copper Project, Distt. Bharuch, Gujrat	50
Hindalco Industries Ltd., Dahej, Distt. Bharuch, Gujrat	500
Sterlite Industries Ltd., Thoothukudi, Tamil Nadu,	400

HCL has two primary smelting & refining plants at KCC and ICC. However, due to economic considerations the Company suspended KCC's smelting and refinery operation from December 2008. HCL has one secondary copper smelter in Bharuch district, Gujarat. HCL also has one continuous casting plant of copper wire rod, namely, Taloja Copper Project (TCP) with 60,000 tonnes per annum capacity at Taloja, Maharashtra.

Hindalco at Dahej in Gujarat and Sterlite Industries in Thoothukudi (plant at Tuticorin in Tamil Nadu (which is closed since May 2018) have set up port-based smelting and refining plants which depend on imported copper concentrates either from their own mines abroad or other overseas sources. Besides, there are a few small companies which produce Electrowon copper but their capacities are very low and production is inconsistent.

RECYCLING OF COPPER

Copper scrap is traded in the form of new scrap generated from copper smelters, copper workings as well as old scrap recovered from electrical motors, electronic equipment, cables, wires, utensils, etc.

Copper is one of the most recycled metals of all the metals.

The recycling of copper scrap is gaining importance worldwide simply because of the fact that recovery of copper metal from scrap requires much less energy than its recovery made from primary source. Besides, it enables conservation of natural resources.

In Indian condition, however, collection of scrap is in the Unorganised Sector and there is paucity of factual data in this regard. Still, as per the licences granted by Central Pollution Control Board as on 13.05.2010, there were 35 units operating in different states with a combined capacity of 2.42 lakh per annum for handling different types of scrap. In addition, there are 132 units with combined capacity of 5.17 lakh tonnes per annum which recover copper along with other metals. As per the estimates made in the Market Survey on Copper published by IBM, production of 1.07 lakh tonnes per annum of secondary copper was reported and all of which have been from the Organized Sector in the country.

USES & CONSUMPTION

Electrical/Electronic Industry is by far the largest consumer of copper, where it is used in the form of cables, winding wires as it is the best non-precious metal conductor of electricity as it encounters much less resistance and is safe for electrical distribution system from high voltage transmission cables to micro-circuits. Copper also has relatively high creep strength as compared to other commonly used materials. In Electronic Industry, semi-conductor manufacturers have launched a revolutionary 'copper chip'. By using copper for circuitry in silicon chips, microprocessors are able to operate at higher speeds using less energy. Copper heatsinks help remove heat from transistors and enable computer speeds using less energy, and processors operate at peak efficiency. Copper is used in Construction Industry as plumbing, taps, valves and fittings components.

The corrosion-resistant properties of copper and copper alloys (such as brass, bronze and copper-nickel) make them especially suitable for use in marine and other demanding environments. Vessels, tanks and piping exposed to seawater, propellers, oil platforms and coastal power stations, all depend on copper's corrosion resistance for protection.

In Transportation Industry, copper is used in various components. According to ICSG the world Copper Factbook 2024, most cars contain an average of 23 kg copper and luxury & hybrid vehicles contain about 40 kg copper. Copper is extensively used in industrial machinery and equipment. It is used in a number of consumer products, such as, coinage, utensils, fixtures, etc. Large quantities of copper are consumed in making copper-based alloys, such as, brass and bronze.

As per the estimate of ICSG, the share of Electrical and Telecommunication Industry in total consumption is 56%, followed by Transport (8%), Consumer Durables (7%), Building & Construction (7%), General Engineering Goods (6%) and other industries including Process Industries (16%). The apparent availability of copper for internal consumption in various industries has been computed on the basis of production of refined copper (cathodes) and from the imports and exports data of copper (refined). Copper is also traded in the form of alloys but has not been considered for arriving at apparent availability of copper. During 2022-23, the imports of refined copper were more than the exports. The availability of refined copper increased from 5,14,545 tonnes in 2021-22 to 7,04,735 tonnes in 2022-23 (Table-13).

Table – 13: Apparent Availability of Copper for Domestic Consumption

(Based on Production of Refined Copper, Imports and Exports)

(Quantity in tonnes)

Item	2021-22 (P)	2022-23
I) Total Production* (Cathodes)	483994	554242
II) Total Imports (copper refined)	138531	180622
III) Total Exports (copper refined)	107980	30129
IV) Apparent Availability	514545	704735

* *Primary*

SUBSTITUTES

Copper is vulnerable for substitution on grounds of price, technical superiority or weight. Aluminium is used as substitute for copper in various products, such as, electrical power cables, electrical equipment, automobile radiators and cooling/refrigeration tubing. Optical fibre has substituted copper in some telecommunication applications and plastics are used as substitute for copper in water pipe, plumbing, fixtures and many structural applications.

WORLD REVIEW

The world reserves of copper metal are assessed at 1000 million tonnes of copper content. Chile has the largest share, accounting for about 19% of world reserves, followed by Peru (12%), Australia (10%), Congo (Democratic Republic) & Russia (8% each), Mexico & USA (5% each), China (4%), Poland (3%), Indonesia, Kazakhstan & Zambia (2% each) and Canada (1%). Remaining about 18% was contributed by other countries (Table-14).

Table – 14: World Reserves of Copper

(By Principal Countries)

(Quantity in '000 tonnes of copper content)

Country	Reserves
World Total (rounded)	**1000000**
Australia [(a)]	100000
Canada	7600
Chile	190000
China	41000
Congo Dem. Rep.of	80000
Germany	–
Indonesia	24000
Japan	–
Kazakhstan	20,000
Korea, Rep. of	–
Mexico	53000
Peru	120000
Poland	34000
Russia	80000

Table- 14 (Concld.)

(Quantity in '000 tonnes of copper content)

Country	Reserves
USA	50000
Zambia	21000
Other countries	180000

Source: USGS, Mineral Commodity Summaries, 2024,
(a): For Australia, Joint Ore Reserves Committee Compliant reserves were about 27 million tonnes.

The world mine production of copper was 22.2 million tonnes of metal content in 2022 as compared to 21.8 million tonnes in 2021. Chile continued to be the largest single producer of copper in 2022 with 24% share followed by Peru & Congo. Democratic Republic (11% each), China (9%), USA (5%), Indonesia, Russia, Mexico, Australia (4% each) and Zambia (3%) (Table-15).

Table – 15: World Mine Production of Copper

(By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
World Total (rounded off)	**20900000**	**21800000**	**22200000**
Chile	5733100	5624900	5330500
Peru	2150126	2326035	2438631
Congo Dem. Repub. Of	1601208	1802897	2394630
China	1723100	1818000	1937800
USA	1200000	1230000	1100000
Indonesia	507000	775000	965600
Russia	924100	938800	948000
Mexico	800316	782136	828180
Australia	868019	795955	818816
Zambia	868671	800696	763550
Other countries	4524360	4905581	4674293

Source: BGS, World Mineral Production, 2018-22.

(In tonnes of metal content)

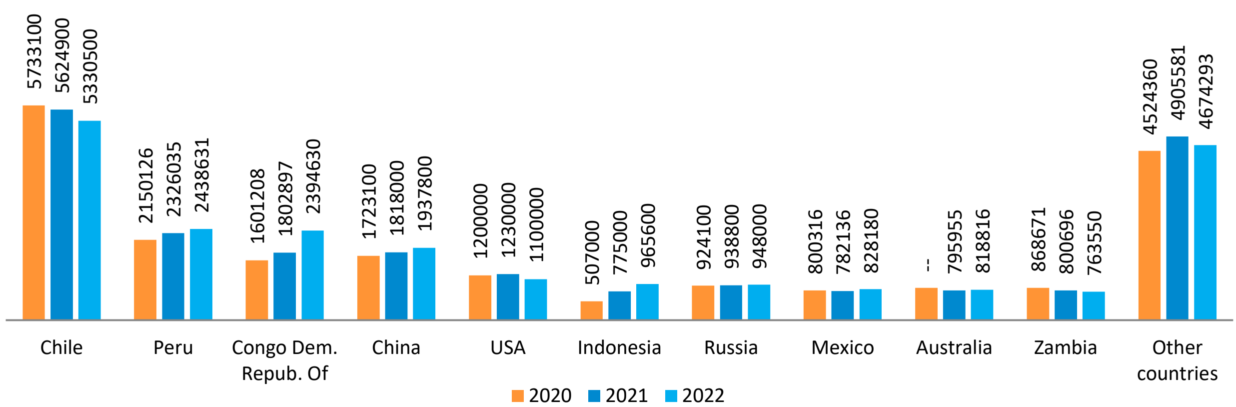


Fig. 2: World Mine Production of Copper

As per BGS, world refined copper production was 25.8 million tonnes in the year 2022 which showed an increase of 3.2% from 25 million tonnes in the 2021. China was the largest producer of refined copper with 11.12 million tonnes in the year 2022 (43% of world production) followed by Chile with 2.15 million tonnes (8%), Dem. Rep. of Congo with 1.81 million tonnes (7%), Japan with 1.56 million tonnes (6%), Russia & USA (4% each) etc.

In 2023, China accounted for 50% of world copper smelter production, followed by Japan (6%), Chile & Russia (5% each). China was also the largest consumer of refined copper in 2023 with apparent usage of around 15.5 million tonnes as per International Copper Study Group (ICSG).

FOREIGN TRADE

Exports

The exports of copper from India are in various forms, such as, copper ores & concentrates, refined copper, copper & alloys, alloys of copper, blister & other unrefined copper, copper alloys, brass & bronze, scrap, cement copper, mattes and powder & flakes etc.

Exports of copper ores & concentrates decreased considerably by 24% to 26,336 tonnes during 2022-23 from 34,827 tonnes in 2021-22. The export were mainly to China almost (100%) followed by Cambodia. Exports of refined copper decreased substantially by 72% to 30,129 tonnes in

2022-23 from 1,07,980 tonnes in 2021-22. Exports of refined copper were mainly to China (89%), Saudi Arabia (10%). The total exports of copper & alloys (including brass & bronze) were at 1,60,431 tonnes in 2022-23 as against 2,46,963 tonnes in 2021-22. Export of copper (scrap) were at 12,995 tonnes in 2022-23 as against 18,244 tonnes in 2021-22 (Tables-16 to 18).

Table- 16: Exports of Copper Ores & Conc. (By Countries)

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (Ton)	Value (₹ '000)	Qty (Ton)	Value (₹ '000)
All Countries	**34827**	**3964549**	**26336**	**2435371**
China	9815	995831	26279	2433187
Cambodia	--	--	57	2184
Philippines	22202	2521496	--	--
Malaysia	2810	447213	--	--
Canada	++	9	--	--

Table-17: Export of Refined Copper

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (Ton)	Value (₹ '000)	Qty (Ton)	Value (₹ '000)
All Countries	**107980**	**75635022**	**30129**	**19896262**
China	96377	67360076	26886	17588591
Saudi Arabia	125	8363	2993	2141879
UAE	482	351579	146	95611
Malaysia	++	25	50	30056
Nigeria	--	--	19	15785
Germany	--	--	18	11640
Taiwan	--	--	15	10963
Philippines	--	--	++	460
Nepal	1	451	++	409
Kenya	--	--	++	168
Other countries	10995	7914528	2	700

Table- 18: Exports of Copper and its Commodities (by items)

All items	2021-22		2022-23 (P)	
	Qty (Ton)	Value (₹ '000)	Qty (Ton)	Value (₹ '000)
Blister & Other Unrefined Copper	**5169**	**3608670**	**--**	**--**
Copper & Alloys :Worked(Bars,Rods,Plates,Etc)	13132	11454522	17244	15951851
Copper & Alloys :Worked,Nes	15749	15962044	9941	10046532
Copper Alloys:Unwrought Excl. Brass&Bronze	1798	1184227	4690	3336064
Copper Mattes	9961	1230271	9303	1329375
Copper Powder & Flakes	244	227005	141	113293
Copper Refined Copper Worked	14936	10928585	33863	24532219
Electroplated Anode Of Nickel	14	13359	++	2860
Master Alloys Of Copper	753	537887	641	471314
Refined Copper	107980	75635022	30129	19896262
Copper And Alloys (Incl. Brass And Bronze)	246963	171342596	160431	108765921
Cement Copper Precipitated	501	25047	293	19034
Copper (Scarp)	18244	8312550	12995	7965012
Copper and Alloys	169736	120781592	105952	75679770
Master Alloys Of Copper	753	537887	641	471314
Brass And Bronze (Scarp)	2020	1002659	2261	1134445
Brass And Bronze	56963	41245793	39223	23986694
Brass And Bronze :Bronze Powder	81	13361	++	901
Brass And Bronze Unwrought	26635	12263801	24935	11834095
Brass And Bronze Worked	30247	28968631	14288	12151698

Imports

The imports of copper in the country are in the form of copper ore & concentrates, refined copper, copper & alloys, brass & bronze, scrap, cement copper, mattes, blister, worked (bars, rods & plates), copper powder & flakes, etc.

During the year 2022-23, imports of copper ores & concentrates increased by 16% to 11,78,921 tonnes as compared to 10,18,934 tonnes in 2021-22. Chile with a share of 34% was the leading supplier followed by Indonesia (22%), Peru (14%) and Australia (9%). While imports of refined copper increased by 30% to 1,80,622 tonnes in 2022-23 from 1,38,531 tonnes in 2021-22. Japan was the leading supplier of refined copper with share of 81% followed by Tanzania (12%) and UAE (2%). Out of the total imports in 2022-23, copper & alloys comprised 6,50,824 tonnes and copper (scrap) comprised 1,35,906 tonnes (Tables- 19 to 21).

Table-19: Import of Copper Ores And Conc.

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (Ton)	Value (₹ '000)	Qty (Ton)	Value (₹ '000)
All Countries	**1018934**	**223814328**	**1178921**	**273744293**
Indonesia	205140	46083939	262835	73145069
Chile	375188	67704766	400156	72498499
Australia	111474	41880647	102379	36276452
Peru	120062	25675980	162446	31185149
Panama Republic	91636	17694145	90887	16406274
Papua New Guinea	--	--	49105	13439081
Malaysia	--	--	31440	11304238
Canada	30902	9029113	29878	8136590
Taiwan	--	--	19374	5069256
Brazil	30532	6698492	20418	3786715
Other countries	54000	9047246	10003	2496970

Table-20-: Import of refined copper

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (Ton)	Value (₹ '000)	Qty (Ton)	Value (₹ '000)
All Countries	**138531**	**89656181**	**180622**	**116365086**
Japan	119775	77685170	145878	91190284
Tanzania	9437	6941877	22202	16042465
UAE	4443	1653538	2746	1942105
Mozambique	26	14350	2009	1491315
Zambia	31	22229	1373	947761
Thailand	1401	976238	1339	929134
South Africa	937	680877	1115	811713
Malaysia	831	531060	896	658647
Austria	585	433076	710	533182
Congo Dem. Rep.	25	18950	557	400836
Other countries	1040	698816	1797	1417644

Table-21: Imports of Copper (by Items)

All items	2021-22		2022-23 (P)	
	Qty (Ton)	Value (₹ '000)	Qty (Ton)	Value (₹ '000)
All items	**2221367**	**1460768662**	**2560781**	**1687926091**
Blister & Other Unrefined Copper	103456	75547984	78368	55626124
Copper & Alloys :Worked(Bars,Rods,Plates,Etc)	95258	70745986	122417	91842227
Copper & Alloys :Worked,Nes	8175	10441584	3788	5644197
Copper Alloys:Unwrought Excl. Brass&Bronze	748	735160	193	313323
Copper Mattes	++	2090	1	1017
Copper Powder & Flakes	928	961700	902	922598
Copper Refined Copper Worked	109628	75271271	103540	77045951

Table- 21 (Concld.)

All items	2021-22		2022-23 (P)	
	Qty (Ton)	Value (₹ '000)	Qty (Ton)	Value (₹ '000)
Electroplated Anode Of Nickel	96488	68600951	160756	108987699
Master Alloys Of Copper	231	214563	237	237624
Refined Copper	138531	89656181	180622	116365086
Copper And Alloys (Incl. Brass And Bronze)	823597	526294673	943404	606646258
Cement Copper Precipitated	281	8758	1039	7114
Copper (Scarp)	116755	53221910	135906	66026351
Copper and Alloys	553443	392177470	650824	456985846
Brass And Bronze (Scarp)	133181	65116768	134801	66231070
Brass And Bronze	20218	15778525	21873	17402991
Brass And Bronze :Bronze Powder	333	362080	313	377561
Brass And Bronze Unwrought	597	376823	516	385679
Brass And Bronze Worked	19288	15039622	21044	16639751
Master Alloys Of Copper	231	214563	237	237624

FUTRE OUTLOOK

HCL during FY (Financial year) 2020-21 had envisaged to enhance the ore production capacity from the current level of 4 million tonnes per annum (MTPA) to 12.20 MTPA by FY 2028-29 in its mines, namely, Malanjkhand, Khetri, Kolihan, etc. to increase production. Apart from this the Company has initiated action to re-open the closed mines, development of new underground mine at Singhbum Copper Belt of ICC, namely, Kendadih and Rakha mines. HCL carried out surface exploration drilling & underground definition drilling from April 2023 till March 2024 of 25,385 meters & 24,443 meter for enhancing copper ore reserve and resources within its mining leases. Metal in concentrate production of HCL in FY 2023-24 was 27,404 tonnes. HCL has plans to enhance the mining capacity of Surda mine from the current level of 0.4 MTPA to 0.9 MTPA in the next seven years. Recently, Jharkhand Cabinet has also given it's nod for lease extension for the Kendadih and Rakha mines. Reopening of Kendadih and Rakha mines is on the cards this year which will lead to 2,000 direct employment and 10,000 indirect employment among the local populace and triple the production of Indian Copper Complex. HCL further plans to ramp up mining capacity of the copper mine from the current level of 0.4 to 0.9 MTPA in the next seven years.

Copper demand in India is expected to grow at 6–7% due to increased thrust of Government of India towards "Make in India" and "Smart City" programmes and increased investments in railways, power, defence and infrastructure sectors would drive the demand for copper in the country. Demand is expected to show significant growth considering the initiatives, such as, development of industrial corridors, smart city project, housing for all Indians, National Highway development project, Rail project, defence production policy to encourage indigenous manufacturing, India energy plan 2022–100 GW solar, 32 GW wind, 260 GW thermal & nuclear, 62 GW hydro etc. that are vigourosly pursued by the Government. In addition to this, there is plan for green energy corridor for transmission of renewable energy.

The per capita copper consumption in India is expected to increase. The per capita copper consumption of China is 6 kg and world average is 3.2 kg. As per ICSG, world refined copper production is forecast to rise by about 3.8% in 2023 and 4.6% in 2024 & world apparent refined copper usage is expected to increase by about 2% in 2023 and 2.7% in 2024. Based on parameters, such as, resource/reserve position in the country, production, import dependency, use for future technology/ clean energy, etc., copper has been identified as a critical mineral in India. The Central Government is working towards creating a sustainable scrap recycling ecosystem. In this regard, Ministry has issued a 'National Non-ferrous Metal Scrap Recycling Framework, 2020' including copper, in a bid to cut down the scrap imports. In 2022, ICSG estimated that 32% of global copper use would come from recycled copper. Refined copper usage (usage by semis plants or the first users of copper) in 2022 reached 26.1 million tonnes. China was also the largest consumer of refined copper in 2022 with apparent usage of around 14.7 million tonnes.

The market for Electric Vehicles (EVs) and renewable energies are expected to witness growth in coming years as Government incentives continue around the world. Copper is essential to EV technology and its supporting infrastructure. The increase in the electric vehicles in the market and government push to achieve renewable energy targets will significantly boost the demand for copper in coming years. The projected demand for copper due to electric vehicles is expected to increase by 1.7 million tonnes by 2027. A new generation of high performance copper alloy wire is attracting attention of the Electronic Industry.

16. Gallium

Gallium is a soft, silvery-white strategic metal predominantly used in electronics. There is no primary source of gallium in the country. Gallium does not occur as a free element in nature. It usually occurs as trace component in zinc & bauxite ores. It is generally recovered from sodium aluminate liquors obtained in Bayer's alumina process during aluminium production and from residues obtained during zinc processing in some countries. It can also be extracted from polymetallic ores by leaching and also from coal ash and coal. Gallium is also recycled from scrap generated from industries that manufacture Gallium arsenide (GaAs) and Gallium nitride (GaN) based devices. Though India is endowed with bauxite ores in abundance due to limitation in the viability of economically producing gallium, no production has been reported in the recent past.

Ministry of Mines, Govt. of India, in June 2023, released the list of 30 Critical Mineral for India which also included Gallium bearing minerals into it. In line of the same, the Central Government of India has amended the Mines and Minerals Development and Regulation Act, 1957 (MMDR Act, 1957) through the MMDR Amendment Act, 2023, whereby 24 critical and strategic minerals (including Gallium bearing minerals) have been inserted in part D to the Schedule-1 of the MMDR Act, 1957 which have been identified as critical and strategic minerals for the country. Further, the amended Act has also empowered Central Government to auction critical and strategic minerals blocks.

USES & CONSUMPTION

Gallium is predominantly used in the Electronic Industry. It has an unusual property that it expands by 3.1 % when it solidifies. Gallium-based compounds, such as, Gallium arsenide (GaAs) and Gallium nitride (GaN) are used in the production of semiconductors for use in Electronic Industry. GaAs and GaN are increasingly used in the production of light-emitting diodes (LEDs), solar panels and laser diodes. It is also used in the manufacture of memory cells and other optoelectronic devices, such as, photo-detectors and solar cells. Use of GaAs is expected to increase especially in Electronics & Communication Industry. Increased use of cellular communications and direct broadcast satellite applications are expected to inflate the demand for gallium.

Gallium is increasingly used in the manufacture of new gallium nitride devices used in high density data storage (compact disk players and digital video disk players), high-quality laser printing, communications and lighting purposes. Gallium nitride power transistors operate at high voltages and with higher power density than current GaAs devices. Gallium nitride is also used as a semiconductor and in Blu-ray Technology, mobile smartphones and LEDs.

Gallium salts, such as, gallium citrate and gallium nitrate are used in medical imaging as radio contrast agents. The plutonium used in nuclear weapon pits is machined by alloying with gallium to stabilise its phase. It is used as the alloying element in the Magnetic-shape-memory alloy "Ni-Mn-Ga". Gallium Gadolinium Garnet (GGG) is used as substrate for a bubble memory device. Gallium is used in some high temperature thermometers and an eutectic alloy of gallium, indium and tin is widely utilised in fever thermometers, replacing mercury. It is also used as a component in low melting alloys and in creating brilliant mirrors.

In 2022, the largest end-use consumption of gallium was used in for lighting and accounted for a share of 44%. In that year, integrated circuits and photovoltaics accounted for 36% and 7% respectively of the global gallium end-use consumption. As per available data, India consumed an estimated 205 tonnes of primary refined gallium and 165 tonnes of recycled gallium in 2018.

MINING LEASE & PRODUCTION

Gallium is recovered as a by-product while producing alumina. Two plants, namely, Hindalco Industries Ltd, at Renukoot, Uttar Pradesh and National Aluminium Co. Ltd at Damanjodi alumina refinery, Odisha, had recovered gallium in the past.

NALCO

NALCO was reportedly in the process of sourcing environment-friendly technology for establishing a gallium extraction plant. NALCO has plans to set up 10 tpy gallium extraction plant at its Alumina Refinery in Damanjodi (Odisha). NALCO has targets to produce gallium metal with a purity of 99.99%. In December 2015, NALCO has signed R & D agreement with Chalieco, China for separation of iron concentrate from Red Mud and extraction of gallium from Bayer's Liquor.

As there is no primary source of gallium in the country, no Mining Lease has been granted for exploration or mining of Gallium metal in India as on date.

RESEARCH & DEVELOPMENT

An MoU was signed with Bhabha Atomic Research Centre (BARC), Mumbai in May 2016 for various R&D works like extraction of Gallium and other rare earth elements from Bayer Process liquor and Alumina waste and studies on the suitability of red mud for sacrificial core catcher material is in progress with BARC.

SUBSTITUTES

Liquid crystals made from organic compounds are used in visual displays as substitutes for LEDs. Silicon-based complementary metal-oxide semiconductor power amplifiers compete with GaAs power amplifiers in midtier 3G cellular handsets. Indium phosphide components can be substituted for GaAs-based infrared laser diodes in some specific wavelength applications. The GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor for GaAs in solar cell applications. GaAs-based integrated circuits are used in many defense applications because of their unique properties and there are no effective substitutes for GaAs in these applications. In some bipolar transistor applications, silicon-germanium is used as substitute for GaAs. Researchers are working to develop organic-based LED that may compete with GaAs in future.

WORLD REVIEW

The production of gallium was reported mainly from countries like China, Russia, Japan, Ukraine and the Republic of Korea. Imports of gallium into Japan and the United States, two leading consuming countries, were initially used as the basis for estimating world gallium production.

China's primary low-purity gallium production capacity increased by 100,000 kilograms per year in 2022 to 7,50,000 kilograms per year. This latest increase followed a series of expansions from a capacity of 140,000 kilograms per year in 2010. China accounted for approximately 86% of worldwide primary low-purity gallium production capacity of an estimated 8,70,000 kilograms per year. China accounted for 98% of worldwide primary low-purity gallium production.

The remaining primary low-purity gallium producers outside of China most likely restricted output owing to China's dominant production capacity. These producers included Japan, the Republic of Korea, Russia, and Ukraine. Germany, Hungary, and Kazakhstan ceased primary production in 2016, 2015, and 2013, respectively. However, owing to the increase in gallium prices, Germany announced that it would eventually restart primary gallium production.

High-purity refined gallium production in 2022 was estimated to be about 290,000 kilograms, a 16% increase from the revised estimated figure of 2,50,000 kilograms in 2021. Canada, China, Japan, Slovakia, and the United States were the known principal producers of high-purity refined gallium. The United Kingdom ceased high-purity refined gallium production in 2018. Gallium was recovered from new scrap in Canada, China, Japan, Slovakia, and the United States. World high-purity refined gallium production capacity was an estimated 320,000 kilograms per year, and secondary high-purity gallium production capacity was an estimated 3,00,000 kilograms per year.

The world demand has been strongest in optoelectronic applications, particularly, in light-emitting displays. The enhanced properties of GaAs-based integrated circuits have enabled its use as substitute for silicon in many defense applications. The cellular telephone market was principally responsible for growth in gallium consumption in the past few years.

China, with 400 tonnes, is the largest producer of Gallium (primary) in the World during 2022 followed by Russia (5 tonnes), Japan (3 tonnes), Ukraine (2 tonnes), and the Republic of Korea (2 tonnes) (Table-1).

Worldwide gallium consumption was estimated to be about 370 tonnes in 2018, an increase of 4% from that of 2017. Approximately 40% to 45% of total consumption was from recycled material. Therefore, about 205 tonnes of high purity primary refined gallium and 165 tonnes of recycled gallium were estimated to have been consumed in 2018. In 2022, the largest end-use consumption of gallium was used in for lighting and accounted for a share of 44 percent. In that year, integrated circuits and photovoltaics accounted for 36 and seven percent of the global gallium end-use consumption.

Table – 1: World Production of Gallium (Primary)

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
China	**336**	**423**	***400**
Russia	*13	*13	*5
Ukraine	*4	*4	*2
Japan	3	3	*3
Korea (Rep. of) [(a)]	*2	*2	*2

Source: BGS, World Mineral production, 2018-22
Note(s)
(1) Accurate data for gallium is difficult to obtain because it is produced only as a by-product of bauxite or zinc processing usingproprietary techniques. As a consequence, this table may not be complete.
(2) Lower grade production is often subsequently refined to higher grade material which complicates the collection of data as doublecounting is a significant risk.
(a) Primary production only
** estimated*
(3) In addition to the above primary production, there is also believed to be significant production of refined gallium from scrap recycling.
(a) Primary production only
** estimated*

FUTURE OUTLOOK

The demand for gallium is likely to increase with the growth of Electronic Industry in the country. Strategic importance of gallium has raised the imperative demand for development of indigenous technology and also the need for collaboration with foreign countries for refining and improving production of gallium. Zinc deposits, as an alternative source, may attract attention in the future, when the present accessible sources would deplete.

India has potential for increasing alumina production with greenfield export-oriented plants which can contribute substantially in meeting the domestic demand of gallium by establishment of gallium recovery units.

Smartphones are a fundamental structural shift in mobile communications, offering services not available on standard cellular telephones, such as, internet access, video streaming, computer programme applications (“apps”), and global positioning systems. Smartphones, which use up to 10 times the amount of GaAs-rich RF content than 2G cellular telephones, are expected to account for 87% of all worldwide handset sales by near future. Overall installation of 5G mobile networks in India is expected to further increase sales of smartphones. Additional increases in GaAs demand will also result from new Wi-Fi applications, such as, point-to-point communications, smart meters and tablet personal computer technologies.

Further, the higher switching capacities combined with low energy losses make gallium nitride an ideal material for power converters. These are an integral part of cell phones and are already often made of gallium nitride. The fact that chargers today are much smaller than they were ten years ago is also due to gallium nitride. The efficient flow of current in the semiconductor means that much less heat is generated, allowing components to be placed closer together without creating safety risks. The compact design generally requires less material, such as for the module's housing. This also makes a gallium nitride charger more resource-efficient in this respect. 6G is not yet feasible with existing technologies. Gallium nitride is the key to achieving the efficiency and performance needed for 6G mobile communications.

Recent research has also shown that gallium nitride technology aims to replace silicon and boost electric vehicle (EV) performance while cutting costs. GaN power transistors are being brought into greater focus due to their large power-handling capabilities, high-switching frequencies, and higher voltage capabilities.

The gallium market size has grown exponentially in recent years. It will grow from $1.85 billion in 2023 to $2.32 billion in 2024 at a CAGR of 25.5%. The growth in the historic period can be attributed to electronics industry, medical applications, solar energy, aerospace and defense.

The gallium market is also expected to see exponential growth in the next few years. It will grow to $5.38 billion in 2028 at a CAGR of 23.4%. The growth in the forecast period can be attributed to renewable energy, electric vehicles, advanced materials, nanotechnology. Major trends in the forecast period include gallium nitride dominance, recycling and sustainability, hybrid solar cells, healthcare innovations.

17. Gold

Gold in its purest form is a bright, slightly reddish yellow, dense, soft malleable and ductile metal. It is one of the least reactive chemical elements and is solid under standard conditions. Gold often occurs in free elemental (native) form, as nuggets or grains, in rocks, in vein and in alluvial deposits. Gold dissolves in alkaline solution of cyanide, which are used in mining and electroplating. It also dissolves in mercury, forming amalgam alloys, but this is not a chemical reaction. Gold is resistant to corrosion and to most acid and has unique properties distinct from other metals.

Gold is a relatively scarce metal in the world and a scarce commodity in India. The domestic demand is mainly met through imports.

RESERVES/RESOURCES

As per NMI data, based on UNFC system, as on 1.4.2020, the total reserves/resources of gold ore in the country have been estimated at 518.23 million tonnes. Out of these, 23.72 million tonnes were placed under Reserves category and the remaining 494.50 million tonnes under Remaining Resources category. The total reserves/resources of gold (primary), in terms of metal stood at 607.26 tonnes. Out of these, 92.76 tonnes were placed under Reserves category and 514.50 tonnes under Remaining Resources category. The resources include placer-type gold ore in Kerala estimated at 26.12 million tonnes containing 5.86 tonnes gold metal.

By States, largest resources in terms of gold ore (primary) are located in Bihar (43%) followed by Rajasthan (24.92%), Karnataka (20%), West Bengal (2.47%) & Andhra Pradesh (3.03%) and Jharkhand (2%). The remaining 5.22% resources of ore are located in Chhattisgarh, Madhya Pradesh, Kerala, Maharashtra and Tamil Nadu.Although, Bihar is the leading State in India as far as resources of gold ore are concerned the resource estimate is at preliminary stage and falls under Inferred (333) and Reconnaissance (334) categories. In terms of metal content, Karnataka remained on top followed by Rajasthan, Andhra Pradesh, Bihar, Jharkhand, etc. (Table-1).

Table – 1 : Reserves/Resources of Gold as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total			
Ore (Primary)	23728100	494506270.2	518234370.2
Metal (Primary)	92.76	514.5	607.26
Ore (Placer)	--	26121000	26121000
Metal (Placer)	--	5.86	5.86
By States			
Andhra Pradesh			
Ore (Primary)	3258100	12472898	15730998
Metal (Primary)	5.3	41.87	47.17
Bihar			
Ore (Primary)	--	222884860	222884860
Metal (Primary)	**--**	**37.6**	**37.6**
Chhattisgarh			
Ore (Primary)	--	4841033	4841033
Metal (Primary)	**--**	**5.51**	**5.51**
Jharkhand			
Ore (Primary)	--	10076526.7	10076526.7
Metal (Primary)	**--**	**15.43**	**15.43**
Karnataka			
Ore (Primary)	20470000	82538505.51	103008505.5
Metal (Primary)	**87.46**	**163.71**	**251.17**
Kerala			
Ore (Primary)	--	558460	558460
Metal (Primary)	**--**	**0.2**	**0.2**
Ore (Placer)	--	26121000	26121000
Metal (Placer)	--	5.86	5.86
Madhya Pradesh			
Ore (Primary)	--	7692934	7692934
Metal (Primary)	**--**	**8.25**	**8.25**
Maharashtra			
Ore (Primary)	--	1627000	1627000
Metal (Primary)	**--**	**3.64**	**3.64**
Rajasthan			
Ore (Primary)	--	125913720	125913720
Metal (Primary)	**--**	**234.56**	**234.56**
Tamil Nadu			
Ore (Primary)	--	67000	67000
Metal (Primary)	**--**	**1**	**1**
Uttar Pradesh			
Ore (Primary)	--	13000000	13000000
Metal (Primary)	**--**	**2.08**	**2.08**
West Bengal			
Ore (Primary)	--	12833333	12833333
Metal (Primary)	**--**	**0.65**	**0.65**

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

MINING LEASES AND PRODUCTION

As on 31.03.2023,the total number of mining leases in respect of Gold in force was 10 with an area covered 6934.46 Ha. The production of gold ore at 634 thousand tonnes during 2022-23 increased by 33% as compared to that in the previous year. The quantity of ore treated also increased to 615 thousand tonnes from 482 thousand tonnes as compared to previous year. There were six reporting mines of gold ore in 2022-23.

The average grade of gold ore produced in india during 2022-23 was 2.67 g/t as against 3.20 g/t in previous year whereas that of gold treated was 2.63 g/t in 2022-23 as compared to 2.65 g/t in the previous year.

Production of primary gold in 2022-23 at 1433 kg increased by 2% as compared to that in the previous year.

Karnataka was the leading producer of gold accounting for 94% of the total production. The remaining production was reported from Andhra Pradesh and Jharkhand.

The average daily employment of labour in 2022-23 was 4776 as against 3128 in the previous year.

Production of gold by HINDALCO, a subsidiary of (Aditya Birla Group), as extracts from imported copper concentrates has been reported. During the process of copper refining, gold and other precious metals like silver and selenium are also recovered at the plant located in Dahej, district Bharuch, Gujarat.

Table– 2: Principal Producers of Gold, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
The Hutti Gold Mines Co. Ltd., Hutti, Distt. Raichur-584 115, Karnataka	Karnataka	Raichur
Manmohan Industries (P) Ltd., Shanti Niketan, 286, New Patliputra Colony, Patna, Bihar	Jharkhand	Saraikela - Kharaswan

Table – 3: Production of Gold Ore 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22		2022-23 (P)	
	Ore Produced	Avg. Grade (gram/tonne)	Ore Produced	Avg. Grade (gram/tonne)
India	474994	3.2	633514	2.67
Andhra Pradesh	856	1.26	31028	1.38
Jharkhand	3682	3.51	8809	2.84
Karnataka	470456	3.2	593677	2.68

(p) : Provisional

Table – 4: Gold Ore Treated 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22		2022-23 (P)	
	Ore treated	Avg. Grade (gram/tonne)	Ore treated	Avg. Grade (gram/tonne)
India	**482205**	**2.65**	**614978**	**2.63**
Andhra Pradesh	9	2.49	193	1.68
Jharkhand	3682	3.51	8809	2.76
Karnataka	478514	2.64	605976	2.63

(p) : Provisional

Table – 5: Production of Gold, 2021-22 to 2022-23

(By States)

(Quantity in kg; Value in ₹ '000)

State	2020-21		2021-22		2022-23 (P)	
	Qty	Value	Qty	Value	Qty	Value
India	**1127**	**5475470**	**1407**	**6761018**	**1433**	**7654670**
Primary Gold	1127	5475470	1407	6761018	1433	7654670
Andhra Pradesh	-	-	-	-	++	32
Jharkhand	11	53310	12	56268	22	119607
Karnataka	1116	5422160	1395	6704750	1411	7535031

(p): Provisional; ++: Qty is negligible

Table-6 : Production of Gold, 2021-22 and 2022-23

(By Sectors/States/Districts)

(Quantity in kg; Value in ₹ '000)

State	No. of Mines	2021-22 Production		No. of Mines	2022-23 (P)	
		Qty	Value		Production	Value
India	**6**	**1407**	**6761018**	**6**	**1433**	**7654670**
Public Sector	4	1395	6704750	4	1411	7535031
Private Sector	2	12	56268	2	22	119639
Primary Gold	**6**	**1407**	**6761018**	**6**	**1433**	**7654670**
Andhra Pradesh	**1***	**-**	**-**	**1***	**++**	**32**
Kurnool	1*	-	-	1*	++	32
Jharkhand	**1**	**12**	**56268**	**1**	**22**	**119607**
Saraikela-Kharaswan	1	12	56268	1	22	119607
Karnataka	**4**	**1395**	**6704750**	**4**	**1411**	**7535031**
Raichur	4	1395	6704750	4	1411	7535031

**: Only labour reported; ++: Qty in negligible*
(p): Provisional

GOLD BULLION

Production of gold bullion in India is reported both in primary and secondary forms and includes gold recovered from imported copper concentrates. Total production of gold bullion during 2022-23 at 13854 kg increased by 37% as compared to 10087 kg in the previous year. (Table -7). The prices & gold are covered in the Review on "prices" under General Review.

Table-7 Production of Gold Bullion, 2020-21 to 2022-23

(Quantity in kg; Value in ₹ '000)

Year	Qty	Value
2020-21	**7387**	**35813770**
2021-22	10087	48426018
2022-23(p)	13854	73341570

(p): Provisional
Note: Includes gold recovered as by-product from copper concentrates by Hindalco Industries Ltd. in Gujarat.

MINING & MILLING

Presently, HGML is the only Public Sector Company producing gold in the country. While in the Private Sector, Manmohan Mineral Industries Pvt. Ltd is engaged in mine production of gold at Kunderkocha in Singhbhum East district, Jharkhand by underground method of mining. Geomysore Services (India) Pvt. Ltd has been granted a mining lease over an area of 597.82 ha for gold mining in VillageJonnagiri in Kurnool district of Andhra Pradesh. HGML operates mines at Huttiand Hira-Buddini in Raichur district, Karnataka. Sub-level and LDBH stoping methods are adopted in exploitation of gold ore. In the Uti mine, mining was carried out by opencast method till the year 2006 and thereafter by underground method. The ore from this mine is transported to Huttimine by road for processing at the mills. Underground exploratory mining too is in progress. Several operations at Hira-Buddini old unit, such as, exploratory mine development and deepening and reequipping of main shaft are in progress. Exploratory mine development using compressed air jackhammer drilling and electrical hoist in the shaft is presently underway. Based on the developmental work and feasibility, the locomotive loaders, wagon drills and other required machinery are likely to be used to increase the ROM.

The new ore processing plant based on modern technology (SAG and Ball Mill) with a capacity of 2,000 TPD has been operational at Hutti underground gold mine since 2010. At theHutti Mineral Treatment Plant, the r.o.m. of -8" size is crushed. The final product from crushing plant, i.e. -10 mm size is stored in a 1,500 tonnes capacity fine ore bin for subsequent treatment, i.e., grinding. The Milling/ Grinding process of gold ore employs two distinct grinding techniques. The first technique involves grindingdone in two stages, i.e., primary grinding followed by secondary grinding for adequate comminution. The processes involve one primary mill and three tube mills which constitute one stream of grinding in which pebblesand smaller size balls are used as composite grinding media.

There are two such streams and strake tables for collection of coarse gold as concentrate for this circuit. In the second technique, grinding is done by four ball mills of different sizes and each of them is an independent circuit in which large size balls are used as grinding media. In these circuits, Knelson concentrator is used to collect coarse gold as concentrate. In all the milling techniques, cyclones are in closed circuit with the mills so as to get the required sizes (80% passing 75 micron) for the subsequent treatment process.

The concentrate collected from both the techniques is upgraded on James Table. The upgraded concentrates are roasted, magneted and finally smelted into bullion buttons. All the cyclone overflow, i.e., finely-ground ore in the form of slurry from the two streams of first technique and 4 streams of second technique join together in a distributor box from which finely-ground ore slurry is fed to High Rate Thickener for thickening purpose. The thickened pulp (60% solid w/w) thus obtained from thickeners is subjected to cyanidation process in which cyanide accessible gold in slurry makes complexes with cyanide in presence of oxygen and dissolves in solution at high ph. To increase the oxygen potential of slurry, H2O2 is added in addition to compressed air. The cyanidation or leaching process is carried out in a series of mechanically agitated agitators of different sizes.

The cyanide leached pulp is then fed to two Carbon-in Pulp (CIP) plants. The CIP plants are of 1,000 tpd size each and are parallel in circuit. The objective of CIP plant is to absorb the dissolved gold in activated carbon from the solution.

The gold-loaded carbon is removed from the CIP plant periodically, subjected to acid and alkaline wash and then eluted in four elution columns with 1.0% NaOH and 0.1% NaCN solution at 95°C for a period of 60 hours. The solution is then passed through four electrowinning cells in which gold is deposited on steel wool cathodes. The gold loaded steel wool cathodes are manually removed periodically and subsequently subjected to acid digestion, drying and smelting to obtain bullion buttons. The bullion buttons thus obtained from table concentrate and steel wool are cast into bullion bars weighing 4 to 11 kg and then despatched for sales.

In the past, gold was produced by the Central Government undertaking, namely, BGML. BGML earlier mined and processed the ore from Chigargunta reef in Chittoor district, Andhra Pradesh; Mysore Mines of Kolar Gold Fields in Karnataka; and Yeppamana mine in Anantapur district, Andhra Pradesh. All activities of BGML were stopped and BGML was closed w.e.f. 1.3.2001 under Section 25 (O) of the Industrial Disputes Act, 1947 in terms of Ministry of Labour, Government of India's Order dated 29.1.2001.

Gold is sometimes recovered from the pregnant (Simple gold-bearing solution) solutions by adding zinc to form soluble zinc cyanide and precipitate of gold & silver. The pregnant solution can also be passed through activated carbon which absorbs dissolved gold. Gold from either process is cast into bars, bullion and dore (when it contains silver), which must be further refined to remove impurities, suchas, mercury, arsenic and copper. Some ores cannot be treated by cyanide processing as gold in them is in small inclusions or even by solid solutions in minerals, such as, pyrite. This gold is generally recovered by roasting which converts pyrite into porous iron oxides containing small grains of gold that can be dissolved by cyanide.

DEVELOPMENT

The Deccan Gold Mines Ltd (DGML) is listed gold exploration company with deep roots in the Exploration and Mining sector. DGML's exploration activities are mainly in Karnataka and Andhra Pradesh States. Within the States of Karnataka, Andhra Pradesh and Kerala, DGML has explored several regions spanning 6,574 sq. km. in Dharwar-Shimoga Greenstone belt, Hutti-Maski Greenstone Belt, Mangalur Schist Belt and Ramagiri Schist Belt.

The main prospects for gold at Ganajur and Karajgi have progressed into advanced stages of exploration and existence of high-grade gold-bearing zones in the prospect has been established. DGML has entered into MoU with Government of Karnataka to establish a Gold Mining industry in this project area.

Exploration is being conducted in Hutti belt at various prospects, viz, in Hutti Mine north prospect, Hirenagnur prospect, southern & northern continuity of Uti mine lodes, Uti Temple prospect, Chinchergi prospect, Buttapur prospect and Yatkal prospect. In south Hutti RP block, investigations are going on in Tuppadhur-Buddini prospect, Maski prospect, Ashoka prospect and Sanbal prospect.

Birla Copper Complex of Hindalco Industries Ltd situated at Dahej, district Bharuch, Gujarat has an installed capacity of 15 tpy for gold recovery from imported copper concentrates.

HCL which recovers by-product secondary gold from indigenous copper ores at its ICC plant in Jharkhand has an installed capacity of 698 kg per annum gold recovery plant. This plant, however, did not reported production since 2007-08.

NMDC has secured a Bulyang / 'Ombe gold prospect in Tanzania. The gold prospect has a total area of 38.83 sq.km. Initial studies of NMDC revealed that Bulyang'Ombe I had a prospect for good concentration where gold values have shown a maximum of 7.2 gram per tonne, which is close to the top quality standard of 8 to 10 gram per tonne set by the World Gold Council.The Company is in process of setting up of a pilot-scale processing plant for gold in Tanzania.

NMDC has submitted the proposal for Bhukia Gold block to DMG, Govt. of Rajasthan, for over an area of 24 sq. km in Dist. Banswara. The Company has been allocated 3 Gold blocks, 2 in Karnataka and 1 in Madhya Pradesh.

Legacy Iron Ore Ltd (NMDC holding 90.05% equity stake) based in Perth, Australia is concentrating in exploration of gold in Mount Ceila where good occurrence of gold is observed. Mount Celia gold project has identified two gold occurrences, namely, Kangaroo Bore and Blue Peter deposit. Currently exploration drilling and mining study is being carried out to get the confidence & complete the feasibility study.

In Jharkhand, NMDC has submitted application to DMG, Jharkhand, for proposal to reserve 24.80 sq. km area in Kuchai Tehsil, District - Saraikela - Kaswan, Jharkhand under Section 17A (2A) of MM(D&R) Amendment Act, 2015 for prospecting and mining operation of gold & associated minerals. The matter is being pursued by NMDC with Govt. of Jharkhand for reservation.

NMDC has applied for Peravali-Betapalli Block for gold. NMDC has requested the Government of Andhra Pradesh to reserve the block in favour of NMDC under 17A (2A) of MM (D&R) Amendement Act, 2015 for prospecting & mining.

NMDC has been allotted 3 gold blocks (2 in Karnataka & 1 in Madhya Pradesh) by Ministry of Mines, for G4 level exploration under NMET. NMDC has completed exploration of 5 blocks and submitted Geological Report to NMDC.

NMDC has applied for prospecting of various minerals (diamond, gold, PGE, nickel, etc.) in Jabalpur, Katni Block (563 sq. km). Tripartite MoU among GoMP (MRD, through DGM) MPSMCL & NMDC was signed for geological and geophysical exploration for various districts of Madhya Pradesh.

A committee on Transforming India's Gold Market was constituted by NITI Aayog to recommend measures for Transforming the Gold Market Ecosystem in the country. The major recommendations of the committee are structured into five key areas. These are Make in India Gold, finalisation of Gold, Tax and duty structure, Regulatory Infrastructure and Skill Development & Technology Upgradation.

The Recommendations of the Committee are summarised as follows:

Gold Mining

1. Make gold mining viable and attractive to investors by promoting ease of doing business with single window clearances.

2. Government may consider making available the risk capital for long-term capital-intensive mining projects to attract investments.

3. The mining policy should consider availability of suitable exit option. Aspects related to brownfield exploration may also be considered.

4. Improve the quality and availability of digital data, covering geological database (which includes quality and scale of maps and ease of access to informations).

5. A comprehensive taxation policy should be formulated to align India's taxation framework with the strategic needs of the gold mining sector.

POLICY

Foreign Direct Investment (FDI) up to 100% in Mining Sector has been allowed.In the revised Export-Import Policy, comprised in the Foreign Trade Policy (FTP), 2015-20, gold ores and concentrates are under freely importable category. Under Heading No.7108, the import of non-monetary gold metal also falls under free category subject to RBI regulations, while import of gold metal in monetary form is restricted.

DEMAND & CONSUMPTION

Jewellery accounted for major consumption of gold. The Industrial demand especially in the Electrical Sector for gold is mainly due to excellent thermal and electrical properties. Besides, a significant amount is consumed in dentistry and medicine. Continuing research has discovered new applications for gold as catalyst and in nano-technology. There is increase in demand from Ornamental and Electronic Sectors. Gold is considered a valuable asset, for investments and bank reserves.

SUBSTITUTES

Platinum and palladium substitute gold to some extent, but their use is influenced by price relationship and by an established consumer preference for gold. Silver can be a substitute, but it offers less resistance to corrosion. Gold-plated palladium and bright tin-nickel can be used in electronics. Titanium and chromium-based alloys can be used in dental work. High prices encourage substitutes, particularly base metal clad with gold in Electronic & Electrical Industry and in jewellery products. No metal or alloy substitute has all the properties of gold, and therefore, the emphasis is only on reduction of gold content rather than substitution.

WORLD REVIEW

The estimated world reserves of gold were about 52,000 tonnes of metal content. The gold reserves are mainly located in Australia, Russia, South Africa, USA, Indonesia, Brazil and Peru. The world reserves of gold are provided in Table-8

Table – 8: World Reserves of Gold

(By Principal Countries)

(In tonnes of gold content)

Country	Reserves
World: total (rounded off)	52,000
Australia	[(a)]18400
Russia	6800
South Africa	5000
USA	3000
Peru	2900
Brazil	2400
Indonesia	2600
Canada	2300
China	1900
Uzbekistan	1800
Other countries	14500

Source: USGS, Mineral Commodity Summaries, 2022.
(a) For Australia, Joint Ore Reserves Committee-compliant reserves were 4,000 tonnes.

The world mine production of gold was estimated at 3,342 thousand tonnes in 2022 as compared to the 3,275 thousand tonnes in the preceding year. China contributed about 11% to the world's total mine production of gold followed by Russia (10%), Australia (9%), Canada (6%), USA (5%), Mexico (4%) & Kazakhstan (3%) and South Africa & Usbekistan (3% each) (Table-9).

Table – 9: World Mine Production of Gold

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World:Total (rounded off)	**3231464**	**3275734**	**3342193**
China	365340	329000	372048
Russia	308600	313830	320000
Australia	327952	307577	306320
Canada	182352	222524	192012
USA	193000	187000	173000
Mexico	142787	133340	147700
Kazakhstan	116964	114843	129583
Ghana	125884	88013	108115
Usbekistan	100000	100360	105000
Peru	88053	96586	96700
Other countries	1280532	1382661	1391715

Source: BGS, World Mineral Production, 2017-2021.
(d):-Metal production

FOREIGN TRADE

Exports

During the year 2022-23, the exports of gold ores &conc were Nil as compared to the negligible as in preceding year. Out of the total exports of gold (Non-monetary & Monetary), the share of Non-monetary was maximum while the share of Monetary was negligible. The exports of gold (Non-monetary and monetary) increased to 2623 kg in 2022-23 from 126 kg in 2021-22 (Table- 10).

Table –10: Export of Gold (Non-Monetory And Monetory):

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
Export of Gold-Nonmonetory	**126**	**463986**	**2623**	**11920184**
Export of Gold-Nonmonetory	126	463986	2623	11920184

Imports

Imports of gold ores & concentrates increased manifolds to 2464467 kg during 2022-23 from 799178 kg, in the preceding year. Imports of total gold (Monetary and Non-monetary) decreased substantially by 33% to 678299 kg in 2022-23 from 879010 kg in 2021-22. Out of the total imports of gold (Non-monetary & Monetary) the share of Non-monetary was percent (Tables-11 to 12).

Table –11: Import of Gold (Non-Monetory And Monetory):

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**879010**	**3440928249**	**678299**	**2804792414**
Switzerland	359825	1545226314	220073	1014901340
South Africa	57080	243116207	56480	268756428
UAE	99757	434899095	52808	248620208
Bolivia	38122	153892235	47959	203211076
USA	16306	58695275	39589	149844571
Peru	50490	172458876	44508	141669149
Guinea	61498	247595230	31967	135781049
Ghana	19385	78410163	26655	112365460
Australia	15602	67245208	16250	77517319
Tanzania	13323	42665121	19862	72266246
Other Countries	147622	396724525	122148	379859568

Figures rounded off

Table–12: Import of Gold Ores And Conc.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**799178**	**2376524**	**2464467**	**7336354**
Colombia	798712	2320786	2463049	6964298
Bolivia	--	--	1417	372055
Malaysia	--	--	1	1
Peru	466	55738	--	--

FUTURE OUTLOOK

Historically, purchase of gold was consider to be a safe haven, hedge against economic failures, portfolio diversifier and store of wealth.

India is a traditional and stable market for gold consumption. The present production of gold is insufficient and does not meet the ever increasing demand. Therefore, efforts will be required to reduce the gap between production and demand.

The recommendations of the Committee on Transforming India's Gold Market (Constituted by NITI Aayog) contributes for fulfilling the transformational vision for India's gold market seeking to double its contribution in GDP, enhance employment opportunities, increase FDI inflow and increase the gold market size, without negatively impacting upon India's Current Account Deficit.

Further, to reduce dependence on gold imports, it is necessary to boost domestic supply which has to happen through the 'Make in India' initiative for mining, recycling & refining and increased monetisation. The policies around gold mining may need to be revisited with regard to the auctioning process, providing for single window clearance for the pending proposals and increasing co-operation between the States and the Centre.

18. Iron, Steel & Scrap

Iron & steel is decidedly the vital component of a country's economy and is considered pivotal amongst the driving forces of modernisation. The level of per capita consumption of steel is treated as one of the important indicators of socio-economic development and living standards in any country. Steel continues to be the foremost of engineering materials, which is not only environment-friendly but also is recyclable.

The total finished steel (alloy+stainless+non-alloy) production in India has grown from a mere 1.1 million tonnes in 1951 to 123.195 million tonnes (Crude Steel Equivalent) in 2022-23. Out of this, 66.92 million tonnes was Non-Flat steel and the remaining 56.28 million tonnes was Flat steel. The contribution of non-alloy finished steel, alloy finished steel and stainless steel segment is 113.55 million tonnes, 6.87 million tonnes and 2.77 million tonnes respectively.

Steel exports from India began in 1964. Exports in the first five years were mainly as a result of low demand in the domestic Iron and Steel market. Exports subsequently declined due to revival of domestic demand. India once again started exporting steel in 1975 which subsequently registered a slump due to rising domestic demand. Post liberalisation, rejuvenation in the Steel Sector resulted in large-scale exports of iron and steel. The total finished steel exports stood at 6.71 million tonnes in 2022-23, while imports stood at 6.02 million tonnes.

LIBERALISATION OF THE INDIAN STEEL SECTOR

At the time of independence in 1947, India had only three steel plants–the Tata Iron & Steel Company, the Indian Iron & Steel Company and Visveswaraya Iron & Steel Ltd and a few electric arc furnace-based plants. In the period till 1947, the viable steel producers in the country that operated with a capacity of about 1 million tonnes was wholly under the Private Sector. The provisions of the economic policy implemented during different phases of time engendered several marked changes in Indian Steel Industry. From the fledgling one million tonnes capacity status at the time of independence, India has now risen to be the 2nd largest crude steel producer in the world and the largest producer of Sponge Iron. From a negligible global presence, the Indian Steel Industry is now globally acknowledged for its product quality.

The rapid pace of growth of the Industry and the observed market trends called for certain guidelines and framework. Thus, the concept of the National Steel Policy was born with the aim to provide a roadmap of growth and development for the Indian Steel Industry. The National Steel Policy (NSP), 2005 was announced in November 2005 as a basic blueprint for the growth of a self-reliant and globally competitive Steel Sector. The long-term objective of the National Steel Policy 2005 was to ensure that India has a modern and efficient Steel Industry of world standards, catering to diversified steel demand. The focus of the policy was to attain levels of global competitiveness in terms of global benchmarks of efficiency and productivity. Then, after a detailed review in 2017, the Government released the National Steel Policy 2017, which laid down the broad roadmap for encouraging long-term growth for the Indian Steel Industry, both on demand and supply sides, by 2030-31, with a vision to create a technologically advanced and globally competitive Steel Industry that would promote economic growth. At the same time, in present as a facilitator it de-regulated, liberalised economic/market scenario, the Government also announced a policy for providing preference to domestically manufactured Iron & Steel products in Government procurement. This policy seeks to accomplish the Hon'ble Prime Minister's vision of 'Make in India' with the objective of nation building and to encourage domestic manufacturing and is applicable on all Government tenders where price bid is yet to be opened. To ensure quality scrap for the Steel Industry, the Govt. of India came out with a Steel Scrap Recycling Policy that aims to reduce imports, conserve resources and save energy.

The structure of the Indian Steel industry in 2022-23 along with the production for 2021-22 to 2022-23 is furnished in Table-1. Production of iron & steel, crude steel, pig iron and finished steel (alloy + non-alloy) by SAIL, TSL Group, RINL, AM/NS (erstwhile Essar Steel), JSWL, JSPL and other producers along with production of crude steel from oxygen route, electric arc furnace route and induction furnace route during the year 2018-19 to 2022-23 is reflected in Table-2 along with the production of sponge iron through gas-based & coal-based units during the year 2018-19 to 2022-23. The production of iron & steel by Public and Private Sectors during 2018-19 to 2022-23 is furnished in Table-3. The details on plant-wise capacity and production of hot metal and crude/liquid steel are listed out in Table-4. Table-5 elucidates the production of crude/liquid steel by BOF and Electric route (EAF/IF) routes. Crude Steel Scenario Region/State-wise covering No. of Units, Annual Capacity and Production in respect of 2022-23 is shown in Table 6. Prices of steel are provided in Table-7.

Table – 1 : Structure of the Indian Steel Industry, 2021-22 & 2022-23

(Capacity/Production: In million tonnes)

Sector	Total Annual Capacity	Production	
		2021-22	2022-23
Crude Steel	**154.062**	**120.293**	**127.2**
(A) Producer-wise			
SAIL, TSL GROUP, RINL, AM/NS, JSWL, JSPL	88.232	74.875	80.06
Other Producers	65.83	45.419	47.14
(B) Sector-wise			
Public Sector	26.932	22.636	22.42
Private Sector	127.13	97.658	104.78
Hot Metal	84.834#	78.223	81.16
Pig iron	NA	6.262	5.86
Sponge Iron	49.273	39.2	43.62
Total Finished Steel (Non alloy + Alloy + stainless)	**NA**	**113.597**	**123.19**
Total (None-Flat)		59.564	66.91
(Total Flat)		54.033	56.28
1) Finished Steel (Non-alloy)	**NA**	**106.615**	**113.55**
A) Non-Flat Products	NA	54.998	61.78
Bars & Rods		46.338	51.67
Structural		7.314	8.60
Rly Material		1.346	1.49
B) Flat Products	NA	51.617	51.77
PM Plates		5.355	5.33
HR Coil/Strip		46.262	46.43
2) Finished Steel (Alloy)	**NA**	**4.17**	**6.87**
A) Non-Flat Products	NA	3.832	4.28
B) Flat Products	NA	0.337	2.58
3) Finished Steel (Stainless)	**NA**	**2.812**	**2.77**
A) Non-Flat Products	NA	0.733	0.80
B) Flat Products	NA	2.078	1.92

Source: Annual Statistics, 2022-23 of JPC

Note : Finished steel data are reported in terms of Crude Steel Equivalent.This change is due to change in reporting system of JPC as approved by Ministry of Steel and Industry Experts.

 # : Combine Capacity pig Iron & Hot metal ; Figures rounded off.

Table – 2 : Production of Iron and Steel, 2018-19 to 2022-23

(In '000 tonnes)

Item/producers	2018-19	2019-20	2020-21	2021-22	2022-23(P)
I. Pig Iron : Total	**6414**	**5421**	**4877**	**6262**	**5861**
SAIL, TSL GROUP, RINL, AM/NS, JSWL, JSPL	1663	1193	1413	1462	1184
Other Producers	4751	4227	3464	4801	4677
II. Sponge Iron : Total	**34705**	**37102**	**34376**	**39200**	**43621**
Gas based	6899	6564	6175	8866	8007
Coal based	27806	30539	28201	30334	35614
III. Crude Steel : Total	**110921**	**109137**	**103545**	**120293**	**127197**
SAIL, TSL GROUP, RINL, AM/NS, JSWL , JSPL					
Oxygen Route	47412	46735	43947	52515	56665
EAF Units	21295	21647	21106	22359	23389
Other Producers					
Oxygen Route	2043	1838	1138	2070	2127
EAF Route (incl.Corex & MBF / EOF)	7181	6719	8301	8138	4815
Induction Furnaces	32990	32198	29052	35211	40201
IV. Total Finished Steel (Non alloy +Alloy + Stainless)	**101287**	**102621**	**96204**	**113597**	**123196**
SAIL,TSL GROUP , RINL, AM/NS, JSWL, JSPL	61283	61286	55322	65055	72265
Other Producers	40004	41336	40882	48542	50931

Source: Annual Statistics, 2022-23 of JPC

1. Finished steel data are reported in terms of Crude Steel Equivalent.This change is due to change in reporting system of JPC as approved by Ministry of Steel and Industry Experts; Figures rounded off.

2. TSL Group includes Bhushan Steel Limited, Tata Steel Long Products Limited & BMW - Gamharia (Jharkhand) along with TSL plants in Jamshedpur & Kalinganagar.

(In '000 tonnes)

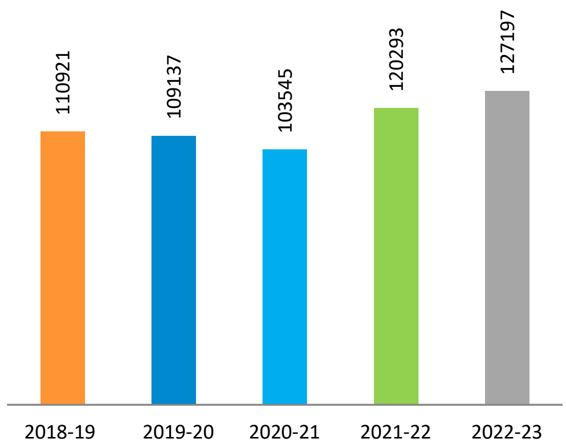


Fig 1: Production of Crude Steel 2018-19 to 2022-23

(In '000 tonnes)

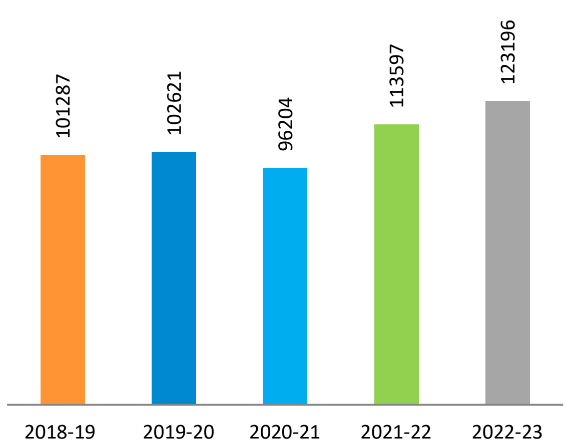


Fig 2: Production of Finished Steel 2018-19 to 2022-23

Table – 3 : Production of Iron and Steel, 2018-19 to 2022-23

(By Sectors)

(In '000 tonnes)

Item/producers	2018-19	2019-20	2020-21	2021-22	2022-23(P)
I. Pig iron : Total	**6414**	**5421**	**4877**	**6262**	**5861**
Public sector (SAIL+RINL)	588	614	669	634	401
Private sector (JSWL+JSPL+TSL Group	1075	580	744	792	783
Other Blast Furnace /Corex Unit)	4751	4227	3464	4801	4677
II. Crude steel /SEMIS: Total	**110921**	**109137**	**103545**	**120293**	**127197**
Public sector	21496	20905	19515	22636	22429
Private sector	89425	88232	84030	97658	104768

Table- 3 (Concld.)

(In '000 tonnes)

Item/producers	2018-19	2019-20	2020-21	2021-22	2022-23(P)
III. Finished steel (Non-Alloy+Alloy+ Stainless): Total	**101287**	**102621**	**96203**	**113597**	**123195**
Public sector (SAIL+RINL)	16933	16029	13783	17579	18926
Private sector {TSL + AM/NS (ESL) +JSWL+JSPL+Other Producers}	84353	86593	82420	96017	104269

Source: Annual Statistics, 2022-23 of JPC
Note : Finished steel data are reported in terms of Crude Steel Equivalent.This change is due to change in reporting system of JPC as approved by Ministry of Steel and Industry Experts; Figures rounded off

Table – 4 : Capacity and Production of Hot Metal and Crude/Liquid Steel, 2021-22 and 2022-23

(By Principal Producers)

(In '000 tonnes)

Unit	Annual installed capacity		Production			
	Hot metal	Crude/Liquid steel	Hot metal		Crude steel	
			2021-22	2022-23	2021-22	2022-23
SAIL	**17105**	**20632**	**18734**	**19409**	**17363**	**18292**
Rashtriya Ispat Nigam Ltd (Andhra Pradesh)	6300	6300	5774	4407	5272	4137
Private Sector						
JSW Steel Ltd	16500	25750	16794	22476	18023	23623
TSL Group	17169	20600	19405	19835	19464	19805
AM/NS (Essar Steel Ltd)	3490	9600	3335	3375	7295	6688
Jindal Steel & Power Ltd	5325	8100	6068	6165	7458	7509
Others	13680	69317	8112	5496	45419	47143
Other BOF	-	3177	-	-	2070	2127
Other EAF	-	8743	-	-	8138	4815
IF Units	-	57397	-	-	35211	40201

Source: Annual Statistics, 2022-23 of JPC

Table – 5 : Production of Crude / Liquid Steel, 2018-19 to 2022-23

By Route

(In '000 tonnes)

Route/plant	2018-19	2019-20	2020-21	2021-22	2022-23
All Routes: (A+B) Total	**110921**	**109137**	**103545**	**120293**	**127197**
A. Oxygen Route : Total	49455	48573	45085	54585	58792
SAIL	16045	15946	15054	17153	18055
RINL	5233	4749	4302	5272	4137
TSL Group	16038	16399	15811	17215	17514
JSW Steel Ltd	10096	9641	8780	10380	14236
Other Oxygen Route	2043	1838	1138	2070	2127
B. Electric Route: Total	**61466**	**60564**	**58460**	**65708**	**68405**
Electric Arc Furnace	28476	28366	29407	30498	28204
SAIL	218	210	158	210	237
TSL Group	2363	2126	1392	2249	2290
AM/NS (Essar Steel Ltd)	6813	7121	6696	7295	6688
JSW Steel Ltd	6647	6329	6080	7643	9387
Jindal Steel & Power Ltd	5254	5861	6859	4963	4786
Lloyds Steel Ltd	518	495	452	681	538
Jindal Stainless Ltd	1554	1418	1458	1812	1577
Bhushan Power & Steel Ltd	2778	2901	3754	2720	-
Other Electric Arc Furnace	2331	1905	2638	2926	2701
Electric Induction Furnace	32990	32198	29052	35211	40201

Source: Annual Statistics, 2022-23 of JPC
Note:- TSL Group includes Bhushan Steel Ltd, Tata Steel Long Products, TSL Jamshedpur & TSL Kalinganagar, Figures rounded off

Table-6: Region / State -wise Crude Steel Scenario in respect of No. of Units, Annual Capacity and Production: 2022-23

State	No. of Units				Annual Capacity ('000 tonnes)				Annual Production ('000 tonnes)			
	BOF	EAF	IF	TOTAL	BOF	EAF	IF	TOTAL	BOF	EAF	IF	TOTAL
TOTAL	**18**	**34**	**887**	**939**	**67295**	**36607**	**57397**	**161299**	**58792**	**28204**	**40201**	**127197**
Eastern Region	**9**	**11**	**135**	**155**	**35577**	**9137**	**14192**	**58906**	**34031**	**8164**	**10207**	**52401**
Arunachal Pradesh	0	0	3	3	0	0	130	130	0	0	40	40
Assam	0	0	6	6	0	0	147	147	0	0	66	66
Bihar	0	0	11	11	0	0	794	794	0	0	576	576
Jharkhand	3	1	23	27	17477	1000	2807	21284	15684	705	1774	18164
Meghalaya	0	0	7	7	0	0	236	236	0	0	73	73
Odisha	4	6	44	54	13400	7556	3721	24677	13629	7016	2753	23398
Tripura	0	0	1	1	0	0	30	30	0	0	12	12
West Bengal	2	4	40	46	4700	581	6327	11607	4718	443	4912	10073
Western Region	**2**	**14**	**252**	**268**	**12000**	**23682**	**20984**	**56666**	**9478**	**16075**	**14129**	**39682**
Chhattisgarh	1	5	90	96	7000	6303	9469	22771	5188	3735	6960	15876
Dadra and Nagar haveli and Daman Diu	0	0	17	17	0	0	338	338	0	0	318	318
Goa	0	0	10	10	0	0	538	538	0	0	407	407
Gujarat	0	2	71	73	0	9750	4258	14008	0	6708	1920	8628
Madhya Pradesh	0	0	12	12	0	0	877	877	0	0	644	644
Maharashtra	1	7	52	60	-	7629	5505	18134	4296	5633	3881	13810
Northern Region	**0**	**7**	**285**	**292**	**0**	**1609**	**13022**	**14630**	**0**	**1169**	**8215**	**9385**
Delhi	0	0	1	1	0	0	7	7	0	0	6	6
Haryana	0	3	18	21	0	847	250	1097	0	638	195	833
Himachal Pradesh	0	0	27	27	0	0	2485	2485	0	0	1286	1286
Jammu & Kashmir*	0	0	8	8	0	0	213	213	0	0	162	162
Punjab	0	4	118	122	0	762	5198	5960	0	531	3532	4063
Rajasthan	0	0	30	30	0	0	1074	1074	0	0	681	681
Uttar Pradesh	0	0	43	43	0	0	2086	2086	0	0	1442	1442
Uttarakhand	0	0	40	40	0	0	1709	1709	0	0	911	911
Southern Region	**7**	**2**	**215**	**224**	**19718**	**2180**	**9198**	**31096**	**15283**	**2795**	**7650**	**25728**
Andhra Pradesh	2	0	24	26	7600	0	2126	9726	4440	0	1848	6288
Karnataka	4	1	21	26	11118	2000	1131	14249	9722	2655	1016	13393
Kerala	0	0	28	28	0	0	490	490	0	0	379	379
Puducherry(UT)	0	0	10	10	0	0	451	451	0	0	378	378
Tamil Nadu	1	1	101	103	1000	180	2753	3933	1121	140	2219	3481
Telangana	0	0	31	31	0	0	2248	2248	0	0	1810	1810

Source: Annual Statistics, 2022-23 of JPC

Table – 7 : Prices of Steel, 2020-21 to 2022-23

(Domestic Markets)

(In ₹ per tonne)

Grade	Market	2020-21	2021-22	2022-23
TMT Bars (ISI, 8mm)	Delhi	-	-	-
MS Squares (8mm)	Delhi	43998	49383	63694
MS Angles (25 x 3mm)	Delhi	45550	51011	63289
Channels (75 x 40 mm)	Delhi	45979	51335	64184
Joists (150 x 75 mm)	Delhi	46451	52416	64492
Melting Scrap	Delhi	29857	40515	42856
Induction Ingots	Delhi	36334	47258	50911
TMT Bars (local 8 mm)	Mumbai	44879	50682	63725

Table- 7 (Concld.)

(In ₹ per tonne)

Grade	Market	2020-21	2021-22	2022-23
MS Rounds (8 mm)	Mumbai	43052	48358	61391
MS Angles(40 x 6 mm)	Mumbai	45197	50893	63665
Joists (150 x 75 mm)	Mumbai	43251	49986	61070
Melting Scrap (Foundry Grade)	Mumbai	34052	45980	52645
Melting Scrap (Steel Grade)	Mumbai	28864	43625	51779
Melting Scrap (CRCA)	Mumbai	35403	46201	50103
Induction ingots	Mumbai	36819	47950	51953
Arc Ingots	Mumbai	36481	47827	51700
Concast Billet ingots	Mumbai	36899	46627	51906
TMT Bars (ISI, 8 mm)	Kolkata	46683	51752	59127
MS Squares (8 mm)	Kolkata	45955	51161	58572
MS Angles (25 x 3 mm)	Kolkata	45785	51530	63410
Channels (75 x 40 mm)	Kolkata	45931	51318	63313
Joists (150 x 75 mm)	Kolkata	44554	50396	61082
Induction Ingots	Kolkata	37004	47740	51462
Arc Ingots	Kolkata	37094	48231	52311
Concast Billet Ingots	Kolkata	37311	47525	51730
Induction ingots (round)	Gobind (Punjab)	35462	46456	50325
Blooms (SAIL, 150 mm)	Gobind (Punjab)	35674	47052	51192
Old Ship Breaking Scrap	Gobind (Punjab)	31721	39898	49351
Melting Scrap (rolling)	Gobind (Punjab)	30410	41169	45768
MS Rounds (10 mm)	Gobind (Punjab)	44841	58165	57108
MS Squares (8 mm)	Gobind (Punjab)	46805	59723	59819
MS Angles (25 x 3 mm)	Gobind (Punjab)	43963	56954	58903
MS Sponge Iron	Gobind (Punjab)	26693	37985	40042
MS Flat (3 x 20 mm)	Gobind (Punjab)	50050	60044	59549
Pig Iron Foundry Grade – A*	Mumbai	38527	49710	57416
Pig Iron Foundry Grade – B**	Punjab	37359	48285	54195
Pig Iron Steel Grade	Punjab	32346	46050	50813

A: Low Sulphur/Phosphorus i.e. 0.09% Max which is used in Critical automotive engine components and specialize casting.*
*B**: High Sulphur / Phosphorus i.e. above 0.09% which is used in Non-Critical castings.*
Source: Minerals & Metals Review.

A. Crude Steel

At 127.19 million tonnes (mt) in 2022-23, India's crude steel production increased by 5.7% as compared to 120.29 million tonnes in 2021-22. Given the above production for 2022-23 and with capacity at 161.23 million tonnes, crude steel capacity utilisation stood at 78.85% during 2022-23. The Crude Steel working Capacity and Capacity Utilisation during the last five years are furnished below in Table- 8.

Tabe- 8: Production and Working Capacity Crude Steel (2018-19 to 2022-23)

(Quantity in million tonnes)

Year	Working capacity	Production	% Utilisation
2018-19	142.236	110.921	78%
2019-20	142.299	109.137	77%
2020-21	143.914	103.545	72%
2021-22	154.062	120.293	78%
2022-23	161.299	127.197	79%

Figures rounded off.
Source: Annual Statistics, 2022-23 of JPC

With 82% share, the Private Sector (104.76 million tonne, led the crude steel production in 2022-23. In fact, India's crude steel production has been consistently led by the Private Sector in the last five years ending 2022-23.

The following are the two primary routes of crude steel production:

(i) BF/BOF route also called the Oxygen route.

(ii) Electric route comprising of Electric Arc Furnace and Electric Induction Furnace.

Basic Oxygen Furnace (BOF)

Presently, there are around 18 Basic Oxygen Furnace units which are available in the Indian Iron & Steel Sector with a total capacity of 67.29 million tonnes and with reported production of 58.79 million tonnes of crude steel through BOF route in 2022-23 at 87.36% of its capacity utilisation.

Electric Arc Furnace (including corex & MBF/EOF)

Crude steel produced in the Electric Arc Furnace (including corex & MBF/EOF) is mostly by recycling of steel scrap using Electric Arc Furnace (EAF). Electric Arc Furnace units, which are popularly known as mini steel plants, are significantly contributing to the production of steel in the country. Presently, in the Electric Arc Furnaces, there are 34 working units with total capacity of 36.60 million tonnes which produced 28.20 million tonnes crude steel through EAF route in the year 2022-23 at 77% of its capacity utilisation. The recent developments in EAF technology, viz, to increase oxygen consumption, to reduce power consumption and to reduce tap time have led to increase in metal production. The development of thin slab casting has made EAF route more productive. This route enables slab strips rolling at lesser cost, facilitating production of cheaper strips/sheets than those that can be achieved through BF/BOF route.

Induction Furnace (IF)

In case of the Induction Furnace (IF) segment, there are presently 887 IF working units with total capacity of 57.397 million tonnes which produced 40.201 million tonnes crude steel through IF route in 2022-23 at 70 % of its capacity utilisation. These units are better than their EAF counterparts mainly because of their low cost of production and other factors mainly related to local market supply-demand conditions. Over the time, the IF sector has witnessed considerable technological upgradation with better charge-mix of DRI and refining facilities.

An analysis of the production of crude steel through various process routes indicates that the above performance has been contributed largely by the strong trends in growth of the electric route of steel making, particularly, the induction furnace route (encouraged by strong growth in sponge iron).This is reflected in Table- 9.

Table- 9 : Crude Steel Production — By Process

(million tonnes)

Process Route	2018-19	2019-20	2020-21	2021-22	2022-23
Oxygen	49.455	48.573	45.085	54.585	58.792
EAF	28.476	28.366	29.407	30.498	28.204
IF	32.99	32.198	29.052	35.211	40.201
Total	**110.921**	**109.137**	**103.545**	**120.293**	**127.197**

Source: Annual Statistics, 2022-23 of JPC

On further analysis of the relative shares of the various routes in total production of crude steel, electric furnace route is dominated by the Induction Furnace route, which has emerged as a key driver of crude steel production in the country (Table- 10).

Table- 10 : Process Route Share in total Production (In Percent)

Process Route	2018-19	2019-20	2020-21	2021-22	2022-23
Oxygen	44	45	44	45	46
EAF	26	26	28	25	22
IF	30	29	28	30	32

Source: Annual Statistics, 2022-23 of JPC

B. Hot Metal

At 81.16 million tonnes in 2022-23, domestic hot metal production increased by 3.80% over 2021-22.

C. Total Finished Steel (Crude Steel Equivalent)

1. Trend in Production of Total Finished Steel

In the year 2022-23, the production of finished steel, stood at 123.196 million tonnes.

An analysis of the broad divisions in terms of the total production of finished steel reflects the following —

- Contribution of the Non-alloy Finished Steel stood at 113.52 million tonnes.
- Contribution of the Alloy Steel stood at 6.871 million tonnes.
- Contribution of the Stainless Steel stood at 2.77 million tonnes.

2. Trends in Consumption of Total Finished Steel

Finished Steel consumption stood at 119.89 million tonnes in 2022-23 as compared to 105.752 million tonnes during 2021-22, notching down a growth of 13.4%. Data on overall consumption of total finished steel (non-alloy + alloy + stainless) during the last five years is provided in Table-11 and these indicate a steady growth in domestic steel consumtion during the said period. However, reflecting on the year-on-year (yoy) rate of growth it could be said that such a trend, impacted and shaped largely by macroeconomic factors and prevailing steel market conditions, has followed a zig-zag track (Table-12).

Table – 11 : Total Finished Steel Consumption (Non-alloy + alloy + stainless steel) (Crude Steel Equivalent) (2018-19 to 2022-23)

(In '000 tonnes)

Year	Total Finished Steel Consumption	% yoy change
2018-19	98708	8.8
2019-20	100171	1.5
2020-21	94891	-5.3
2021-22	105752	11.44
2022-23	119893	13.37

Source: Annual Statistics, 2022-23 of JPC

Table- 12 : Total Finished Steel Consumption - Non-alloy / alloy / stainless steel wise Crude Steel Equivalent (2021-22 to 2022-23)

(In '000 tonnes)

ITEM	2021-22		2022-23	
	Qty	% share	Qty	% share
Total Finished Steel (Non alloy+ alloy + stainless)	**105752**	**-**	**119893**	**-**
Non-alloy Finished Steel	98194	92.85	110421	92.1
Alloy Finished Steel	4514	4.27	6038	5.04
Stainless steel	3044	2.88	3435	2.87

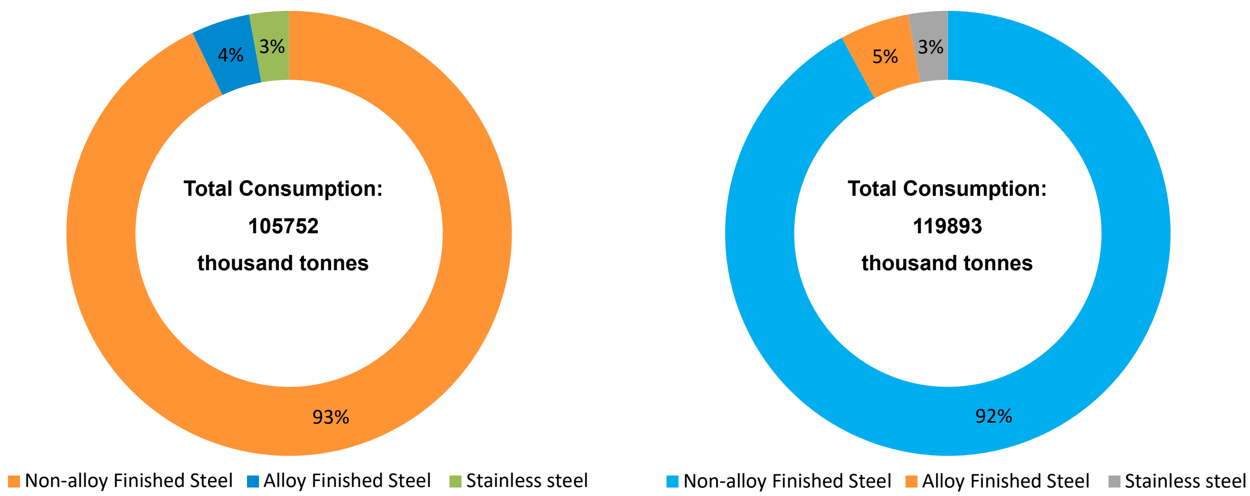


Fig 3: Percentage share of Total Finished Steel Consumption –Non-alloy / alloy / stainless steel wise 2021-22 to 2022-23

Table-13 highlights the growth pattern yoy along with share of domestic total finished steel consumption, in terms of its two broad components – flat steel and non-flat/long steel – in 2022-23 and 2021-22. Both these components include non-alloy, alloy and stainless steel constituents as well.

Table-14 shows detailed consumption data for major categories of finished steel in 2022-23 over 2021-22 in terms of crude steel equivalent of finished steel as per the present reporting system.

Table- 13 : Total Finished Steel Consumption— Non - flat/Flat wise Crude Steel Equivalent (2021-22 to 2022-23)

(include non-alloy + alloy + stainless)

(In '000 tonnes)

ITEM	2021-22		2022-23	
	Qty	% share	Qty	% share
Total Finished Steel (Non Flat+ Flat)	**105752**	**-**	**119893**	**-**
Non-Flat Finished Steel	58780	55.58	65294	54.46
Flat Finished Steel	46972	44.42	54599	45.53

Source: *Annual Statistics, 2022-23 of JPC*

Table – 14 : Detailed Consumption for Major Categories of Total Finished Steel in 2021-22 over 2022-23

(Crude Steel Equivalent)

(In '000 tonnes)

ITEM	2021-22	2022-23	% yoy Change
Total Finished Steel (Non-alloy + Alloy + stainless)	**105752**	**119893**	**13.37**
1. Finished Steel (Non-alloy)	98194	110421	12.45
a) Non-Flat Products	54665	60402	10.49
Bars & Rods	46002	50529	9.84
Structural	7244	8319	14.84
Rly Material	1419	1554	9.51
b) Flat Products	43529	50020	14.91
PM Plates	4651	4800	3.20
HR Coil/Strip	38878	45220	16.31
2. Finished Steel (Alloy)	4514	6038	33.76
a) Non-flat Products	3543	4215	18.97
b) Flat Products	971	1823	87.74
3. Finished Steel (Stainless)	3044	3435	12.84
a) Non-flat Products	572	678	18.53
b) Flat Products	2472	2757	11.53

Source: *Annual Statistics, 2022-23 of JPC*

D. Pig Iron

Pig iron is a product in solid (lumpy) form obtained upon solidification of Hot Metal in Pig Casting Machine. It is called Pig or Pig Iron because of its typical humpy shape. It is a basic input for making iron casting, which finds application in industrial and other sectors of economy. Pig iron is one of the basic raw materials required by the Foundry & Casting Industry for manufacturing various types of castings for the engineering section. In advanced countries pig iron is also used as a partial substitute of melting scrap in the charge mix of Electric Arc Furnaces. Pig Iron is mainly classified into two grades, ' Basic Grade' used for making steel and ' Foundry Grade' used for manufacturing iron castings. Domestic pro¬duction of pig iron lags behind and is not in tandem with the demand. Efforts were, therefore, made to increase pig iron manufacturing facilities in the Secondary Sector. Production of pig iron in merchant units in the Secondary Sector got its first major boost in 1992. Thereafter, the growth of this Sector accelerated greatly as Foundry-grade pig iron fast became the preferred raw material for the quality conscious foundries.

The working capacity of hot metal & pig iron during 2022-23 was reported as 88.935 million tonnes. The location and capacity of principal pig iron/ hot metal as well as State-wise capacity and production of hot metal and pig iron units are furnished in Table- 15 & Table- 16 respectively. The domestic production of pig iron was at 5.81 million tonnes in 2022-23.

As a result of various policy initiatives taken by the Government, the Private Sector showed considerable interest in setting up new pig iron units, especially in the post-liberalised period. This has resulted in drastic change in the contribution of Private Sector producers.

Table – 15 : Location and Capacity of Principal Pig Iron Units

(In thousand tonnes)

Sl. No.	Plants/unit	Location	Capacity
1	Adhunik Metaliks Ltd, Odisha	Odisha	70
2	Ankit Metal and Power Ltd	West Bengal	12
3	Aparant Iron and Steel Pvt. Ltd	Goa	125
4	Arcelor Mittal Nippon Steel India Ltd, Surat	Gujarat	3490
5	Arjas Steel Pvt Ltd (Gerdau Steel)	Andhra Pradesh	300
6	Atibir Industries Co. Ltd. (Unit Ii)	Jharkhand	600
7	B R G Iron and Steel Co. Pvt. Ltd	Odisha	120
8	Balmukund Sponge and Iron Pvt. Ltd	Jharkhand	40
9	Bhushan Power and Steel Ltd, Odisha	Odisha	2500
10	Electro Steels Ltd, Jharkhand	Jharkhand	1450
11	Electrosteel Castings Limited, Khardah	West Bengal	250
12	Electrotherm (India) Ltd	Gujarat	277
13	Ispat Damodar Ltd	West Bengal	15
14	J S W Steel Ltd, Salem (Siscol)	Tamil Nadu	1000
15	J S W Steel Ltd, Vijaynagar	Karnataka	12000
16	Jai Balaji Industries Ltd West Bengal Unit-3	West Bengal	429
17	Jai Balaji Industries Ltd West Bengal Unit-4	West Bengal	81
18	Jai Balaji Industries Ltd - I	West Bengal	30
19	Jayaswals Neco Inds Ltd	Chhattisgarh	650
20	Jindal Steel and Power Ltd, Chhattisgarh	Chhattisgarh	2125
21	Jindal Steel and Power Ltd, Odisha	Odisha	3200
22	Jsw Ispat Special Products Ltd, Raigarh	Chhattisgarh	613
23	Jsw Steel Ltd, Dolvi	Maharashtra	3500
24	K I C Metaliks Ltd	West Bengal	165
25	Kalyani Steels Ltd	Karnataka	480
26	Kirloskar Ferrous Inds Ltd	Karnataka	385
27	Kohinoor Steels Ltd	Jharkhand	48
28	Makers Casting India Pvt Ltd	Jharkhand	2
29	Mideast Integrated Steels Ltd	Odisha	460
30	Narsingh Ispat Ltd	Jharkhand	83
31	Neelachal Ispat Nigam Ltd	Odisha	1099
32	Neo Metaliks Ltd	West Bengal	188
33	Niranjan Hi- Tech Ltd.	Jharkhand	15
34	Rashmi Metaliks Limited	West Bengal	170
35	SAIL–Bhilai Steel Plant	Chhattisgarh	3925
36	SAIL–Bokaro Steel Plant	Jharkhand	4360
37	SAIL– Durgapur Steel Plant	West Bengal	1802
38	SAIL– Iisco Steel Plant	West Bengal	2500
39	SAIL–Rourkela Steel Plant	Odisha	4400
40	SAIL–Visveswaraya Iron And Steel Ltd, Bhadrabati	Karnataka	118
41	Sathavahana Ispat Ltd	Andhra Pradesh	240
42	Satyam Ferro Tech Ltd	Jharkhand	30
43	Shyam SEL and Power Ltd, Jamuria	West Bengal	60
44	SLR Metaliks Ltd	Karnataka	240
45	Sree Metaliks Ltd	Odisha	36
46	Sri Kalahasthi Pipes Limited (Lanco)	Andhra Pradesh	300
47	Suraj Products Ltd	Odisha	24
48	Swati Concast and Power Pvt Ltd	Jharkhand	43

Table- 15 (Concld.)

(In thousand tonnes)

Sl. No.	Plants/unit	Location	Capacity
49	Tata Metaliks Ltd, West Bengal	West Bengal	600
50	Tata Steel BSL Ltd, Odisha	Odisha	3919
51	Tata Steel Long Products Limited	Jharkhand	650
52	Tata Steel Ltd, Jamshedpur Works	Jharkhand	9600
53	Tata Steel Ltd, Kalinganagar Works	Odisha	3000
54	Uttam Galva Metallics Ltd	Maharashtra	600
55	Vedanta Limited	Goa	625
56	VISA Steel Ltd	Odisha	225
57	VIZAG Steel Plant	Andhra Pradesh	6300

Table-16 : State-wise Capacity and Production of Hot metal and Pig Iron

(2022-23)

(In '000 tonnes)

State	No.of working Units	Working Capacity	Annual Production	
			Hot metal	Pig Iron
Total	**50**	**88935**	**81162**	**5861**
Jharkhand	8	16935	17661	640
Odisha	9	17460	18686	634
West Bengal	14	7012	6158	1831
Chhattisgarh	4	11813	8106	461
Goa	1	625	0	691
Gujarat	2	3767	3460	12
Maharashtra	3	9200	8308	158
Andhra Pradesh	3	7900	5182	504
Karnataka	5	13223	12509	912
Tamil Nadu	1	1000	1092	18

Source: Annual Statistics, 2022-23 of JPC

E. Sponge Iron

India is the largest producer of sponge iron in the world. Sponge iron means porous iron produced by direct reduction (DR) process which may be either gas-based or coal-based. This is a solid-state reaction process (i.e., solid-solid or solid-gas reaction) by which removable oxygen is removed from the iron ore, using coal or reformed natural gas as reductants, below the melting and fusion point of the lump ore or agglomerates of fine ore. The external shape of the ore remains unchanged. Due to removal of oxygen, there is about 27 to 30 per cent reduction in weight, a honey combed microstructure remains which is called Sponge Iron (means solid porous iron, lumps/pellets, with many voids filled with air). It is also known as Direct Reduced Iron (DRI).

During early 1990s, Sponge Iron Industry was specially promoted to provide an alternative to steel melting scrap which was increasingly becoming scarce. The installed capacity of sponge iron has also increased over the years from 1.52 million tonnes in 1990-91 to 43.62 million tonnes in 2022-23. The total number of working units are 310. At 43.62 million tonnes in 2022-23, India's sponge iron production increased by 11.3% over that of 2021-22.

Over the years, the coal-based route has emerged as a key contributor to overall production and its share increased from 63% in 2004-05 to about 82% (35.61 million tonnes) of total sponge iron production in the country in 2022-23. State-wise capacity and production of sponge iron are reflected in Table-17.

Indian Iron & Steel Industry at a glance for all types of Industry covering the No. of working Units, Working Capacity and their Production is furnished in Table-18.

Table-17: State-wise Capacity and Production of Sponge Iron

(In '000' tonnes)

State	No.of working Units	Working Capacity	Annual Production
Total	**310**	**54754**	**43621**
Western Region	**95**	**23511**	**17988**
Chhattisgarh	73	11408	9917
Goa	3	221	199
Gujarat	10	8371	5577
Maharashtra	9	3512	2296
Eastern Region	**148**	**23841**	**19776**
Jharkhand	23	3623	2783
Odisha	83	13388	10623
West Bengal	42	6831	6370
Northern Region	**4**	**785**	**557**
Uttar Pradesh	4	785	557
Southern Region	**63**	**6617**	**5300**
Andhra Pradesh	8	959	591
Karnataka	39	4643	3957
Tamil Nadu	6	528	379
Telangana	10	487	374

Source: Annual Statistics, 2022-23 of JPC

Table- 18: Indian Iron & Steel Industry At A Glance During 2022-23

(In '000' tonnes)

Sl. No.	Type of Industry	No.of working Units	Working Capacity ('000 tonnes)	Production ('000 tonnes)
I	**Pellets**	**40**	**107316**	**79327**
II	**Sponge Iron**	**310**	**54754**	**43621**
III	**Blast Furnace**	**50**	**88935**	**87023**
	1 BOF	18	67295	58792
	2 Electric Arc Furnace	34	36607	28204
	3 Induction Furnace	887	57397	40201
IV	**Crude Steel (1-3)**	**939**	**161299**	**127197**
V	**Finished Steel (Crude Steel Equivalent)**			
	4 Re-rolling	1076	93398	70464
	5 HR Product	21	57853	52732
VI	**Value - added steel**			
	6 HR Product	21	57853	3312
	7 CR Product	68	30435	19052
	8 GP/GC Sheets	30	11049	8474
	9 Colour Coated	21	4301	2668
	10 Tin plate	4	999	637
	11 Pipes	115	11873	5252

Source: Annual Statistics, 2022-23 of JPC

Iron & steel scrap is one of the essential requirements for manufacture of steel in Mini-steel Industry. it is also consumed by some major steel plants. Scrap, especially from the Ship Breaking Industry supplies substantial quantity of re-rollable steel as well as steel scrap for the Iron & Steel Industry and Secondary Sector, such as, Micro, Small &Medium Enterprises (MSME). Other form of scrap, i.e., end-of-life cycle scrap or obsolete scrap these get generated in large quantities and form substantial reserves of scrap that could be efficiently put to use. Iron scrap is available in the country in the form of pressed bundles, a mixture of used steel components (called as a commercial scrap), turnings & borings and heavy melting scrap. These are generated by industries of all sectors like automobiles, railways and engineering workshops.

The collection and processing of scrap in an organised manner is undertaken by a few units in the country. In the local market, scrap is supplied by dealers who in turn arrange to have scrap collected manually or through sub-dealers.

The consumption of scrap is mainly reported by Induction Furnace &Electric Arc Furnace units, Integrated Steel Plants and Alloy Steel & Foundry industries. Scraps are used in the Steel Sector after recycling. Recycling of one tonne of steel scrap saves about 1.1 tonnes of iron ore, 0.6 to 0.7 tonnes of coking coal and around 0.2 to 0.3 tonnes of fluxes. Besides, saving of energy by about 16–17%. It also reduces the water consumption and GHG emission by 40% and 58% respectively. Recycling scrap helps in conservation of energy as remelting of scrap requires much less energy than production of iron or steel from iron ore. Also, the consumption of iron and scrap by remelting reduces the burden on landfill disposal facilities and prevents the accumulation of abandoned steel products in the environment. It increases the availability of semi-finished material, which otherwise would have to be produced using the ore. Thus, it helps in conservation of natural resources.

Ship Breaking

Ship breaking has been a major source of scrap generation. Ship breaking activities are carried out at various places on the Indian coast, the largest concentration being in the West coast. Private entrepreneurs handle the task of ship breaking in India. It is a labour-intensive job, and in India, it is a cost-efficient activity. Locations of present ship breaking activities are:

(i) Alang and Sosiya yards in Bhavnagar district, Gujarat,

(ii) Sachana district, Gujarat

(iii) Mumbai and

(iv) Kolkata

Alang & Sosiya yards account for 98% concentration of the Ship Breaking Industry in India.The yard has capacity to recycle about 450 ships per year generating re-rollable steel of > 4.5 million tonnes per annum. There are a total of 167 plots available for ship recycling spread over 10 km stretch along the coast of Alang.

The NGO Shipbreaking Platform is a global coalition of environmental, human and labour rights organisations working to promote safe and environmentally sound ship recycling practices. The coalition quickly evolved from being a European Platform to a global one, including NGOs based in the major shipbreaking countries, such as, India, Bangladesh, Pakistan and Turkey. It now has 18 member organisations and six partners in 12 countries. The Platform is recognised by United Nations agencies, the European Union and leading media outlets as the preeminent international civil society advocacy organisation on ship recycling.

Today, Alang possibly represents the single largest concentration of Ship-breaking Industry in the world. The average life of an ocean-going ship is about 25–30 years. About 40% of the ships broken are dry cargo ships, while the remaining 60% of the ships broken are wet cargo, tanker–specialised ships etc. These recyclable steels mainly as steel scrap provide feed to Steel and Foundry Industry in India. The steel generated from ship recycling contributes to around 1% to 2% of the domestic steel demand.

MSTC Ltd

(Formerly Metal Scrap Trade Corp. Ltd)

MSTC Limited was incorporated as "Metal Scrap Trade Corporation Limited", under the provisions of the then Companies Act, 1956 on September 9, 1964 at Kolkata for regulating export of ferrous scrap from India. The status of the Company underwent a change in February 1974 when it was made a subsidiary of Steel Authority of India (SAIL). In the year 1982-83, the Corporation was converted into an independent PSU under administrative control of Ministry of Steel. It was the canalising agency for import of carbon steel melting scrap, sponge iron, hot briquetted iron and re-rollable scrap till February 1992.

Presently, the Company has diversified mainly into providing e-auction /e-procurement services. Under this segment, the Company undertakes disposal of ferrous and non-ferrous scrap arisings, surplus stores, condemned plants, minerals, Agri & forest produce etc. from Public Sector Undertakings and Government Departments including private companies. The Trading Division is engaged in import as well as domestic sourcing of bulk industrial raw material for actual users as well as traders. This Division looks after sourcing, purchase and sale of industrial raw materials like low ash metallurgical coke, HR coil, naphtha, crude oil, coking coal, steam coal, line pipes etc. on behalf of customers across steel, oil & gas, power sectors under Private and Public Sector. It also undertakes trading of items within the country in competition with any other private trader.

Ferro Scrap Nigam Ltd (FSNL)

FSNL is a wholly owned subsidiary of MSTC Ltd under the Ministry of Steel. The Company undertakes the recovery and processing of scrap from slag and refuse dumps in the nine steel plants at Bhilai, Bokaro, Burnpur, Durgapur, Rourkela, Visakhapatnam, Dolvi, Duburi and Haridwar and also at Rail Wheel factory Bengaluru. The scrap so recovered is returned to the steel plants for recycling/disposal and the Company pays processing charges on the quantity recovered at varying rates depending on the category of scrap. Scrap is generated during iron & steel making and also in the rolling mills. In addition, the Company provides steel mill services, such as, scarfing of slabs, handling of BOF slag, etc.

TRADE POLICY

As per the notified Export-Import Policy incorporated under the Foreign Trade Policy (FTP) for 2015-20, the imports of primary forms of pig iron, spiegeleisen, sponge iron, ferroalloys, stainless steel, remelting scrap, as also the semi-finished products of iron, non-alloy steel or stainless steel (such as flat-rolled products, bars, rods, coils and wires), primary and semi-finished forms of other alloy-steels, etc. are unrestricted. Similarly, the exports are also allowed freely.

WORLD REVIEW

The world production of pig iron in 2022 was about 1,414 million tonnes which decreased marginally by 2 % as against 1,446 million tonnes in 2021. China (61%), India (8%) and Japan & Russia (4% each), were the main producers of pig iron including sponge iron and direct reduced iron (DRI) (Table-19).

The world crude steel production in 2022 marginally decreased by 4 % to 1,874 million tonnes from 1,947 million tonnes in 2021. China was the top producer accounting for 54% of world's crude steel production, followed by India (7%) and Japan & USA (4% each) (Table-20).

Table – 19 : World Production of Pig Iron

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World Total	**1413864122**	**1446935853**	**1414205415**
China	888976100	868567800	863827800
India	101400000	116600000	122200000
Japan	61600469	70344478	64146549
Russia	52000000	53900000	59300000
Korea, Rep. of	45359000	46440000	43400300
Iran	33300000	34300000	35400000
Brazil	24628000	28530000	26700000
Germany	25500000	26200000	24200000
USA	21700000	22000000	19800000
Taiwan	13400000	15200000	13400000
Other countries	146000553	164853575	141830766

Figures rounded off ;
Source: BGS, World Mineral Production, 2018-2022
Note: The data in this table include sponge iron and direct reduced iron (DRI),where these have been separately identified.

Table – 20 : World Production of Steel Crude

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World	**2074506462**	**1947887832**	**1874513353**
China	1064766800	1035242600	1017959000
India	100256500	118201400	125067000
Japan	83186485	96181132	89092932
USA	72732100	85791400	80535000
Russia	74600000	77850000	71469200
Korea, Rep. of	67082000	70418000	65846000
Germany	35658000	40241200	36849100
Turkey	35810300	40360000	35133800
Brazil	31415000	36071000	34500000
Iran	226301205	21659618	231683319
Other countries	282698072	325871482	294893002

Source: BGS, World Mineral Production, 2018-2022,
Figures rounded off;

FOREIGN TRADE

Exports

In terms of value, exports of iron & steel (total) decreased by 25 % to ₹ 1,53,232 crore in the year 2022-23 from ₹ 2,03,435 crore in the previous year. Iron & Steel exports in 2022-23 comprised mainly of Semi-finished Steel (including Steel Ingots) with ₹ 38,306 crore and Finished Steel Including Cold Rolled Sheet with ₹ 52,494 crore and Other Finished Steel, NES with ₹ 52,582 crore. In terms of value, exports of iron & steel in the year 2022-23 were mainly to USA (18%), Italy (9%), UAE (6%) and Nepal (5%) (Tables- 21 to 32).

Table – 21 : Exports of Iron & Steel (Total)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**2034353812**	**	**1532329704**
USA	**	245606335	**	277222223
Italy	**	155462318	**	141560590
UAE	**	121686163	**	90895397
Nepal	**	110497157	**	79793674
Belgium	**	126461596	**	73165807
Germany	**	54252017	**	53843367
Vietnam	**	106986718	**	46931268
UK	**	57639929	**	44483620
Turkey	**	79020874	**	44454236
Spain	**	52024677	**	44432378
Other Countries	**	924716028	**	635547144

Figures rounded off

Table – 22 : Exports of Iron & Steel (Finished Steel Including CR Sheet)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6798430**	**607736761**	**5226893**	**524940706**
USA	377390	64019634	461107	91274448
Italy	484039	49801439	375527	36205274
UAE	271528	26356053	420228	35982591
Nepal	1086071	51728527	602788	32628331
Belgium	587246	61891663	285744	30194861
Vietnam	17662	2595157	606431	29525286
Indonesia	330708	20090307	307691	23410931
Spain	203577	23728126	192711	19408599
Turkey	39099	6404538	166077	13672537
UK	229289	22136783	124528	12489161
Other Countries	3171821	278984534	1684061	200148687

Figures rounded off

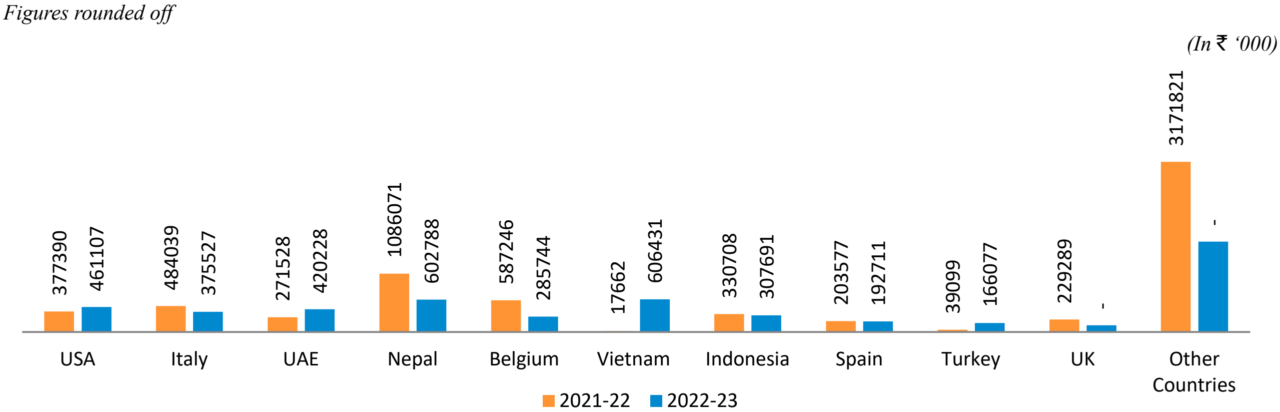


Fig 4 Countrywise Value of Export of Iron & Steel (Finished steel including LR sheet)

Table – 23 : Exports of Iron & Steel wire

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**250944**	**48353501**	**182786**	**43621658**
USA	40286	9590759	24000	7934488
Netherlands	21835	5182686	19115	4533008
Russia	6196	1663773	9227	2902616
Germany	10687	2806086	8870	2845487
Turkey	10467	2326751	9698	2476907
Italy	9487	2498473	7166	2220777
France	11418	2717725	7327	1866017
UAE	15878	1816494	11081	1695242
UK	5681	1362339	6339	1488491
Brazil	8550	1409291	6707	1400069
Other Countries	110459	16979124	73256	14258556

Figures rounded off

Table – 24 : Exports of Iron & Stee (other finished steel,NES)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**464631364**	**	**525828855**
USA	**	143329003	**	157928394
Germany	**	29428809	**	31215525
UAE	**	19267085	**	22470269
UK	**	24120806	**	22021486
Netherlands	**	16449086	**	16342943
Saudi Arabia	**	10767560	**	16236839
Italy	**	12922196	**	14053491
Bangladesh	**	9519129	**	13410039
Australia	**	11026880	**	13205718
Canada	**	11531486	**	12979473
Other Countries	**	176269324	**	205964678

***: Not additive*
Figures rounded off

Table – 25 : Exports of Iron & Steel (semi-finished steel including steel ingots)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**13492292**	**874972590**	**4545495**	**383068371**
Italy	1301053	89333448	1212844	87561865
Belgium	689151	56128203	384180	34692546
UAE	1090106	73511960	376597	28789893
Turkey	1062348	67724283	324042	25716509
Nepal	689218	38078439	290068	16544797
Spain	282121	20637176	204795	16162267
Vietnam	1688207	102256201	289625	15561918
USA	340953	24818390	130303	15282195
Netherlands	65046	10101271	71981	11707504
Germany	91604	14401387	39704	11193959
Other Countries	6192485	377981832	1221356	119854918

Figures rounded off

Table – 26 : Exports of Iron & Steel : Alloy Steel (Granules)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**678**	**45269**	**487**	**39652**
UAE	162	9295	196	13406
Saudi Arabia	45	3141	46	5815
Oman	75	5077	56	3965
Nepal	37	3484	38	3358
Qatar	--	--	34	3159
Bangladesh	36	2569	30	2619
Kenya	5	399	18	1545
Tanzania	8	616	15	1305
Taiwan	144	7857	24	1278
Thailand	--	--	6	854
Other Countries	166	12831	24	2348

Figures rounded off

Table – 27 : Exports of Iron & Steel: Alloy Steel (Powder)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**129**	**66798**	**78**	**29057**
Turkey	58	18931	65	23102
Taiwan	14	6565	8	3723
Bangladesh	4	2340	2	893
Indonesia	2	920	2	830
USA	--	--	++	428
Germany	++	5	++	60
Nepal	++	4	1	21
China	40	33558	--	--
UAE	10	4236	--	--
Israel	++	79	--	--
Other Countries	1	160	--	--

Figures rounded off

Table – 28 : Exports of Iron & Steel (Scrap)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**11492**	**941199**	**14610**	**1547783**
Sweden	2223	566603	2408	799743
Bhutan	6246	156385	9326	270414
China	17	3217	788	254855
France	--	--	61	42146
Germany	622	81272	339	35664
Malaysia	168	7369	56	26127
UAE	57	7361	276	22128
Brazil	459	55592	120	17679
Netherlands	96	5634	70	16943
Singapore	620	11024	652	14429
Other Countries	984	46742	514	47655

Figures rounded off

Table–29 : Exports of Iron & Steel (Sponge iron)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**789189**	**25256226**	**1096806**	**38009852**
Nepal	343687	10956055	614660	21223905
Bangladesh	401223	12770585	380570	13180774
Bhutan	34786	1107956	88154	3009656
Thailand	2492	81267	5105	206218
Madagascar	2746	110402	2553	103939
Sudan	--	--	2764	94333
USA	585	96447	588	79755
Malaysia	1307	39297	1003	36437
Myanmar	--	--	463	17742
Sri Lanka	1530	49242	320	11177
Other Countries	833	44975	626	45916

Figures rounded off

Table – 30 : Exports of Iron & Steel (Stainless steel)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**16901**	**4444268**	**13348**	**6052557**
USA	6774	2154252	7120	3521124
UAE	1684	238708	768	378289
Italy	124	67629	518	281420
Saudi Arabia	401	192157	546	276042
Nigeria	768	169611	208	110362
Bangladesh	1322	122338	302	104375
Costa Rica	1	31732	4	94715
Oman	492	67309	784	94127
Thailand	12	90708	11	86682
Belgium	1	786	125	74653
Other Countries	5322	1309038	2962	1030768

Figures rounded off

Table–31 : Exports of Iron & Steel Material

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	92907	7905836	103820	9191213
UAE	5057	474579	18051	1542199
Belgium	12758	1144327	14561	1279744
Italy	8439	838475	12501	1237752
USA	18487	1595684	11518	1197759
South Africa	93	8743	13507	730617
Puerto Rico	2927	205315	4537	364835
Slovenia	--	--	2864	288785
Qatar	4339	302449	3834	277954
Turkey	6579	447316	1697	196271
Germany	753	54926	2222	185911
Other Countries	33475	2834022	18528	1889386

Figures rounded off

Table – 32 : Exports of Pig & Cast Iron (Including Speigeliesen)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	1250907	49495194	672227	36969622
USA	265667	10992715	423938	25461746
Oman	97299	3615115	51289	2365700
Nepal	27809	1138547	46375	2185608
UAE	36325	1635781	29662	1363527
Turkey	97324	3915008	31310	1251499
Indonesia	6495	297971	24523	1016444
Bangladesh	60924	2451345	16722	955646
Japan	10925	524296	10564	590310
Thailand	51628	2153968	4554	303832
China	332396	12410756	17921	285148
Other Countries	264115	10359692	15369	1190162

Figures rounded off

Imports

In terms of value, imports of iron & steel (total) in 2022-23 increased by 46% to ₹ 1,70,224 crore from ₹ 1,15,950 crore in the previous year. Iron & steel imports in 2022-23 comprised mainly of finished Steel Including Cold Rolled Sheet with ₹ 54,660 crore, Scrap with ₹ 54,205 crore, Other Finished Steel, NES with ₹ 26,203 crore and Semi-finished Steel including Ingots with ₹ 26,502 crore. In terms of value, the imports in 2022-23 were mainly from China (17%) followed by Republic of Korea (14%), Japan (8%), Indonesia (7%) and USA (6%) (Tables- 33 to 43) .

Table - 33 : Imports of Iron & Steel (Total)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**1159500736**	**	**1702246642**
China	**	210209567	**	294503996
Korea Rep.of	**	208888470	**	239844439
Japan	**	96870320	**	133822752
Indonesia	**	52145651	**	119794510
USA	**	53370197	**	115294832
UAE	**	65196125	**	86251318
UK	**	24674331	**	70037653
Germany	**	43803504	**	54631113
Vietnam	**	29312311	**	47553037
Singapore	**	39360812	**	44041623
Other Countries	**	335669448	**	496471369

Figures rounded off
***: Not Additive.*

Table – 34 : Imports of Iron & Steel (Finished Steel Including CR Sheet)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3186329**	**400431501**	**3980055**	**546607218**
China	915194	111065196	1377934	171819045
Korea Rep.of	758990	79176258	892193	94445032
Japan	595076	63724629	645996	92437503
Indonesia	202840	42683436	135105	34318939
Vietnam	55068	8517831	115550	14833763
Hong Kong	88568	6430966	146643	12903266

Table- 34 (Concld.)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Belgium	46592	6157339	72333	11846448
Germany	44167	9986483	34850	11521292
Taiwan	14110	2288003	43913	9516717
Russia	47055	6774443	41950	8921310
Other Countries	418669	63626917	473588	84043903

Figures rounded off

(In ₹ 000)

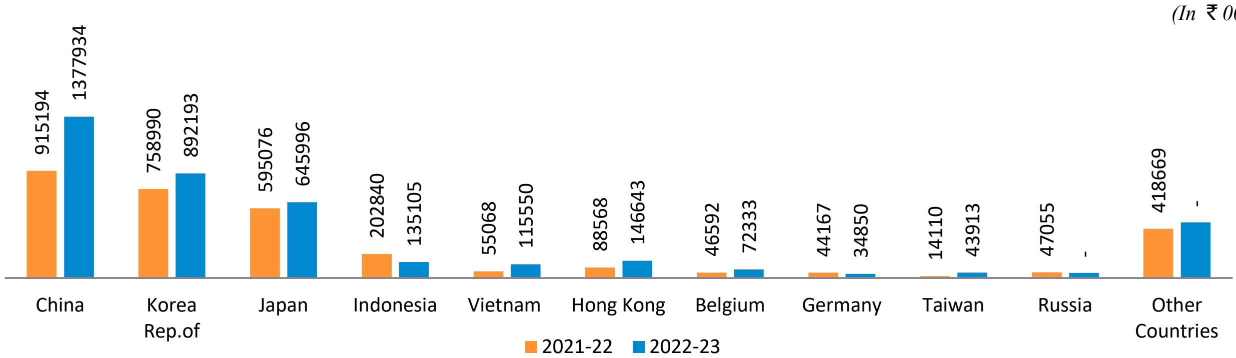


Fig 8: Countrywise Value of Import of Iron & Steel (Finished Steel Including CR Sheet)

Table – 35 : Imports of Iron & Steel (Other Finished Steel, NES)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**149312**	**21164209**	**149052**	**22150739**
China	61878	8285680	60734	7916035
Korea Rep.of	34119	3991246	21301	3104788
Japan	7852	2638152	7941	2696480
Malaysia	14872	1525865	15926	1906342
Vietnam	8299	816738	10138	1167374
Germany	1381	644970	1623	830210
UAE	1113	98859	12786	810605
Thailand	3670	392756	4065	548920
U S A	402	351310	354	383393
Italy	1691	265145	2197	379738
Other Countries	14035	2153488	11987	2406854

Figures rounded off

Table – 36 : Im ports of Iron & Steel (Other Finished Steel, NES)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**239661220**	**	**262032936**
China	**	75763884	**	91961866
Germany	**	18519560	**	21262875
Korea Rep.of	**	21717882	**	20487386
Japan	**	19056216	**	17129618
USA	**	12660918	**	16002583
Thailand	**	11707848	**	13839545
Italy	**	9650488	**	9975437
Singapore	**	7756839	**	8638584
Vietnam	**	7839347	**	6805297
Taiwan	**	6502604	**	6290081
Other Countries	**	48485634	**	49639664

Figures rounded off

Table – 37 : Imports of Iron & Steel (Semi-finished Steel Including Steel Ingots)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1504120**	**116884064**	**2932868**	**265021615**
Korea Rep.of	1094507	73920037	1387829	97902759
Indonesia	36140	2553811	408879	78617329
Japan	83853	7625663	253164	17279607
Russia	6	1953	308936	16881744
China	79532	7197291	176313	14772291
Vietnam	2898	322180	173283	9263446
Sweden	8997	3653638	13307	5501093
France	27308	2517746	19218	3195841
Thailand	9524	564346	37282	2397248
Italy	32296	3326105	12910	2313147
Other Countries	129059	15201294	141747	16897110

Figures rounded off

Table – 38 : Imports of Iron & Steel: Alloy Steel (Granules)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**18629**	**1463023**	**18666**	**1586757**
France	7232	512053	5471	460529
China	2457	159373	5991	420009
Thailand	2944	203630	2899	236105
Germany	2338	283644	1702	181063
Netherlands	405	35705	729	69669
Spain	1130	81938	649	61067
Taiwan	910	66631	440	53271
Turkey	688	45316	566	49689
Japan	134	27309	73	33346
Belgium	25	25357	6	7474
Other Countries	366	22067	140	14535

Figures rounded off

Table-39: Imports of Iron & Steel: Alloy Steel (Powder)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3450**	**911990**	**3473**	**1042530**
Sweden	485	63686	1536	238674
Japan	23	88167	33	196373
UK	271	202067	159	155420
China	572	150019	499	139941
Canada	1376	136002	1082	139026
USA	113	60279	88	73811
Belgium	67	46558	61	51220
Singapore	7	31251	7	30231
Germany	449	68197	3	10542
Netherlands	61	57271	5	6111
Other Countries	26	8493	++	1181

Figures rounded off

Table-40 : Imports of Iron & Steel (Scrap)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**4976246**	**323514680**	**10375501**	**542058265**
USA	452657	32684436	1843160	88548058
UAE	1209633	57704441	1491070	73260896
UK	260957	12295941	1482268	60489964
Singapore	335279	27567740	526859	30465612
Netherlands	121286	15460688	343300	21273519
Malaysia	147033	17546814	274808	20925673
Canada	158457	10139970	327863	17545974
South Africa	130793	4758523	369773	15469326
Poland	39919	1454529	304362	11830062
Belgium	66406	7358004	189646	11079070
Other Countries	2053826	136543594	3222392	191170111

Figures rounded off

Table-41 : Imports of Iron & Steel (Sponge iron)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**37451**	**1088387**	**304299**	**9750521**
Qatar	--	--	156885	5007069
UAE	1264	37539	102850	3285498
South Africa	33500	981032	30880	1021729
Oman	--	--	8507	279188
Kuwait	148	4106	1642	46538
Bahrain	--	--	1047	38690
UK	5	4712	910	28890
Canada	654	18921	845	28580
Egypt	1199	25742	494	7587
Saudi Arabia	--	--	105	3442
Other Countries	681	16335	134	3310

Figures rounded off

Table – 42 : Imports of Iron & Steel (Stainless Steel)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**32950**	**7510586**	**36862**	**10000540**
Vietnam	10649	2371136	14150	3660517
China	14226	3181341	14043	3426504
Japan	323	107230	2569	995873
Italy	3734	634300	3598	761856
Germany	201	141990	186	186608
Netherlands	88	69361	309	145343
UK	11	29988	222	143554
USA	259	131126	247	133756
UAE	972	256192	403	123479
Korea Rep. of	1163	112272	185	110357
Other Countries	1324	475650	950	312693

Figures rounded off

Table–43: Imports of Iron & Steel Material

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**526903**	**46871076**	**432675**	**41995521**
Korea Rep.of	216038	19329450	165208	14238194
Taiwan	173862	12770556	111950	8147473
Germany	49402	4377242	65297	7951883
China	40118	4379897	42822	4026090
Vietnam	23773	3577630	20332	3861528
Russia	26	1535	7098	792248
Japan	3752	450469	4484	614801
France	2291	228480	3270	461691
Singapore	3339	335135	4042	412650
USA	427	110346	338	390000
Other Countries	13875	1310336	7834	1098963

Figures rounded off

FUTURE OUTLOOK

Steel is one of the most important products of the modern world and of strategic importance to any industrial nation. Steel finds its way into a wide variety of applications from construction, industrial machinery to consumer products. The Indian Steel Industry has entered into a new development stage, post de-regulation, riding high on the resurgent economy and rising demand for steel. Besides being the 2nd largest global Crude Steel producer, India has also made a mark globally in the production of Sponge Iron/Direct Reduced Iron (DRI). The growth of coal-based sponge iron units in key mineral-rich pockets of the country resulted in rapid increase of domestic Sponge Iron production, enabling the country to achieve and maintain the number one position in the global market. With several expansion projects at different stages of implementation, the future of the Indian Steel Industry is optimistic. Steel consumption shows a strong correlation with GDP and is indicative of environmentally sustainable economic development of any Nation. In India in particular, the Steel Industry can play an important role to make India one of the largest economies in the world.

Globally, India made noticeable strides — the country remained the second largest producer of crude steel, the 3rd largest consumer of total finished steel and the largest DRI producer during the year, as per ranking released by World Steel Association.

As per World Steel Association, construction is one of the most important steel-using industries, accounting for more than 50% of world steel demand. Buildings, from houses to car-parks to schools and skyscrapers, rely on steel for their strength. Steel is also used on roofs and as cladding for exterior walls. The world's population is expected to increase by 2 billion persons in the next 30 years, from 7.7 billion currently to 9.7 billion in 2050, according to United Nations report launched in 2019. Commensurately, the demand and consumption of Steel are expected to soar in multi dimensional levels.

19. Lead & Zinc

Lead is a soft, heavy, toxic and highly malleable metal. It is bluish white when freshly cut, but tarnishes to dull grey when exposed. Both lead & zinc are found to occur together in ore along with other metals like silver and cadmium. Zinc is a silvery blue-grey metal with a relatively low melting and boiling point.

The largest single use of lead worldwide today is in the manufacture of lead-acid storage batteries which is about 74%, while the single largest use for zinc is in the Galvanising Industry which is about 50%.

Zinc is the fourth most widely used metal across the globe, trailing only steel, aluminium and copper. The country has the self-sufficiency in respect of zinc. In contrast, there is short supply of lead vis-a-vis the demand in the country.

The ever increasing demand for lead especially from Lead Acid Battery Sector is met by the thriving market of lead scrap recycling. The Government of India has enacted Battery Management and Handling Rule (BMHR), 2002, in order to enable further increase in the availability of scrap from the Organised Sector. It is estimated that 56% of refined lead produced worldwide is from recycled material. Producing lead through this route requires around one-third of the energy needed to extract it from its ores. Recovery of secondary zinc and lead is economically more attractive because of certain advantages. Besides lower energy consumption, it also entails low capital cost, less environmental hazards and high metal contents.

RESERVES/RESOURCES

The total resreves/resources of lead and zinc ore as on 1.4.2020 as per NMI database based on UNFC system have been estimated at 766.49 million tonnes. Of these, 103.27 million tonnes (13.47%) fall under 'Reserves' category while the balance 663.22 million tonnes (86.53%) are classfied as 'Remaining Resources'.

The total/resources of ore containing +10% Pb & Zn were estimated at 97.52 million tonnes (12.72%), ore containing 5 to 10% Pb & Zn were 280.05 million tonnes (36.53%) and ore containing less than 5% Pb & Zn were 388.90 million tonnes (50.73%).

The total metal content in total/ resources of lead is 12.86 million tonnes and that of zinc is 33.17 million tonnes and for lead & zinc metal is 0.14 million tonnes. In terms of reserves, 1.90 million tonnes of lead metal and 7.43 million tonnes of zinc metal have been estimated. Rajasthan is endowed with the largest reserves/resources of lead – zinc ore amounting to 684.65 million tonnes (89.32%), followed by Andhra Pradesh 22.69 million tonnes (2.96%), Madhya Pradesh 19.06 million tonnes (2.48%), Bihar 11.43 million tonnes (1.49%) and Maharashtra 9.27 million tonnes (1.20%). Resources are also established in Gujarat, Meghalaya, Odisha, Sikkim, Tamil Nadu, Uttarakhand and West Bengal (Table-1).

Table - 1: Reserves/Resources of Lead & Zinc Ores as on 1.4.2020

(By Grades/States)

(In `000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India			
Ore	103275	663222	766497
Lead metal	1900.19	10969.8	12869.99
Zinc metal	7438.05	25732.32	33170.37
Lead & Zinc metal	_	143.13	143.13
By Grades			
Ore with (+) 10% Pb & Zn	39100	58429	97529
Ore with 5-10% Pb & Zn	50490	229569	280059
Ore with (-) 5% Pb & Zn	13685	375225	388909
Lead metal	1900.19	10969.8	12869.99
Zinc metal	7438.05	25732.32	33170.37
Lead & Zinc metal	_	143.13	143.13
By states			
Andhra Pradesh			
Ore	_	22689	22689
Lead metal	_	836.88	836.88
Zinc metal	_	63.16	63.16
Bihar			
Ore	_	11435	11435
Lead metal	_	24	24
Zinc metal	_	38.75	38.75
Gujarat			
Ore	_	5689	5682
Lead metal	_	208.45	208.45
Zinc metal	_	261.4	261.4
Lead & Zinc metal	_	0.9	0.9
Madhya Pradesh			
Ore	_	19067	19067
Lead metal	_	36.29	36.29
Zinc metal	_	470.53	470.53
Maharashtra			
Ore	_	9272	9272
Lead metal	_	589.67	589.67
Meghalaya			
Ore	_	880	880
Lead metal	_	16.5	16.5
Zinc metal	_	14	14
Odisha			
Ore	_	1750	1750
Lead metal	_	76.96	76.96
Rajasthan			
Ore	103275	581381	684656
Lead metal	1900.19	9431.73	11331
Zinc metal	7438.05	23827.97	31266.02
Lead & Zinc metal	_	142.23	142.23
Sikkim			
Ore	_	950	950
Lead metal	_	8.58	8.58

Table- 1 (Concld.)

(In `000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
Zinc metal	_	20.07	20.07
Tamil Nadu			
Ore	_	790	790
Lead metal	_	7.74	7.74
Zinc metal	_	36.52	36.52
Uttarakhand			
Ore	_	5620	5620
Lead metal	_	182.6	182.6
Zinc metal	_	266.83	266.83
West Bengal			
Ore	_	3706	3706
Lead metal	_	140.07	140.07
Zinc metal	_	143.42	143.42

MINING LEASES & PRODUCTION

Lead & Zinc Ores and Concentrates The production of lead and zinc ore at 16.74 million tonnes in 2022-23 increased 2.5% as compared to that in the previous year.

The metal content of lead and zinc in the ore produced in 2022-23 works out to 2,32,254 tonnes and 7,36,740 tonnes respectively as against the corresponding figures of 2,69,634 tonnes and 8,87,105 tonnes in the previous year. During the year under review, 16.68 million tonnes of lead & zinc ore was treated as against 16.29 million tonnes in previous year (Tables-2 to 4).

Table - 2: Producer of Lead & Zinc Ore, Concentrates & Metals 2022-23

Name and address of the Producer	Location	
	State	District
Hindustan Zinc Ltd.,Yashad Bhavan, Udaipur – 313 004, Rajasthan.	Rajasthan	Ajmer Bhilwara Rajsamand Udaipur

Table - 3: Production of Lead and Zinc Ore, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22			2022-23(p)		
	Ore	Metal content		Ore	Metal content	
	Produced	Lead (Pb)	Zinc (Zn)	Produced	Lead (Pb)	Zinc (Zn)
India	**16338564**	**269634**	**887105**	**16744080**	**232254**	**736740**
Rajasthan	16338564	269634	887105	16744080	232254	736740

(p) : Provisional

Table - 4: Lead and Zinc OreTreated, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22			2022-23(p)		
	Ore	Metal content		Ore	Metal content	
	Produced	Lead (Pb)	Zinc (Zn)	Produced	Lead (Pb)	Zinc (Zn)
India	**16292734**	**268828**	**884161**	**16684113**	**274763**	**922251**
Rajasthan	16292734	268828	884161	16684113	274763	922251

(p) : Provisional

The production of lead concentrates in 2022-23 at 376666 tonnes increased by 2.3% as compared to that in the previous year. Entire production of lead concentrate was reported from Rajasthan (Table-5 & 6).

Table - 5: Production of Lead Concentrates, 2020-21 to 2022-23

(By States)

(Quantity in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(P)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**376923**	**18810483**	**368040**	**22025747**	**376666**	**24761930**
Rajasthan	376923	18810483	368040	22025747	376666	24761930

(p): Provisional

Table - 6: Production of Lead Concentrates, 2021-22 and 2022-23

(By Sector/State/Districts)

(Quantity in tonnes; Value in ₹'000)

State/District	No.of mines	2021-22			No.of mines	2022-23 (P)		
		Quantity	Pb%	Value		Quantity	Pb%	Value
India	**10**	**368040**	**57.55**	**22025747**	**9**	**376666**	**58.67**	**24761930**
Public Sector	2	-	-	-	1	-	-	-
Private Sector	8	368040	57.55	22025747	8	376666	58.67	24761930
Rajasthan	**10**	**368040**	**57.55**	**22025747**	**9**	**376666**	**58.67**	**24761930**
Ajmer*	1	-	-	-	1	-	-	-
Bhilwara	1	81132	56.97	3797645	1	84902	61.67	4033261
Rajsamand	3	187584	47.71	10515327	2	194781	46.77	12263592
Sirohi	1	-	-	-	1	-	-	-
Udaipur	4	99324	61.22	7712775	4	96983	63.88	8465077

(p): Provisional
**: 34RAJ01001 - Reported production of lead and zinc ore only and processing is done along with ore produced from Rampura ghucha mine at Bhilwara.*
34RAJ24001 reported employment but no production.
34RAJ27007 has not submitted Annual Returns for both years. Estimation is done from Monthly Returns. It has reported employment but no production.

The production of zinc concentrates increased from 1594085 tonnes in previous year to 1670207 tonnes in the 2022-23. Entire production of zinc concentrates was also reported from Rajasthan (Tables-7 & 8).

The entire output of lead & zinc ore and concentrates in both the years was reported by mines owned by Hindustan Zinc Ltd., a Private Sector unit.

As on 31.03.2023 (P), there were a total of 11 leases for lead and zinc ore, having an area of 7,274.25 hectares.

Table - 7: Production of Zinc Concentrates, 2020-21 to 2022-23

(By States)

(Quantity in tonnes ;Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**1513996**	**63127101**	**1594085**	**78727814**	**1670207**	**92306379**
Rajasthan	1513996	63127101	1594085	78727814	1670207	92306379

(p): Provisional

Table - 8: Production of Zinc Concentrates in India, 2021-22 and 2022-23

(By Sector/State/Districts)

(Quantity in tonnes; Value in ₹'000)

State/District	No.of mines	2021-22			No.of mines	2022-23 (P)		
		Quantity	Zn%	Value		Quantity	Zn%	Value
India	**@**	**1594085**	**50.16**	**78727814**	**@**	**1670207**	**51.04**	**92306379**
Private Sector	@	1594085	50.16	78727814	@	1670207	51.04	92306379

Table- 8 (Concld.)

(Quantity in tonnes; Value in ₹'000)

State/District	No.of mines	2021-22			No.of mines	2022-23 (P)		
		Quantity	Zn%	Value		Quantity	Zn%	Value
Rajasthan	@	**1594085**	**50.16**	**78727814**	@	**1670207**	**51.04**	**92306379**
Bhilwara	@	978250	49.98	42449478	@	1029008	50.55	47093890
Rajsamand	@	426384	48.69	23118849	@	442674	49.31	28110009
Sirohi	@	-	-	-	@	-	-	-
Udaipur	@	189451	52.61	13159487	@	198525	52.03	17102480

(p): Provisional

**: 34RAJ01001 - Reported production of lead and zinc ore only and processing is done along with ore produced from Rampura Aghucha mine at Bhilwara.*

Grade Analysis

All-India average metal content of ore treated during 2022-23 worked out to 7.18% (1.65% Pb and 5.53% Zn) as against 7.08% (1.65% Pb and 5.43% Zn) in previous year. The metal content of ore treated at Rampura Agucha mine in Bhilwara district of Rajasthan was the highest at 11.92% (1.49% Pb and 10.43% Zn). The lead concentrates produced in Rajasthan during 2022-23 was of grade 58.67% Pb as against 57.55% Pb in previous year. Metal content of zinc concentrates produced in Rajasthan worked out to 51.04% Zn in 2022-23 as against 49.91% Zn in the previous year.

Stock

Mine-head closing stock of lead concentrates in 2022-23 was 42,572 tonnes as against 30,961 tonnes in previous year (Table-9).

Mine-head closing stock of zinc concentrates in 2022-23 was 33,208 tonnes as against 33,750 tonnes in previous year (Table-10).

Table - 9: Mine-head ClosingStocks of Lead Concentrates, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22	2022-23(p)
India	**30961**	**42572**
Rajasthan	30961	42572

(p): Provisional

Table - 10: Mine-head closing stocks of Zinc Concentrates, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22	2022-23(p)
India	**33750**	**33208**
Rajasthan	33750	33208

(p):Provisional

Employment

The average daily labour employed in lead and zinc mines during the year under review was 13,300 as against 14,876 in previous year.

Lead and Zinc Metals

The production of primary lead during the year 2022-23 increased to 2,10,690 tonnes from 1,91,185 tonnes during the previous year. The entire output of primary lead was contributed by Chanderia and Dariba smelters of Hindustan Zinc Ltd.

The production of zinc ingot metal at 8,20,899 tonnes in 2022-23 increased by 5.8% as compared to that in the previous year. Hindustan Zinc Ltd. contributed 100% of the total output (Tables-11 to 14).

Table - 11: Production of Lead Metal,

2020-21 to 2022-23

(Quantity in tonnes; Value in ₹'000)

Year	Lead Primary	
	Quantity	Value
2020-21	214399	34531700
2021-22	191185	34944605
2022-23(p)	210690	39567243

(p): Provisional

Table -12: Production of Zinc Metal,

2020-21 to 2022-23

(Quantity in tonnes; Value in ₹'000)

Year	Zinc Ingots	
	Quantity	Value
2020-21	715445	147976396
2021-22	775808	202092090
2022-23(p)	820899	241626520

(p): Provisional

Table – 13: Production of Lead (Primary), 2021-22 and 2022-23

(Quantity in tonnes; Value in ₹'000)

(By State/Plants)

State	Plant	2021-22		2022-23(p)	
		Quantity	Value	Quantity	Value
India		**191185**	**34944605**	**210690**	**39567243**
Rajasthan	HZL Chanderi/Dariba	191185	34944601	210690	39567243

(p): Provisional

Table – 14: Production of Zinc(Ingots), 2021-22 and 2022-23

(By State/Plants)

(Quantity in tonnes; Value in ₹'000)

State	Plant	2021-22		2022-23(p)	
		Quantity	Value	Quantity	Value
India		**775808**	**202092090**	**820899**	**241626520**
Rajasthan	HZL Chanderi/Dariba/ Debari	775808	202092090	820899	241626520

(p): Provisional

MINING & MILLING

HZL is the only integrated lead and zinc metal producer in the country. Its operations can be classified into mining and smelting. At present, HZL's eight mines and all mining operations are located in Rajasthan. The eight mines are Rampura Agucha mine (Bhilwara district), Kayad mine (Ajmer district), Rajpura Dariba mine, Sindesar Khurd mine (both in Rajsamand district) and Zawar group of mines (4 mines in Udaipur district i.e. Mochia, Balaria, Zawarmala and Baroi), Rajasthan. All the mines of HZL undertake underground mining operations. Rampura Agucha mine was completely turned to underground mine with an annual production capacity of 5 million tonnes of lead & zinc ore. Sindesar Khurd mine is highly mechanised and the largest ore producing underground mine with annual production capacity of 6 million tonnes. The other six mines viz, Rajpura Dariba, Zawar group of mines (Mochia, Balaria, Zawarmala and Baroi) and Kayad mine are underground mines with an annual production capacity of 1.25 million tonnes, 4.41 million tonnes and 0.93 million tonnes of lead & zinc ore respectively (Table-15).

Table – 15: Ore Production Capacity of HZL Mines

(million tpy)

Mine	Ore	Capacity
Total		**16.33**
Zawar Mines, Distt Udaipur, Rajastthan	Zinc-lead	4.41
Rajpura-Dariba, Distt Rajsamand, Rajasthan	Zinc-lead	1.25
Sindesar Khurd Mine, Distt Rajsamand, Rajasthan	Zinc-lead	5.23
Rampura Agucha, Distt Bhilwara, Rajasthan	Zinc-lead	4.51
Kayad, Distt Ajmer, Rajasthan	Zinc-lead	0.93

Zawar group of mines is a cluster of four underground mines viz. Mochia, Balaria, Zawarmala and Baroi mines and one beneficiation plant for all mines commissioned in the year 1966. Zawar group of mines, one of the oldest mines is located about 40 km south of Udaipur. Lead & Zinc ore of the mines is divided into stope blocks which are drilled and blasted using sub-level open stoping mining method. Loading and transportation are done using combination of LHDs, LPDTs, LOCO and shaft hoisting to surface. The ore is further crushed and passed through a flotation process to produce concentrate. Zawarmala Mine has started extraction from pillar posts and filled the voids. It achieved highest ever 271.45 kilometres surface and underground exploration drilling in FY 2022-23, and discovered new lenses at shallow depth in Bowa Magra and eastern Zawarmala, using new methods like Mobile Carrier Rig (MCR) for shallow angle surface drilling. Opening of new production front South of Baroi by UG exploration and ore body (OB) delineation is under progress to increase production in Baroi Mine and COP reduction by less hauling distance. In 2022-23, the Zawar group of mines produced 4.30 million tonnes ore as compared to 4.4 million tonnes in the year 2021-22. It aims to expand its capacities further to achieve 6.50 Mtpa in the coming years. As on 31.03.2023, Zawar group of mines have total ore reserve of 49.4 million tonnes with Zn grade of 2.8% and Pb grade of 1.3%.

The Rajpura Dariba mine is an underground lead & zinc mine where mining operations began in 1983. It is located at 75 kilometers north-east of Udaipur, Rajasthan. Mining is carried out by using Blasthole stoping method with hydraulic filling. Mined out stopes are backfilled with cement tailings. During the year 2022-23, Rajpura Dariba Mine continued to improve its performance metrics with highest ever ore production of 1.39 million tonnes as compared to 1.25 million tonnes in the year 2021-22. Presently, the mine is accessed via decline and two shafts. As RDM ore body also allows for multiple production centres, the mine is poised to produce at the capacity of 2 million tonnes per annum of ore in future with new level of mechanisation & automation. Mine has achieved highest truck filling hours and exploration drilling resulting in its readiness for expansion. Rajpura Dariba mine upgrade the Mill from 0.9 to 1.1 Mtpa capacity, through crusher house upgradation. As on 31.03.2023, Rajpura Dariba mine have total ore reserve of 34.3 million tonnes with Zn grade of 5.4% and Pb grade of 1.6%.

Rampura Agucha mine is located at 230 km north of Udaipur in Bhilwara district, Rajasthan and it was commissioned in 1991. It has high zinc-lead reserve grades averaging 15.4%. In 2022-23, the production of ore was carried out by underground mining at 4.8 million tonnes as compared to 4.51 million tonnes in the year 2021-22. Until 2017-18 the production of ore from the mine was by surface mining and the mine has been fully transformed into an underground mine. Two ventilation shafts (North and South) each with diameter of 7.5 m and 450 m depth are in operation. The main hoisting shaft of 7.5 m diameter has been sunk and furnished to its final depth of 950 m and winders, skip loading & surface conveyors have been installed, while off-shaft development activities to commision underground crushing and conveying system are under progress. It improved the shaft hoisting capacity from 6,000 tpd to 7,500 tpd during the year 2022-23. Further actions are in progress to reach 10,000 tpd capacity. Paste-Fill plant has been established in the mine area. Underhand stoping method has been adopted which will use mine tailings to fill stopes after ore extraction. As on 31.03.2023, Rampura Agucha mine have total ore reserve of 44.8 million tonnes with Zn grade of 11.2% and Pb grade of 1.3%.

Sindesar Khurd mine is located at 6 km NNE of Rajpura Dariba mine and 82 km north-east of Udaipur. It is an underground mine, commissioned in 2006. The mine lies on the same geological belt as the Rajpura Dariba mine. Sindesar Khurd has access to the mine through inclined ramps and underground shaft. Mining method is blast hole stoping with back filling. During the year 2022-23, Sindesar Khurd mine reported highest ever ore production of 5.6 million tonnes as compared to 5.23 million tonnes in the year 2021-22. As on 31.03.2023, Sindesar Khurd mine have total ore reserve of 43.4 million tonnes with Zn grade of 3% and Pb grade of 2%.

Kayad mine is a newly developed underground mine near Ajmer, Rajasthan. It started operations in 2011 and commenced ore production from FY 2012-13. In Kayad mine, 21 tonnes capacity of LHD and 65 tonnes capacity of LPDT are used to produce the ore. The mine has access through a single decline from surface portal to the top of the ore body and split in two declines 75 meters below surface. Longitudinal Long-Hole Open Stoping method is used for the steeper and thinner portion of ore body and Transverse Long-Hole Open Stoping method for flatty dipping and thick portion of the ore body. In the year 2022-23, the Kayad mine produced 0.66 million tonnes ore as compared to 0.93 million tonnes in the year 2021-22. The ore from Kayad mine is treated at Rampura Agucha's beneficiation plant. As on 31.03.2023, Kayad mine have total ore reserve of 1.5 million tonnes with Zn grade of 5.2% and Pb grade of 0.9%.

SMELTING

Primary lead was produced entirely by HZL which operated smelter at Chanderiya and Dariba having capacity of 90,000 tonnes and 1,20,000 tonnes per annum of lead metal, respectively. Thus, the smelting capacity for lead (primary) in the country presently is 2,10,000 tonnes per annum. Company-wise smelting capacity of lead and zinc smelters is furnished in Table-16.

Table – 16: Company-wise Capacity and Production of Primary Lead and Zinc

(By Sector/State/Districts)

(Quantity in tonnes)

Company	Lead Capacity (tpy)	Production		Zinc Capacity (tpy)	Production	
		2021-22	2022-23(P)		2021-22	2022-23 (P)
Hindustan Zinc Ltd	210000	191185	210690	913000	775808	820899
Edayar Zinc ltd	–	–	–	38000	–	–
Total	210000	191185	210690	951000	775808	820899

(P): Provisional

The smelting capacity of HZL for zinc is distributed between three smelters at Debari (88,000 tonnes), Chanderiya (5,85,000 tonnes) and Dariba (2,40,000 tonnes). Edayar Zinc Ltd's plant at Binanipuram (Aluva), Kerala, has capacity of 38,000 tonnes per annum. Thus, the smelting capacity for zinc in the country is 9,51,000 tonnes per annum. EZL produced zinc from imported concentrates but since the Company has been declared as sick unit, it did not operate its plant. Besides lead & zinc capacities, HZL has capacities to produce 800 tonnes per annum of silver. HZL is India's largest manufacturer of sulphuric acid which is by-product of its smelting operations.

Edayar Zinc Ltd (EZL) has been incurring huge fixed costs due to shutdown of the plant from April, 2014 onwards, except for a brief period of 59 days when the plant operated. The company entered into a One Time Settlement (OTS) with the Lenders and payments are being made under the sanctioned OTS. Due to Covid-19 and consequent lockdown, Company sought extension of time for payment under the settlement. Settlement with the statutory authorities and Government agencies is underway. The Company is hopeful that Lenders, Creditors and Authorities will take a measured stand to safeguard interest of all stakeholders.

Chanderiya lead-zinc smelting complex is located at 110 km North of Udaipur in Chittorgarh district, Rajasthan. It was commissioned in 1991 with an initial production capacity of 70,000 tonnes per annum. Chanderiya lead-zinc smelting complex comprises one zinc Pyro-metallurgical smelter having production capacity of 1,05,000 tonnes zinc, one lead Pyrometallurgical smelter having production capacity of 90,000 tonnes lead and one Hydro-metallurgical zinc smelter having production capacity of 4,80,000 tonnes zinc. It employs Roast-Leach Electro-winning technology in its Hydro-metallurgical smelters, Imperial Smelting process in lead-zinc smelter and Top Submerged Lance Technology (Designed by M/s Ausmelt Ltd, Australia) coupled with Cansolv Technology for its lead smelter. In the year 2022-23, Chanderia lead-zinc smelter produced 503821 tonnes of zinc and 94,989 tonnes of lead.

Zinc fuming is a process that recovers valuable metals from zinc residue and will help in higher recovery of zinc, lead and silver. At the Hydro plant, Hydro-2 cell house was upgraded from 192 kA to 200 kA for enhancing zinc output.

Zinc Smelter Debari was commissioned in the year 1968 with an initial production capacity of 18,000 tonnes per annum of zinc. The present capacity has now reached 88,000 tonnes per annum of zinc. It is located at about 13 km north of Udaipur, Rajasthan. Zinc smelter Debari employs Roast-leach Electro-winning Technology at its Hydro-metallurgical zinc smelter. The plant has three roasting facilities, leaching & purification section, electrolysis, melting and casting sections. It produced surplus calcine, an intermediate product, which is supplied to the rest of the Hydro-metallurgical zinc smelter. In the year 2022-23, Zinc Smelter Debari produced 82,517 tonnes of zinc.

Dariba smelting complex is located at 75 km north-east of Udaipur near to Rajpura Dariba mine and 7 km from Sindesar Khurd mine in Rajsamand district, Rajasthan. The zinc smelter at Dariba was commissioned in March 2010 and has a capacity of 2,40,000 tonnes per annum while lead smelter was commissioned in July, 2011 and has a capacity of 1,20,000 tonnes per annum. Dariba smelting complex employs Roast-Leach Electro-winning technology at its Hydro-metallurgical zinc smelter. The plant has two roasting facilities, a leaching & purification section and a cell house. The lead smelter employs SKS bottom blowing technology. The plant consists of SKS furnace–bottom blowing, blast furnace, electric arc furnace & fuming furnace and electro-refining. Fuming furnace is also installed to produce zinc oxide from blast furnace slag. In the year 2022-23, the smelter produced 2,34,000 tonnes of zinc and 1,12,000 tonnes of lead metal. Dariba Smelting Complex lead plant steam was utilised in Dariba Smelting Complex Captive Power Plant (CPP) for reducing the auxiliary steam consumption.

The product range of HZL constitutes two grades, namely, Special High Grade (SHG) zinc containing 99.995% Zn (min.) and Prime Western (PW) containing 98.65% Zn (min.). Both these products are available in the form of slabs weighing 25 kg, SHG Jumbo weighing 1,000 kg and PW Jumbo weighing 600 kg. Lead is available as HZL Grade containing 99.99% Pb (min.) in the form of slab weighing 24 kg. In October, 2016, a new zinc alloy value-added product, HZDA or Hindustan Zinc Die-cast Alloy was added to the Company's portfolio from Chanderiya Lead-Zinc Smelter. HZL produce refined silver; recovered as a by-product of zinc-lead facility, it has high quality silver bullion having a minimum purity 99.9% of silver is listed on LBMA Good delivered List (LGD) and supply silver in the form of Standard 30 kg bars, 1 kg bars and silver powder. HZL also produce 98% concentrated sulphuric acid at production facilities in Chanderia, Debari and Dariba in the state of Rajasthan.

RECYCLING OF LEAD & ZINC

Lead

The storage battery scrap is the main source of secondary lead production. Lead is one of the highest recycled metals. It can be re-melted any number of times, and provided enough processes to remove impurities. The final product (termed secondary lead) is indistinguishable from primary lead produced from ore. The amount of lead recycled is about 75% of the total lead production in India. More than 80% of lead consumed in the country goes for manufacturing of lead batteries.

The Government of India enacted Battery Waste Management Rules, 2022 and issued Gazette Notification No. S.O. 3984(E) dated 22nd August, 2022 to organise the recycling of lead acid batteries and to make available raw material to the lead reproducers. The said Rules are in supersession of the Batteries (Management and Handling) Rules, 2001, published vide number S.O.1035(E) dated 16th May 2001. The said Rules shall apply to Producer, dealer, consumer, entities involved in collection, segregation, transportation, re-furbishment, recycling of Waste Battery and all types of batteries regardless of chemistry, shape, volume, weight, material composition and use, except battery used in equipment connected with the protection of the essential security interests including arms, ammunitions, war material, those intended specifically for military purposes and equipment designed to be sent into space. At present, 672 units are registered as lead recycling units with CPCB for processing used lead batteries with the production capacity of 3.53 million tonnes per annum in India. CPCB has also developed online web-based application "Batteries (Importer) Registration Management" for registration /renewal of registration for import of new lead acid batteries.

Lead when used as metal in batteries, cable sheathing and sheathing for containing radiation is fully recyclable and it does not lose its properties. There is indeed a thriving industry that recycles lead in the country. However, due to the health risk involved in lead recycling the Central Pollution Control Board issues licences to the lead-reprocessors to ensure adherence to environmental norms.

Zinc

The largest consumer of zinc is the Galvanising Industry. The zinc once used for galvanising as well as for brass making is not recoverable. Hence, the quantum of zinc recycling is comparatively small as compared to lead recycling. The secondary zinc was recovered from pure zinc scrap in the form of sheet cutting, zinc roofings, old zinc anodes and alloys containing zinc as a major constituent.

USES & CONSUMPTION

Consumption of lead and zinc in various industries is not available readily. However, it is known that lead and zinc are consumed in the form of metals as well as in the form of compounds and oxides.

Lead

The Battery Industry consumes about 80% of lead and remaining 20% is consumed in pigments & compounds, rolled & extruded products, alloys, cable sheathing and other industries.

The apparent consumption of lead during the year 2021-22 and 2022-23 was calculated on the basis of production of lead (primary) and imports & exports of refined lead (unwrought). The apparent consumption thus arrived at was 83012 tonnes in 2021-22 and 144361 tonnes in 2022-23 (Table-17). In addition to this, it is understood that large quantities of recycled lead were also consumed in certain other industries.

Table - 17: Apparent consumption of Lead (Based on the Production of Lead (Primary) and Import & Export of refined Lead, Unwrought)

(In tonnes)

Item	2021-22	2022-23
Total Production Lead (Primary)	**191185**	**210690**
Total Import*	51810	63422
Total Export*	159983	129751
Apparent Consumption (Primary)	83012	144361

** DGCI & S, Kolkata*

Zinc

Owing to its corrosion resistance in varied types of environment, zinc is used for protecting steel by way of galvanising. The Galvanising Industry alone consumes about 57% of zinc, followed by coatings (16%), die-casting alloys (14%), oxides & chemicals (7%) and extruded products (6%).

The apparent consumption of zinc during the year 2021-22 and 2022-23 was calculated on the basis of production of zinc, import & export of zinc (not alloyed). The apparent consumption, thus arrived at was 594808 tonnes in 2021-22 and 607075 tonnes in 2022-23 (Table-18). The data on trade of zinc (not-alloyed) was taken from DGCI&S (HS Code 79011100). In addition to this, some quantities of recycled zinc are also consumed in certain other industries.

Table - 18: Apparent Consumption of Zinc (Based on the Production of Zinc (Ingots) and Import & Export of Zinc (not alloyed)

(In tonnes)

Item	2021-22	2022-23
Total Production Zinc	**775808**	**820899**
Total Import*	86,667	120,269
Total Export*	267,667	334,093
Apparent Consumption	594,808	607,075

** DGCI & S, Kolkata*

SUBSTITUTES & TECHNICAL POSSIBILITIES

Lead

Battery replacements include batteries of nickel-zinc, zinc lithium chloride, sulphide or nickel lithium hydride. The large-scale commercial use of any of these four possible substitutes was so far precluded by cost and operating problems. Polyethylene and other materials work as substitute in some cable applications.

In construction applications, in place of galvanised sheets, copper and aluminium are alternatives. In corrosive chemical environment, stainless steel, titanium, plastics and cements are substitutes. Tin, glass, plastics and aluminium are alternatives in tubes and containers; iron & steel or bismuth in shots for ammunition; and tin in solder. In Electronic Industry, there has been a move towards lead-free solders with varying compositions of tin, bismuth, silver and copper.

Environmental concerns for lead are limiting the uses, particularly in gasoline, where its use as an anti-knocking agent was phased out by the introduction of catalytic converters. Storage batteries for industrial load levelling, mains power management and electric vehicles have growing markets. The continued search for weight reduction is reducing the amount of lead per battery, and battery lives are being extended. Possible new developments include the use of lead as an anti-oxidant in asphalt, as a shielding material in nuclear waste, in protection of buildings against radon gases and as a sound buffer. Environmental legislation will inhibit the growth of new uses and possibly eliminate lead from many existing uses. The Organisation for Economic Cooperation & Development (OECD) is actively examining possible restrictions on uses of lead. New techniques to recover lead from concentrates and from scrap are being developed and are bound to become more important in future. Recycling of lead and zinc through environmentally safe processes needs to be encouraged as the growing use of lead and zinc in railway electrification as well as in road transport vehicles have created shortage of these metals in the country.

Zinc

Aluminium, magnesium and plastic compete in some die-casting applications. Ceramic and plastic coatings, electroplated cadmium & aluminium and special steel compete in some galvanising applications. Aluminium, magnesium and titanium can replace zinc in chemicals and pigments. Zirconium is an alternative in ceramic and enamel applications. New alloys, e.g. superplastic alloys of zinc and aluminium could be developed. Many elements are substitutes for zinc in chemical, electronic and pigment uses.

WORLD REVIEW

Reserve

Lead

The world's reserves of lead were estimated at 85 million tonnes in terms of lead content. Australia possesses 43% of the world's reserves followed by China (14%), Russia & Mexico (7% each), Peru (6%), USA (5%) and India (3%) (Table- 19).

Table - 19: World Reserve of Lead

(By Principal Countries)

(In '000 tonnes of lead content)

Country	Reserves
World: Total (rounded off)	**85000**
Australia[(a)]	37000
China	12000
Russia	6000
Mexico	5600
Peru	5300
USA	4600
India*	2500
Iran	2000
Sweden	1700
Bolivia	1600
Turkey	860
Tajikistan	NA
Other countries	5900

Source: USGS, Mineral Commodity Summaries, 2023
(a) For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 12 million tons.
** India's total reserve/resources of lead & zinc as per National Mineral Inventory based on UNFC as on 01.04.2020 are 766.49 million tonnes.*

(In '000 tonnes of lead content)

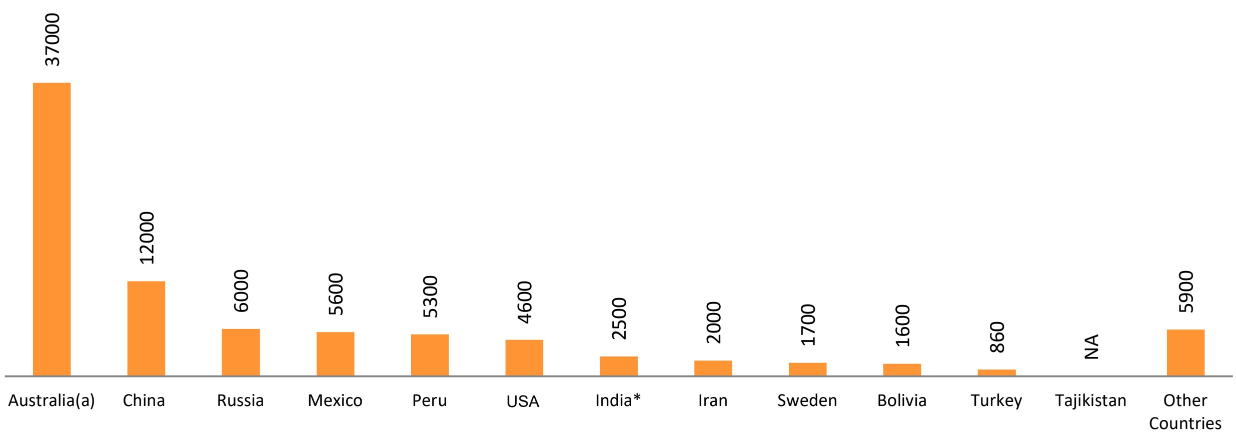


Fig 1: Countrywise Reserves of Lead

Zinc

The world's reserves of zinc were estimated at 210 million tonnes of zinc content. Australia accounts for 31% of world's zinc reserves, followed by China (15%), Russia (10%), Peru (8%), Mexico (6%), India (5%) and Kazakhstan (4%) (Table-20).

Table - 20: World Reserve of Zinc

(By Principal Countries)

(In '000 tonnes of zinc content)

Country	Reserves
World: Total (rounded off)	**210000**
Australia[a]	66000
China	31000
Russia	22000
Peru	17000
Mexico	12000
India*	9600
Kazakhstan	7400
USA	7300
Sweden	4000
Canada	1800
Bolivia	NA
Other countries	30000

Source: USGS, Mineral Commodity Summaries, 2023
(a) For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 23 million tons.
** India's total reserve/resources of lead & zinc as per National Mineral Inventory based on UNFC as on 01.04.2020 are 766.49 million tonnes.*

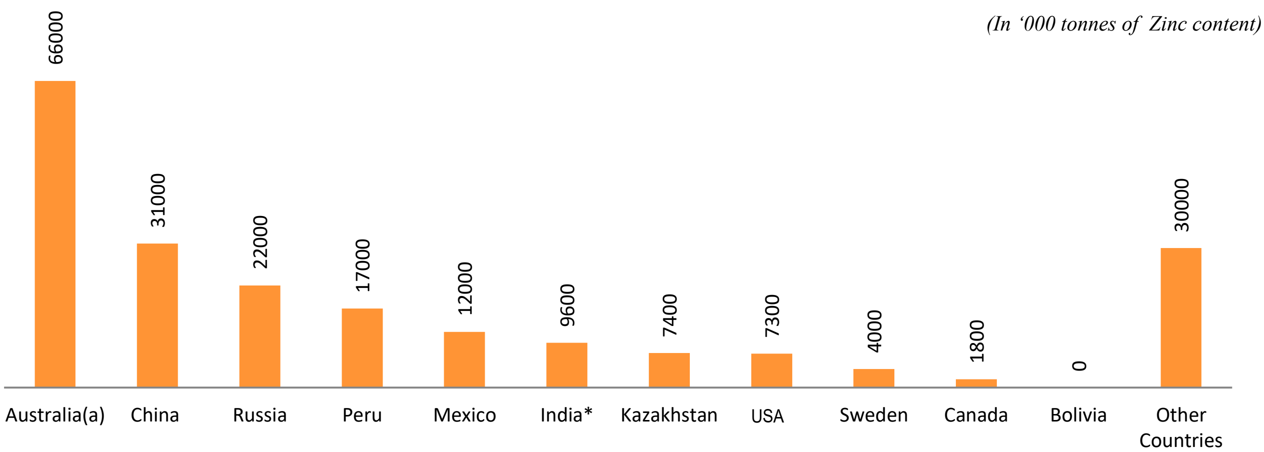


Fig 2: Countrywise Reserves of Zinc

PRODUCTION

Lead

World mine production of lead in terms of metal content was about 4.48 million tonnes in the year 2022 which is 2.61% less as compared to 4.60 million tonnes in the previous year. China is foremost amongst producing countries with about 1.94 million tonnes (43%) followed by Australia (10%), Mexico, USA & Peru (6% each), Russia & India (5%) (Table-21).

Table - 21: World Mine Production of Lead

(By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
World: Total (Rounded off)	**4516436**	**4606168**	4485555
China	1970000	1964400	1945900
Australia	494271	485487	437825
Mexico	260400	272200	272100
USA	297000	286000	264000

Table- 21 (Concld.)

(In tonnes of metal content)

Country	2020	2021	2022
Peru	241548	264427	255333
Russia	200700 *	212300 *	220000
India#	217787(c)	212654 (c)	213320
Bolivia	64619	92767	89761
Turkey	81500 *	93700 *	81700
Sweden	65402	65404	70339
Other countries	623209	656829	635277

Source: BGS, World Minerals Production, 2018-22
**) Estimate*
c) Years ended 31 March following that stated
#) India's production of primary lead in 2019-20, 2020-21 and 2021-22 was 217 thousand tonnes, 212 thousand tonnes and 213 thousand tonnes respectively.

Zinc

World mine production of zinc ore was at 12.60 million tonnes in terms of zinc content in the year 2022 which was decreased by 18.64% from 15.50 million tonnes in the year 2021. China is at top position with 4.04 million tonnes (32%) followed by Peru (11%), Australia (10%), Mexico & India (7% each), USA (6%) and Bolivia (4%) etc. (Table- 22).

Table - 22: World Mine Production of Zinc

(By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
World: Total (rounded off)	**12734776**	**15499938**	**12610036**
China	4058000	4136000	4041000
Peru	1334570	1533135	1369532
Australia	1314910	1315160	1243715
Mexico	1008252	2542751	877000
India#(b)	756998	1532044	832194
USA	723000	704000	761000
Bolivia	358411	499257	517523
Kazakhstan	341400	318400	315100
Russia	260700*	287900	293000
Sweden	234811	236416	233958
Other countries	2341704	2392854	2126014

Source: BGS, World Minerals Production, 2018-22
**) Estimate*
b) Years ended 31 March following that stated
 # India's production of primary zinc in 2019-20, 2020-21 and 2021-22 was 756 thousand tonnes, 1532 thousand tonnes and 832 thousand tonnes respectively.

FOREIGN TRADE

Lead

Exports

Exports of lead from the country are in the form of ore & concentrates, lead & alloys including scrap, lead waste & scrap, lead unrefined, refined lead unwrought, pig lead, lead & alloys worked and others.

Exports of lead ores and concentrates which were 12 tonnes in 2021-22 increased to 137 tonnes in 2022-23. Iran, U.A.E and Bangladesh are the country which imports lead ores & concentrates from India (Table- 23).

Exports of lead & alloys including scrap decreased by 12% to 2,02,248 tonnes during 2022-23 as compared to 2,29,864 tonnes in the preceding year. Similarly, export of lead and alloys also decreased by 11.96% to 2,02,238 tonnes in 2022-23 as compared to 2,29,727 tonnes in the previous year. Exports of refined lead unwrought also decreased by 18.89% to 2,02,238 tonnes in 2022-23 as compared to 2,29,727 tonnes in the previous year. (Tables- 24).

Table - 23: Export of Lead Ores And Conc.

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**12**	**1595**	**137**	**7521**
Iran	--	--	78	4576
UAE	--	--	54	2255
Bangladesh	12	1290	5	640
Canada	++	45	++	48
New Zealand	--	--	++	2
Sri Lanka	++	198	--	--
South Africa	++	62	--	--

Figure rounded off

Table - 24: Export of Lead & Alloys

(By Items)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All items	**689592**	**121627347**	**606744**	**116257659**
Lead And Alloys :Worked(Bars,Rods,Plates, Etc)	2068	460794	1858	438526
Antimonial Lead	22633	4087251	22852	4426688
Lead And Waste And Scrap	137	18892	10	1558
Lead And Alloys Unwrought Nes	41844	8169395	47776	9994489
Lead Unrefined ,Nes	3199	91080	1	329
Lead: Pig Lead	++	205	--	--
Refined Lead, Unwrought	159983	27714832	129751	23890963
Lead And Alloys Incl. Scrap	229864	40542449	202248	38752553
Lead And Alloys	229727	40523557	202238	38750995
Lead (Scrap)	137	18892	10	1558
Lead and Alloys Total	225448	40056256	269596	49768026

Figure rounded off

Imports

Imports of lead in India are in the form of lead ores & concentrates, lead & alloys including scrap, refined lead/ unwrought, pig lead, refined lead & alloys (bars, rods, plates, etc.), lead unrefined etc.

Imports of lead ores & concentrates increased marginally to 5,558 tonnes in 2022-23 as compared to 5,325 tonnes in 2021-22. Imports were mainly from UAE (31.14%), Sudan (13.31%), Taiwan (12.19%), Morocco (9.78%), Ghana (7.43%), Ethiopia (7.28%) and Singapore (6.90%) (Table-25). The total imports of lead (scrap) increased marginally by 3.29% in 2022-23 to 80,698 tonnes as compared to 78,125 tonnes during 2021-22. Imports of lead and alloys during 2022-23 were 2,69,596 tonnes as compared to 2,25,448 tonnes in 2021-22 (Tables-26).

Table - 25: Import of Lead Ores and Concs.

(By Items)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**5325**	**255224**	**5558**	**294381**
UAE	2033	90006	1731	91371
Morocco	354	22289	544	37934
Sudan	194	7637	740	36195
Taiwan	312	18580	678	35816
Singapore	--	--	384	23786
Ghana	215	8111	413	20466
Ethiopia	--	--	405	13050
Argentina	1418	61012	209	9687

Table- 25 (Concld.)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Oman	--	--	91	5521
Tanzania	141	16407	84	5403
Other Countries	658	31182	279	15152

Figure rounded off

Table - 26: Import of Lead & Alloys

(By Items)

Items	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All items	**523031**	**91156104**	**580170**	**103352643**
Lead (Scrap)	78125	12913604	80698	12941635
Lead And Waste And Scrap Total	78125	12913604	80698	12941635
Lead And Alloys :Worked (Bars,Rods,Plates, etc)	838	208380	188	142452
Lead And Alloys Unwrought Nes	44681	8703426	39137	8242806
Lead Unrefined ,Nes	92646	15812725	107437	18888066
Lead: Pig Lead	3168	548109	2416	428023
Lead And Alloys Total	225448	40056256	269596	49768026
Refined Lead, Unwrought	51810	9125700	63422	11795402
Lead and Alloys incl. Scrap	303573	52969860	350294	62709661
Antimonial Lead	32305	5657916	56996	10271277

Figure rounded off

Zinc

Exports

Exports of zinc are in the form of ores & concentrates, zinc & alloys including scrap and zinc & alloys in the form of bars, rods & plates.

Exports of zinc ores & concentrates increased to 43,877 tonnes in 2022-23 as against 1,762 tonnes in the previous year. Republic of Korea was the main export destination of zinc ores & concentrates and accounted for 96.31% of all the exports of zinc ores & concentrates followed by Vietnam (3.07%) and Iran (0.6%) (Table-27).

Exports of zinc & alloys including scrap during 2022-23 were 3,54,217 tonnes as against 2,83,204 tonnes in the preceding year. Almost entire exports during 2022-23 of zinc (scraps) were nominal. Exports of zinc and alloys including scrap during 2022-23 were 3,54,217 tonnes as compared to 2,83,204 tonnes in 2021-22. Exports of zinc or spelter during 2022-23 were 3,38,705 tonnes as compared to 2,69,725 tonnes in 2021-22 (Table-28).

Table - 27: Export of Zinc Ores And Conc.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1762**	**46757**	**43877**	**182437**
Korea, Rep. of	890	3342	42260	157557
Iran	--	--	265	19790
Vietnam	--	--	1350	5080
USA	++	22	1	4
Canada	--	--	++	4
Australia	--	--	1	2
China	672	20337	--	--
Netherlands	100	12367	--	--
Cuba	100	10689	--	--

Figure rounded off

Table - 28: Export of Zinc & Alloys

(By Items)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All items	**846168**	**223960252**	**1059751**	**317386254**
Zinc And Alloys Incl. Scrap	283204	74950497	354217	106078261
Zinc (Scrap)	4	501	1	245
Zinc And Alloys	283200	74949996	354216	106078016
Zinc And Alloys :Worked (Bars,Rods,Plates, Etc)	7900	2107088	10993	3442426
Zinc And Alloys Nes	2135	1162043	1619	1064013
Zinc Or Spelter	269725	70790127	338705	100723293

Figure rounded off

Imports

Imports of zinc in the country are in the form of zinc ores & concentrates, zinc & alloys including scrap, zinc or spelter and zinc & alloys in the forms of bars, rods, plates, etc.

Imports of zinc ores & concentrates during 2022-23 were at 1,041 tonnes as against 720 tonnes during the previous year. Imports were mainly from Ethiopia (51.10%), U.A.E. (43.9%) and Tanzania (4.99%) (Table-29). Imports of zinc & alloys during 2022-23 were at 1,88,566 tonnes as compared to 1,48,376 tonnes in 2021-22. Imports of zinc (scrap) were 91,406 tonnes during 2022-23 as compared to 79,048 tonnes in 2021-22. Imports of zinc or spelter were at 1,67,705 tonnes in 2022-23 as compared to 1,19,157 tonnes during the previous year (Table-30).

Table - 29: Import of Zinc Ores And Concs.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**720**	**24772**	**1041**	**39415**
UAE	328	14212	457	21303
Ethiopia	240	5031	532	16224
Tanzania	--	--	52	1883
Nigeria	--	--	++	5
Zambia	128	3052	--	--
Mexico	24	2421	--	--
USA	++	56	--	--

Figure rounded off

Table - 30: Import of Zinc & Alloys

(By Items)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All items	**582029**	**132629560**	**735622**	**196643842**
Zinc And Alloys Incl. Scrap	227424	50722547	279972	73134370
Zinc (Scrap)	79048	14135488	91406	18814024
Zinc And Alloys	148376	36587059	188566	54320346
Zinc And Alloys : Worked (Bars,Rods,Plates, etc)	5276	1329629	5082	1644842
Zinc And Alloys Nes	2748	1228041	2891	1320521
Zinc Or Spelter	119157	28626796	167705	47409739

Figure rounded off

FUTURE OUTLOOK

International Lead & Zinc Study Group (ILZSG) forecasted the global demand for refined lead metal to rise by 0.2% to 13.13 million tonnes in 2024 and by 1.9% to 13.39 million tonnes in 2025. After rising by 4.1% in 2023, European lead demand is expected to fall by 1.8% in 2024. In 2025, demand is forecast to recover in Europe and Mexico and continue to rise in India and Vietnam. ILZSG also forecasted that world demand for refined zinc metal would rise by 1.8% to 13.83 million tonnes in 2024 and would further increase by 1.6% to 14.04 million tonnes in 2025. European demand fell by 8.6% in 2023, and this year a further decline of 1% is anticipated. Elsewhere, apparent zinc demand is forecast to rise significantly in India and the Republic of Korea. In 2025, zinc usage is forecast to rise in Europe, India and Vietnam but to fall in the Republic of Korea.

India is likely to witness a substantial growth in the demand for lead batteries given that several sectors, including automotive, telecommunication, railways and defense, are set to expand in the years ahead. As a battery ingredient, lead is increasingly used in inverters, UPS and similar energy storage devices. The zinc mining market in India is expected to reach a projected revenue of US$ 2,819.8 million by 2030. A compound annual growth rate of 1.7% is expected of India zinc mining market from 2023 to 2030. The lead acid battery market in India is expected to reach a projected revenue of US$ 9,594.2 million by 2030. A compound annual growth rate of 8.3% is expected of India lead acid battery market from 2024 to 2030. To meet the demand domestically in view of low production trend and higher imports, recycling can be a good alternative.

As every major national plan sees continuous rise in the power generation capacity of the country, the demand for galvanised transmission tower is also expected to increase along with increasing necessity of erection of mobile towers for which higher investment in infrastructure would have to meet. Railways will also lead in the use of galvanised steel.

20. Lithium

Lithium is an alkaline metal and its symbol is Li. Its atomic number is 3. It is a soft, silvery-white alkali metal. Lithium-bearing minerals are prescribed as Critical and Strategic Minerals in Schedule I Part D of The Mines & Minerals (Development and Regulation) Amendment Act, 2023. Lithium mainly occurs as pegmatitic minerals and it is known to be present in sea water. In air it oxidises to lithium oxide. Lithium carbonate, lithium hydroxide and lithium chloride are produced from brines.

USES

Lithium and its compounds have several industrial applications, including heat-resistant glass and ceramics, lithium grease lubricants, flux additives for iron, steel & aluminium production, lithium metal batteries and lithium-ion batteries. These uses consume more than three-quarters of lithium production. Lithium is mostly used for making lithium-ion batteries for electric cars and mobile devices.

WORLD REVIEW

The world lithium reserves are estimated at 26 million tonnes. Lithium reserves are mainly located in Chile which contributes to the total reserves followed by Australia (24%) and Argentina (10%). Besides, major reserves are also located in China (8%) and USA & Canada (4% each). The world reserves of lithium are provided in Table-1.

The world lithium minerals production was 0.15 million tonnes in 2022 in value of LI content. The Australia dominated the world production by accounting for 50% output which was followed by Chile (27%) and Argentina (7%). The details are furnished in Table-2.

Table-1: World Reserves

(In tonnes of metal content)

Country	Reserves
World total (rounded)	**26000000**
United States	1000000
Argentina	2700000
Australia *	6200000
Brazil	250000
Canada	930000
Chile	9300000
China	2000000
Portugal	60000
Zimbabwe	310000
Other countries	3300000

Source: USGS Mineral Commodity Summaries, 2023

** For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 3.8 million tons.*

Table- 2 : World Production

(In tonnes)

Country	Sub-commodity	2020	2021	2022
Argentina	Carbonate	26846	47917	50000*
	Chloride	7705	6017	6200*
	(Carbonate–Li-content)	5047	9008	9400*
	(Chloride–Li-content)	1256	981	1011*
Australia	Spodumene	1477240	1966744	2683754
	(Li content)	41126	54754	74716
Bolivia	Carbonate	191	540	617
	(Li content)	36*	102	116*
Brazil	Spodumene	114260	102938	143720
	(Li content)	1888	2634	3652
Chile	Carbonate	114260	150348	201950
	Hydroxide	9030	12129	15763
	(Carbonate–Li-content)	21481	28265	37967
	(Hydroxide–Li-content)	1490	2001	2601
China	(Li content)	13300*	14000*	14000*
Nigeria	Petalite	130*	130*	130*
	(Li content)	2*	2*	2*
Portugal	Lepidolite	23185	18533	19000*
	Li content	161	129	132
Namibia	Lepidolite	0	0	325400
	Li content	0	0	951
USA (c)	(Li content)	4000*	5000*	2700*
Zimbabwe	Petalite	20859	40726	86330
	(Li content)	397	775	1642
World Total	**(Li content)**	**90200**	**117700**	**148900**

Source: BGS, World Mineral Production, 2018-2022.
*(c) : carbonate * : estimate*

FOREIGN TRADE

Exports

In 2022-23, exports of lithium oxide and hydroxide by value increased manifold by 337% to ₹ 117.74 crore from ₹ 26.96 crore in the previous year. Exports were mainly to UAE (47%), Netherlands (31%), and Egypt (9%). In 2022-23, exports of lithium carbonate by value increased manifold to ₹ 78.15 crore from ₹ 10.43 crore in the previous year. Exports were mainly to Russia (49%), China (35%) and Thailand & Vietnam (4% each). In 2022-23, exports of lithium-ion (cell/batteries) by value increased manifold to ₹ 778.49 crore from ₹ 143.18 crore in the previous year. Exports were mainly to Germany (56%), Japan (17%) and Indonesia (8%) (Tables-3 to 5).

Table-3 : Countrywise Export of Lithium Oxide and Hydroxide

(By Countries)

Country	2021-22		2022-23	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
World : Total (Rounded)	**	**269646**	**	**1177440**
Egypt	++	132	20	102743
Kenya	++	918	2	10787
Kuwait	++	29	1	6489
Nepal	7	9692	1	8114
Netherlands	60	57195	63	360199
Qatar	12	22791	7	49813
Saudi Arabia	2	2258	2	12665
Sri Lanka	3	2678	5	30787

Table- 3 (Concld.)

Country	2021-22		2022-23	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
UAE	114	106141	102	554996
UK	++	36	5	259.67
Other Countries	**	77504	**	40587

Figures rounded off
*(++): negligible ** Total quality can not be calculated due to partial coveraage of data*

Table-4: Countrywise Export of Lithium Carbonates

(By Countries)

Country	2021-22		2022-23	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
World : Total (Rounded)	**	**104331**	**	**781494**
Bangladesh	15	7066	5	10081
Belgium	-	-	++	3419
China	0	14	67	273214
Ecuador	9	1024	25	4709
Malaysia	1	5665	1	8435
Russia	-	-	86	382435
Thailand	2	4974	8	31473
USA	11	11981	2	25395
Vietnam	406	38281	281	28314
Other Countries	**	35326	**	14019

Figures rounded off
*(++): negligible ** Total quality can not be calculated due to partial coveraage of data*

Table-5: Countrywise Export of Lithium-ion (Cell/Batteries)

(By Countries)

Country	2021-22		2022-23	
	Qty ('000 t)	Value (₹ '000)	Qty('000 t)	Value (₹ '000)
World : Total (Rounded)	**	**1431757**	**	**7784933**
China	37	21303	666	185084
Germany	293	221572	99	4398239
Hong Kong	37	4006	1886	333901
Indonesia	3	105032	36	611943
Japan	12	577713	35	1296590
Nepal	66	27808	16	38402
Somalia	++	255	1	157237
Thailand	-	-	147	1872
Usa	2	3034	11	1854
Other Countries	**	471034	**	759811

*Figures rounded off   (++): negligible   ** Total quality can not be calculated due to partial coveraage of data*

Imports

In 2022-23 imports of lithium oxide and hydroxide by value increased drastically by 155% to ₹ 552.53 crore from ₹ 216.13 crore in the previous year. Imports were mainly to Belgium (50%) and Russia & UAE (16% each). In 2022- 23, imports of lithium carbonate by value increased by 176 % to ₹ 179.01 crore from ₹ 64.82 crore in the previous year. Imports were mainly to Belgium (53%), USA (18%) and UK (13%). In 2022-23, imports of lithium-ion (cell/battries) by value increased substantially by 69 % to ₹ 23,149 crore from ₹ 13,673 crore in the previous year. Imports were mainly from China (20%), Hong Kong (10%) and Republic of Korea (9%). (Tables-6 to 9)

Table-6 : Countrywise Import of Lithium Oxide and Hydroxide

(By Countries)

Country	2021-22		2022-23	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
World : Total (Rounded)	**	**2161284**	**	**5525301**
Belgium	473	429110	538	2789743
China	149	153028	51	3225
Germany	25	20106	41	101054
Korea Rep. of	-	-	20	69263
Latvia	120	119938	20	87951
Netherlands	-	-	16	90728
Russia	863	845718	186	887619
Singapore	120	202782	60	211448
UAE	267	321497	156	893344
Other Countries	**	69105	**	390926

*Figures rounded off (++): negligible ** Total quality can not be calculated due to partial coveraage of data*

Table-7 : Countrywise Import of Lithium Carbonates

(By Countries)

Country	2021-22		2022-23	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
World : Total (Rounded)	**	**648245**	**	**1790125**
Argentina	40	30557	43	119053
Belgium	510	257388	227	953345
Chile	38	20920	4	23368
Germany	46	27671	23	59083
Ireland	300	12590	200	9976
Netherlands	200	8370	400	17624
Slovenia	10	34677	13	47342
UK	20	12441	40	228993
USA	34	153617	75	331083
Other Countries	**	90014	**	258

*Figures rounded off (++): negligible ** Total quality can not be calculated due to partial coveraage of data*

Table-8 : Countrywise Import of Lithium-ion (Cell/Batteries)

(By Countries)

Country	2021-22		2022-23	
	Qty ('000 t)	Value (₹ '000)	Qty ('000 t)	Value (₹ '000)
World : Total (Rounded)	**	**136731464**	**	**231495104**
China	459552	83473439	637358	45955197
Germany	23	161159	98	417796
Hong Kong	120859	34804408	87791	22171671
Japan	1557	2852389	247	1031779
Korea, Rep. of	21379	5514740	81349	21583253
Singapore	4160	4521563	1671	3105963
Taiwan	921	695054	346	1090830
USA	1361	874402	823	736997
Vietnam	5005	2354456	3950	3202593
Other Countries	**	1479854	**	132199025

Figures rounded off (++): negligible

Table- 9 : Countrywise Import of Lithium Perfluorooctane Sulphonate

(By Countries)

Country	2021-22		2022-23	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
World : Total (Rounded)	-	-	-	249
China	-	-	-	249

Figures rounded off

FUTURE OUTLOOK

There is very high demand of Lithium batteries in mobile and Automotive sector. India is solely depend upon Import to fulfil its demand for Lithium. India could explore for lithium deposits in Australia, Argentina, Chile and Brazil for fulfilling its requirements. Efforts also need to be in place for India to have access to lithium processing technology by entering into bilateral treaty with foreign countries.

21. Molybdenum

Molybdenum (Mo) is a refractory metal used principally as an alloying agent in steel, cast iron &superalloys to enhance strength and resistivity to wear & corrosion. It does not occur in nature in free state. Usually, it is found in chemically combined form with other elements. Molybdenite (MoS_2) is the principal ore of molybdenum. About two-thirds of global molybdenum production is as by-product of copper mining and only about one-third is obtained from primary molybdenum mines. In India, by-product concentrates of molybdenum are produced intermitten tly from uranium ore of Jaduguda mine belonging to Uranium Corporation of India Ltd (UCIL) in Jharkhand. The internal demand for molybdenum and its products is met mostly through imports.

RESERVES/RESOURCES

India though is endowed with rich mineral wealth, there are several critical minerals that it lacks and one of them is molybdenum. In India, molybdenum is associated generally with copper, lead and zinc ores. Rakha copper deposit in Jharkhand contains 45 to 48 ppm molybdenum. Malanjkhand copper deposit in Madhya Pradesh contains 0.04% recoverable molybdenum. Dariba-Rajpura lead-zinc deposit in Rajasthan contains molybdenum besides bismuth, arsenic and cadmium. The multimetal deposit at Umpyrtha in Khasi and Jaintia Hills, Meghalaya, reportedly contains molybdenum in association with copper, lead and tungsten. Molybdenum deposit in Karadikuttam in Madurai district, Tamil Nadu, contains 0.02 to 0.14% recoverable molybdenum.

As per NMI database as on 1.4.2020, based on UNFC System, the resources of molybdenum ore in the country have been estimated at 27.20 million tonnes containing about 16,891 tonnes MoS_2. The above resources of ore are located in Tamil Nadu (17.88 million tonnes), Madhya Pradesh (8 million tonnes) and Karnataka (1.32 million tonnes) (Table-1).

Table1 :Reserves/resources of Molybdenum as on 1.4.2020

(By Grades/States)

Unit : tonne

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total			
Ore	0	27203398	27203398
Contained MoS_2	0	16890.56	16890.56
By States			
Karnataka			
Ore	0	1320900	1320900
Contained MoS_2	0	1718.7	1718.7
Madhya Pradesh			
Ore	0	8000000	8000000
Contained MoS_2	0	5020	5020
Tamil Nadu			
Ore	0	17882498	17882498
Contained MoS_2	0	10151.86	10151.86

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

SUBSTITUTES

There is hardly any substitution for molybdenum in its major application, viz, as an alloying element in steel and cast irons. Owing to the non-availability of molybdenum, there was an apparent need to develop new materials that could be a suitable subsititutevis-a-vis the alloying properties of the metal. Potential substitutes for molybdenum include chromium, vanadium, niobium (columbium) and boron in alloy steels; tungsten in tool steels; graphite, tungsten and tantalum for refractory materials in high temperature electric furnaces and chrome-orange, cadmium-red and organic-orange pigments for molybdenum orange.

USES AND CONSUMPTION

Usually, molybdenum is used in the form of roasted concentrates, oxide or ferro-molybdenum in the Defence industries. The production of ferro- molybdenum increased from 435 tonnes in 2021-22 to 581 tonnes in 2022-23 (Table-2).

Table – 2 : Production of Ferromolybdenum

2018-19 to 2022-23

(In tonnes)

Year	Production
2018-19	1003
2019-20	527
2020-21	428
2021-22(P)	435
2022-23(P)	581

Source: Monthly Statistics of Mineral Production, March, 2023, IBM

Non-ferrous Technology Development Centre at the Defence Metallurgical Research Laboratory, Hyderabad, has a pilot plant for producing molybdenum powder. Institute of Minerals and Materials Technology (formerly RRL), Bhubaneswar, has been undertaking basic research on recovery of molybdenum from spent catalysts.

Moly Metal LLP, a leading manufacturer of Molybdenum alloys ferromolybdenum (FeMo) and molybdenum disulphide (MoS2), commenced production in 2007 at a new manufacturing plant in the Union Territory of Daman. RUBAMIN, a Gujarat-based Company, reportedly has a capacity of 1,500 tonnes per annum sodium molybdate and 800 tonnes per annum ammonium molybdate both of which are derivates of molybdenum.

TRADE POLICY

As per Foreign Trade Policy, 2015-2020, imports and exports of molybdenum ores & concentrates under Exim

Code 2613 and molybdenum & articles thereof under Exim Code 8102 are allowed free, except waste and scrap (under ITC-HS Code No. 8102 9700) which are restricted.

WORLD REVIEW

The world reserves of molybdenum are at 12 million tonnes, located mainly in China (31%), USA (22%), Peru (20%),Canada (11%) and Russia (3%) (Table-3).

Table – 3 : World Reserves of Molybdenum

(By Principal Countries)

(In '000 tonnes of molybdenum content))

Country	Reserves
World: Total (rounded off)	**12000**
China	3700
USA	2700
Peru	2400
Chile	1400
Russia	430
Turkey	360
Armenia	150
Mexico	130
Argentina	100
Canada	72
Other countries	72

Source: USGS, Mineral Commodity Summaries, 2023.

The world mine production of molybdenum in terms of metal content decreased marginally by 1.16% to 2.63 lakh tonnes in 2022 from 2.68 lakh tonnes in 2021. China with 36% production was the main producer of molybdenum in the world followed by Brazil (17%), Chile (12%), USA (16%) and Mexico (7%) (Table-4).

Table-4:World Mine Production of Molybdenum

(By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
World:Total (rounded off)	**288000**	**268000**	**263000**
China	96000	95300	*95000
Brazil	59319	49403	45551
USA	51100	41100	42000
Chile	32185	34148	31588
Mexico	20577	19894	19330
Armenia	12691	11310	11390
Iran(a)	6762	6700	*6700
Mongolia	2889	2973	2780
Kazakhstan	400	396	2679
Russia	1707	*2000	*1700
Other countries	2893	3470	2593

Source: BGS World Mineral Production, 2018-22,
(a) years ended 20th March following that stated.

FOREIGN TRADE

Exports

Exports of molybdenum ores & concentrates was 60 tonnes in 2022-23 from negligible in 2021-22. Exports were mainly to Republic of Korea (Table-5).

Table – 5 : Exports of Molybdenum Ores & Conc.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**120**	**60**	**223955**
Korea, Rep of	--	--	60	223768
USA	--	--	++	173
Mexico	++	90	++	10
Indonesia	--	--	++	4
South Africa	++	21	--	--
Austria	++	9	--	--

Imports

Imports of molybdenum ores &concentrates increased by 14% to 10436 tonnes in 2022-23 from 9114 tonnes in 2021-22. Imports were mainly from Chile (42%) , Thailand (26%), UAE (6%), and Netherlands (7%) (Table-6).

Table – 6 : Imports of Molybdenum Ores and Conc.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**9114**	**15470962**	**10436**	**23316669**
Chile	4376	6700724	4259	9596166
Thailand	1330	2677220	2791	6167116
UAE	1114	1999829	625	1821013
USA	877	1327059	741	1475082
Korea, Rep of	172	415532	515	943227
Switzerland	53	138738	239	931880
Netherlands	734	1370753	263	579702
China	210	430143	241	549414
Belgium	--	--	180	366131
Luxembourg	138	259116	120	298445
Other Countries	110	151848	462	588493
Other countries	393	296153	38	66429

Figures rounded off

FUTURE OUTLOOK

The principal uses for molybdenum are expected to continue to be as catalysts in chemicals and as an additive in steel manufacturing, most importantly alloy and stainless steel. Molybdenum plays a vital role in the Energy Industry, and it may become an increasingly important factor in environmental protection technology, where it is used in high-strength steels for automobiles to reduce weight and improve fuel economy and safety. Molybdenum-based catalysts have a number of important applications in the Petroleum and Plastics industries. A major use is in the hydrodesulfurisation of petroleum, petrochemicals, and coal-derived liquids. Catalysts are estimated to account for more than 70% of chemical uses of molybdenum. Molybdenum not only allows for economical fuel refining, it also contributes to a safer environment through lower sulphur emissions. Analysts expect global demand for molybdenum-based catalysts to continue its increasing trend as there are no practical alternatives to molybdenum in many of the catalytic applications. The need for companies to reduce carbon dioxide emissions from coal-fired power stations will require plants to run at higher temperatures, resulting in greater demand for higher grade molybdenum-bearing steels. Increase in molybdenum use is expected to continue in stainless steels and full alloy steels mainly in the consumer product and transportation industries.

According to the International Molybdenum Association 2021/2022, SMR predicts that over the next 10 years the chemical processing industry and the oil and gas industry will be significant growth areas for molybdenum demand. Transport vehicle production with stainless steel bipolar plates (BPP)containing 2% moly is forecasted to be the main technology in the future for hydrogen fuel cells. While these will be used in electric vehicles and buses, the main demand is expected to be in the truck sector.

There are many exciting opportunities on the horizon which are likely to lead to an increase in demand for molybdenum, for example, molybdenum alloying is particularly valuable to special steels used in wind power generation. Due to the growth of the sector and the increasing size and power output of wind turbines, such special steels are reaching high tonnages. The potential molybdenum use, based on likely wind power capacity scenarios, is estimated to amount to 300,000 metric tonnes by 2050.

22. Nickel

Nickel is a lustrous, silvery-white metal. Nickel is fifth most common element of earth's crust. Nickel does not occur in native state. Pure nickel is obtained by reduction of its oxides or by the Mond process which consists of the formation of volatile nickel carbonyl produced by passing carbon monoxide over heated nickel oxide, and the dissociation of this compound data higher temperature into nickel and carbon monoxide, which can be used again. It has a melting point of 1,453 °C, relatively low thermal & electrical conductivities, high resistance to corrosion & oxidation, excellent strength & toughness at high temperatures and capable of getting magnetized. It is attractive and very durable as a pure metal and alloys readily with other metals.

Nickel is not produced from primary sources in the country and the entire demand is met through imports. However, aided by latest technology HCL is carrying out recovery of nickel, copper and Sulphuric acid from the spent electrolyte (waste stream) of ICC refinery at Ghatsila, Jharkhand.

OCCURRENCES AND RESERVES & RESOURCES

Nickel occurs princi pally as oxides, sulphides and silicates in India. Important occurrence is nickeliferous limonite in the overburden of chromite in Sukinda Valley, Jaipur district, Odisha. In addition, nickel is found associated with uranium deposits at Jaduguda, Jharkhand and a processing being developed for its recovery. Resources are spread over in Singhbhum East district of Jharkhand and Jajpur, Keonjhar & Mayurbhanj districts of Odisha.

As per NMI database as on 1.4.2020, based on UNFC, Resources of nickel are estimated at 189 million tonnes. The entire resources fall under Remaining Resources category. The State of Odisha is endowed with the largest share of resources of nickel ore in the country at 175 million tonnes (93%) followed by Jharkhand and Nagaland. These resources are mainly occurred in three districts, namely as Jajpur (140 million tonnes), Mayurbhanj (27 million tonnes) and Keonjhar (8 million tonnes). Jharkhand has 9 million tonnes (5%) resources most of which are in Singhbhum (East) district. Nagaland has 5 million tonnes (3%) resources which predominantly are in Kiphire district (Table-1).

Table –1: Reserves/Resources of Nickel Ore as on 1.4.2020

(By Grades/States)

(In million tonnes)

Grade/State	Reserves (A)	Remaining Resources (B)	Total Resources (A+B)
All India : Total			
By Grades		**189**	**189**
+ 0.9% Ni	_	42	42
0.5 to 0.9% Ni	_	94	94
(+) 0.5% Ni, unclassified	_	53	53
Not-known	_	0.23	0.23
By States			
Jharkhand	_	9	9
Karnataka	_	0.23	0.23
Nagaland	_	5	5
Odisha	_	175	175

Figures rounded off

MINING LEASE & PRODUCTION

Vedanta, one of the world's largest natural resources conglomerates has acquired Nicomet, a leading Nickel and Cobalt producer based in Goa. With this acquisition, Vedanta has become India's sole producer of Nickel. Nicomet has emerged as a certified producer of high-quality battery grade Nickel Sulphate Crystals used for manufacturing of batteries of electric vehicles globally. India's demand for nickel is currently pegged at 45 KTPA which is entirely met through imports. At present, Nicomet's plant has a capacity to produce 7.5 KTPA Nickel & Cobalt. With an ambitious growth plan in place, Vedanta is well poised to meet 50% of the country's total Nickel demand.

Nickel is generally found in association with copper ores. Small deposits are known to exist in Odisha and Jharkhand. India's reserves are relatively modest. Till now no Mining lease of Nickel Ore has been allotted in India.

RESEARCH & DEVELOPMENT

India's first facility to produce nickel, a metal for which the country is completely dependent on imports, has been launched by the Hindustan Copper Limited (HCL) at its Indian Copper Complex (ICC) at Ghatsila in Jharkhand. The new facility "Nickel, Copper and Acid Recovery Plant" is the first facility in India to produce nickel metal of London Metal Exchange (LME) grade from primary resource.

NMDC has submitted application to DMG, Govt. of Odisha for proposal to reserve 8 sq. km area in Jajpur district, Odisha, under Section 17 A (2A) of MM (D&R) Amendment Act, 2015 for prospecting and mining operation of Nickel. CSIR-NML has developed CSIR'first complete and holistic T RL- 4 Process for Extraction and Separation of Nickel and other metals from spent lithium batteries of mixed origin. Considering the need and significance of the problem related to energy materials, CSRI-IMMT has carried out study synthesis of nickel-based alloys by Pyrometallurgy recycling of spent Nickel-Metal hydride (Ni-MH) batteries. Key finding of the study was (a) the recovered nickel and cobalt in the form of alloys (99% pare) could be reused in battery industry. (b) Also, 25% of the nickel requirement in steel making is met from secondary sources, so this alloy can fulfill some of the requirement.

USES & CONSUMPTION

Sectoral uses of nickel metal are in the areas of stainless steel making; catalysis chemical industries, as an electroplating material; heat resistant alloys; alloying element for non-ferrous metals; space, defence & rocket industries; and nickel cadmium batteries. Nickel is used in many specific and recognizable industrial and consumer products including stainless steel, alnico magnets, coinage, for filters & binders, rechargeable batteries, foundry, electric guitar strings, microphone capsules and special alloys. It is also used for plating and as green tint in glass. Nickel is predominantly an alloy metal & its chief use is in the nickel steel & nickel cast iron of which there are many varieties. It is also widely used in many other alloys, such as, nickel bronze & brasses and alloys with copper, chromium, aluminum, lead, cobalt, silver & gold. It is used as catalyst which is key to several important reactions including the hydrogenation of vegetable oils, reforming of hydrocarbons and in the production of fertilizers, pesticides and fungicides.

Nickel sulphate is an important compound used commercially in the country in nickel plating, in dip baths for enamelling, in preparation of nickel compounds and as a catalytic nickel. Nickel based alloys, like stainless steel with higher nickel content are used for more demanding applications, such as, in gas turbines and some chemical plants.

World over about 65% of nickel is used in the manufacturing of stainless steel and 20% in other steel and non-ferrous (including super alloys) components often used for highly specialized industrial, aerospace and military applications. About 9% issued in plating and 6% in other uses, including coins and variety of nickel chemicals.

SUBSTITUTES

Aluminium, coated steels, plain chromium steels and plastics are the common substitutes that could replace stainless steel to a limited extent in many construction and transportation applications. Low-nickel, duplex, or ultra-chromium stainless steels are being substituted for austenitic grades in construction. Nickel-free specialty steels are sometimes used in place of stainless steel within the power-generating, petrochemical and petroleum industries. Titanium alloys or specialty plastics are in use as materials that could substitute nickel metal or nickel-based alloys in applications to resist corrosion in highly corrosive chemical environments. Lithium ion batteries are replacing nickel-metal hydride batteries in many applications.

WORLD REVIEW

The world reserves of nickel are estimated at 100 million tonnes of metal content. Indonesia & Australia (21% each), Brazil (16%), Russia (8%) and New Caledonia (7%) are the major countries having reserves of Nickel. The identified land-based resources averaging approximately 0.5% nickel or more contain at least 300 million tonnes of nickel. About 60% of nickel reserves are in laterite and 40% in sulphide deposits. Extensive nickel resources are also found in manganese crusts and as nodules in the ocean floor (Table-2).

Table –2: World Reserves of Nickel

(By Principal Countries)

(In Metric tonnes of nickel content)

Country Name	Reserves
World: Total (rounded off)	>100000000
Australia[(a)]	21000000
Indonesia	21000000
Brazil	16000000
Russia	7500000
New Caledonia[(b)]	7100000
Philippines	4800000
Canada	2200000
China	2100000
USA [(c)]	370000
Other countries	20000000

Source: USGS, Mineral Commodity Summaries, 2023
(a) For Australia, Joint Ore Reserve Committee - compliant reserves were 9.5million tonnes.
(b) Overseas territory of France. NA- Not Available
(c) Includes reserve data for three projects. An additional three domestic projects a have defined resources but have not yet defined reserves.

In 2022, world mine production of nickel increased considerably to 3.19 million tonnes as compared to 2.71 million tonnes of metal content in the previous year. The chief producers of nickel in the world in 2022 were Indonesia (49%), Philippines (11%), Russia (6%), New Caledonia (6%), Australia (4%), Canada & China (3% each) etc. (Table-3). fig. 1.

Table –3: World Mine Production of Nickel

(By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
Indonesia	767000	1069000	1579000
Philippines	328372	386359	360000
Russia	237300*	190000	220000
New Caledonia	199475	186284	199951
Australia	169344	150876	154378
China	104674	103900	109400
Canada	167243	133581	96757
Brazil	68100	76000	77400

(In tonnes of metal content)

Country	2020	2021	2022
Guatemala	50300	61600	48200
Others Countries	342066	352972	352154
World Total:(round off)	**2434000**	**2711000**	**3197000**

Notes

(*)Estimate

(In tonnes of metal content)

Fig 1: World Mine Production of Nickel

FOREIGN TRADE

Exports

Exports of nickel ores and concentrates were negligible in the current year. However, there were 20 tonnes exports of nickel ores & concentrates in the preceding year. On the other hand, exports of Nickel and Alloys including Scrap increased by 16% as export of quantity 6,885 tonnes in 2022-23 from 5,893 tonnes in the previous year. Exports of Nickel and Alloys were 4,996 tonnes in the year 2022-23. However, exports of Nickel and Alloys was 4,199 tonnes in the preceding year 2021-22. Out of the total Nickel and Alloys including Scrap exported in 2022-23, nickel & alloys were 4996 tonnes, while Nickel Waste & Scrap were 1,889 tonnes. Exports of Nickel and Alloys including Scrap were mainly to Netherlands (18%), UK (14%), Malaysia (7%), Singapore (7%), and Thailand (6%) (Tables-4 & 5)

Table- :4 Export of Nickel Ores And Conc.

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**20**	**5183**	**++**	**++**
Brazil	20	5183	--	--

Table- 5: Export of Nickel And Alloys Incl. Scrap

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**5893**	**9407073**	**6885**	**16097003**
Export of Nickel Waste And Scrap	1694	1303261	1889	2255404
Export of Nickel And Alloys	4199	8103812	4996	13841599

Imports

Imports of nickel ores & concentrates were 20 tonnes in the year 2022-23. Imports of nickel & alloys including scrap were at 48,896 tonnes in 2022-23 which decreased by 5% from that of 51,519 tonnes in the previous year. Out of the total alloys and scrap imported in 2022-23, nickel & alloys were at 45,782 tonnes as compared to 48,437 tonnes in the previous year, while nickel waste & scrap were 3,114 tonnes as compared to 3,082 tonnes in the previous year. Imports of nickel and alloys including scrap in 2022-23 were mainly from China (14%), Netherlands (11%), Norway (9%), UAE (9%) and Japan (8%) (Tables-6 & 7)

Table- 6: Import of Nickel Ores And Concs.

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**106**	**16165**	**20**	**369**
Ethiopia	--	--	20	369
USA	22	9783	--	--
Saudi Arabia	84	6382	--	--

Table- 7: Import of Nickel And Alloys Incl. Scrap

(By Countries)

Item	2021-22(R)		2022-23(P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**51519**	**79427347**	**48896**	**104926707**
Import of Nickel and Alloys: Total	48437	77416339	45782	102235427
Import of Nickel (Scrap)	3082	2011008	3114	2691280

As per Schedule 1of Foreign Trade Policy, ITC (HS), 2022, Import Policy of nickel ores & concentrates (ITC-HS Code no. 2604) and Nickel Waste & Scrap (ITC-HS Code no. 75030010) are allowed free. However, some forms of metal waste & scrap (ITCHS Code No. 75030090) are restricted.

FUTURE OUTLOOK

Primarily World nickel demand is for the production of stainless steel where about 65% nickel is consumed. Nickel accounts for 10 to 20% input cost in stainless steel production depending on the nickel content. The future outlook for nickel depends mainly on the production of stainless steel which is one of the main drivers for nickel produced. Batteries and the ongoing Electric Vehicle revolution could prove to be a transformational event as NCA and NCM, one still predominantly used. However, Li-ion technology is gaining popularity and increasingly getting established as the battery of choice.

Nickel has been under constant demand from the ferro-alloys and alloy/stainless steel industry. Nickel is practically unavailable in the country and the entire quantity of unwrought and other forms of the nickel needs to be imported. Hence, the industry may be encouraged to acquire such assets globally to maintain a steady supply to the industry. Simultaneously, R&D will be pursued to extract Nickel from the lateritic ore overburden available in Sukinda Valley, Odisha.

India will have no option but to depend on imports for this metal till a technology to recover nickel from the overburden of chromite ore in Odisha is established on a commercial scale. The process developed by HCL for the production of primary nickel from waste generated during copper refining will be a breakthrough in the area of nickel production in the country.

India imports as well as exports nickel scrap covered by ISRI code, Aroma, Barly, Dandy, Daunt, Delta, Decov, Depth, Hitch, House, Ideal, Indian, Junto, Lemon, Lemur are covered under HS code 75030010. But there is hardly any data available or reported for recycling and recovery of nickel from scrap. The recycling of nickel-bearing scrap in Organised Sector will be another source for meeting the demand.

23. Platinum and Palladium

Platinum Group of Metals (PGM) is a family of 6 metals–platinum, palladium, rhodium, iridium, osmium and ruthenium. They have similar physical and chemical properties and tend to occur together in the same mineral deposits. These six elements are classified into two groups with reference to the specific gravity of gold (19.2). The elements, Ru, Rh, Pd (sp. gr. 12–12.4) are lighter, while the other three specific gravity elements, Os, Ir and Pt are heavier than gold but within the range of 21.0–21.5. Platinum is an extremely rare metal occurring at a concentration of only 0.005 ppm in earth's crust. Major applications of platinum and palladium are in Automotive Sector for emission control and in chemical and petroleum refining.

RESERVES/RESOURCES

Reserves/Resources of PGM in the country as on 1.4.2020 as per NMI Database, based on UNFC System, are placed at 20.92 tonnes of metal content. By State, Odisha alone accounts for 67% of country's resources of PGE followed by Uttar Pradesh (13%) and Tamil Nadu (8%)

Boula-Nausahi, a 3 km-long belt, 170 km NE of Bhubaneswar, Odisha, is the only proven Platinum Group of Metals (PGM) deposit in the country. Preliminary assessment of PGMs in Sukinda ultramafic field indicated isolated anomalous values in chromite. Platinum values of 2 to 400 ppb and palladium values of 1 to 500 ppb were established on analysis. The limonite cappings over ultramafic rocks showed combined platinum and palladium values between 40 and 290 ppb. In Boula-Nuasahi ultramafic complex, the easternmost chromite band known as Shankar-Ganga load, investigations revealed potential PGM mineralisation. In Sittampudi Complex, Salem district, Tamil Nadu, analysis of chromite bands showed 0.03 to 0.75 ppm Pt and 0.1 to 1.0 ppm Pd, whereas amphibolite samples showed 0.03 to 0.05 ppm Pt and 0.03 to 0.5 ppm Pd. A platinum-rich chromite-ferro-chromite breccia zone stretching to about hundred metres in gabbroic matrix was identified in the southern extension of the already known Boula-Nuasahi area in Kendujhar district, Odisha. In Usgaon area, Southern Goa, PGM samples analysed up to 0.03 ppm Pt and 0.03 to 0.15 ppm Pd. In recent past, occurrences of PGE mineralisation were reported in mafic-ultramafic complex of Shivamogga schist belt in Davanagere district of Karnataka. Three zones having 10 to 830 ppb of platinum and 50 to 1500 ppb of palladium were established (Table-1).

Table – 1: Reserves/Resources of PGM as on 1.4.2020

(By States)

(In tones of metal content)

Grade/State	Reserves (A)	Remaining Resources (B)	Total Resources (A+B)
India	**-**	**20.92**	**20.92**
Karnataka	-	1.5	1.5
Kerala	-	0.18	0.18
Odisha	-	14.2	14.2
Tamil Nadu	-	1.69	1.69
Uttar Pradesh	-	3.35	3.35
Figures rounded off	-		

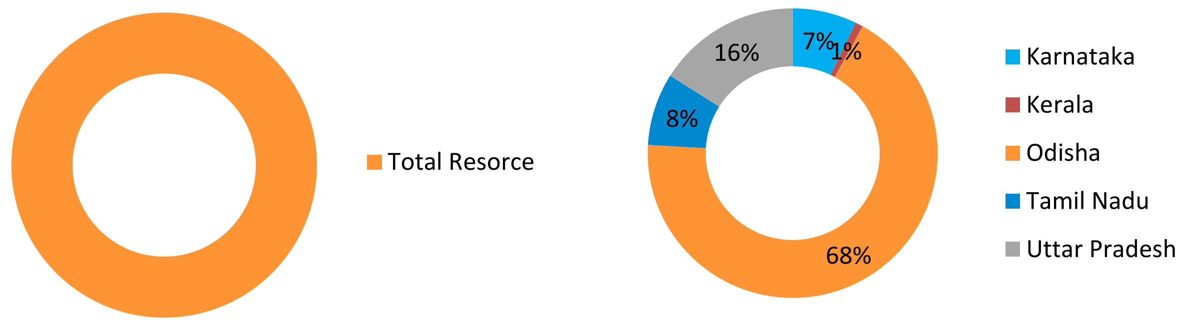


Fig 1: Resources of PGM in India

USES & CONSUMPTION

China and India are moving forward with large-scale plans to reduce the amount of carbon emission in their respective countries. Currently, more than half of platinum and palladium mineral goes into making catalytic converters in automobiles. Automobiles that run on diesel predominantly use platinum for catalytic conversion. Platinum-cured silicones are used to coat and protect automotive air bags from their explosive system. The air bags contain an initiator senser, which uses a fine platinum wire coated with explosive material to facilitate release of the air bag. The chemical inertness and refractory properties of these metals are conducive for their applications in electrical, electronics, dental, medical fields and in the Glass Industry. These metals are also used as catalyst in various chemical processes, viz, in organic synthesis in hydrogenation, de-hydrogenation and isomerisation, production of nitric acid, the raw material for the manufacture of fertilizers, explosives & polymers and fabrication of laboratory equipment.

In addition, platinum, palladium and a variety of complex gold-silver-copper alloys are used as dental restorative materials. The non-corrosive and non-allergic properties of platinum find varied applications in the medical field. Platinum's excellent compatibility with living tissue unaffected by the oxidising reaction of blood, enables its utility in pacemakers.

The primary usage of PGM is in chemotherapy for treatment of cancer. It has the ability to prevent division of certain living cells, a remarkable characteristic which finds profound application in treatment of cancer. Besides, platinum-iridium alloys are extensively used in prosthetics and biomedical devices.

Platinum's excellent conductivity lends itself for use in the electrodes of phosphoric acid fuel cells for generating electricity. Another significant use of platinum and its alloys, in cast or wrought form is in jewellery. Platinum-iridium alloys find major application in making crucibles for growing crystals. Glass made with platinum and rhodium is used in housing construction, flat screen televisions, computer monitors, display panels, automobile displays, factory monitoring equipment, etc. Recently, a new metallic glass featuring micro-alloys of palladium with silicon, germanium, silver, etc. was reportedly developed at University of California. The glass is characterised by strength and toughness. Platinum is used to enhance storage capacity of devices, such as, computer hard discs, cellphones, digital cameras and personal music players. Recently, palladium-silver resistors have been used in secondary lightning surge protection devices. In Electronic Industry, palladium's use is for Multi-Layer Ceramic Capacitors (MLCC). The effect of miniaturisation of MLCC has not reduced the quantum of palladium used as more number of MLCC are required for the same electronic device. Platinum-based fuel cells are proving to be more cost effective, cleaner and more reliable than alternatives, such as, diesel generators.

Rhodium usage is also on the rise in the Automotive Industry apart from fibre glass. Platinum is the catalyst used by fuel cells to convert hydrogen and oxygen to electricity.

Palladium is also likely to play a role in fuel cells.

Platinum acts as an effective and durable catalyst in hydrogen-powered Fuel Cell Electric Vehicles (FCEVs).

PGMs are also used in electronics, chemical manufacturing, jewelry and renewable energy sectors. India relies heavily on imports to meet its PGM needs, as domestic production is negligible. The country's growing focus on reducing emissions and increasing industrial applications is driving up the demand for these metals.

SUBSTITUTES

Platinum and palladium are two of the most expensive metals on the planet. Platinum is currently about 30% more expensive than gold while palladium is about half the cost of gold. It is usually easier to substitute metals of the platinum group for one another, especially in alloys, than to use alternative materials, which is evident from the total dominance of ruthenium-based resistors over the palladium-silver resistors for high-powered applications. Substitutes in electrical use include tungsten, nickel, silver, gold and silicon carbide. Alternative catalysts include nickel, molybdenum, tungsten, chromium, cobalt, vanadium, silver and rare earths. Rhenium, however, has been used most satisfactorily as substitute for platinum as a catalyst in petroleum refining. Stainless steel and ceramics can be substituted where resistance to corrosion is the primary concern. Some motor vehicle manufacturers have substituted platinum by palladium in catalytic converters, especially for petrol engines. Particulate matter and residual sulphur contaminate palladium and hence, it was excluded from catalysts used in diesel vehicles. A new technology now allows up to 25% substitution of platinum in diesel catalytic converters with palladium.

Similarly, manufacturers of electronic parts are also reducing the average palladium content of the conductive pastes used to form the electrodes of multi-layer ceramic capacitors, substituting base metals or silver-palladium pastes which contain significantly less palladium.

Rhenium, tungsten and molybdenum as substitute for platinum in aeromatics hydrogenation catalysts have been investigated. Recently, a new type of iron and carbon-based catalysts has been discovered which is stable and active in both acidic and alkaline media and may even eliminate the need of platinum in catalysts and thus revolutionise the Proton Exchange Membrane Fuel Cell (PEFC) Industry.

WORLD REVIEW

The world reserves of PGM are estimated at 71,000 tonnes concentrated mostly in South Africa (89%) followed by Russia (8%), Zimbabwe (2%) and USA (1%) (Table - 2).

Table – 2 : World Reserves of Platinum Group of Metals

(By Principal Countries)

(In kilograms of PGM content)

Country	Reserves
World: Total (rounded off)	**71000000**
USA	820000
Canada	310000
Russia	5500000
South Africa	63000000
Zimbabwe	1200000
Other countries	NA

Source: USGS.Mineral Commodity Summaries, 2024.

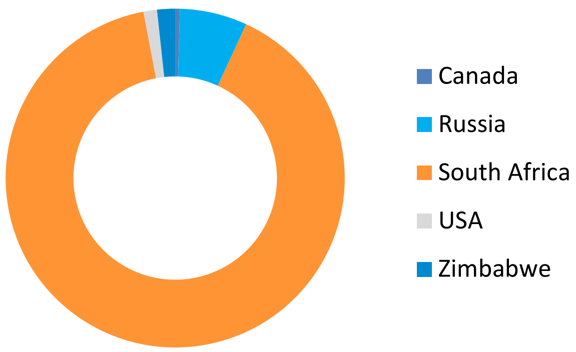


Fig.2 :Country wise Reserves of PGM

World mine production of PGMs decreased slightly by 8% to 437 tonnes of metal content in 2022 from 476 tonnes of metal content in 2021 (Table-3).

South Africa, which accounted for 57% of the total PGM mine production in 2022 was followed by Russia (25%), Zimbabwe (8%), Canada (5%), USA (3%) while other countries contributed the remaining 2 percent.

Table – 3 : World Mine Production of PGMs

(By Principal Countries)

(In kilograms of metal content)

Country	2020	2021	2022
World (Total) (Rounded off)	**420000**	**476000**	**437000**
Russia (Total)	**118800**	**108800**	**109827**
Platinum	23500	21000	20248
Palladium	92300	85000	86779
Iridium	200	200	200
Rhodium	2500	2300	2300
Ruthenium	300	300	300
South Africa (Total)	**226473**	**286687**	**250305**
Platinum	111993	141626	124401
Palladium	66264	84336	73104
Iridium	6186	7006	6100
Rhodium	16972	22256	18800
Ruthenium	25058	31463	27900
Zimbabwe (Total)	**31125**	**30535**	**33799**
Platinum	15004	14732	16460
Palladium	12890	12619	13935
Iridium	837	612	602
Rhodium	1368	1333	1461
Ruthenium	1026	1239	1341
Canada (Total)	**16653**	**20163**	**21866**
Platinum	4037	4888	5301
Palladium	12616	15275	16565
Rhodium	168	204	221
USA (Total)	**19400**	**19400**	**13199**
Platinum	4500	4500	3003
Palladium	14800	14800	10096
Rhodium	100	100	100
China (Total)	**3800**	**6600**	**4100**
Platinum	2500	5300	2800
Palladium	1300	1300	1300
Finland (Total)	**2134**	**2483**	**2203**
Platinum	1276	1447	1243
Palladium	858	1036	960
Australia (Total)	**521**	**470**	**492**
Platinum	107	90	100
Palladium	414	380	392
Other countries	**642**	**924**	**552**
Platinum	444	660	355
Palladium	198	264	197

Source: BGS, World Mineral Production, 2018-2022.
(a) Sales from mine production and stocks.

FOREIGN TRADE

Exports

Exports of platinum alloys and related metals increased by about 11% to 1,328 kg valued at ₹ 76.976 crore in 2022-23 from 1,194 kg valued at ₹ 479.51 crore in the previous year. Exports were mainly to UK (42%) and USA (48%). Exports in 2022-23 comprised of platinum (unwrought) at 1,191 kg and platinum (others) at 123 kg. During 2022-23, exports of other metals of platinum group were 14 kg as compared to 125 kg during the preceding year while that of platinum-powder were negligible for the current and in the previous year (Tables- 4 to 11)

Table – 4: Exports of Platinum Alloys & Related Metals: Total

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**1194**	**4795081**	**1328**	**769761**
Italy	72	333322	95	348990
UK	1047	4338221	551	297016
USA	32	76559	640	86101
France	--	--	3	26720
Japan	1	28189	++	5580
UAE	6	12791	1	2378
Tanzania	--	--	20	1385
Switzerland	--	--	++	920
South Africa	--	--	5	156
Malaysia	++	++	1	107
Other countries	36	5999	12	408

Figures rounded off

(In kg)

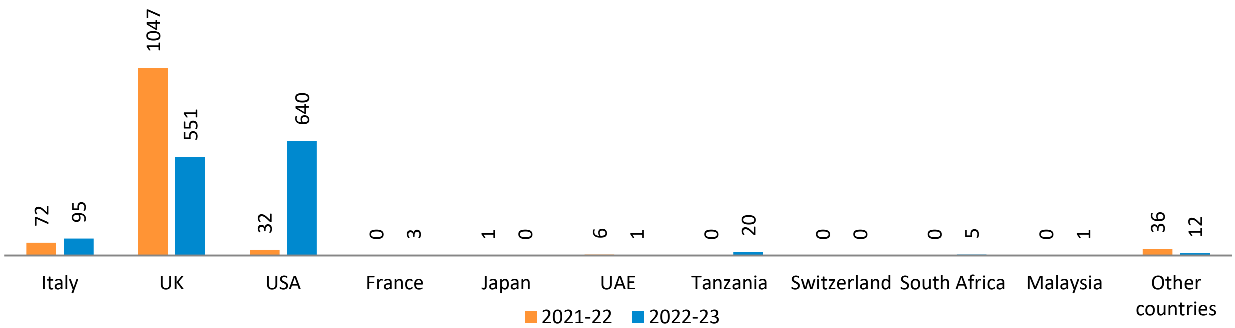


Fig 3: Countrywise Exports of Platinum alloys & Related Metals

Table – 5 : Exports of Platinum (Powder, Unwrought & Others)

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**869**	**917208**	**1191**	**457116**
UK	836	832403	498	294465
USA	31	76264	635	83989
Italy	--	--	31	68778
Japan	++	3103	++	5580
UAE	1	15	1	2378
Tanzania	--	--	20	1385
South Africa	--	--	5	156
Kenya	--	--	++	104
Netherland	1	114	++	90
Canada	--	--	++	79
Other countries	++	5309	1	112

Figures rounded off

Table – 6 : Exports of Platinum (Unwrought)

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**869**	**914077**	**1191**	**451536**
UK	836	832403	498	294465
USA	31	76252	635	83989
Italy	--	--	31	68778
UAE	1	15	1	2378
Tanzania	--	--	20	1385
South Africa	--	--	5	156
Kenya	--	--	++	104
Netherland	1	114	++	90
Canada	--	--	++	79
Korea Rep. of	++	8	1	47
Other countries	++	5285	++	65

Figures rounded off

Table – 7 : Exports of Platinum (Others)

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**200**	**1555483**	**123**	**311710**
Italy	52	249860	64	280212
France	--	--	3	26720
UK	111	1280086	47	2549
USA	1	90	5	2112
Malaysia	++	++	1	105
Netherlands	--	--	++	10
Cambodia	--	--	3	1
Nigeria	--	--	++	1
Japan	1	25086	--	--
Germany	++	212	--	--
Other countries	35	149	--	--

Figures rounded off

Table – 8 : Exports of Platinum (Powder)

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**++**	**3131**	**++**	**5580**
Japan	++	3103	++	5580
Australia	++	16	--	--
USA	++	12	--	--

Figures rounded off

Table – 9 : Exports of Other Metals of Platinum Group

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**125**	**2322390**	**14**	**935**
Switzerland	--	--	++	920
China	--	--	8	13
UK	100	2225732	6	2
Italy	20	83462	--	--
UAE	5	12776	--	--
Israel	++	215	--	--
USA	++	205	--	--

Figures rounded off

Table – 10 : Exports of Platinum-Clad Base/Precious Metal

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**70**	**6**	**3**	**9**
Singapore	--	--	2	8
Canada	--	--	1	1
Mauritius	70	6	--	--

Figures rounded off

Table – 11 : Export of Other Metals of Platinum Group (Iridium, Osmium, Ruthenium etc. unwrought)

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**325**	**3877873**	**137**	**312645**
Italy	72	333322	64	280212
France	--	--	3	26720
UK	211	3505818	53	2551
USA	1	295	5	2112
Switzerland	--	--	++	920
Malaysia	++	++	1	105
China	--	--	8	13
Netherlands	--	--	++	10
Cambodia	--	--	3	1
Nigeria	--	--	++	1
Other countries	41	38438	--	--

Figures rounded off

Imports

Imports of platinum alloys and related metal increased exorbitantly by 228% to 31,498 kg valued at ₹ 12,289 crore during 2022-23 as compared to 9,603 kg valued at ₹ 3,756 crore in the previous year. Imports were mainly from UAE (69%), UK (12%) and USA (5%). Imports in 2022-23 comprised of platinum (powder, unwrought & others) at 25,040 kg, platinum (others) 5,568 kg and other metals of platinum group 890 kg. Imports of other metals of platinum group were mainly from USA (26%), South Africa (25%), UK (23%), Hong Kong (19%) and Germany (5%). During 2022-23, imports of platinum-clad base (precious metals) increased by exorbitantly to 7,665 kg as compared to 178 kg in the previous year. Imports were mainly from China (97%) and Italy & Spain (1% each). During 2022-23, imports of platinum powder were at 266 kg as compared to 530 kg in the preceding year. Imports were mainly from USA (94%) and UK (4%) (Tables- 12 to 19).

Table – 12 : Imports of Platinum Alloys and Related Metals : Total

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**9603**	**37563471**	**31498**	**122892033**
UAE	261	699525	21844	93444553
UK	3549	12116931	3731	16444447
USA	911	4334047	1420	3930061
South Africa	1843	8048617	1142	3432451
Germany	1390	8241153	507	3234980
Italy	649	1439156	615	1367126
Hong Kong	295	330042	420	799514
Czech Republic	145	60747	11	70379
Singapore	46	55340	33	56206
Korea, Rep. of	60	1079	1751	51071
Other countries	454	2236834	24	61245

Figures rounded off

(In kg)

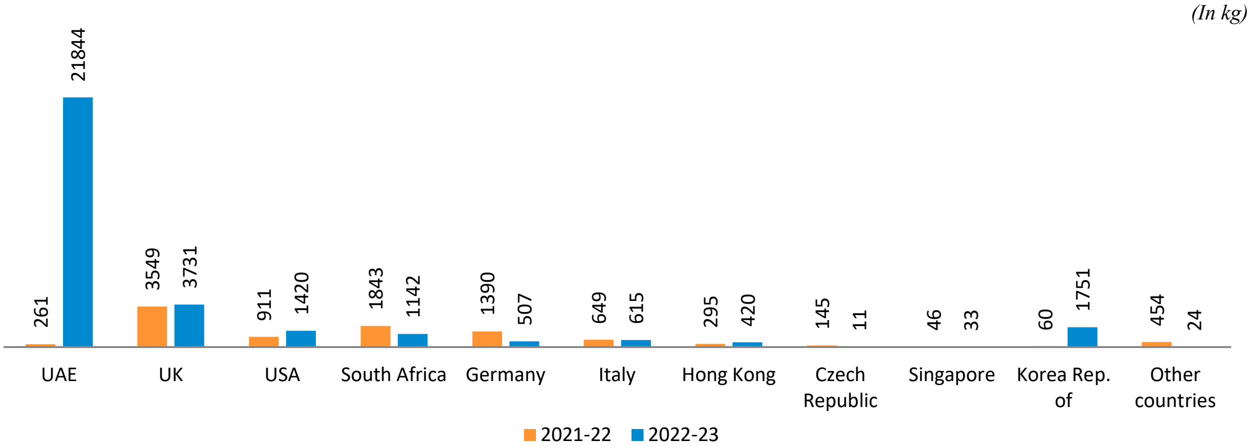


Fig. 4: Imports of Platinum Alloys and Related Metals

Table – 13 : Imports of Platinum (Powder, Unwrought & Others)

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**6020**	**14641574**	**25040**	**101387439**
UAE	261	699525	21829	93400281
UK	2572	6380571	818	2001048
USA	538	1397343	784	1911347
South Africa	1105	2798201	761	1881642
Germany	884	2190021	333	814786
Hong Kong	44	116135	255	631517
Italy	322	781370	225	581833
Czech Republic	145	60747	11	70379
Korea Rep. of	++	929	10	47667
Switzerland	11	25333	10	22115
Other countries	138	191399	4	24824

Figures rounded off

Table – 14: Imports of Platinum–Unwrought

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**5490**	**13309778**	**24774**	**100762587**
UAE	261	699525	21829	93400281
UK	2560	6345842	807	1976662
South Africa	1029	2642518	756	1870556
USA	255	660059	534	1321967
Germany	788	1937685	333	814786
Hong Kong	44	116135	255	631517
Italy	322	781370	225	581833
Czech Republic	145	60747	11	70379
Korea, Rep. of	++	929	10	47667
Switzerland	11	25333	10	22115
Other countries	75	39635	4	24824

Figures rounded off

Table – 15: Imports of Platinum (Others)

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**2371**	**14122761**	**5568**	**15817087**
UK	706	4459397	2710	13379214
Italy	327	657786	390	785293
Germany	389	3148306	130	729875
South Africa	468	3479679	161	650884
USA	114	478295	404	178558
UAE	--	--	10	39899
Singapore	5	24390	15	38444
Spain	--	--	1	6645
Korea, Rep. of	60	150	1741	3404
China	100	566	1	2233
Other countries	202	1874192	5	2638

Figures rounded off

Table – 16 : Imports of Platinum – Powder

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**530**	**1331796**	**266**	**624852**
USA	283	737284	250	589380
UK	12	34729	11	24386
South Africa	76	155683	5	11086
Germany	96	252336	--	--
Russia	40	97722	--	--
Belgium	23	54042	--	--

Figures rounded off

Table – 17: Imports of Other Metals of Platinum Group

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**3583**	**22921897**	**6458**	**21504594**
UK	977	5736360	2913	14443399
Germany	506	6051132	174	2420194
USA	373	2936704	636	2018714
South Africa	738	5250416	381	1550809
Italy	327	657786	390	785293
Hong Kong	251	213907	165	167997
Singapore	45	52860	33	56206
UAE	--	--	15	44272
Spain	--	--	1	6645
China	100	566	4	5281
Other countries	266	2022166	1746	5784

Figures rounded off

Table – 18 : Imports of Platinum - Clad Base / Precious Metal

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**178**	**72575**	**7665**	**17093**
Italy	41	2225	96	7980
Spain	30	4198	40	2442
Belgium	--	--	30	1658
China	--	--	7455	1442
USA	100	64513	12	1214
Germany	--	--	17	1185
Israel	--	--	8	751
Portugal	--	--	7	421
France	2	1316	--	--
Netherlands	5	323	--	--
Other countries	--	--	--	--

Figures rounded off

Table – 19 : Imports of Other Metals of Platinum Group (Iridium, Osmium, Ruthenium etc. unwrought)

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**1212**	**8799136**	**890**	**5687507**
USA	259	2458409	232	1840156
Germany	117	2902826	44	1690319
UK	271	1276963	203	1064185
South Africa	270	1770737	220	899925
Hong Kong	251	213907	165	166979
Singapore	40	28470	18	17762
UAE	--	--	5	4373
China	--	--	3	3048
Japan	--	--	++	714
Belgium	4	147824	++	46
Other countries	--	--	++	++

Figures rounded off

FUTURE OUTLOOK

India is meeting its demand entirely by imports. The demand for PGEs is expected to touch 120 tonnes by 2025, as per the Report of the Sub-group for 12th Plan period. As per PGM Market Report, 2023 of "Johnson Matthey Platinum Group Metals Service" the demand for platinum is expected to rise by nearly 20% in 2023 in industrial and automotive use, including expanded applications in gasoline autocatalysts. This growing demand, alongside increased investment in platinum, will likely lead to a supply deficit. Indian platinum jewellery demand is most likely to expand following successful industry marketing and campaigns to promote the purchase of platinum jewellery sets as wedding gift.

24. Selenium & Tellurium

Selenium and tellurium are rare elements widely distributed within the Earth's crust. They do not occur in concentrations high enough to justify mining solely for their content. They are recovered as by-products, mostly from anodemud or slime obtained during electrolytic refining of copper. Tellurium is found mostly in tellurides associated with metals, such as, bismuth, lead, gold and silver. It is found with selenium in the anode slime from electrolytic copper refineries.

EXTRACTION

Selenium and tellurium metals were being recovered as allied products at Ghatsila Copper Smelter of HCL in Jharkhand, where the annual licensed capacity was 10,000 kg while annual installed capacity to produce selenium was 14,600 kg. HCL has not reported production of selenium since 2006-07 and that of tellurium since 2004-05. HCL has developed its own Precious Metal Recovery Plant at ICC successfully. As per the Annual Report 2022-23 of Hindalco Industries Ltd., in the electrolytic refining step in the copper manufacturing process, anode slime is generated as a by-product including tellurium, selenium. During the copper removal stage in slime leachate, about 50-60% of tellurium in anode slime gets co-dissolved. The remaining tellurium is present in a solid residue, resulting in the loss of this valuable element. At HIC Copper, Hindalco developed a process to recover this tellurium from slime leachate in the form of Copper Telluride (Cu_2Te) powder at its Dahej Smelter in Gujarat.

USES & CONSUMPTION

Selenium

Selenium is used as a decolourising agent in the Glass Industry. Selenium decolorises the green tint caused by iron impurities in glass bottles. Approximately, 1 kg selenium is used for about 150 tonnes of glass production. It is also used in architectural plate glass to reduce solar heat transmission. High purity selenium compounds were used principally as photoreceptors on the drums of older plain paper copiers which are gradually being replaced by newer models that do not use selenium in the reproduction process. Dietary supplement for livestock is the largest agricultural usage of selenium. Also, selenium is known to be added to fertilizer to enrich selenium-poor soils.

Selenium is added to steel, copper and lead alloys to improve machinability which enables faster production with better surface finish and casting properties. Selenium is added to low antimony-lead alloys used in the support grids of lead acid storage batteries. The addition of

0.02% selenium by weight as a grain refiner improves the casting and mechanical properties of alloy. Metallurgical applications of selenium also include its use in the production of Electrolytic Manganese Metal (EMM) as a current efficiency enhancer wherein about 2 kg of SeO_2 is required per tonne of electrolytic manganese metal produced. Due to this high absorption coefficient values, selenium has been found to be useful solar PV material.

Chemical uses of selenium are in industrial and pharmaceutical applications. The principal pharmaceutical use of selenium is in anti-dandruff hair shampoos. Selenium is also used as a human dietary supplement. Other industrial chemical uses are as lubricant, rubber compounding catalysts and as a promoter in the reformation of naptha.

In pigment applications, selenium is used to produce colour changes in cadmium sulphide-based pigments. Sulphoselenide pigments have good heat stability, resistant to light and chemical attack and hence are used in ceramics, plastics, paints, inks and enamels. Selenium is used in catalysts to enhance selective oxidation and in plating solutions to improve appearance and durability. It is also used in blasting caps and gun bluing.

The use of selenium in glass has increased due to higher colourless glass production. The use of selenium in fertilizer and supplements in the plant-animal human chain and as human vitamin supplements increased as its health benefits were documented. The use of selenium in copper-indium-gallium-diselenide (CIGD) solar cell has increased.

Selenium is recovered from used electronic and photocopier components and recycled. The estimated global use of selenium was in metallurgy (40%); glass (25%); agriculture/ chemicals/ pigments/ electronic (10% each); and other industries (5%).

Since, selenium is primarily used in the glass, electronics, and health supplements industries. Its consumption has been relatively stable, with growing interest due to its role in solar energy technologies. India imports most of its selenium, primarily for use in industries like metallurgy and electronics.

Tellurium

Tellurium (Te) element lies on the borderland between metals and non-metals. It is added to nonferrous metals like aluminium, tin, copper and lead to modify certain physical properties, like ductility, hardness, mechinability, toughness, strength and resistance. Tellurium (Te) demonstrates properties similar to those of elements known to be toxic to humans and has application in industrial processes, which is rapidly growing in importance and scale. Tellurium is used principally as an alloying element in the production of free-machining low carbon steel, where additions up to 0.1% tellurium greatly improves machinability. It is also used as a minor additive in copper alloys to improve machinability without reducing conductivity. Tellurium catalysts are used chiefly for the oxidation of organic compounds and also in hydrogenation and halogenation reactions. Tellurium chemicals are used as vulcanising and accelerating agents in processing of rubber compounds. It finds use as a component of catalysts for synthetic fibre production that is increasingly used in cadmium-tellurium-based solar cells. In plain paper copiers and in thermoelectric and photoelectric devices, tellurium is used along with selenium. Mercury-cadmium telluride is used as a sensing material for thermal imaging devices. Tellurium is also used as an ingredient in blasting caps and as a pigment to produce colours in glass and ceramics. High purity tellurium is used in alloys for electronic applications. India's tellurium consumption is modest, with demand linked to the renewable energy sector, which is gradually growing as the country expands its solar energy capacity.

Both minerals i.e Selenium and Tellurium are largely imported since domestic production is minimal, and their consumption trends are closely tied to advancements in technology and renewable energy initiatives in India.

SUBSTITUTES

The use of selenium as an alloy to substitute for lead in plumbing continued to increase in response to requirements of Public Law for safe drinking Water Act Amendment 1996. High-purity silicon has replaced selenium in high-voltage rectifiers and is the major substitute for selenium in low and medium voltage rectifiers and solar photovoltaic cells. Other inorganic semi-conductor materials, such as, silicon, cadmium, tellurium, gallium and arsenic as well as organic photoconductors are the substitutes for selenium in photoelectric applications. Cerium oxide is one substitute of selenium used as a colorant or decolorant in glass. Amorphous silicon and organic photoreceptors are substitutes of selenium in plain paper photocopiers. Sulphur dioxide can be used as a replacement for selenium dioxide in the production of electrolytic manganese metal.

Several materials can replace tellurium in most of its uses, but usually with loss in production efficiency or product characteristics. Bismuth, calcium, lead, phosphorus, selenium and sulphur can be used in place of tellurium in many free-machining steels. Several of the chemical process reactions catalysed by tellurium can be carried out with other catalysts or by means of non-catalytic processes. The chief substitutes for tellurium were selenium and sulphur in rubber compound applications and selenium, germanium and organic compounds in electronic applications.

WORLD REVIEW

Selenium

The world reserves of selenium at 95,000 tonnes or 0.095 million tonnes only cover the estimated selenium contents of copper reserve, with the exception of China. Selenium was obtained as a by-product with copper. Substantial resources also exist in association with other metals and in uneconomic copper deposits. Selenium reserves are mainly found in Russia (27%), Peru (20%), USA (12%), Canada (6%), China (5%) and Poland (3%) (Table-1).

Table – 1 : World Reserves of Selenium

(By Principal Countries)

(In tonnes of Selenium content)

Country	Reserves
World: Total (Rounded off)	95000
USA	11000
Belgium	-
Canada	6000
China	5000
Finland	300
Germany	-
India	500
Japan	-
Peru	19000
Poland	3000
Russia	26000
Sweden	500
Turkey	NA
Other countries	24000

Source: USGS, Mineral Commodity Summaries, 2024.

The world production of refined selenium is furnished in Table-2. The chief producers of selenium in the world in 2022 were China, Japan, Russia, Belgium and Germany. In addition to the countries listed, Mexico, Finland USA and Canada are believed to produce refined selenium. Global selenium and tellurium output cannot be determined easily because not all companies or countries report production and because trade in scrap and semi-refined products may be included with refined metal trade data.

Table – 2: World Production of Selenium, Refined

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
China	1200	1260	1300
Japan	740	750	750
Russia	190	194	350
Belgium	200	200	200
Germany [(a)]	300	200	200
Mexico	106	135	141
Finland	84	100	130
USA	66	112	112
Canada	102	100	110
Other countries	355	328	360

Source: BGS, World Mineral Production, 2018-2022
(a): Includes selenium produced from imported material

(In tonnes of metal content)

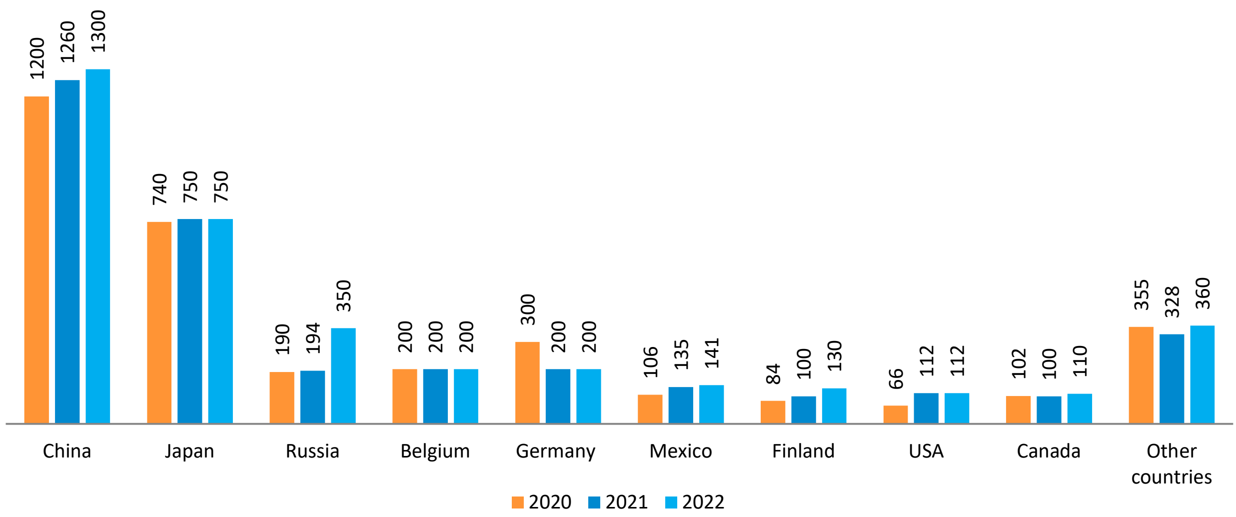


Fig 1: Countrywise Production of Selenium

Tellurium

The world reserves of tellurium were at 36,000 tonnes contained in copper resources. Tellurium reserves are mainly located in Russia (16%), USA (11%) and China (9%). In addition to the countries listed Bulgaria, Canada, Japan, South Africa, Sweden and Uzbekistan. Concentration of tellurium could also be found in lead and gold deposits. The quantity of tellurium in deposits of coal, copper and other metals that are of sub-economic grade are several times the amount of tellurium contained in identified economic copper deposits (Table-3).

Table – 3: World Reserves of Tellurium

(By Principal Countries)

(In tonnes of Tellurium content)

Country	Reserves
World: Total (Rounded off)	**36000**
USA	4000
Bulgaria	NA
Canada	800
China	3100
Japan	-
Russia	5800
South Africa	800
Sweden	700
Uzbekistan	NA
Other countries	21000

Source: USGS, Mineral Commodity Summaries, 2024.

More than 90% of tellurium is produced from anode slimes as a by-product of electrolytic copper refining, and the remainder was derived from skimmings at lead refineries and from flue dusts and gases generated during the smelting of bismuth, copper, and lead-zinc ores. Other potential sources of tellurium include bismuth telluride and gold telluride ores. Thse anode slimes of copper and lead refineries normally contain about 3% tellurium. The chief producers of refined tellurium in the world in 2022 were China, Russia, Japan, Uzbekistan, Sweden, Canada, Bulgaria and USA. These countries together contributed as an estimated 608 tonnes to the world production in 2022 as compared to 578 tonnes produced in 2021 (Table-4).

Table – 4 : World Production of Tellurium, Refined

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
China	330	330	340
Russia	55	56	80
Japan	70	75	75
Uzbekistan	50	48	50
Sweden	42	41	33
Canada	23	25	25
Bulgaria	4	3	3
USA	-	-	2

Source: BGS, World Mineral Production, 2018-2022

(In tonnes

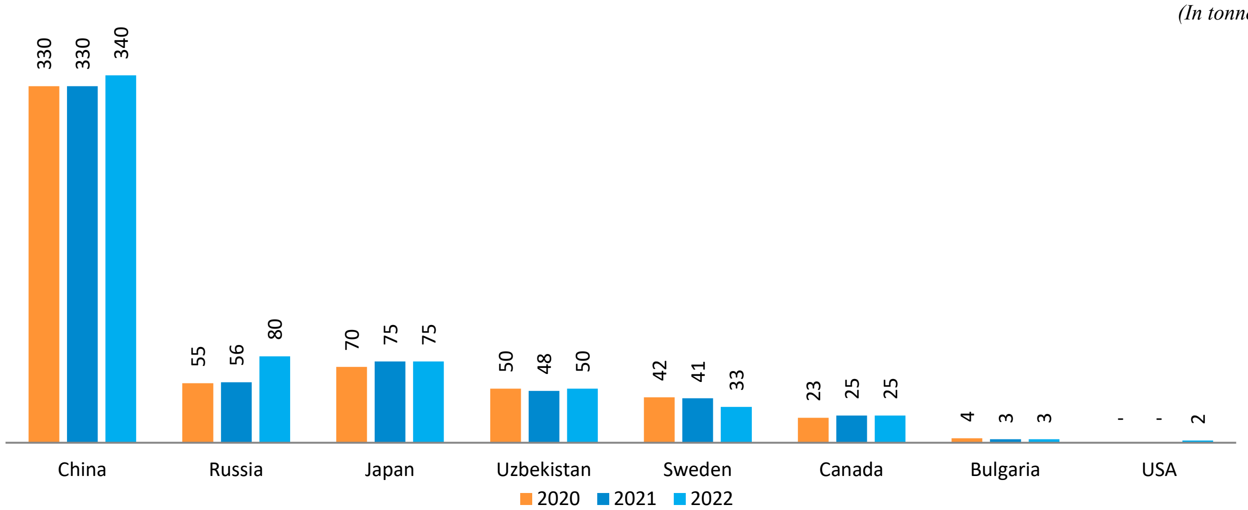


Fig 2: Countrywise Production of Tellurium

FOREIGN TRADE

Exports

Exports of selenium during 2022-23 increased substantially by 372% to 184 tonnes from 39 tonnes in 2021-22. Exports were mainly to Hong Kong (82%), Philippines (5%) and China (3%). There were negligible amount of exports of selenium to Germany, UK, UAE, Canada, Nigeria, Turkey and Oman. Exports of tellurium were negligible about 2 tonnes during 2022-23 (Tables-5 & 6).

Table – 5: Exports of Selenium

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**39**	**81781**	**184**	**295421**
Hong Kong	--	--	151	251531
Philippines	12	16561	9	11856
Germany	++	372	2	11172
China	10	15139	6	8634
UK	--	--	1	3776
UAE	1	1895	2	3095
Canada	2	6089	++	1169
Nigeria	1	1603	++	868
Turkey	++	7	++	647
Oman	++	737	++	578
Other countries	13	39378	13	2095

Figures rounded off

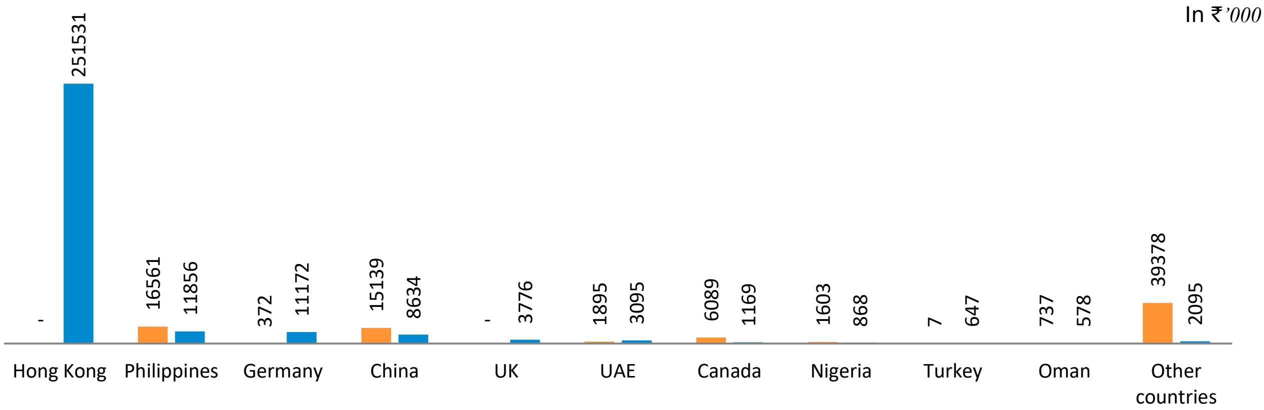


Fig 3: Countrywise Value of Export of Selenium

Table – 6 : Exports of Tellurium

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**17**	**2**	**197**
USA	--	--	++	155
Czech Republic	--	--	++	28
South Africa	++	6	++	6
Korea, Rep. of	--	--	++	5
Nepal	--	--	2	3
Singapore	++	6	--	--
Azerbaijan	++	5	--	--

Figures rounded off

Imports

Imports of selenium during 2022-23 decreased substantially by 24% to 387 tonnes as compared to 508 tonnes in the preceding year. Imports were mainly from Japan (41%), Republic of Korea (33%), Belgium (11%), Germany & Philippines (7% each) and China (1%). Imports of tellurium decreased by 33% to 2 tonnes as compared to 3 tonnes in the preceding year. Imports were mainly from China. Negligible quantities were also contributed from Canada, Germany, USA, UK and other countries (Tables-7 & 8).

Table – 7: Imports of Selenium

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**508**	**712159**	**387**	**689860**
Japan	202	303678	158	350935
Korea Rep.of	116	151179	128	163241
Belgium	83	96825	41	55793
Germany	48	70084	29	47717
Philippines	16	18344	26	37849
China	14	35773	3	21738
Canada	++	2738	1	11163
Singapore	--	--	++	625
USA	++	1073	1	531
Hong Kong	15	18095	++	268
Other countries	14	14370	++	++

Figures rounded off

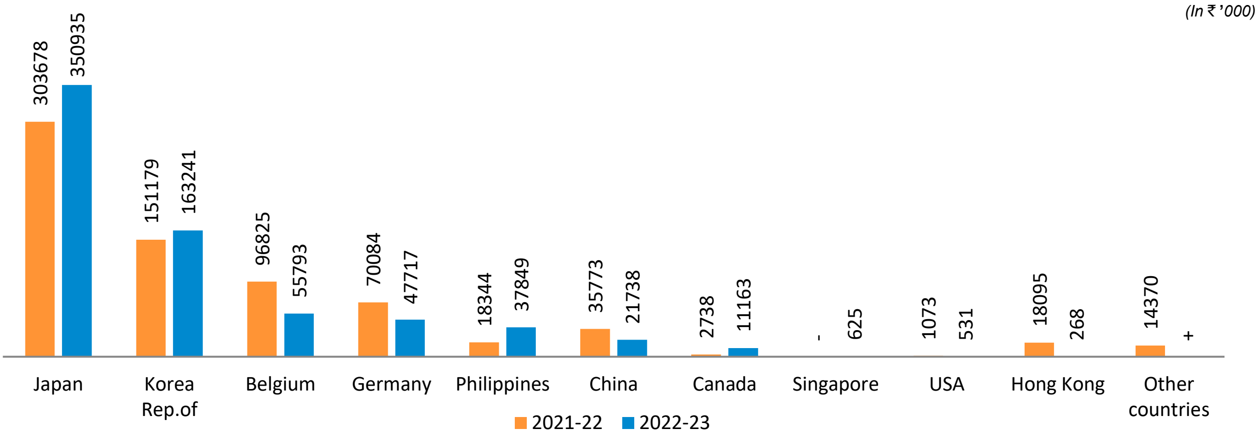


Fig 4: Countrywise Value of Import of Selenium

Table – 8: Imports of Tellurium

(By Countries)

Country	2021-22(R)		2022-23(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3**	**18935**	**2**	**20915**
China	1	5984	2	14822
Canada	++	5564	++	4136
Germany	++	1670	++	1747
USA	++	207	++	172
UK	--	--	++	38
Belgium	2	3913	--	--
Japan	++	1037	--	--
Luxembourg	++	560	--	--

Figures rounded off

FUTURE OUTLOOK

The supply of selenium is dependent on the supply of main product from which it is derived, copper and also to a lesser extent by the supply of nickel where the nickel production is from sulphide ore. The selenium prices are often inversely related to the supply of copper and nickel.

China has been purchasing large quantities of crude selenium. As this material becomes scarce, the prices for standard grade selenium may rise. The combination of these two factors, the decline of selenium containing concentrates from North America and the growth of Chinese demand, should firm up the prices for selenium in the short term.

Demand for selenium in photoreceptors is likely to see further decline as the cost of substituting organic compounds decreases. The Photoreceptor Industry which was once a major consumer of selenium and tellurium has reached the replacement stage. Selenium has been substituted by alternative material in newer models. Further, use of selenium in cancer prevention and other health applications may eventually lead to increased consumption of the metal. Dosages taken directly for human consumption will not affect the demand for the metal because only minute quantities are necessary for effective therapy.

The demand and supply of tellurium has remained fairly balanced for a decade. In short term, significant increases are not anticipated in either consumption or production, although reduction in copper production may have a bearing on tellurium supply. An increase in demand for high purity tellurium for cadmium telluride solar cells might have a major impact on tellurium consumption. The use of tellurium alloys in DVD's consumes only small amounts of tellurium and will, therefore, have minimal impact on tellurium demand.

25. Silver

Silver is soft and lustrous metal that is grouped in the category of noble metals. Its brilliant white colour, malleability and resistance to atmospheric oxidation have enhanced its value as a highly desired precious metal which is used in many industrial applications. Apart from its monetary and decorative uses, silver is known to have the highest electrical conductivity amongst all metals that enhances its potential in modern age applications, viz, for printed electric circuits, coating for electronic conductors and in alloys of gold & copper for electrical contacts. Its chloride and iodide are light-sensitive and hence used in photographic material. Silver is typically used (in paste form) on solar cells. It means the photovoltaics (PV) market has become one of the most important areas of silver demand. These two major uses have contributed to the increase in supply of scrap of silver contained products. Silver, which is the least expensive of the precious metals, is the whitest element and has the highest electrical and thermal conductivity among all the metals.

In India, there are no native silver deposits except the small and unique Bharak deposit in Rajasthan. It occurs generally with lead, zinc, copper (especially their sulphide ore) and gold ores and is extracted as a by-product from electrolysis or chemical methods. It was usually extracted by melting silver-bearing lead ore (ore containing argentiferous galena).

Silver is recovered as a co-product as well as a by-product in the country. Silver was recovered in the past as a co-product in gold refining at KGF Complex and Hutti Gold Mines in Karnataka and as a by-product in smelting and refining of lead, zinc and copper concentrates at Chanderiya and Debari smelters in Rajasthan, Tundoo and Moubandar (Ghatsila) smelters in Jharkhand and at Visakhapatnam smelter in Andhra Pradesh. The present production of silver comes from Chanderiya lead-zinc smelter of HZL and from gold refinery of HGML.

In addition, Hindalco extracts silver as a by-product during smelting of imported copper concentrates at Dahej in Gujarat.

RESERVES/RESOURCES

As per the NMI database, based on UNFC system, the total reserves/resources of silver ore in the country as on 1.4.2020 has been estimated at about 568.64 million tonnes. Out of these, 170.44 million tonnes were placed under 'Reserves' category and 398.20 million tonnes under the 'Remaining Resources' category.

The total reserves/resources of silver in the country as on 1.4.2020 in terms of metal content was estimated at 30,267 tonnes, of which 7,707 tonnes are under 'Reserves' and 22,560 tonnes are under the 'Remaining Resources'. By States, Rajasthan accounted for about 86% reserves/ resources in terms of ore, Karnataka & Jharkhand 4% each, Andhra Pradesh 3% and Madhya Pradesh, Uttarakhand, Odisha, Meghalaya, Sikkim, Tamil Nadu and Maharashtra together shared 3% ore reserves/remaining resources (Table-1). As per reserves & resources summary of HZL 2022-23, grade of silver was 56 gram/tonne under Total Reserves category, 62 gram/tonne under measured and indicated Resources category and 57 gram/tonne under inferred Resources categories.

Table – 1 : Reserves/Resources of Silver as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Total Reserves (A)	Total Remaining Resources (B)	Total Resources (A+B)
All India : Total			
Ore	170446020	398197732	568643752
Metal	7707.07	22560.84	30267.91
By State			
Andhra Pradesh			
Ore	0	16950000	16950000
Metal	0	128.13	128.13
Jharkhand			
Ore	0	23840000	23840000
Metal	0	5.22	5.22
Karnataka			
Ore	22120000	3813612	25933612
Metal	5.43	4.29	9.72
Madhya Pradesh			
Ore	0	3216000	3216000
Metal	0	159.86	159.86
Maharashtra			
Ore	0	235000	235000
Metal	0	0.23	0.23
Meghalaya			
Ore	0	880000	880000
Metal	0	19.8	19.8
Odisha			
Ore	0	1749500	1749500
Metal	0	64.91	64.91
Rajasthan			
Ore	148326020	342383997	490710017
Metal	7701.64	21940.57	29642.21
Sikkim			
Ore	0	949623	949623
Metal	0	56.69	56.69
Tamil Nadu			
Ore	0	790000	790000
Metal	0	42.55	42.55
Uttarakhand			
Ore	0	3390000	3390000
Metal	0	138.59	138.59

Figures rounded off

MINING LEASES & PRODUCTION

Silver is recovered as a by-product from lead & zinc concentrates, copper slime and as a co-product of gold refining. As per Annual Report of HZL 2022-23, silver refining capacity is 800 tonnes per annum. HZL is also currently operating a plant for processing and refining of zinc, lead and silver at SIDCUL, Pantnagar, Uttarakhand since 2011. This facility does not add to the overall smelting capacity.

During the year 2022-23, the production of silver at 7,13,768 kg increased by 10% as compared to the previous year 2021-22. The production of silver from gold refining was 148 kg in 2022-23 as against 143 kg in 2021-22. One Private Sector and one Public Sector undertaking reported production of silver during current year 2022-23 (Tables- 2 to 4).

In addition, Hindalco Industries Limited reported production of 80,663 kg and 66,497 kg silver from imported copper concentrates in 2022-23 and 2021-22 respectively.

Table-2: Principal Producers of Silver, 2022-23

Name and address of the Producer	Name of plant	Location of the plant	
		State	District
Hindustan Zinc Ltd., Yashad Bhavan, Udaipur-313004, Rajasthan.	Chanderia	Rajasthan	Chittorgarh
The Hutti Gold Mines Co. Ltd., Hutti, Distt. Raichur-584115, Karnataka.	Hutti	Karnataka	Raichur

Table-3 : Production of Silver*, 2021-22 and 2022-23

(By Sectors/States/Districts)

(Qty in kg; Value in ₹ '000)

State/District	2021-22 (R)		2022-23 (P)	
	Qty	Value	Qty	Value
India	**647156**	**42126921**	**713768**	**43814376**
Public Sector	143	11503	148	9299
Private Sector	647013	42115418	713620	43805077
Karnataka	**143**	**11503**	**148**	**9299**
Raichur	143	11503	148	9299
Rajasthan	**647013**	**42115418**	**713620**	**43805077**
Chittorgarh	647013	42115418	713620	43805077

(p): Provisional
** : Silver as a by-product; -- (i) In Karnataka, it is recovered at Raichur while refining of gold at Hutti and Uti gold mines.*
(ii) In Rajasthan, it is recovered at Chanderia lead- zinc smelter of HZL.
(iii) Excludes by-product recovery of 80663 kg and 66497 kg silver from imported copper concentrates in 2022-23 and 2021-22 respectively.

Table-4 : Production of Silver*, 2020-21 to 2022-23

(By States)

(Quantity in kg; Value in ₹ '000))

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**705796**	**42664424**	**647156**	**42126921**	**713768**	**43814376**
Karnataka	120	7244	143	11503	148	9299
Rajasthan	705676	42657180	647013	42115418	713620	43805077

(p): Provisional
**: Excludes by-product recovery of silver by Hindalco Industries Ltd. at Dahej, Gujarat from imported copper concentrates.*

RECYCLING

Recycling, a significant factor in the supply of many of the metals used in our society, provides environmental benefits, such as, energy saving, reduced emission associated with energy saving etc. Photographic wastes, spent catalysts and electronic scrap are the major sources of materials for silver recycling. Other recyclable silver-bearing materials include dental alloys, jewellery and silverware. Cell phones have become one of the major sources for recycled silver recovery.

As per USGS Report entitled "Recycled Cell Phones — A Treasure Trove of Valuable Metals", references on data offered by the Falconbridge Ltd, indicate that one tonne of obsolete cellphones (exclusive of batteries) contains an average 3.14 kg of silver metal.

As per World Silver Survey 2023 report, Global silver recycling rose by 3% to a 10-year high of 5,618 tonnes (180.6 Moz). Every key segment of scrap supply rose except photography, which suffered further structural losses. Industrial scrap benefited from growth in ethylene oxide (EO) change-outs and electrical supplies. It was also observed that, higher silver prices contributed to a rise in jewellery and silverware scrap supply especially from India.

WORLD REVIEW

The total reserves of silver in metal content is estimated at 6,10,000 tonnes. Peru (18%), Australia and Russia (15% each), China (12%), Poland (10%), Mexico (6%), Bolivia, Chile & USA (4% each) and Argentina & India (1% each). Mexico, China, Peru, Poland, Russia, Chile, Bolivia, Australia, and Kazakhstan are the main producers of silver. The total world mine production of silver in metal content was reported at 27,616 tonnes during the year 2022 which increased by 28% as compared to 26,848 tonnes in the preceding year. Mexico was the leading producer with 26% share in the total production followed by China (13%), Peru (11%), Poland (6%), Russia & Chile (5% each), Bolivia, Australia, Botswana & Kazakhstan (4% each). World mine production of silver is furnished in Table- 6.

Table – 5 : World Reserves of Silver

(By Principal Countries)

(In tonnes of silver content)

Country	Reserves
World: Total (rounded off)	*610000
Argentina	6500
Australia	[10] 94000
Bolivia	22000
Chile	26000
China	72000
India	8000
Kazakhstan	NA
Mexico	37000
Peru	110000
Poland	*63000
Russia	92000
USA	23000
Other countries	57000

Source: USGS Mineral Commodity Summaries, 2024.
1:One tonne (1,000 kilograms)=32,150.7 troy ounces,
[10:] For Australia, Joint Ore Reserves Committee-compliant reserve were 27,000 tonnes.
**Correction posted on March 5, 2024.*

Table – 6 : World Mine Production of Silver

(By Principal Countries)

(In Kilograms of metal content)

Country	2020	2021	2022
World:Total	**26585000**	**26848000**	**27616000**
Mexico	7424554	6492180	7067580
China	3405800	3511554	3477400
Peru	2723879	3334000	3080000
Poland	1423000	1522000	1533000
Russia	1380000	1508000	1300000
Chile	1575794	1383041	1274363
Bolivia	929909	1289456	1214301
Australia	1337344	1329718	1169252
Botswana	–	67563	1099644
Kazakhstan	1035181	1004789	1013100
Other countries	5349539	5405699	5387360

Source: BGS World Mineral Production, 2018-22.
c:- Years ended 31 March following that stated.

(In Kilograms of metal content)

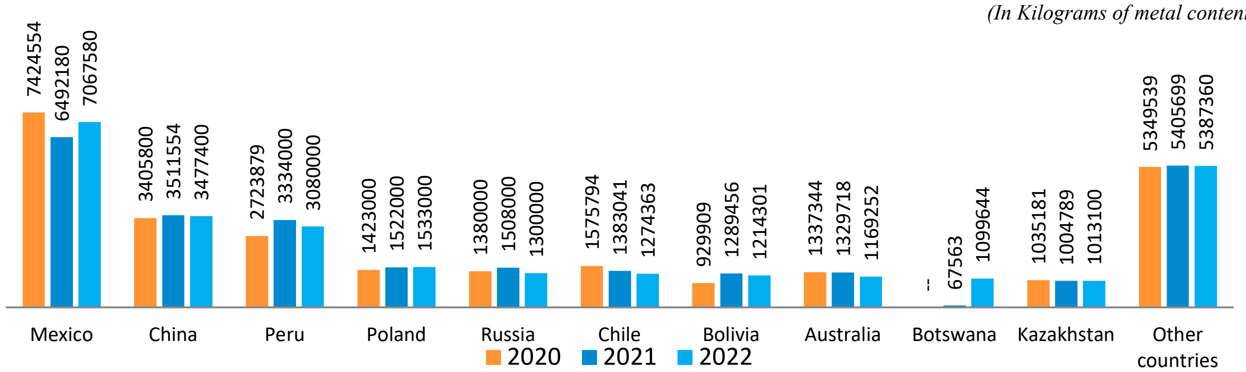


Fig 1: Countrywise Production of Silver

FOREIGN TRADE

Exports

Exports of silver increased to 130 tonnes in 2022-23 as compared to 89 tonnes in the preceding year. Exports were mainly to UK (62%), USA (16%), Germany (7%). Exports of silver-clad base metals decreased to 2,861 kg during 2022-23 from 2,979 kg in 2021-22. Exports of Semi-manufactured silver increased to 127 tonnes in 2022-23 as compared to 77 tonnes in the preceding year. Exports of silver-unwrought were negligible during the year 2022-23. Similarly, exports of silver powder were 3 tonnes during the year 2022-23 (Tables-7 to 11).

Table-7: Export of Silver

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**89**	**3633631**	**130**	**5737293**
UK	41	2507513	81	4560685
USA	24	392109	21	464869
Puerto Rico	2	60282	5	184977
Germany	7	156453	9	159084
Canada	3	59246	3	70201
Italy	4	121278	2	56582
Turkey	1	38948	1	51853
Denmark	3	35311	3	31554
Poland	1	30910	++	23675
Saudi Arabia	++	10335	1	14004
Other Countries	3	221246	4	119809

Figures rounded off

(Value in ₹ '000)

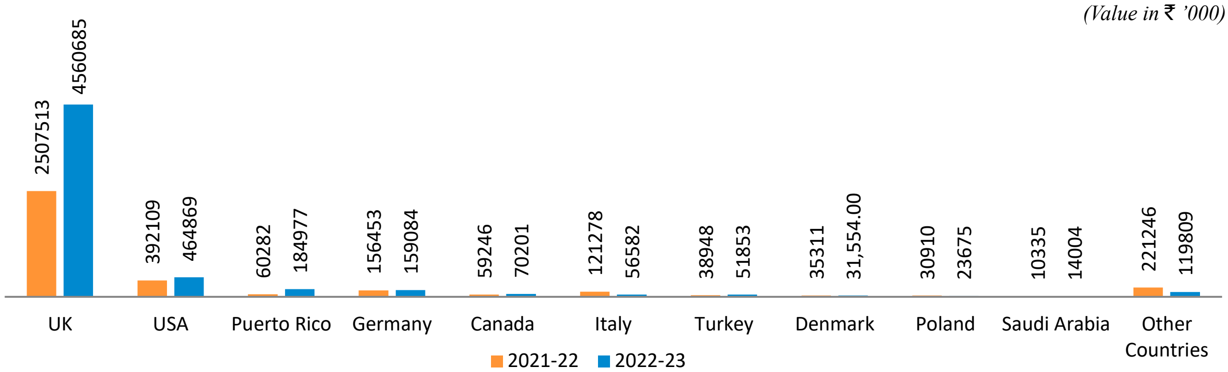


Fig 2: Countrywise Value of Export of Silver

Table 8: Export of Silver Clad Base Metals

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (Kg)	Value (₹ '000)	Qty (Kg)	Value (₹ '000)
All Countries	**2979**	**14664**	**2861**	**13326**
Sri Lanka	2785	11118	2672	11017
USA	162	3426	102	2271
Kenya	--	--	3	21
Bangladesh	--	--	74	11
Canada	--	--	7	5
Netherlands	--	--	3	1
Seychelles	--	--	++	++
Australia	30	119	--	--
Germany	2	1	--	--

Figures rounded off

Table 9: Export of Silver : Semi - Manufactured

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ ’000)	Qty(t)	Value (₹ ’000)
All Countries	**77**	**3512744**	**127**	**5567938**
UK	41	2507513	81	4560664
USA	13	325417	21	460961
Germany	7	156453	9	159084
Canada	3	58334	3	69463
Italy	4	121126	2	56036
Turkey	1	38948	1	51853
Denmark	3	35311	3	31554
Puerto Rico	1	8571	2	25368
Poland	1	30910	++	23675
Saudi Arabia	++	10335	1	14004
Other Countries	3	219826	4	115276

Figures rounded off

Table 10: Export of Silver : Unwrought

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ ’000)	Qty(t)	Value (₹ ’000)
All Countries	**10**	**4177**	**++**	**7931**
USA	10	2680	++	3824
Sri Lanka	--	--	++	1932
Bangladesh	--	--	++	923
Canada	++	802	++	738
UAE	--	--	++	158
Ghana	--	--	++	144
Australia	++	44	++	142
Hong Kong	--	--	++	49
UK	--	--	++	21
Bhutan	++	385	--	--
Other Countries	++	266	--	--

Figures rounded off

Table 11: Export of Silver : Powder

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ ’000)	Qty(t)	Value (₹ ’000)
All Countries	**2**	**116710**	**3**	**161424**
Puerto Rico	1	51711	3	159609
Bhutan	--	--	++	744
Italy	++	66	++	546
Australia	++	53	++	153
Indonesia	--	--	++	103
USA	1	64012	++	84
Spain	--	--	++	58
Taiwan	--	--	++	38
Israel	++	58	++	36
UAE	--	--	++	34
Other Countries	++	810	++	19

Figures rounded off

Imports

Imports of silver increased by 84% to 8,156 tonnes in 2022-23 as compared to 4,422 tonnes in the preceding year. Imports were mainly from the UK (50%), Hong Kong (21%), China (12%) and Switzerland, Russia & USA (3% each). Imports of silver-clad base metals decreased to 1,342 kg in 2022-23 as against 4,862 kg in the previous year. Imports were mainly from Thailand (39%) and France (30%). Imports of semi-manufactured silver were at 7,927 tonnes during the year 2022-23 as compared to 4092 tonnes in the previous year. Besides, imports of silver unwrought were at 191 tonnes during the year 2022-23 as compared to 304 tonnes in previous year. Imports were mainly from Singapore (21%) and Italy (15%). Imports of silver powder increased to 38 tonnes in 2022-23 from 26 tonnes reported in the previous year (Tables-12 to 16).

Table 12: Import of Silver Total

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**4422**	**244542763**	**8156**	**422370924**
UK	1736	97563798	4113	213432868
Hong Kong	1547	86656215	1749	91713085
China	189	10441947	973	51185299
Switzerland	142	8018583	275	14248619
Russia	250	14013300	243	12148339
USA	81	2584295	215	9289849
Australia	9	512674	88	4345537
Germany	38	1597286	81	4304268
Kazakhstan	144	8344177	73	3644069
Singapore	90	5198263	50	2592239
Other Countries	196	9612225	296	15466752

Figures rounded off

(In tonnes)

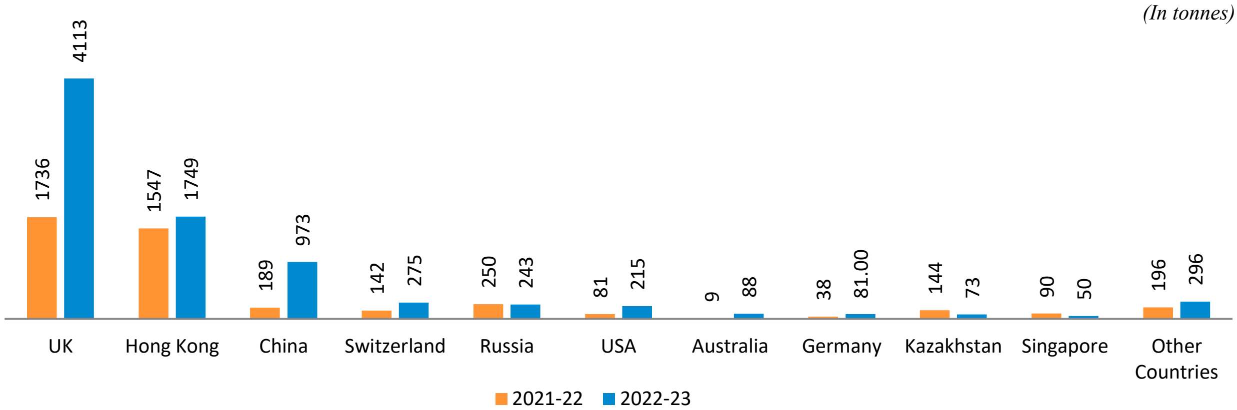


Fig 3 Countrywise Value of Imports of Silver

Table 13: Import of Silver Clad Base Metal Total

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**4862**	**22436**	**1342**	**26471**
Thailand	750	9696	525	6853
USA	112	2928	188	5956
Netherlands	--	--	36	3964
UK	--	--	61	3952
France	--	--	400	2953
Malaysia	--	--	32	2101
Belgium	--	--	100	691
Sweden	--	--	++	1
China	4000	9812	--	--

Figures rounded off

Table 14: Import Silver : Semi - Manufactured

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**4092**	**227283914**	**7927**	**411350242**
UK	1677	94225764	4113	213432868
Hong Kong	1491	83447086	1724	90227888
China	189	10441947	961	50961230
Switzerland	115	6454827	267	13800074
Russia	250	14012470	243	12148339
USA	46	1619823	184	8658619
Australia	9	512674	88	4345537
Kazakhstan	144	8344177	73	3644069
Germany	11	653380	66	3375241
Korea Rep. of	1	89640	30	1592001
Other Countries	159	7482126	178	9164376

Figures rounded off

Table 15: Import Silver : Unwrought

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**304**	**16957397**	**191**	**10617695**
Singapore	62	3522024	41	2249064
Italy	32	1929978	28	1648392
Hong Kong	56	3209129	25	1485197
Indonesia	4	186829	20	995399
Germany	27	915578	15	917606
UAE	7	390979	16	881495
South Africa	18	1027078	17	859164
USA	12	849822	8	478106
Korea Rep. Of	++	2285	9	449100
Switzerland	27	1563756	8	448545
Other Countries	59	3359939	4	205627

Figures rounded off

Table 16: Import Silver : Powder

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**26**	**301452**	**38**	**402987**
Brazil	2	152275	3	169194
USA	23	114650	23	153124
China	--	--	8	40341
Singapore	1	3811	4	28432
Germany	++	28328	++	11421
Italy	++	1302	++	467
Korea Rep. Of	--	--	++	8
Russia	++	830	--	--
Japan	++	256	--	--

Figures rounded off

FUTURE OUTLOOK

Silver has the dual usefulness of being a precious metal as well as an industrial metal. World over, silver is primarily traded for its industrial applications, however, Indian silver imports are largely consumed for jewellery and silverware. India is among the top 5 silver consumers in the world. About 60% of silver consumption in India is from the rural population who views it as a solid saving commodity. India does not produce silver on a significant scale and most of the silver has to be imported. Moreover, silver demand has been on the rise in major growing economies including India during the past few years. New industries, such as, medicine, manufacturing etc. are scaling up their demand for silver, and this may soon translate to higher levels of imports.

However, the counter-narrative is that notwithstanding the Government's initiative for infrastructural boost, the benefits for industrial demand would be only to modest levels as the high inventory levels of semi-fabricated products across the supply chain would offset any demand escalation of silver. Housing projects (driven by a new government initiative) is another potential demand escalator for electrical equipment which would in turn influence the demand for silver. HZL is further scaling up silver production to achieve capacity of 800 MT, and moving gradually towards 1,000 MT in line with its vision to be among the top three global primary silver producers.

Capitalising on India's potential for growth, it would be pragmatic for India to build its own silver powder producing facilities mainly in order to facilitate the projected growth in domestic solar generating power capacity.

26. Strategic and Critical Minerals

Critical Minerals have attained major significance in todays modern world. These minerals have come to be the building blocks of the new economy. Most countries in the world have identified critical minerals as per their priorities and future requirement. India's rapid development has escalated the nation's reliance on these minerals which are critical for the country. As the demand of these minerals continues to rise, it is vital to have a clear understanding of their availability, extraction methods and application prospects to essentially secure India's economic, technological and environmental future.

The future of India's economy will be underpinned by technologies that depend on minerals such as lithium, graphite, cobalt, titanium and rare- earth elements. These are essential for advancement of many crucial Sectors, such as, electronics, telecommunication, transport and defence.

Strategic Minerals are those minerals in which a country has more or less negligible resource available and depends upon outside resources. MMDR (Amendment) Act 2023, Schedule I Part D prescribed 24 Critical and Strategic Minerals. These minerals are:

1. Beryl and other beryllium-bearing minerals
2. Cadmium-bearing minerals
3. Cobalt-bearing minerals
4. Gallium-bearing minerals
5. Glauconite
6. Graphite
7. Indium-bearing minerals
8. Lithium-bearing minerals
9. Molybdenum-bearing minerals
10. Nickel-bearing minerals
11. Niobium-bearing minerals
12. Phosphate (without uranium)
13. Platinum group of elements-bearing minerals
14. Potash
15. Minerals of the "rare earths" group not containing Uranium and Thorium
16. Rhenium-bearing minerals
17. Selenium-bearing minerals
18. Tantalum-bearing minerals
19. Tellurium-bearing minerals
20. Tin-bearing minerals
21. Titanium-bearing minerals and ores (ilmenite, rutile and leucoxene)
22. Tungsten-bearing minerals
23. Vanadium-bearing minerals
24. Zirconium-bearing minerals and ores including zircon

This Review covers 5 minerals, namely, Beryl and other beryllium-bearing minerals, Indium-bearing minerals, Niobium-bearing minerals, Rhenium-bearing minerals and Tantalum-bearing minerals. The remaining 19 minerals have been already covered in other sections of Indian Minerals Yearbook 2023.

BERYL AND OTHER BERYLLIUM-BEARING MINERALS

RESOURCES & PRODUCTION

There is no production of Beryl and other beryllium-bearing mineral in India.

USES

It has various uses in electronics for i ts conductivity and in aerospace for its light weight strength. These minerals are also used in nuclear reactors, aerospace applications and as a moderator in some reactors due to their ability to absorb neutron.

These minerals are commonly found in pegmatites, granite as well as in hydrothermal veins associated with granitic rock. Additionally, beryllium can be found in certain types of sedimentary rocks and as a trace element in some soil and clays.

WORLD REVIEW

The world's identified resources of beryllium have been estimated to be more than 1,00,000 tons. About 60% of these resources are in the United States—by tonnage, the Spor Mountain area in Utah, the McCullough Butte area in Nevada, the Black Hills area in South Dakota, the Sierra Blanca area in Texas, the Seward Peninsula in Alaska, and the Gold Hill area in Utah account for most of the resources (Source: U. S. Geological Survey, Mineral Commodity Summaries, 2023).

The world beryl production was estimated at 8.41 thousand tonnes in 2022. The USA dominated the world production by accounting for 53% output which was followed by China (21%) and Mozambique (15%) (Table-1).

Table – 1: World Production of Beryl

(In tonnes)

Country	2020	2021	2022
China	1750*	1750*	1750*
Madagascar [(a)]	16*	16*	16*
Mozambique	80	330	1285
Namibia	-	15000	360
USA[(b)]	4130*	4250*	4500*
Uganda	186	473	500*
Zambia	6*	3*	4*

Source: BGS, World Mineral Production, 2018-2022.
** Estimate (a) Include ornamental and industrial products*
(b) Includes bertrandite ore, calculated as equivalent to beryl containing 11% beryllium oxide.

Foreign Trade

Exports

In 2022 -23, exports of other beryllium by value decreased drastically to ₹ 0.36 lakh from ₹ 2.65 lakh in the previous year. Exports were mainly to Bangladesh (61%) (Table-2).

Imports

In 2022-23, imports of beryllium by value increased 41% to ₹ 3.67 crore from ₹ 2.6 crore in the previous year. Imports were mainly from Rep. of Korea (39%), Germany (24%),Belgium (16%) and Mexico (15%) (Table-3).

Table-2 : Countrywise Export of other Beryllium

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**265**	**	**36**
Iran	0	2	-	-
Japan	0	263	-	-
Bangladesh	-	-	1	22
South Africa	-	-	++	4
UAE	-	-	0	10

*Figures rounded off (++): negligible ** Total quality can not be calculated due to partial coveroage of data*

Table-3 : Countrywise Import of other Beryllium

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**26014**	**	**36650**
Belgium	-	-	20	5748
China	-	41	++	629
France	-	-	++	1700
Germany	++	3029	++	8756
Hong Kong	43	9614	-	-
Japan	20	4399	-	-
Korea, Rep.of	-	-	60	14152
Mexico	39	8414	19	5457
UK	-	9	0	40
USA	++	508	++	168

*Figures rounded off (++): negligible ** Total quality can not be calculated due to partial coverage of data*

INDIUM-BEARING MINERALS

Resources & Production

There is no production of Indium bearing minerals panels and transparency. It is also used in semiconductors, solders and as thin fill for lubrication. It has application in medical imaging and as a coating for bearings in high performance engine.

Occurrences

It is primary found in zinc ores, tin, iron and copper ores. However, commercial extraction typically occurs as a by-product of zinc smelting in India.

Uses

It is primarily used in electronics especially in the production of flat panel display, touch screens and solar

World Review

As per U.S. Geological Survey, Mineral Commodity Summaries, 2023, Quantitative estimates of reserves were not available.

The world production of Indium refinery was estimated at 927 tonnes in 2022. China dominated the world production by accounting for 72% output which was followed by Republic of Korea (11%), Japan (8%) and Canada (4%) (Table-4).

Table – 4: World Production of Indium

(In tonnes)

Country	2020	2021	2022
Belgium	20*	20*	20*
Brazil	5*	5*	5*
Canada	61	44	40
China	500*	580*	667*
France	38*	38*	20*
Italy	5*	5*	5*
Japan	70	70	70*
Korea, Rep. of	100*	100*	100*
Peru	12*	12*	-
Russia	7*	7*	5*

Source: BGS, World Mineral Production, 2018-2022
** Estimate*

RHENIUM-BEARING MINERALS

Resources & Production

There is no production of Rhenium-bearing minerals in India.

Uses

These minerals are valuable for their application in high temperature environment. It is primarily used in super alloys for jet engine components, catalyst for petroleum refinery and in production of lead free gasoline. It has application in thermo couples for measuring high temperature.

It is quite rare in nature and often found as a trace element in various minerals associated with molybdenum and copper deposits. These can also be found in some PGM including sulphites. However, commercial production involves by-product recovery from the refining of molybdenum and copper ores.

World Review

The world reserves of rhenium are estimated about 2,295 million tonnes. Rhenium reserves are mainly in Chile which contributes (57 %) to the total reserve followed by USA (17%) and Russia (14%) (Table-5).

Table-5: World Reserves of Rhenium

(In million tonnes)

Country	Reserves
World: Total	Large
USA	400
Armenia	95
Chile	1300
Kazakhstan	190
Korea, Rep. of	NA
Poland	NA
Russia	310
Uzbekistan	NA

Source: USGS Mineral Commodity Summaries, 2023

The world production of rhenium was estimated at 50 tonnes in 2022. Chile dominated the world production by accounting for 58% output which was followed by USA (18%) and Poland (12%) (Table-6).

Table – 6 : World Production of Rhenium

(In tonnes)

Country	2020	2021	2022
Chile	30*	30*	29*
China	3*	3*	3*
Kazakhstan	1*	1*	1*
Poland	10	9	6
Russia	2*	2*	2*
USA	9	9*	9

Source: BGS, World Mineral Production, 2018-2022.
** Estimate*

NIOBIUM-BEARING MINERALS

Resources & Production

There is no production of Niobium-bearing minerals in India.

Uses

Niobium is predominantly used in the production of high strength, low alloy steels for infrastructure pipelines and automotive applications. It is also used in jet engines, in electronics for capacitors and super conducting magnets. It has application in medical implants due to its biocompatibility and corrosion resistance properties.

Niobium-bearing minerals are often associated with complex pegmatites, carbonatites, and rare-earth elements. These are also found in some alluvial deposits and as trace elements in various igneous and metamorphic rocks.

World Review

The world reserves of Niobium are estimated to be about 18 million tonnes. Niobium reserves are mainly in Brazil which contributes (94 %) to the total reserve (Table-7).

Table-7: World Reserves of Niobium

(In million tonnes)

Country	Reserves
World: Total	18
USA	small
Brazil	16
Canada	2
Congo ,Dem. Rep.	NA
Russia	NA
Rwanda	NA

Source: USGS Mineral Commodity Summaries, 2023

TANTALUM-BEARING MINERALS

Resources & Production

There is no production of Tantalum-bearing minerals in India.

Uses

Tantalum is primarily used in electronic devices like smart phones and laptops, due to high capacitance and reliability. It is also used in jet engine components, turbine blades and in cutting tools for its high melting points and resistance to corrosion and wear. Its applications in Medical Industry is also pronounced. Tantalum-bearing minerals are associated with pegmitites, granites and certain rare-metal minerals like lithium-bearing spodumene and baryl. They are also found to occur in alluvial deposits.

World Review

Tantalum reserves are mainly in China which contributes (56 %) to the total reserve followed by Australia (31%) and Brazil (13%) (Table-8).

Table-8: World Reserves of Tantalum

(In Thousand tonnes))

Country	Reserves
World: Total	NA
Australia	99@
Brazil	40
China	180
Bolivia	NA
Burundi	NA
Congo (Kinshasa)	NA
Ethiopia	NA
Mozambique	NA
Nigeria	NA
Russia	NA
Rwanda	NA
Uganda	NA

Source: USGS Mineral Commodity Summaries, 2023
@ For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 39,000 tons. NA : Not Available

The world production of tantalum and niobium was 85.50 thousand tonnes in 2022 with respect to Nb and Ta content. Brazil dominated the world production by accounting for 90% output which was followed by Canada (5%) (Table-9).

Table 9 : World Production of Tantalum and Niobium Minerals

(In tonnes)

Country	Sub-commodity	2020	2021	2022
Australia	Tantalite	153	208	88
	Ta content	75	102	43
Bolivia	Tantalite	40*	2*	9*
	Ta content	20*	1*	4*
Brazil	Pyrochlore	164008	209560	210000*
	Nb content	59819	78822	76896*
	Columbite-tantalite	380	419	420*
	Ta content	85	94	98*
Burundi	Columbite-tantalite	21	42	42*
	Nb content	8	16	16*
	Ta content	3	7	7*
Canada	Pyrochlore	11900*	13900*	12400*
	Nb content	4500*	5200*	4700*
China	Columbite–tantalite	296*	304*	300*
	Nb content	115*	118*	117*
	Ta content	46*	47*	46
Congo, Dem. Rep.	Columbite–tantalite	1712	2422	2500*
	Nb content	503	711	734*
	Ta content	491	694	717*
Ethiopia (a)	Nb content	7*	12*	15*
	Ta content	10*	19*	19*
Malaysia	Struverite	9	-	35
	Ta content	1	-	3
Mozambique	Tantalite	209	178	211
	Ta content	103	87	104
Nigeria	Tantalite	1*	44	45
	Ta content	1*	22	22*
	Columbite	1700*	1378	1400*
	Columbite–Nb content	662*	537	545*
	Columbite–Ta content	263*	213	217*
Russia	(Nb content)	431	454	384
	(Ta content)	49	34	20
Rwanda (b) (c)	Columbite–tantalite	1201	1118	1116
	Nb content	468	435	435
	Ta content	186	173	173*
Spain	(Ta content)	11	12	16
Uganda	Columbite–tantalite	173	404	400*
	Nb content	69	161	159*
	Ta content	21	50	49*
Zimbabwe	Columbite–tantalite	4	-	-
	Nb content	2	-	-
	Ta content	1	-	-

Source: BGS, World Mineral Production, 2018-2022.
** Estimate (a) years ended 7 July of that stated (b) years ended 30 June of that stated*
(c) Exports

FOREIGN TRADE

Export

In 2022-23, exports of ferroniobium by value decreased drastically by 54% to ₹ 321.85 lakh from ₹ 695.28 lakh in the previous year. Exports were mainly to Malaysia (49%), UAE (21%) and Russia (18%). On the other hand, in 2022-23, exports in terms of value of niobium or tantalum ores and concentrates increased manifold to ₹ 10.00 lakh from ₹ 0.18 lakh in the previous year. Exports in 2022-23 were mainly to Bangladesh (Tables-10 & 11).

Table-10 : Countrywise Export of Ferroniobium

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**69528**	**	**32185**
Chile	-	-	++	41
Egypt	-	-	++	935
Malaysia	9	22061	6	15611
Russia	-	-	2	5906
South Africa	4	10739	1	1807
Turkey	0	3	++	697
UAE	2	3863	3	6872
UK	++	138	++	317
Other Countries	**	32,724	**	-

Figures rounded off
(++): negligible

Table-11 : Countrywise Export of Niobium or Tantalum Ores and Concentrates

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**18**	**	**1007**
Bangladesh	-	-	105	973
Bhutan	-	-	++	34
Turkey	0	18	-	-

Figures rounded off
*** Total quality can not be calculated due to partial coveraage of data*
(++): negligible

Import

In 2022-23, imports of ferroniobium by value increased by 43 % to ₹ 123364.14 lakh from ₹ 86428.42 lakh in the previous year. Imports by value were mainly from Singapore (66%) and Brazil (27%). On the other hand, in 2022-23, imports of niobium or tantalum ores and concentrates decreased nearly by 50% with respect to the previous year. Imports were mainly from Italy (Tables-12 & 13).

Table-12 : Countrywise Import of Ferroniobium

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
World: Total	**	**8642842**	**	**12336414**
Brazil	1065	1866600	1649	3332583
Canada	265	595637	259	681310
Hong Kong	32	31120	12	14021
Netherlands	38	119934	21	41871
Singapore	2456	5713088	3,249	8127677
Switzerland	6	21546	16	55351
UAE	59	127723	19	42276
USA	0	19	20	41326
Other Countries	**	167175	**	-

Figures rounded off
*** Total quality can not be calculated due to partial coverage of data*
(++): negligible

Table-13 : Countrywise Import of Niobium or Tantalum Ores and Concentrates

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
World : Total	**2**	**488**	**1**	**242**
France	2	488	-	-
Italy	-	-	1	242

Figures rounded off
(++): negligible

FUTURE OUTLOOK

India has set a goal 'Net Zero' commitment by 2070. So in future consumption of these critical minerals will be increased as they are vital to power the transition to a low-emission economy and in renewable technologies.

27. Tin

Tin is one of the oldest metals known to mankind and is commonly utilised in bronze implements. The Earth's crust contains just around 2 ppm of this element, making it scarce. Its distinctive features, including non-toxicity, malleability, chemical inertness, and ease of alloying with other metals, distinguish it from other non-ferrous metals. Tin is a silvery-white metal that is soft and pliable. It is not a naturally occurring metal. Casiterite (SnO_2) is the primary tin mineral, with a theoretical purity of 78.77%. However, it typically contains impurities, such as, Nb, Ta, Zr, Sc, W, and Fe. Stannite (Cu_2SnFeS_4) is a less common tin ore. In an updated list of critical minerals released by the Government of India under the aegis of Ministry of Mines, Tin was also included along with 29 other minerals. Tin is considered as a mineral of high economic importance and has high supply chain risk.

RESERVES/RESOURCES

In India, tin ore is found associated with granite, pegmatites and quartz veins and also in placer deposits. Resources are spread over in Bastar and Dantewada districts of Chhattisgarh, Tosham deposit in Bhiwani district of Haryana and Malkangiri district of Odisha.

The total reserves/resources of tin ore in the country as per NMI data, based on UNFC system, as on 1.4.2020 is placed at 83.72 million tonnes containing about 1,03,757 tonnes metal. About 2,101 tonnes ore containing 974 tonnes metal are placed under 'Reserves' category and the bulk, i.e., about 83.72 million tonnes containing about 1,02,783 tonnes metal are placed under 'Remaining Resources' category. As per DMG Chhattisgarh, the total recoverable reserves of cassiterite concentrate is 19,544.58 tonnes in Tongpal area, Katekalyan area and Padapur-Bacheli area. Out of 19,544.58 tonnes, 18,837.16 tonnes are placer deposit. The entire resources of tin are located in Haryana, Chhattisgarh and Odisha. About 64% of the total ore resources are located in Haryana and 36% in Chhattisgarh, while nominal resources have been reported from Odisha as well (Table-1).

Table – 1 : Reserves/Resources of Tin as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India			
Ore	2101	83720794	83722895
Metal	973.99	102782.91	103756.9
By States			
Chhattisgarh			
Ore	2101	29795176	29797277
Metal	973.99	15909.58	16883.57
Haryana			
Ore	-	53910000	53910000
Metal	-	86220.6	86220.6
Odisha			
Ore	-	15618	15618
Metal	-	652.73	652.73

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on 'Exploration and Development' under 'General Reviews', i.e., Vol.-I of the title.

MINING LEASES & PRODUCTION

As on 31st March 2023, a total of 15 mining leases with a cumulative area of 319.17 ha were granted.

Tin Concentrates

The production of tin concentrates in 2022-23 was at 45,429 kg as against 26,301 kg in the preceding year. One Public Sector and threePrivate Sector mines reported production in 2022-23. All these mines are located in Chhattisgarh. The mine-head closing stock of tin concentrates was nil in 2022-23 as against 260 kg in 2021-22. The Chhattisgarh Mineral Development Corporation Ltd. (CMDC) purchases tin concentrates from local tribals, allowing them to collect it from the lease area. Hence, no labour was reported by the mine owned by CMDC Ltd., where as Precious Minerals and Smelting Ltd. employed 16 workers in the current year and 11 workers in the previous year. (Tables- 2 to 5)

Table- 2: Producers of Tin Concentrates (2022-23)

Name and address of the Producer	Location of the mine	
	State	District
Chhattisgarh Mineral Dev. Corpn. Ltd., 27/520,New Shanti Nagar Shankar Nagar Road, Raipur-462011, Chhattisgarh.	Chhattisgarh	Dantewada
Precious Minerals and Smelting Ltd., Semi Urban Industrial Estate, Frezerpur, Jagdalpur-494001, Chhattisgarh.	Chhattisgarh	Dantewada

Table- 3: Production of Tin Concentrates, 2020-21 to 2022-23

(By Countries)

(Quantity in kg; Value in ₹ '000)

Country	2020-21		2021-22		2022-23 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
India	**16865**	**10413**	**26301**	**32619**	**45429**	**51850**
Chhattisgarh	16865	10413	26301	32619	45429	51850

(p): Provisional

Table- 4: Production of Tin Concentrates, 2021 -22 an d 2022 -23

(By Sectors/State/District)

(Quantity in kg; Value in ₹ '000)

State	No. of Mines	2021-22 Production		No. of Mines	2022-23 (P)	
		Qty	Value		Production	Value
India	**6**	**26301**	**32619**	**4**	**45429**	**51850**
Public sector	1	24812	30523	1	44895	51058
Private sector	5	1489	2096	3	534	792
Chhattisgarh	**6**	**26301**	**32619**	**4**	**45429**	**51850**
Dantewada	5	26251	32471	4	45429	51850
Sukma	1	50	148	-	-	-

(p): P rovisional

Table- 5 : Mine-head Closing Stocks of Tin Concentrates, 2021-22 & 2022-23

(By State)

(In kg))

State	2021-22	2022-23(p)
India	**260**	**-**
Chhattisgarh	260	-

(p): Provisional

Tin Metal

The plant owned by Precious Minerals and Smelting Ltd. reported production of tin metal was 17,160 kg in 2022-23 as against 4,868 kg in the preceding year. The plant is located at Jagdalpur in Dantewada district of Chhattisgarh (Table 6).

Table 6: Production of Tin Metal 2020-21 to 2022-23

(Qty. in kg, Value in ₹ '000)

Year	Quantity	Value
2020-21	4337	5400
2021-22	4868	7307
2022-23(p)	17160	35435

(p): Provisional

USES & CONSUMPTION

Tin, as a metal, is the most preferred and environment-friendly packing material. Tin plate, a value-added flat steel product, is a versatile packaging substrate used in edible oils, paints, pesticides, processed foods, beverages and other industries. As a pure metal, it can be used in storage tanks for pharmaceutical chemical solutions, in capacitors, electrodes, fuse-wires, ammunitions, tinned iron sheets to protect victuals, sweets, tobacco, etc.

Tin readily forms alloys with other metals to create useful materials, such as, solders, bronzes and fusible alloys. Tin with lead forms an excellent alloy which melts at very low temperature and is used as solders in electronics or as a seal in plumbing. Tin is used in making fusible alloys to be used in safety devices, such as, fire sprinklers, pressure cookers, boiler plugs and electrical fuses. Tin is used in cast iron to improve the microstructure and it results in higher uniform hardness. Tin bronzes are used for making gears, tubing, springs and plumbing fitments and for making bearings. Tin is also used in making high-tech alloys, such as, zirconium-tin, used for cladding the fuel elements in thermal nuclear reactors and a niobium- tin-intermetallic compound used in certain high- performance superconducting fields, such as, in high-energy physics.

Tin oxide-based catalysts are used in air purification system, gas sensors and CO_2 lasers. Organotin compounds are used in agrochemicals and antifouling paints in seafaring vessels. Float Glass Industry is an important user of tin, it utilises a method of floating molten glass over a huge vat of molten tin. Pure tin in molten form is used to provide a flat surface as well as fire-polish on both sides of float glass which solidifies on it. It is also used in the production of lead crystal glass. Tin oxide films thicker than 1 mm on glass, produce a transparent, yet electrically conductive layer. This layer is used in de-icing windscreen, antistatic glassware, security alarm, etc.

Tin has established a long-term future as an innovative, competitive and sustainable material. A new low cost, efficient and environment-friendly solar cell has been developed that uses tin instead of the hazardous lead. Tin, known as fuel catalyst, can save energy and reduce emissions when added to fuel. Tin is also considered as synergist for replacement of antimony fire retardants used in most plastics. Tin can make lithium ion batteries last more than three times longer. Tin and zinc work well together to heal wounds and kill bacteria, enabling use in new range of animal healthcare products. Electrolytic Tinplate undoubtedly enjoys the pride of place as a packaging medium especially of food.

POLICY

As per the Import Policy, under Schedule 1 of ITC (HS) 2022 and export policy under Schedule 2 of ITC (HS) 2022) there are no restrictions on the export and import of tin ores and concentrates.

SUBSTITUTES

Tin is most commonly used for packing goods since it is environmentally beneficial. Alternatives to tin include aluminium, glass, paper, plastic, and tin-free steel. A variety of materials can be utilised to replace tin in its many applications, including tetrapack for liquid food items, plastic/polycontainers for solid and semi-solid food, and aluminium, glass, and tin-free steel cans and containers. Tin-Free Steel (TFS) is an electrolytic chrome-plated steel with a thin layer of chromium and a layer of chromium oxide formed on the steel substrate, resulting in a stunning, lustrous metallic finish on both sides. TFS provides excellent corrosion resistance, lacquer adhesion and printability. TFS also has filiform rust resistance, sulphur blackening resistance, and a coating. Other substitutes for tin include new epoxy resins for tin solders, bronze-aluminum alloys, copper-base alloys, and plastic; plastic for bearing metals that contain tin; and lead-sodium compounds for various tin chemicals.

WORLD REVIEW

The world reserves of tin metal estimated in 2023 were 4.6 million tonnes, located mainly in Indonesia (17%), China (16%), Myanmar (15%) and Brazil & Bolivia (9% each). The world reserves of tin by principal countries are furnished in Table-7.

Table – 7 : World Reserves of Tin

(By Principal Countries)

In '000 tonnes of tin content)

Country	Reserves
World: Total	**4,600**
Australia	570
Bolivia	400
Brazil	420
Myanmar	700
China	720
Congo (Kinshasa)	130
Indonesia	800

Table 7 (Concld.)

Country	Reserves
Laos	NA
Malaysia	NA
Nigeria	NA
Peru	130
Russia	430
Other countries	321

Figures rounded off
Source: USGS , Mineral Commodity Summaries, 2023.
a: For Australia, Joint Ore Reserves Committee-compliant or equvalent reserves were about 3,00,000 tonnes.
e: estimated

The world mine production increased marginally by 0.4% during 2023 to 2,73,000 tonnes as compared to that 2,72,000 tonnes in the preceding year (Table- 8). China is the largest producer of tin in 2023 with contribution of about 25% share in the total world production followed by Indonesia (21%) and Myanmar (15%).

Table – 8 : World Mine Production of Tin

(By Principal Countries)

In tonnes (metal content)

Country	2020	2021	2022
World total	**292000**	**272000**	**273000**
Australia	8118	8772	9001
Bolivia	14709	19628	17613
Brazil	16634	8203	9799
China	94463	83144	67365
Congo, Democratic Republic	14673	15963	14971
Indonesia	65127	52467	57735
Myanmar	36000	*32000	*40500
Peru [(a)]	20647	26995	28231
Vietnam	7260	7666	8139
Other Countries	108832	100306	87011

Figures rounded off
Source: BGS, World Mineral Production, 2018-2022
(a) Recoverable
** Estimated*

FOREIGN TRADE

Exports

There were nil exports of tin ores & concentrates during the year 2022-33 and 2021-22 (Table -9) Productwise details are provided in Table -10.

Table- 9: Export of Tin Ores & Conc.

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (Ton)	Value (₹ ’000)
All Countries	**++**	**++**	**++**	**17**
New Zealand	--	--	++	17

Figures rounded off

Table -10: Exports of Tin

(By Products)

Product	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
1. Tin and Alloys Incl. Scrap	1191	1494894	797	975946
a) Tin and Alloys	721	1432470	361	914572
b)Tin and Alloys : Worked	469	62201	436	61221
c) Tin (Scrap)	1	223	++	153
2. Tin Alloys Nes	349	606809	88	214103
3. Tin :Anode,Cathode,etc of Tin Unwrought	128	356713	121	329981
4. Tin Blocks	++	1483	++	140

Imports

The imports of tin ores & concentrates in 2022-23 was negligible and remained same asthat of the previous year (Table-11). Productwise details are provided in Table 12.

Table- 11: Import of Tin Ores and Conc.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**299**	**++**	**366**
Korea Rep. of	++	244	++	285
USA	++	16	++	75
Uganda	--	--	++	4
Singapore	--	--	++	2
Cameroon	++	37	--	--
Nigeria	++	2	--	--

Figures rounded off

Table- 12: Import of Tin Productwise

Product	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
1. Tin and Alloys Incl. Scrap	10809	28696669	13792	32096144
a) Tin and Alloys	10333	28331809	13507	31791629
b) Tin and Alloys : Worked	476	364860	265	285379
c)Tin Waste And Scrap	--	--	20	19136
2. Tin Alloys Nes	79	213609	105	261511
3.Tin :Anode,Cathode,etc. of Tin Unwrought	9937	27285876	13064	30647451
4. Tin Blocks	8	21969	12	31799
5. Tin (Scrap)	--	--	20	19136

Figures rounded off

FUTURE OUTLOOK

According to the analyses put out by International Tin Association (ITA), the world demand for tin would raise to 50,000 tonnes per year by 2025. The Indian tin market has exhibited consistent growth patterns due to the growing product utilisation across various industries. This can be supported by the widespread production of tin in the manufacturing of consumer electronics, packaging, and automotive industries. India's rapid urbanisation and growth in disposable incomes are leading to increased consumption of products that utilize tin, further boosting the market. On the other hand, the Government's focus on promoting domestic manufacturing, combined with strategic partnerships and investments in mining and refining facilities, ensures a stable supply chain. Additionally, technological advancements in recycling and processing methods are adding to the market's sustainability, aligning with global environmental concerns. In confluence with this, environmental concerns and the need for responsible mining also put pressure on the industry. The future of the Indian tin market appears promising, with continuing technological innovation, investment in infrastructure, and favourable Government policies are ikely to contribute to sustained growth and development. Apart from this, the rise in e-commerce, organised retail and increasing consumer awareness about sustainable packaging are contributing to the market. Tin, with its excellent properties, including recyclability, preservation, and resistance to corrosion, is gaining popularity as a preferred material for packaging solutions.

This trend presents a significant opportunity for tin manufacturers and suppliers to cater to the Packaging Sector's increasing demands. The per capita consumption of tin plate in India is considerably low (0.49 kg per capita) when compared to many developed countries (8-12 kg per capita) and developing economies like China (4.75 kg per capita). High growth in modern retail, FDI in multi-brand retail combined with Government's thrust on food processing industries augur well for the growth of Packaging Industry in India which in turn could spur growth of tin consumption in the country.

28 . Tungsten

Tungsten, also referred to as 'wolfram', is a dense, lustrous metal that ranges from greyish white to steel grey. In June, 2023, an updated list of 30 critical minerals was issued by Ministry of Mines which listed Tungesten as a critical mineral for the security and overall economic development of the nation. The inclusion comes after the committee for identifying critical minerals identified tungsten as a mineral of both of high economic value and high supply risk. It is intrinsically brittle which makes it more challenging to work with. Tungsten is a crucial metal that is essential to the industrial development of the country. Tungsten does not occur in nature as a free metal. Scheelite (Calcium tungstate, $CaWO_4$) and wolframite [combination of ferrous tungstate and manganous tungstate, $(Fe,Mn)WO_4$] are the primary sources of tungsten, both of which are hydrothermal in origin. Tungsten has the highest melting point of any metal at 3,422 °C. It is also resistant to all acids at normal temperatures. It possesses excellent corrosion resistance, thermal and electrical conductivity, and a low coefficient of expansion. It is elastic, ductile, has high tensile strength, and can be formed into tiny wires. Tungsten is considered the most important metal for thermo-emission applications not only because of its high electron emissivity but also because of its high thermal and chemical stability. As tungsten has extremely high melting point and is ductile, it is widely used in filaments of light bulbs and vacuum tubes, and for heating elements in electrical furnaces.When exposed to air, tungsten forms a protective oxide on its surface. However, it can be totally oxidised at higher temperatures. When tungsten is added to steel in modest amounts, it significantly boosts its hardness. Imports are the primary source of tungsten and related derivatives for domestic consumption. Recycling tungsten and its alloys, including waste and scrap, helps recover a considerable amount of the metal.

RESERVES/RESOURCES

According to NMI as on 01.04.2020, India's total tungsten ore resources are assessed to be 89.43 million tonnes, with a WO_3 content of 1,44,650 tonnes. These resources are included under the 'Remaining Resources' category.Resources of tungsten-bearing minerals are mainly distributed in Karnataka (41%), Rajasthan (27%), Andhra Pradesh (17%) and Maharashtra (11%). The remaining 4% resources are in Haryana, Tamil Nadu, Uttarakhand and West Bengal (Table-1). Incidences of WO_3 in tungsten ore have been reported from different areas of the country. At Degana, Rajasthan, in a total of 7 blocks, the minimum and maximum values of WO_3 noticed were 0.09% and 1.62%, respectively. At Balda of Sirohi district, Rajasthan, the average WO_3 content was found to range from 0.24 to 0.48 per cent. In Dewa-Ka-Bera of Sirohi district, the average WO_3 is 0.03% and in Udwarya of Sirohi, it is 0.27%. In West Bengal, Bankura deposit contains an average of 0.1% WO_3. In Kuhi-Khobana-Agargaon belt of Maharashtra, GSI has estimated resources in Sakoli basin in the district of Bhandara and Nagpur. The analysis showed 0.01 to 0.19% WO_3i n Kuhi block, 0.13 to 0.38% WO_3 in Khobana block and 0.48% WO_3in Pardi-Dahegaon-Pipalgaon block. Gold ore at Mysore mine of BGML in Karnataka has been reckoned as a potential source of scheelite. The tailing dumps at Kolar Gold Fields contain about 0.01 to 0.05% WO_3.

Table –1 : Reserves/Resources of Tungsten as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total			
Ore	0	89432464	89432464
Contained WO_3	0	144650	144650
By States			
Andhra Pradesh			
Ore	0	14802300	14802300
Contained WO_3	0	20263	20263
Haryana			
Ore	0	2230000	2230000
Contained WO_3	0	3568	3568
Karnataka			
Ore	0	36677818	36677818
Contained WO_3	0	6235	6235
Maharashtra			
Ore	0	10122250	10122250
Contained WO_3	0	18591	18591
Rajasthan			
Ore	0	23928294	23928294
Contained WO_3	0	93708	93708
Tamil Nadu			
Ore	0	250000	250000
Contained WO_3	0	50	50
Uttarakhand			
Ore	0	658000	658000
Contained WO_3	0	705	705
West Bengal			
Ore	0	763802	763802
Contained WO_3	0	1531	1531

figures roundedoff

EXPLORATION & DEVELOPMENT

The details on exploration and development, if any, are covered in the Review on Exploration & Development under "General Reviews"

MINING LEASES & PRODUCTION

No miming lease for Tungsten has been granted as on March 31st, 2023. Naturally, there was no reported production of tungsten ore/concentrate during 2022-23. In the past, production of tungsten was reported from Degana in Rajasthan and Chendapathar in West Bengal.

Currently, there is no mining activity happening for tungsten in the country. Degana in Rajasthan and Chendapathar in West Bengal were the only mines of tungsten in India that had produced meagre quantities of concentrate. These mines, owing to economic non-viability, had to be closed down. However, NMDC is involved in overseas tungsten exploration project (NMDC LIMITED Annual Report, 2023-24). Legacy Iron Ore Ltd (Legacy) is an ASX-listed mineral resources company based in Perth, Western Australia, focusing on gold, iron ore and base metals. NMDC has 91.38% equity in the company. Legacy holds 24 prospective tenements across its Mount Bevan, South Laverton, and East Kimberley project areas in Western Australia. The tenements are in various stages of exploration for a host of commodities, including iron (1), gold (20), base metals and tungsten (3).

USES & CONSUMPTION

Tungsten is mainly used in the form of ferrotungsten in making of special and alloy steels and military applications. Ferrotungsten typically contains between 25% and 75% tungsten. The other principal use of tungsten is in the manufacture of tungsten carbide, one of the hardest synthetic materials used in various industries like construction, metalworking, mining and oil drilling. It is also consumed for strategic and security purpose such as production of hard materials like high penetration alloy for weaponry, rockets and missiles. Tungsten alloys and tungsten composites are used as a substitute for lead in bullet and shot. It is used widely in the manufacture of cutting tools & devices and in wear-resistant materials, particularly those that need to be operated at high temperatures. In making this, cobalt or nickel metal powder is used as a binder to hold together the tungsten carbide grains. Tungsten compounds are used in dyes and pigments; manufacture of paints & printing ink; and also in Ceramic Industry for producing yellow tint. Other alloys bearing tungsten have wide range of applications, i.e., ornaments, heat sinks, radiation shielding, weights & counter-weights, superalloys for turbine parts, tool steels wear-resistant alloy parts & coatings, etc.. Tungsten is used as filament in incandescent light bulbs and cathodes for electronic tubes, cell phones, television set, HID lamps and other electrical consumer products. The metal is used in superalloys with copper or silver and in Chemical Industry. Tungsten carbide is often used in armor-piercing ammunition.

The entire domestic requirement of tungsten ore/ concentrates is met by imports. Sandvik Asia Pvt. Ltd, Pune, Maharashtra; Widia (India) Ltd, Bengaluru, Karnataka; Rapicut Carbides Ltd, Ankleshwar, Gujarat; Mishra Dhatu Nigam Ltd, Hyderabad, Telangana; and Sunflag Iron & Steel Co. Ltd, Bhandara, Maharashtra were the important consumers of ferrotungsten for production of alloy steel. However, the current information regarding consumption of ferrotungsten by these companies are not available. Mining Machinery Industry is the main consumer of the imported ore/concentrates

SUBSTITUTES

Tungsten is still primarily used for the manufacturing of filaments, electrodes, and contacts in lamp and lighting applications. However, an electrodeless, non-tungsten lamp is offered as an option for commercial and industrial applications. Titanium, tantalum, and niobium carbides can all be used in wear-resistant applications. Molybdenum and tungsten tool steels can be used interchangeably. Bulk ceramic is an option for certain cutting tool applications. In some instances, substitution would almost always result in an increase in cost or a decline in product performance.

TRADE POLICY

As per the Import Policy - ITC(HS) 2022 and Export Policy - ITC(HS) 2018, the imports and exports of tungsten ores and concentrates (HS Code 26110000) are allowed free.

WORLD REVIEW

Global tungsten resources are widely distributed. China leads the world in tungsten resources and reserves, with some of the largest deposits. The total worldwide tungsten reserves in terms of metal content are approximately 3.8 million tonnes, with China accounting for 47%, Russia (11%), Vietnam for (3%), and Spain (1%) (Table- 2).

Table - 2: World Reserves of Tungsten (By Principal Countries)

(In ' 000 tonnes of Tungsten content)

Country	Reserves
World: Total (rounded)	3800
Austria	1 0
Bolivia	N A
China	1 8 0 0
Portugal	3
Russia	40 0
Rwanda	N A
Spain	5 6
USA	N A
Vietnam	10 0
Other countries	1 4 0 0

Source: USGS, Mineral Commodity Summaries, 2023
figures roundedoff

The world mine production of tungsten in terms of metal content in 2022 decreased marginally by 0.5% to 99,200 tonnes from 99,700 tonnes in 2021. China was the leading producer (75%) followed by Vietnam (16%) and Russia & Rwanda (2% each) and (Table-3).

Table – 3 : World Mine Production of Tungsten (By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
World:Total (rounded)	**92 600**	**99 700**	**99 200**
China	76000	75000	75000
Vietnam	8066	15858	15477
Russia	2692	2700	2300
Rwandaa	956	1281	1808
Bolivia	1030	1194	1038
Austria	896	919	910
Spain	238	643	588
Korea, Rep. of	1192	500	500
Congo, Dem. R.	137	127	140
Other countries	1393	1478	1439

Source: World Mineral Production, 2018-22
figures roundedoff

FOREIGN TRADE

Exports

The exports of tungsten and alloys including scrap decreased by 8% to 1,117 tonnes in 2022-23 from 1,209 tonnes in the previous year. In the year 2022-23, exports of tungsten ore & concentrates were reported as Nil compared to 13 tonnes in previous year. (Table 4 % 5)

Table 4 Exports of Tungsten Ores And Conc.

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**13**	**7139**	**--**	**--**
Vietnam Soc Rep	13	7139	--	--

Figures rounded off

Table 5 Export of Tungsten And Alloys Incl. Scrap (By Products)

Product	2021-22 (R)		2022-23 (P)	
	Qty (Kg)	Value (₹ '000)	Qty (Kg)	Value (₹ '000)
Tungsten & Alloys Incl. Scrap (Total)	**1209171**	**2600160**	**1117211**	**2746384**
Tungsten And Alloys Unwrought	421077	861375	440134	1009240
Tungsten Filament	4428	54764	3941	67887
Tungsten Unwrought	138260	252246	101094	204750
Tungsten Waste And Scrap	612817	970235	551199	988690
Tungsten Wire	32589	461540	20843	475817
Ferro-Tungsten	1	4368	2	10724
Tungsten And Alloys ;Worked Nes	378733	815027	366185	909220
Tungsten Powder	42344	46348	73949	100020

figures roundedoff

Imports

Imports of tungsten and alloys including scrap increased by 16% to 422 tonnes in 2022-23 from 365t onnes in the previous year (Table-5). Imports oftungsten ores and concentrates increased by1 80% to 423 tonnes in 2022-23 from 151 tonnes in the previous year. Imports were mainly from Netherlands (81%) followed by Belgium (9%) and Japan (7%).

Table 6 Import of Tungsten Ores And Conc.

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**151**	**14800**	**423**	**142414**
Netherland	132	13703	343	113766
Japan	19	1097	31	11985
Belgium	--	--	40	10377
Canada	--	--	1	3467
Latvia	--	--	8	2819

figures roundedoff

Table 7 Import of Tungsten And Alloys Incl. Scrap (Pruduct wise)

Product	2021-22 (R)		2022-23 (P)	
	Qty (Kg)	Value (₹ '000)	Qty (Kg)	Value (₹ '000)
Tungsten And Alloys Incl. Scrap (Total)	**364880**	**1805805**	**422270**	**2478727**
Tungsten And Alloys Unwrought	198363	911580	223702	1315264
Tungsten Filament	976	33532	1365	33353
Tungsten Unwrought Total	60232	188890	83145	285025
Tungsten Waste And Scrap	--	--	14429	23342
Tungsten Wire	105309	671803	99629	821743
Ferro-Tungsten	2	4892	33	71825
Tungsten And Alloys ;Worked Nes	96449	544453	115270	840838
Tungsten Powder	101914	367127	108432	474426

figures roundedoff

FUTURE OUTLOOK

The tungsten market size was valued at USD 4.75 Billion in 2023. The tungsten industry is projected to grow from USD 5.13 Billion in 2024 to USD 9.49 Billion by 2032, exhibiting a compounded annual growth rate (CAGR) of 8.00% during the forecast period (2024 - 2032) according to various market surveys. Due to its special properties, tungsten can be used in various industrial applications. X-ray tubes, bulb filaments, radiation shielding, super alloys, penetrating projectiles, gas tungsten arc welding, and industrial catalysts are examples of these uses. Some current uses include filaments in light bulbs and cathode ray tubes, electrodes, heating components, and field emitters. The tungsten market is experiencing strong expansion due to increased demand for downstream products in industries such as automotive, industrial engineering, energy, and aviation. The tungsten market is seeing expansion due to the discovery of new uses in industries such as medicine, defence, and electronics.In India, the entire demand of tungsten can only be met by imports and recycling, as there is no indigenous production of tungsten ore & concentrates. High content of WO3 in the tailing dumps of Kolar can be worked on priority basis tomeet the demand. World tungsten supply was dominated by production in China and exports from China. Chinese Government regulated its Tungsten Industry by limiting the number of mining and export licences,imposing quotas on concentrate production, and placing constraints on mining and processing. Scrapcontinued to be an important source of raw material for the Tungsten Industry worldwide. China was the world's leading tungsten consumer.

In view of growing demand of tungsten in key sectors including defense & security and high supply chain risks, the Government of India notified tungsten as one of the 30 critical minerals. KhanijBidesh India Limited (KABIL under the aegis of Ministry of Mines, Government of India, has been established to ensure supply side assurance of critical and strategic minerals and mineral security of the nation.

29. Vanadium

Vanadium was discovered in 1801 by a Mexican Mineralogist Andres del. Rio. It is a scarce element, hard, silvery grey, ductile and malleable transition metal with good structural strength. It is a versatile metal with melting point of 1910 °C. Vanadium metal and its compounds are gaining tremendous importance in the rapidly advancing field of science & technology. It occurs naturally in about 65 different minerals among which are patronite, vanadinite, roscoelite and carnotite. It is also present in bauxite and in fossil fuel deposits. It occurs in association with titaniferous magnetite and is recovered as a by-product during iron & steel manufacture. Vanadium is also concentrated in many end-products of organic material including coal, crude oil, shale and tar sands. It is also found in small percentages in meteorites. In addition, vanadium present in bauxite can also be recovered as vanadium sludge from red mud during the production of alumina. Vanadium is widely used in green technology applications, especially in battery technology.

Vanadium has the property to increase the tensile strength of steel. Its high strength to weight ratio meets fuel efficiency requirements in the Automotive and Aerospace Industries.

The Ministry of Mines, Govt. of India, in June 2023, released the list of 30 Critical Mineral for India which also included Vanadium bearing minerals in it. In line of the same, the Central Government of India has amended the Mines and Minerals Development and Regulation Act, 1957 (MMDR Act, 1957) through the MMDR Amendment Act, 2023, whereby 24 critical and strategic minerals (including Vanadium bearing minerals) have been inserted in Part D to the Schedule-1 of the MMDR Act, 1957 which have been identified as critical and strategic minerals for the country. Further, the amended Act has also empowered Central Government to auction critical and strategic minerals blocks.

In addition to the above, MMDR Amendment Act, 2023 also introduced exploration license for deep-seated and critical minerals such as gold, silver, copper, zinc, lead, nickel, cobalt, platinum group of minerals, diamonds, vanadium bearing minerals etc. which have been placed under 7th Schedule of the MMDR Act.

RESERVES/RESOURCES

In India, vanadium is associated with titaniferous magnetite which contains 0.8 to 3% . It also occurs in significant amounts in association with chromite, laterite, bauxite and ferromagnesian-rich rocks, such as, pyroxenite, base anorthosite and gabbro.

As per NMI database, based on UNFC system, the total estimated reserves/ resources of vanadium ore as on 1.4.2020 are placed at 24.63 million tonnes with an estimated V_2O_5 content of 64,594 tonnes. The entire resources of vanadium are placed under Remaining Resources category (Table-1).

Table – 1 : Reserves/Resources of Vanadium as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total			
By Grades			
Ore	0	24633855	24633855
Contained V_2O_5	0	64594.01	64594.01
By States			
Karnataka			
Ore	0	19384430	19384430
Contained V_2O_5	0	49497.55	49497.55
Maharashtra			
Ore	0	384630	384630
Contained V_2O_5	0	1538.52	1538.52
Odisha			
Ore	0	4864795	4864795
Contained V_2O_5	0	13557.94	13557.94

Figures rounded off

MINING LEASE & PRODUCTION

Vanadium is recovered from slag that is collected from the processing of vanadiferous magnetite ore where iron and steel are the principal products. The processing of gas and petroleum products is also an important source of vanadium, which is recovered both from the raw material and from the recycling of vanadium-bearing catalyst.

RIL has developed a low-cost & low-temperature hybrid green process to extract vanadium from gasifier slag. The green process is being scaled up from lab to pilot level. Vanadium sludge is separated as a by-product during the Bayer process for production of alumina hydrate. NALCO has completed lab-scale studies to recover vanadium sludge from various Bayer Liquors. Vedanta's Lanjigarh Alumina Refinery has developed an in-house process for extraction of V_2O_5 (Vanadium Pentoxide) present in bauxite involving simple operations with very low energy consumption. Thus, it is considered as innovative, cost-effective and environment-friendly besides ensuring optimum utilisation of natural resources. This project was taken up as a part of Vedanta's ambitious project of Zero Discharge and Zero Waste Alumina Refinery. Vanadium recovery will make the country self- sufficient in meeting its demand as most of these hitherto was imported to make ferrovanadium. Vanadium recovery projects help in additional generation of revenue. The vanadium sludge obtained at BALCO's Korba plant contains 6 to 10% V_2O_5, while that at Hindalco's Renukoot plant contains 8.2% V_2O_5 and Muri & Belagavi plants 6 to 20% V_2O_5

As per the auction data available at website of Ministry of Mines, two mineral blocks with respect of vanadium have successfully been auctioned so far (as on 23.09.2024) as per below.

S No	State	Name of the Block	Mineral	Date of auction	ML/ CL	Area (in Ha)	Reserves (in MT)	Final Bid (in %)	Preferred Bidder
1	Madhya Pradesh	Makra Block	Graphite and Vanadium	14.09.2023	CL	37.5	N.A.	94.15	Universal Industrial Equipment and Technical Services Pvt. Ltd
2	Central Government/ Madhya Pradesh	Golighat Graphite and Vanadium Block	Graphite and Vanadium	20.07.2024	ML	82	5.88	155.05	Shanti GD Ispat and Power Pvt.

USES & CONSUMPTION

Vanadium is used primarily as an alloying element in Iron & Steel Industry and to some extent as a stabiliser in titanium and aluminium alloys which are used in aerospace applications. It imparts toughness and strength to steel, alloys and also acts as scavenger for oxygen. Vanadium is consumed in the Steel Industry in the manufacture of a wide-range of products, from low carbon flat rolled steels, high strength plates & structural steels to pipes, reinforcing bars, forging steels, rail steels and tool steels. Vanadium (about 80%) is mostly used in the form of ferrovanadium as a means of introducing vanadium into steel. There are two groups of vanadium steel alloys. Vanadium high carbon steel alloys that contains 0.15% to 0.25% vanadium and High Speed Steels (HSS) where vanadium content is in the range of 1% to 5%. HSS steel is used in surgical instruments and other tools. The content of vanadium in ferro-vanadium varies from 45 to 50% and in some cases up to 80%, depending upon the demand. The 45 to 50% grade is produced from slag and other vanadium containing material by silicothermic reduction of pentoxide (V_2O_5) in presence of steel scrap or by direct reduction in an electric arc furnace. The resultant vanadium steels can be divided into micro-alloy or low-alloy steels with less than 0.15% vanadium and high-alloy steels with up to 5% vanadium. Non-metallurgical applications include its use as catalyst and in ceramic, chemical, pigments, health preparations and electronic industries. It is also used to produce super conductive magnets with a field of 1,75,000 gauss. The most common oxide of vanadium, i.e., vanadium pentoxide (V_2O5) is used as a catalyst in manufacturing sulphuric acid. In biological context, vanadium is a micro-nutrient found naturally in mushroom, shellfish, black pepper, parsley dill, grain and grain products. It exists as both vanadyl sulphate, the form most commonly used in food supplements and vanadale.

Modern applications of vanadium include its use as vanadium secondary batteries for power plants and rechargeable vanadium redox battery (VRB) for commercial applications. The main advantages of VRB are that it can offer almost unlimited capacity simply by using sequentially larger storage tanks; can be left completely discharged for long periods of time with no ill-effects; can be recharged by replacing the electrolyte if no power source is available to charge it; and suffers no permanent damage if the electrolytes are accidentally mixed. The VRB has also been shown to have the least ecological impact of all energy storage technologies.

SUBSTITUTES

Substitution of vanadium in steel by niobium, chromium, titanium, manganese, molybdenum and tungsten is possible although at higher cost or with lower performance. Heat-treated carbon steels can replace vanadium steels in some applications. Platinum and nickel can be used in some catalytic processes but at higher cost. Presently, there is no acceptable substitute for vanadium in titanium alloys used in aerospace application.

WORLD REVIEW

The world reserves of vanadium was about 26 million tonnes of metal located mainly in China (37%), Australia (28%), Russia (19%), South Africa (13%) and the remaining share was accounted for by US & Brazil (Table-2). Titaniferous magnetite is the most important source of about 85% of current world V_2O_5 production from which vanadium could be extracted as a by-product of iron. The resources are also available in crude oil (in Caribbean basin, parts of Middle East and Russia), tar sands (in Western Canada), phosphate rock, uraniferous sandstone and siltstone. In all those cases, extraction depends on economic recovery of the product.

The world production of vanadium in 2022 was 1,11,000 tonnes of metal content. This includes vanadium in slag product but excludes vanadium recovered as a by-product at the refining and burning of heavy oils. Major producing countries were China (69%), Russia (18%) and South Africa (8%) (Table-3). Remaining countries together contributed 5% of the total world mine production. Most of the world's vanadium supply originates from primary sources or co-production.

Table – 2: World Reserves of Vanadium

(By Principal Countries)

(In '000 tonnes of vanadium content)

Country	Reserves
World: Total (rounded off)	26,000
United States	45
Australia#	7,400
Brazil	120
China	9,500
Russia	5,000
South Africa	3,500

Source: USGS, Mineral Commodity Summaries, 2023
 # For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 1.7 million tonnes

Table – 3: World Mine Production of Vanadium

(By Principal Countries)

(In tonnes of metal content)

Country	2020	2021	2022
World: Total (rounded off)	**111000**	**115000**	**111000**
Russia	19533	20058	*20000
South Africa	14421	15424	9100
USA	17	-	-
Brazil	6622	5779	5844
China	*70000	*73000	*76000
India [(a)]	*100	*100	*100
Kazakhstan [(b)]	237	260	306

Source: BGS, World Mineral production, 2018-22
Note :
(1) This table includes vanadium in slag products but excludes vanadium recovered as a by-product of the refining and burning of heavy oils.
(a) Years ending 31 March following that stated
(b) Tonnes of vanadium pentoxide
** estimated*

(In tonnes of metal content)

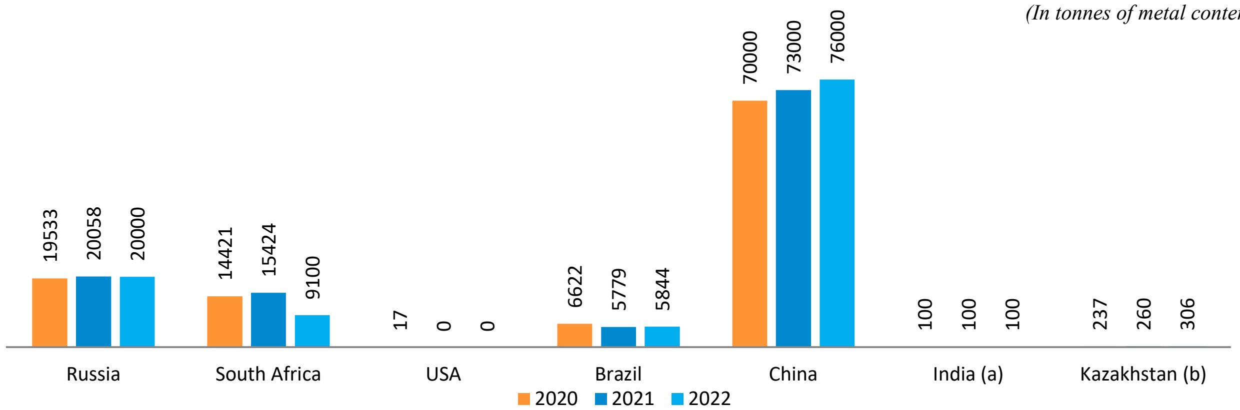


Fig.1: Countrywise Production of Vanadium

FOREIGN TRADE

Exports

In 2022-23, the exports of ferro vanadium decreased drastically by 49% to 85 tonnes from 168 tonnes in the previous year. Exports were mainly confined to Thailand (37%), Netherlands (35%), UAE and Oman (13% each) (Table-4).

The exports of vanadium ore and concentrates were reported as Nil during both the years i.e. 2021-22 and 2022-23 (Table-5).

Table – 4: Export of Ferrovanadium

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**168**	**353217**	**85**	**233314**
Thailand	58	118040	31	85566
Netherlands	20	53247	30	77676
UAE	18	38004	11	34895
Oman	66	126260	11	26582
Turkey	1	3017	1	3600
Fiji	1	1649	1	1936
USA	--	--	++	1575
Malaysia	++	706	++	564
Israel	++	272	++	523
Indonesia	++	1057	++	271
Other Countries	4	10965	++	126

Figures rounded off
++ Negligible

(In tonnes)

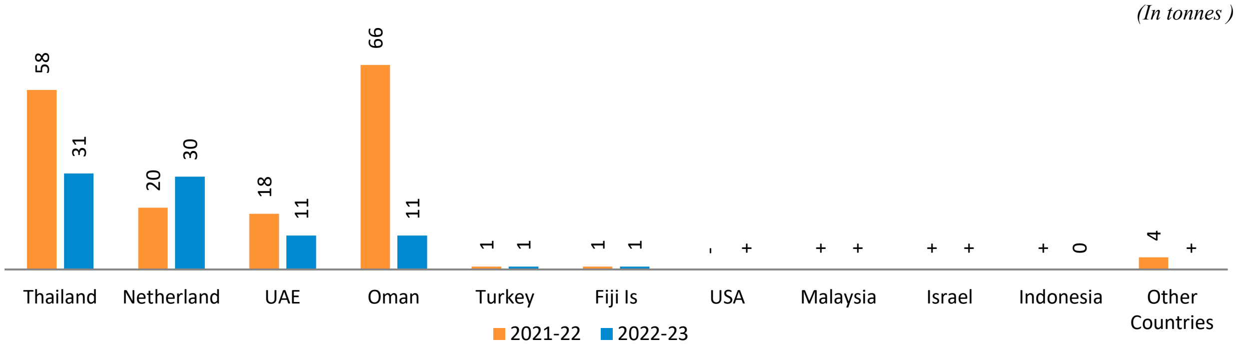


Fig 2: Countrywise Export of Ferrovanadium

Table – 5 : Export of Vanadium Ores & Conc.

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	--	--	--	--

-- Nil

Imports

In 2022-23, the imports of ferro vanadium increased significantly by 35% to 1,211 tonnes from 900 tonnes in the previous year. The imports were mainly from Republic of Korea (45%), Japan (25%), China , UAE and Germany (8% each) (Table-6).

The imports of vanadium ores and concentrates during 2022-23 decreased significantly by 38% to 3,661 tonnes as compared to 5,869 tonnes in the previous year. The imports were mainly from Canada (93%), Mexico (3%), Republic of Korea. (2%), USA & Taiwan (1% each) (Table-7).

Table - 6: Import of Ferrovanadium

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**900**	**1806932**	**1211**	**2795214**
Korea Rpep. of	280	658607	546	1340803
Japan	81	192180	299	570201
China P Rp	20	25003	92	241472
UAE	56	72657	100	239797
Germany	287	555669	92	213941
Russia	--	--	40	80359
Slovenia	16	42155	12	38481
Czech Republic	90	122774	10	28099
Netherlands	5	11338	10	25503
USA	13	14522	8	13151
Other Countries	52	112027	2	3407

Figures rounded off
-- Nil

(In tonnes)

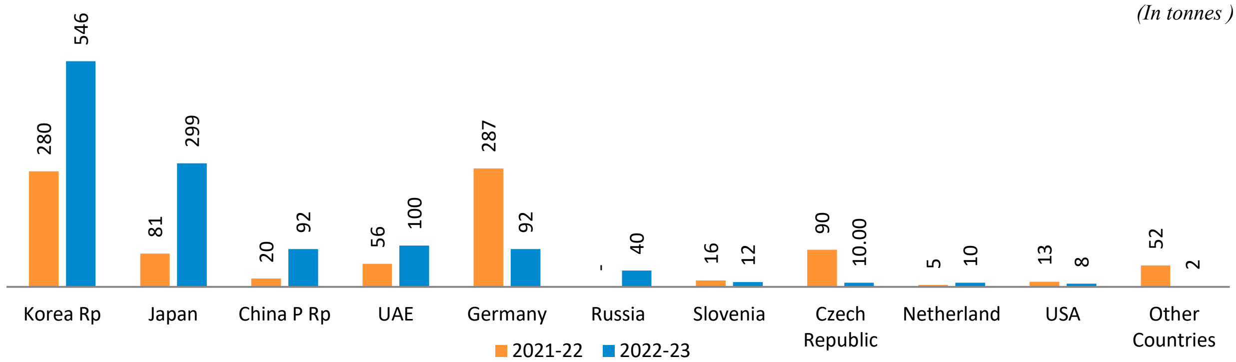


Fig 3: Countrywise Imports of Ferrovanadium

Table - 7: Import of Vanadium Ores and Conc.

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**5869**	**436744**	**3661**	**209238**
Canada	4172	157517	3417	176087
Taiwan	148	64896	33	19165
Mexico	277	104089	114	7564
USA	--	--	37	3595
Korea, Rep. of	253	19474	60	2738
France	--	--	++	89
Kuwait	980	74117	--	--
Russia	16	15593	--	--
Ukraine	23	1058	--	--

Figures rounded off
++ *Negligible*

FUTURE OUTLOOK

The worldwide demand for vanadium is directly linked to the demand for steel specially with demand of high-strength steel. In vanadium batteries, the consumption is likely to increase in future. On the other hand, with growth of Automobile and Casting Sectors, demand for ferrovanadium is expected to increase and this will have to be met by imports. The accelerated growth in the Forging Industry and increased demand for die steels and tool steel have paved way for increased vanadium consumption. Imperatives for utilisation of the huge vanadium-bearing titaniferous ores available in the States viz, Karnataka, Maharashtra and Odisha, through R&D efforts will have to be initiated to meet the domestic demand of vanadium pentoxide and ferrovanadium. Imperatives for utilisation of the huge vanadiumbearing titaniferous ores available in the States viz, Karnataka, Maharashtra and Odisha, through R&D efforts will have to be initiated to meet the domestic demand of vanadium pentoxide and ferro-vanadium.

High Energy Batteries (India) Ltd is broadening its product portfolio to include fuel cells and flow batteries, specifically Vanadium Redox Flow Batteries (VRFBs), intended for hydrogen-based power generation and large-scale energy storage applications. In partnership with IIT-Madras and the ONGC Energy Centre Trust (OECT), the company has developed a 1kW/10kWh VRFB over the past two years. This 'Energy Storage System for extended endurance integrates the battery with renewable energy sources like solar and wind. Further, Indian power utility National Thermal Power Corporation (NTPC) is also progressing towards the commissioning and integration of a 600 kw/ 3,000 kwh Vanadium Redox Flow Battery (VRFB) system for long-duration energy storage (LDES) at NTPC Energy Technology Research Alliance (NETRA) center in Greater Noida. Hence, the increased demand of Vanadium for vanadium Redox Flow Batteries will lead to increase in the domestic exploration of vanadium which will in turn facilitate in-house mining of the same. As more than 90% of vanadium is used in steel production, its demand is correlated to gross crude steel production. Use of vanadium in manufacturing of rebar in China and other emerging markets have picked up, as these countries are increasingly adopting western standards in the fabrication of high-strength rebar used in construction activities.

As per Vanadium Market Size, Share, Analysis & Forecast Report [2032] of Fortune Business Insights, the global vanadium market is expected to grow from $4.28 billion in 2023 to $4.89 billion by 2032, with a compound annual growth rate (CAGR) of 4.4%. Increasing demand of vanadium in Automobile Industry, Medical Industry, Steel Industry and Vanadium Redox Flow Batteries are expected to stimulate the sales of vanadium globally.

Mineral Reviews

30. Apatite and Rock Phosphate

Apatite is a crucial group of phosphate minerals, first named by German Geologist Abraham Werner in 1786. It is the most abundant crystalline phosphate mineral, often found as an accessory mineral in nearly all types of igneous rocks. It can be concentrated in pegmatites, metallic veins, and magmatic deposits, and it also occurs in metamorphic rocks and as a secondary mineral in sedimentary phosphatic rocks.

The term "apatite" generally refers to three main varieties: hydroxyapatite, fluorapatite, and chlorapatite. Among these, fluorapatite ($Ca_5(PO_4)_3F$) is the most prevalent and serves as a secondary source of fluorine. Another form, Collophane ($Ca_3P_2O_8$), is an amorphous or cryptocrystalline calcium phosphate complex.

Rock Phosphates, or phosphorites, are sedimentary deposits rich in various calcium phosphates, primarily hydroxyapatite, carbonateapatite, and fluorapatite. These rocks are essential for global phosphate production, as they contain sufficient purity and quantity of phosphatic minerals to be used directly or after processing for commercial products.

Moreover, rock phosphate is a valuable source of by-product fluorine, with materials containing 3-4% CaF_2 being particularly useful for recovering fluorite. Hydrofluorosilicic acid is generated as a by-product in phosphoric acid plants during rock phosphate processing. Additionally, phosphate rocks are also considered a significant secondary resource for uranium.

India is deficient in Apatite & Rock Phosphate availability. In case of apatite, the country is fully dependent upon imports, while the Rock Phosphate production is only from two States, namely, Rajasthan and Madhya Pradesh.

RESERVES/RESOURCES

Apatite

The total Reserves/Resources of apatite as per NMI data, based on UNFC system as on 1.4.2020 has been placed at 21.11 million tonnes. Out of these resources, the Reserves are placed at 0.029 million tonnes, while 21.08 million tonnes are placed under Remaining Resources category. Of the total reserves/resources, West Bengal accounts for the bulk of 50%, followed by Jharkhand (34%) and Meghalaya (6%). The remaining 10% resources are located in Rajasthan, Andhra Pradesh, Gujarat and Tamil Nadu. Grade wise, soil reclamation grade accounts for 45% followed by beneficiable grade (32%), Low/Non-beneficiable grade (15%) and remaining Blendable, Unclassified & Not-known grades (7%). The resources of Chemical Fertilizer grade are about one per cent (Table-1).

Table – 1 : Reserves/Resources of Apatite as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**29395**	**21080904**	**21110299**
By Grades			
Chemical Fertilizer	29395	230163	259558
Soil Reclamation	–	9513002	9513002
Low/Non-beneficiable	–	3083006	3083006
Beneficiable	–	6799902	6799902
Blendable	–	264831	264831
Unclassified	–	1000000	1000000
Not-known	–	190000	190000
By States			
Andhra Pradesh	29395	200163	229558
Gujarat	–	351000	351000
Jharkhand	–	7270000	7270000
Meghalaya	–	1300000	1300000
Rajasthan	–	1067521	1067521
Tamil Nadu	–	240000	240000
West Bengal	–	10652220	10652220

Figures rounded off

Rock Phosphate

The total reserves/resources of rock phosphate as per NMI data, based on UNFC system as on 1.4.2020 has been placed at 311.25 million tonnes. Out of these, the reserves constitute only 30.87 million tonnes while 280.37 million tonnes are under Remaining Resources category. Of the total reserves/ resources, 34% are in Jharkhand, 30% in Rajasthan, 19% in Madhya Pradesh, 8% each in Uttar Pradesh &Uttarakhand, respectively. Meagre quantities of resources are also located in Gujarat and Meghalaya. Gradewise, Low-grade account for 37%, followed by Beneficiable (22%), Soil Reclamation (15%) Blendable (10%), Chemical Fertilizer (9%) and remaining Unclassified and Not-known grades (about 7%) (Table-2).

Table No. -2: Reserves/Resources of Rock Phosphate as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**30876093**	**280377392**	**311253485**
By Grades			
Chemical Fertilizer	22442415	6005357	28447772
Blendable	0	32399429	32399429
Soil Reclamation	0	46851282	46851282
Beneficiable	5978874	61674385	67653259
Low Grade	0	115547549	115547549
Unclassified	2454804	14324390	16779194
Not known	0	3575000	3575000
By States			
Gujarat	0	314820	314820
Jharkhand	0	107370000	107370000
Madhya Pradesh	9031093	49425938	58457031
Meghalaya	0	1311035	1311035
Rajasthan	21845000	72003769	93848769
Uttar Pradesh	0	25773444	25773444
Uttarakhand	0	24178386	24178386

Figures rounded off

MINING LEASES & PRODUCTION

Apatite

No production of apatite was reported since 2017-18 (Table-3). The mine-head closing stocks at the end of 2022-23 were 6,306 tonnes same as in 2021-22 (Table-4). The average daily labour employed in apatite mines during 2022-23 was nil as same as in the previous year.

Table – 3 : Production of Apatite, 2021-22 & 2022-23

(By Sectors/States/Districts)

(Qty. in tonnes; Value in ₹ '000)

State	2021-22			2022-23 (P)		
	No. of Mines	Qty	Value	No. of Mines	Production	Value
India	**-**	**-**	**-**	**-**	**-**	**-**
Public sector	-	-	-	-	-	--
Private sector	-	-	-	-	-	-
Andhra Pradesh	**-**	**-**	**-**	**-**	**-**	**-**
Visakhapatnam	-	-	-	-	-	-
West Bengal	**-**	**-**	**-**	**-**	**-**	**-**
Purulia	-	-	-	-	-	-

Table – 4 : Mine-head Closing Stocks of Apatite, 2021-22 & 2022-23

(By States)

(In tonnes)

State	2021-22	2022-23 (P)
India	**6306**	**6306**
Andhra Pradesh	-	-
West Bengal	6306	6306

Phosphorite/Rock Phosphate

The total production of rock phosphate/phosphorite is at 1,978 thousand tonnes in 2022-23 increased by 41.82% as compared to that in the previous year. (Tables - 5 to 7).

There were 8 reporting mines in 2022-23 as compared to 7 in 2021-22. Rajasthan continued to be the principal producing state contributing 77.51% of the total production and the rest was contributed by Madhya Pradesh.

Table – 5 : Principal Producers of Phosphorite/Rock phosphate, 2022-23

Name & address of producer	Location of mine	
	State	District
Rajasthan State Mines & Minerals, C-89-90, Janpath, Lal,Kothi Scheme, Jaipur-302 015, Rajasthan	Rajasthan	Udaipur
M.P. State Mining Corporation Ltd Prayas Bhavan Block No 1(A) Second Floor , Jail Road, Arera Hills, Bhopal, Madhya Pradesh	Madhya Pradesh	Chhatarpur
M.P. State Mining Corporation Ltd Prayas Bhavan Block No 1(A) Second Floor , Jail Road, Arera Hills, Bhopal, Madhya Pradesh	Madhya Pradesh	Jhabua
Khajuraho Stones (India) Pvt. Ltd., Sagar Road Dhadari, Chhatarpur -471 001	Madhya Pradesh	Chhatarpur
M.P. State Mining Corporation Ltd Prayas Bhavan Block No 1(A) Second Floor , Jail Road, Arera Hills, Bhopal, Madhya Pradesh	Madhya Pradesh	Sagar

Table 6: Production of Phosphorite, 2020-21 to 2022-23

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**1455829**	**4694525**	**1394959**	**6648070**	**1978449**	**12904533**
Madhya pradesh	97880	92007	113730	111393	444985	482205
Rajasthan	1357949	4602518	1281229	6536677	1533464	12422328

Table 7: Production of Phosphorite, 2021-22 and 2022-23

(By Sectors/States/Districts/Grades)

(Quantity in tonnes; Value in ₹ '000)

State/District	2020-21							2021-22 (P)						
	No.of mines	Grade: P_2O_5 content				Total		No.of mines	Grade: P_2O_5 content				Total	
		Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Qty	Value		Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Qty	Value
India	**7**	**239429**	**440786**	**-**	**714744**	**1394959**	**6648070**	**8**	**234279**	**601295**	**-**	**1142875**	**1978449**	**12904533**
Public Sector	6	239429	440786		615214	1295429	6554512	2	234279	601295	-	1043005	1878579	12810655
Private Sector	1	-	-	-	9953000%	99530	93558	6	-	-	-	9987000%	99870	93878
Madhya Pradesh	**6**	**-**	**-**	**-**	**113730**	**113730**	**111393**	**6**	**-**	**-**	**-**	**444985**	**444985**	**482205**
Chhatarpur	2	-	-	-	99530	99530	93558	2	-	-	-	253845	253845	261405
Jhabua	3	-	-	-	14200	14200	17835	3	-	-	-	151565	151565	178452
Sagar	1	-	-	-	-	-	-	1	-	-	-	39575	39575	42348
Rajasthan	**1**	**239429**	**440786**	**-**	**601014**	**1281229**	**6536677**	**2**	**234279**	**601295**	**-**	**697890**	**1533464**	**12422328**
Udaipur	1	239429	440786	-	601014	1281229	6536677	2	234279	601295	-	697890	1533464	12422328

The mine-head closing stock of rock phosphate/phosphorite in the year 2022-23 was 25,01,119 tonnes as compared to 23,65,997 tonnes in 2021-22 (Table-8).

The average daily labour employed in rock phosphate/ phosphorite mines in 2022-23 was 737 as against 756 in the previous year.

Table 8: Mine- head closing stocks of Rock Phosphate, 2021-22 and 2022-23

(By States/Grades)

(In tonnes)

State	2021-22					2022-23(p)				
	Grade: P_2O_5 content					Grade: P_2O_5 content				
	Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Total	Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Total
India	**337362**	**422105**	**79068**	**1527462**	**2365997**	**264962**	**424572**	**76292**	**1735293**	**2501119**
Madhya Pradesh		1377	3676	77165	82218		1340	900	248575	250815
Rajasthan	337362	420728	75392	1450297	2283779	264962	423232	75392	1486718	2250304

MINING

Production of phosphorite/rock phosphate in India was reported from eight mines. In Rajasthan, the ore body at Jhamarkotra mine of Rajasthan State Mines and Minerals Limited (RSSM) extends over a strike length of more than 10 km and the average width of phosphate bed is about 15 m with an average inclination of about 550 from the vertical. The height of the bench is maintained up to 10 m. Shovels (6.1 cu. m) and dumpers (85 tonnes) are used for removal of ore and overburden. The mine has an annual rock handling capacity of about 20 million tonnes.

The beneficiation plant of RSMM Ltd at Jhamarkotra has 9 Lacs MT per annum capacity to treat run-of-mine low-grade ore, with an average 16% P2O5.

RSMM Ltd produces the following products:

1) (+) 30% P2O5 crushed -1/2" size high-grade rock phosphate (for SSP manufacturing units).
2) 31.5% P2O5 high-grade rock phosphate Chips (for DAP/Phos Acid manufacturing units).
3) 31.54% P2O5 - BRP Grade (for SSP & DCP Manufacturing units, PROM, etc.)
4) 18% P2O5 ground low-grade beneficiated rock phosphate (RAJPHOS) (direct application to acidic soils).

The Meghnagar mine in Jhabua district and Hirapur mine in Chhatarpur and Sagar districts of Madhya Pradesh are worked by opencast method and both the mines are operated by Madhya Pradesh State Mining Corporation Ltd. Compressed-air jack hammers are deployed for drilling. The present run-of-mine capacity of Jhabua mine is 1,50,000 tonnes per year. The production of Meghnagar Mine is used in Fertilizer Industries and Phosphorus Industries. The BRP plant at Hirapur mine is operated by Madhya Bharat Agro Industries Ltd. The processed ore from the plant is predominantly sold to manufacturers of phosphatic fertilizers and chemicals. Some parts of the ore are also internally consumed for fertilizer production.

INDUSTRY

As per Ministry of Chemicals and Fertilizers Department of Fertilizers Annual Report 2022-23, among the major fertilizer products, the estimated production of urea during the year 2022-23 was 21.09 million tonnes (5.10 million tonnes from Public Sector, 5.35 million tonnes from Cooperative Sector and 10.64 million tonnes from Private Sector), Di-ammonium Phosphate (DAP) 3.18 million tonnes (2.34 million tonnes from Cooperative Sector and 0.84 million tonnes from Private Sector), complex fertilizers 7.07 million tonnes (1.10 million tonnes from Public Sector, 1.16 million tonnes from Cooperative Sector and 4.81 million tonnes from Private Sector).

The major phosphatic fertilizer plants in Public Sector are Fertilizers and Chemicals (Travancore) Ltd (FACT) at Udyogamandal, Kochi (Kerala); Rashtriya Chemicals and Fertilizer Ltd (RCF) at Trombay, Mumbai (Maharashtra); Madras Fertilizer Limited at Chennai (Tamil Nadu); Brahmaputra Valley Fertilizers Corporation Ltd (BVFCL) at Namrup (Assam); National Fertilizers Ltd (NFL) at Noida (U.P.); FCI Aravalli Gypsum and Minerals India Ltd (FAGMIL) at Jodhpur (Rajasthan); Projects and Development India Limited (PDIL) at Noida (U.P.); Fertilizer Corporation of India Limited (FCIL) in New Delhi; and Hindustan Fertilizer Corporation Ltd (HFCL) in New Delhi.

The plants in Private Sector are Gujarat State Fertilizer Company Ltd (GSFC) at Vadodara (Gujarat); Zuari Agro Chemicals Ltd in Goa; Mangalore Chemicals and Fertilizers Ltd at Mangaluru (Karnataka); Gujarat Narmada Valley Fertilizers & Chemicals Ltd (GNFC) at Bharuch (Gujarat); Nagarjuna Fertilizer and Chemicals Ltd (NFCL) at Kakinada (Hyderabad); Chambal Fertilizers and Chemicals (CFCL) at Gadepan (Rajasthan); Tata Chemicals Ltd (TCL) at Bardala (Uttar Pradesh); Kanpur Fertilizer and Cements Ltd (KFCL) at Kanpur (Uttar Pradesh); Indo-Gulf Fertilizers Limited at Jagdishpur Uttar Pradesh, etc.

The plants in the Co-operative Sector that manufacture phosphatic fertilizer are Indian Farmers Fertilizer Co-operative Ltd (IFFCO) at Kandla (Gujarat) and Krishak Bharti Cooperative Ltd (KRIBHCO) at Surat (Gujarat). The 2 plants of IFFCO are in Gujarat (Kalol and Kandla), 2 in Uttar Pradesh (Phulpur and Aonla) and one in Odisha (Paradeep).

Besides, RSMML has a beneficiation plant in Jhamarkotra in Rajasthan, while Krishna Phoschem Ltd has set up a 600 tpdrock phosphate beneficiation plant at Meghnagar in Jhabua district of Madhya Pradesh. The Company has long-term tie-up with Madhya Pradesh State Mining Corporation Ltd.

The other associate industries on rock phosphate include Coimbatore Pioneer Fertilizer Ltd and Rashtriya Chemicals & Fertilizers Ltd, Mumbai which have domestic plants that recover by-product fluorine from rock phosphate in the form of hydrofluorosilicic acid, sodium silico-fluoride; and aluminium fluoride. Department of Atomic Energy has issued sanctions for establishment of 2 units for recovery of uranium from rock phosphatic sources and these are Rashtriya Chemicals & Fertilizers, Mumbai in association with Heavy Water Board (HWB); and SPIC, Thoothukudi in association with IREL.

RCF is also setting up a rapidwall plant for manufacture of unique building material using phospho-gypsum as a raw material which is the by-product of phosphoric acid plant. The project is estimated at a cost of ₹ 75 crore.

Red phosphorus is manufactured mainly by United Phosphorus Ltd. Red phosphorus is consumed in Matches Industry. It also has applications as fumigant in Agriculture Industry and as flame retardant.

Joint Ventures Abroad

India's dependency on import at present is to the extent of 25% of our requirements of urea, 90% in case of phosphates either as raw material or finished fertilizers (DAP/MAP/TSP) and 100% in case of potash.

The Government has been encouraging Indian companies to establish joint venture in countries which are rich in fertilizer resources with arrangements to buy back and to enter into long-term agreement for supplying fertilizer to India. The Department of Fertilizers has undertaken joint ventures abroad with 5 countries in the previous years. Although during the year 2021-22, no joint venture with any country was signed, a number of major developments took place with the following countries:

Nepal

Memorandum of Understanding between the Government of India and the Government of Nepal on the supply of Urea and DAP to Nepal from India under Government to Government Arrangement has been approved by the Cabinet. MoU is to be signed shortly.

Russia

To explore the possibility of long term agreement between both the countries and to discuss the terms & conditions of arriving at a mutually long term agreement for supply of fertilizers to India VC meetings were held between both the sides on 21 June, 2021, 4 August, 2021, 09 September, 2021 and 30th December, 2021. An agreement of Intent has been signed between Indian PSUs and Russian Company, PhosAgro on 21.09.21 for supply of 2,50,000 LMT of four type of fertilizers from Russia to India during the year 2022 and options for further engagements for mutual cooperation are being explored.

Saudi Arabia

Rounds of meetings were held between Indian companies along with officials from DoF and Saudi Companies SABIC and MAADEN on 1st July,2021, 6th July, 2021 and 5th August, 2021 in coordination with Indian Embassy to Saudi Arabia for arriving at a mutually long-term agreement between Indian and Saudi Arabian Companies for collaboration in the fertilizer sector. Further, engagements for mutual cooperation are being explored.

Morocco

Rounds of meetings were held between Indian Companies along with officials from DoF and OCP, Morocco with the constitution of a joint committee/ expert committee.

Canada

A meeting held between Secretary (Fertilizers) and India's High Commissioner to Canada on 17.12.2021 was attended by representative of Indian companies importing Potash from Canada. The matter is being pursued with State Government of Gujarat to pursue the case of mining in Canada by GSFC.

Iran

Discussions were held and follow-up actions were taken with Ambassador, Embassy of the Islamic Republic of Iran to strengthen the collaboration and establish a long-term relationship between both the countries for procurement of fertilizers specifically urea and ammonia from Iran.

RESEARCH AND DEVELOPMENT

RSMML has developed the organic fertilizer called Phosphate Rich Organic Manure (PROM) by using high-grade rock phosphate with farmyard waste and other organic matter. The field trials conducted through different agricultural universities in the country have shown that the agronomic efficacy of this new P-fertilizer is higher than that of the complex phosphatic fertilizers available in the market today. 'PROM' is suitable to neutral and alkaline soils, which will prove to be a boon to the Indian farmers. RSMML with the help of GSFC is making efforts for utilisation of secondary Ore accumulated at Jhamarkotra mine either through beneficiation route or its direct conversion into phosphoric acid.

1. R&D efforts in the following areas strengthened the Company's operation through technology absorption, adaptations & innovation:

a) Productivity studies of HEMM at Jhamarkotra Mines.

b) Beneficiation of secondary rock phosphate.

2. Benefits derived as a result of the above R&D:

a) Strengthening of market share.

b) Converting waste into useful product.

c) Conservation of Mineral.

d) Future plan of action-Energy efficient process.

3. The Company has developed the low cost organic fertilizer "PROM".
4. Two patents have been filed by the Company jointly with MLS University, Udaipur, which got approved under the title i) "process for making slow release phosphate fertiliser". ii) "An eco-friendly process for making EPSOM and Gypsum".
5. The Company has introduced 30% crushed Rock phosphate replacing 31.5% CRP, which hasimproved mineral conservation.
6. Benefits derived as a result of the above efforts are product improvement, cost reduction, product development, import substitution, etc.

Above efforts helped in satisfying the consumer needs as well as business requirements by introducing new products.

ENVIRONMENTAL CONCERNS

There are apparent concerns regarding phospho-gypsum which is formed as a by-product during manufacturing of phosphoric acid. It contains about 1% P_2O_5, 1% F and 10-30 times more radon, none of which is desirable. Environmental Protection Agency (EPA) of USA stipulated in 1989 that phospho-gypsum is unsuitable for sale as common gypsum. Production of each tonne of P_2O_5 yields about five tonnes of phospho-gypsum. EPA has prescribed stringent measures for storage, transport and disposal of phospho-gypsum. In India, however, by-product phospho-gypsum is used widely in cement manufacture.

The use of phosphate also falls under scrutiny. Much attention has been paid to its role in stimulating the growth of algae and other organisms in surface water, the process known as eutrophication. This process is deleterious because it causes blooms of algae which consume dissolved oxygen in lakes and even in shallow, isolated arms of the ocean. Phosphate fertilizers are probably not the only cause of phosphate-induced eutrophication. Another concern is fertilizer phosphate does not leach readily from soil. One of the best ways to remove this phosphate is through the addition of lime which causes precipitation of apatite. However, this procedure, being relatively costly, has not been applied widely. Other application where the use of phosphate has been discouraged is in manufacturing of detergents.

USES

Rock Phosphate is primarily mined for fertilizer production but also serves various other applications. Beyond agriculture, it's used in animal feed supplements and as a source for elemental phosphorus and phosphoric chemicals, which have diverse uses in detergents, insecticides, pharmaceuticals, and even soft drinks and toothpaste. Additionally, phosphate compounds play a role in glassmaking, photographic films, and pyrotechnics, including fireworks and military applications.

Apatite, a mineral form of phosphate, is noteworthy for its transparent specimens, which can exhibit vibrant colours like green, blue, yellow, and pink, making them suitable for faceted gemstones. Furthermore, due to their stability and structure, apatite and other phosphates are being researched as potential materials for nuclear waste storage, highlighting their importance in both industrial and environmental contexts.

SPECIFICATIONS

Elemental Phosphorus and Phosphoric Acid

BIS has prescribed the IS:11224-1985, reaffirmed 2010 specifications for rock phosphate required for the manufacture of elemental phosphorus (Type-I) and phosphoric acid (Type-II).

Single Superphosphate

The P_2O_5 content in rock phosphate for manufacturing single superphosphate should be minimum 31%. Silica up to 8% can be tolerated. Iron and alumina, i.e., R_2O_3 should not be more than 3.5%. Higher R_2O_3 may tend reversion of available P_2O_5 (water soluble P_2O_5). Carbonate up to 5% will improve the reactivity of rock phosphate by increasing the reaction temperature and making the mass porous.

Direct Application of Rock Phosphate as Fertilizer

In India, the finely-ground rock phosphate containing 16% P_2O_5 is used for direct application to the soil for soil amendment. This application is dependent upon the structure and chemical composition of the rock. Direct application is suited mostly for pastures and forage crops and for acidic soils. According to PPCL the following specifications are considered for utilising any rock phosphate as phosphatic fertilizer for direct application in acidic soils.

1. Absolute citrate solubility index 7% (max.)
2. Apatite to carbonate ratio 0.035 CO_2% :
3. Origin of rock phosphate Sedimentary
4. Mesh size 100
5. Hydroxyl ion in crystal lattice 2 is higher indicating substitution of OH for PO_4:H_2O
6. Grade of rock phosphate powder 16% P_2O_5 citrate soluble fraction
7. Iron as Fe_2O_3 5%
8. CaO to P_2O_5 ratio 1:8

The use of rock phosphate for direct application as fertilizer depends on its level of solubility

in acidic soil.

CONSUMPTION

The apparent consumption of apatite and rock phosphate in 2022-23 was more or less same as previous year that is about 11.07 million tonnes as against the 11.05 million tonnes during preceding year.

POLICY

Imports of natural calcium phosphates (including apatite), natural aluminium-calcium phosphates and phosphatic chalk are allowed 'free' under Heading No. 2510 as per the Import Policy ITC(HS) 2022. All chemical fertilizers except urea continue to be decontrolled. The Government of India has been implementing a scheme of concession fixing indicative maximum retail price (MRP) for enabling sales of decontrolled phosphatic and potassic fertilizers at reasonable prices.

In case of Phosphate Fertilizer Industry, the scarcity of domestic raw material constrains the attainment of self-sufficiency in the country. A policy has, therefore, been adopted which involves the following three options:

1. domestic production based on indigenous imported rock phosphate and imported sulphur.
2. domestic production based on imported intermediates, viz, phosphoric acid.
3. imports of finished fertilizers.

The Government of India notified new Urea Policy extended for the period 01.6.2015 to 30.9.2020 for existing gas-based urea manufacturing units. Thereafter the target energy norms of NUP-2015 have been enforced on these urea units from 1st October 2020.

WORLD REVIEW

The world reserves of phosphate rock are about 72 billion tonnes, located mainly in Morocco (69%), Egypt (4%), Tunisia (3%), Algeria (3%) & China (3%). The remaining 18% is located in other countries (Table - 9).

The world production of phosphate rock decreased by 8% to 222 million tonnes in 2022 from 242 million tonnes in 2021. China (42%), Morocco (14%), USA (9%), Russia (6%), and Jordan & Peru (5% each) have been the major producers (Table- 10).

Table – 9: World Reserves of Phosphate Rock

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World total (rounded)	**72000000**
Morocco	50000000
Egypt	2800000
Tunisia	2500000
Algeria	2200000
China#	1900000
Brazil	1600000
South Africa	1600000
Saudi Arabia	1400000
Australia	1100000
USA	1000000
Finland	1000000
Jordan	1000000
Russia	600000
Kazakhstan	260000
Peru	210000
Uzbekistan	100000
Israel	60000
Senegal	50000
Turkey	50000
India*	46000
Mexico	30000
Togo	30000
Vietnam	30000
Other countries	2600000

Source: USGS, Mineral Commodity Summaries,2023
For Australia, Joint Ore Reserves Committee compliant reserves were 124 million tonnes.
**India's total reserves/ resources of rock phoshate as per National Mineral Inventory as on 1.4.2020 are 311.25 million tonnes.*
 # - Production data for large mines only, as reported by the National Bureau of Statistics of China

Table – 10 : World Production of Phosphate Rock

(By Principal Countries)

(In tonnes metric)

Country	2020	2021	2022
World: Total (rounded off)	**224000**	**242000**	**222000**
China	90000	104107	93000*
Morocco	40700	38122	30456
USA	23500	22000*	21000*
Russia	13800	13800*	13800*
Jordan	8938	10015	11258
Peru	8594	10776	10955
Saudi Arabia	8000	8400	9000*
Brazil#	5150	5029	5307
Vietnam	2022	2713	2514
Other countries	23296	27038	24710

Source : BGS, World Mineral Production, 2018-22.
#Including beneficiated and directly shipped material.
**estimated*

FOREIGN TRADE

Exports

In 2022-23, exports of Rock Phosphate decreased by 1.48 % to 532 tonnes from 540 tonnes in the previous year. Rock Phosphate was exported mainly to UAE (61%), Nepal (20%) and remaining 8% to other countries. Out of total export of Rock Phosphate 70% is Rock Phosphate (ground) and remaining 30% is Rock Phosphate (unground). (Tables- 11 & 12).

Table – 11: Exports of Rock Phosphate

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**540**	**11316**	**532**	**19359**
USA	41	8314	20	13085
UAE	-	-	325	3362
Nepal	192	1989	105	2192
Lebanon	-	-	25	432
Malaysia	17	127	56	262
Papua New Guinea	-	-	++	14
Belgium	-	-	1	12
Oman	42	555	-	-
Other Countries	248	331	-	-

Figures rounded off

Table – 12 : Exports of Rock Phosphate (by commodity)

Commodity	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Rock Phosphate (Ground)	**328**	**2409**	**371**	**3602**
Rock Phosphate (Unground)	212	8907	161	15757

Figures rounded off

Imports

Imports of rock phosphate decreased by 6% to 9.09 million tonnes in 2022-23 from 9.66 million tonnes in the previous year. Imports were mainly from Jordan (43%), Morocco (14%) Egypt (12%) and Togo (10%). Out of total import of Rock Phosphate 43% is Rock Phosphate (ground) and remaining 57% is Rock Phosphate (unground)(Tables- 13 & 14).

Table –13 : Imports of Rock Phosphate

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	9659818	104667349	9091591	151370002
Jordan	4147424	43813672	3926857	59975345
Morocco	2068626	26044201	1291627	29506099
Togo	854324	10740853	876888	18595995
Egypt	1231647	10277522	1124123	14811344
Algeria	577953	5181858	691078	10163811
UAE	278700	2771080	428207	6197885
Lebanon	--	--	293103	4343207
Senegal	118574	1368732	132220	2239950
Peru	60499	671058	119149	1716650
Mozambique	--	--	70003	1353681
Other Countries	322071	3798373	138336	2466035

Figures rounded off

Table – 14: Imports of Rock Phosphate (by commodity)

Commodity	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Rock Phosphate (Ground)	**4667997**	**52941744**	**3910889**	**71626208**
Rock Phosphate (Unground)	4991821	51725605	5180702	79743794

Figures rounded off

FUTURE OUTLOOK

There is no substitute for phosphorus in agriculture. The country is deficient in all fertilizer minerals. The reserves/ resources of chemical and fertilizer grades apatite and rock phosphate in India are very limited. Therefore, detailed exploration is necessary for conversion of remaining resources into reserves. Secondly, the search for apatite and rock phosphate may have to be intensified in Andhra Pradesh, Rajasthan, Madhya Pradesh, Jharkhand, Tamil Nadu, Meghalaya, Gujarat, Uttar Pradesh, Uttarakhand, West Bengal, etc. Till the domestic resources of these two minerals are improved, the country has no alternative but to depend on imports. Concerted efforts should be made by way of constituting consortia of public-private companies to acquire assets abroad specifically in countries like Uzbekistan, Jordan, etc. Strengthening ties with mineral-rich countries and provinces with functional and specific MoUs and utilisation of IMG mechanism to align domestic stakeholders is required. Only about 10-15% requirement of raw material for phosphate fertilizer production is met through indigenous sources. The remaining requirement is met through imports in the form of rock phosphate, phosphoric acid and direct fertilizers. Private Sector participation in rock phosphate mining needs to be promoted in order to make available the above two minerals to reduce import dependence for promotion of fertilizers for Agricultural sector.

Demand for phosphatic fertilizer is expected to increase gradually in tandem with the growth in population and corresponding increase in food requirements. The Government has been encouraging Indian Companies to establish joint venture abroad in countries which are rich in fertilizer resources.

In India, most of the existing phosphatic fertilizer and phosphoric acid plants have been designed for high-grade imported rock phosphate, mainly from Morocco and Jordan. The Indian deposits on the other hand, are of low-grade variety. Therefore, the fertilizer and phosphoric acid plants those are likely to be set up as replacement of the existing plants may have to be designed to accept indigenous ores as feed. In addition, beneficiation of domestic low-grade ores would be a step in the right direction and should be promoted persuasively.

31. Asbestos

Asbestos is a group of six naturally occurring fibrous silicate minerals. The physical properties, besides fibrous character, such as, fineness, flexibility, tensile strength & length of fibres, infusibility, low heat conductivity and high resistance to electricity & sound as also to corrosion by acids, make asbestos commercially important. Commercial asbestos is classified into two main mineralogical groups: serpentine asbestos or chrysotile asbestos and amphibole asbestos. The latter includes asbestos minerals, such as, tremolite, actinolite, anthophyllite, amosite and crocidolite. Commercially, chrysotile asbestos is far superior in physical properties and hence more valuable than amphibole asbestos.

Inhalation of asbestos fibers increases the risk of various dangerous lung conditions including Mesothelioma Asbestosis and lung cancer.

India's asbestos requirement is met through imports from Russia, Kazakhstan, Brazil, China and other countries.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total reserves/resources of asbestos in the country as on 1.4.2020 has been placed at 22.90 million tonnes. A total of 22.90 million tonnes of asbestos are placed under Remaining Resources. Out of the total resources, Rajasthan accounts for 13.61 million tonnes (59%) and Karnataka 8.28 million tonnes (36%). The remaining five per cent resources are estimated in States of Jharkhand, Andhra Pradesh, Odisha and Uttarakhand (Table-1).

Table – 1 : Reserves/Resources of Asbestos as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**-**	**22908067**	**22908067**
By Grades			
Chrysotile	-	831905	831905
Amosite	-	4463667	4463667
Tremolite	-	4200109	4200109
Chrysotile mixed with others	-	22516	22516

Table 1 cont.

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
Mixed Amphibole	-	12383632	12383632
Actinolite	-	34311	34311
Anthophyllite	-	20000	20000
Others	-	432134	432134
Not-known	-	463091	463091
Unclassified	-	56701	56701
By States			
Andhra Pradesh	-	79799	79799
Jharkhand	-	154893	154893
Karnataka	-	8282457	8282457
Odisha	-	56700	56700
Rajasthan	-	13615710	13615710
Uttarakhand	-	311	311

Figures rounded off

Table-2 summarises the mineralogical varieties of asbestos occurring in various parts of the country.

Table – 2 : Occurrences of Asbestos in India

State	District	Mineralogical variety
Andhra Pradesh	Anantapur Cuddapah	Chrysotile
Jharkhand	Singhbhum (East) Singhbhum (West)	Chrysotile, tremolite, chrysotile mixed with other minerals
Karnataka	Chikkamagaluru	Amosite
	Hassan	Anthophyllite
	Mandya	Mixed amphibole minerals
	Mysuru	Chrysotile
	Shivamogga	Amosite
Odisha	Kendujhar	-
Rajasthan	Ajmer	Mixed amphibole minerals
	Bhilwara	-do-
	Dungarpur	-do-
	Pali	Tremolite, chrysotile mixed with other amphibole minerals
	Rajsamand	Tremolite, actinolite and mixed amphibole minerals
	Udaipur	Chrysotile, tremolite and mixed amphibole minerals
Uttarakhand	Chamoli	Others

PRODUCTION

No production of asbestos was reported in 2022-23 as well as in the previous year and there were no reporting mines in 2022-23 as well as in preceding year.

Similarly, the mine-head closing stocks of asbestos also remained 'Nil' for the year 2022-23 as well as in the preceding year 2021-22. The average daily employment of labour for both the years was 'Nil.'

MINING & MILLING

Presently there is no working mine of asbestos in India. The usual method of mining chrysotile in Pulivendla Tehsil, Cuddapah district, Andhra Pradesh, was by opening an incline along the dip varying from 200 to 250, keeping the trap as floor and limestone as roof. Two or three such inclines were converted into a regular underground mine by developing levels and winzes, connecting them and adopting board-and-pillar system of development. In almost all the mines, operations like blasting, hole drilling, hoisting, pumping and ventilation were mechanised.

The run-of-mine was subjected to manual sorting of asbestos-bearing rock (ABR). ABR was then hand-combed for chipping off the asbestos-bearing portion in small pieces of about 2.5 cm for producing asbestos concentrates. From ABR, the serpentine was removed as a waste. The asbestos concentrate was fed manually into hopper of a hammer mill. In hammer mill, asbestos and other minerals were separated and then fed to double-deck screen having 10 to 40 mesh sieves. The screening gives three fractions: (a) oversize, (b) middling and (c) tailing. Tailing was taken as a waste which generally did not contain appreciable quantity of asbestos. The oversize was recycled in the hammer mill, and the middling fibre was sucked up by a cyclone and collected.

Grading & Marketing

Small fibres recovered through milling process account for nearly a two-third production. The general grading system adopted is as follows:

Grade	Fibre Size	Method
Grade - As	45 mm and above	Hand-sorted
Grade - A	Between 25 and 45 mm	
Grade - B	Between 12 and 25 mm	
Grade - C	Above 16 mesh	Mill-processed
Grade - D3	24 mesh	
Grade - D4	40 mesh	
Grade - D6	60 mesh	

Note: *Producers of amphibole asbestos sell their output as crude or fluff and powder.*

CLASSIFICATIONS

Various classifications of chrysotile asbestos followed in India are based, by and large, on fibre length:

(1) Grade A or	
A Special	- 25.4 mm fibres or larger
As 1 -	- 25.4 mm and larger fibres but brittle compared to As or A Special
A	- 19.05 to 25.4 mm fibres
A1 -	- 19.05 to 25.4 mm fibres but brittle compared to A
A2 -	- 19.05 to 25.4 mm fibres but brittle compared to A1
Grade B	**- 6.35 to 19.05 mm fibres**
B1 -	- 6.35 to 19.05 mm fibres but brittle compared to B
B2	- 6.35 to 19.05 mm fibres but brittle compared to B1
C	- Below 6.35 mm fibres
(2) Grade A Special - Above 31.5 mm	
A	- Between 19 and 31.5 mm
B	- Between 6.3 and 19 mm
C	- Below 6.3 mm including powder
D	- Dust

3) Quebec standard asbestos testing machine classification of chrysotile asbestos according to groups is given below

Crude Asbestos		
Group No. 1	Crude No. 1	Consists basically of crude, 3/4 inch and longer staple
Group No. 2	Crude No. 2	Consists basically of crude, 3/8 to 3/4 inch staple.

Milled Asbestos	
Standard designation of grade	**Guaranteed minimum spinning test**
Group No. 3 (spinning fibres)	
3 D	10.5-3.9-1.3-0.3
3 Z	0-8-6-2
Group No. 4 (shingle fibres)	
4 D	0-7-6-3
4 Z	0-1.5-9.5-5
Group No. 5 (paper fibres)	
5 D	0-0.5-10.5-5
5 R	0-0-10-6
Group No. 6 (waste)	
6 D	0-0-7-9
Group No. 7 (shorts or refuse)	
7 D	0-0-8-11
7 W	0-0-0-16
Group No. 7 (floats)*	
7 RF	No test
7 TF	No test
Group No. 8 (sand & gravel)	
8 S	Less than 50 lb per cu. ft loose measure
8 T	Less than 75 lb per cu. ft loose measure.
Group No. 9 (gravel & stone)	
9 T	More than 75 lb cu. ft loose measure

** The suffix 'F' designates 'floats' in the case of 7R and 7T grades.*

USES

Industrial use of asbestos is linked with the type of asbestos. Chrysotile asbestos, being more fibrous and possessing better tensile strength than amphibole variety is used in the manufacture of asbestos fabrics, cement sheets, pipes, building materials (roofing shingles, ceiling and floor tiles, paper products) and allied products. It is also used in brake linings, insulation and fire proof clothing. Short fibres are used with cement as binders for manufacturing asbestos-cement products. Amphibole asbestos generally finds use in heat insulation and treatment of acids. Anthophyllite and tremolite fibres, although of good length, are too weak and brittle to be spun. They are, therefore, used for boiler lagging, hard-setting magnesia composition and as a filler in asbestos paints and various asbestos-moulded articles.

SUBSTITUTION

Materials substituted for asbestos include calcium silicate, carbon fibres, fibres of cellulose, ceramic, glass & steel, wollastonite and several organic fibres like aramid, polyethylene, polypropylene and polytetrafluoroethylene. Where reinforcement properties of fibres are not required, several non-fibrous minerals are also considered for possible substitution. Some of the most common alternative to asbestos are polyurethane foam, thermoset plastic, fiberglass, mineral woal, cellulose and natural minerals. However, no single substitution is found to be as versatile or as cost-effective as asbestos.

ENVIRONMENTAL IMPACT OF ASBESTOS

Asbestos used as a part of construction material due to flame retardant quality, poses major risk to human health and environment. Asbestos has been linked in number of serious medical conditions. These include the lungs and respiratory problems because asbestos is made of tiny fibres that when released into the air and prolonged breathing of air laden with asbestos dust can settle inside the lungs and irritate the tissues in the chest cavities. Mesothelioma is a rare form of cancer of the lungs and digestive tract which is most commonly caused by exposure to asbestos mixed air. Besides health hazards, asbestos also has negative impact on the environment. A study presented in 2006 at the International Conference on Health, the Environment and Justice found that asbestos dust can easily travel through the air and into the water supply. It can also settle on the surface of the soil instead of getting absorbed into the ground, which means that it can still get picked up by the wind and inhaled into human respiratory system.

However, as per the report of the 'Asbestos Cement Products Manufactures' Association' in India, only chrysotile (white) asbestos fibre is used for the manufacture of asbestos-cement sheets and asbestos-cement pipes which contain a very small quantity of chrysotilefibre (only 8–10%). The other raw materials used are cement 45%, fly ash 30-35% and wood pulp. The asbestos fibres are firmly locked-in or encapsulated within the cement matrix during manufacture so that fibres cannot be emitted into the atmosphere under normal use and thus, pose no health risk to the general public or environment. Several studies abroad have concluded that use of chrysotile in the manufacture of Asbestos Cement Products under controlled conditions is safe for the workers, environment and the general public.

India has again opposed the listing of chrysotile asbestos as a hazardous substance under the Rotterdam Convention at the eighth meeting of the Conference of Parties (COP) held in Geneva from 24th April to 5th May 2017

TRADE POLICY & LEGISLATION

No restrictions have been imposed on exports of asbestos in the Foreign Trade Policy, 2015-20. As per the prevailing Foreign Trade Policy, asbestos under Heading 2524 can be imported freely with the exception of amosite which is restricted. However, the imports of crocidolite, actinolite, anthophyllite, amosite and tremolite are restricted in terms of Interim Prior Informed Consent (PIC) Procedure of Rotterdam Convention for Hazardous Chemicals and Pesticides.

Ministry of Environment and Forest, vide Notification dated 13.10.1998, under Sections 3 (1) and 6 (2) (d) of Environment (Protection) Act, 1986 and Rule 13 of Environment (Protection) Rules, 1986, has prohibited the imports of waste asbestos (dust and fibre), on account of it being a hazardous waste detrimental to human health and environment.

WORLD REVIEW

Large reserves are located mainly in Kazakhstan and Russia. Russia was the leading producer with 700 thousand tonnes, followed by Kazakhstan (230 thousand tonnes), Brazil (183 thousand tonnes) and China (130 thousand tonnes) (Tables-3 and 4).

Table – 3 : World Reserves of Asbestos

(By Principal Countries)

(In million tonnes)

Country	Reserves
World: Total	**Large**
Brazil	11
China	15
Kazakhstan	Large
Russia	110
USA	Small

Source: USGS, Mineral Commodity Summaries, 2023.
** India's total reserves/resources of asbestos as per NMI database, based on UNFC system, as on 1.04.2020 have been estimated at 22.90 million tonnes.*

Table – 4 : World Production of Asbestos

(By Principal Countries)

(In '000 tonnes)

Country	2020	2021	2022
Brazil	**77**	**172**	**183**
China *	130	130	130
Colombia	0	0	0
Kazakhstan	227	250	230 *
Russia*	720	700	700

Source: BGS, World Mineral Production, 2020-2022.
** : Estimated.*

FOREIGN TRADE

Exports

Exports of asbestos increased substantially to 3,286 tonnes in 2022-23 as compared to 1,906 tonnes in the previous year. Exports were mainly to Bangladesh (98%) and Nepal (2%). Exports of asbestos (fibre products) were at 42,269 tonnes in 2022-23 as compared to 49,044 tonnes in the previous year. Exports of asbestos (chrysotile) were at 3,220 tonnes during the year 2022-23 as compared to 1905 tonnes in the preceding year. Exports of asbestos (others) increased substantially to 66 tonnes during the year 2022-23 as compared to 1 tonnes in the preceding year. Exports of asbestos-cement products were 134657 tonnes in 2022-23 as compared to 116492 tonnes in the preceding year (Tables-5 to 7).

Table – 5 : Exports of Asbestos

(By Country)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1906**	**68026**	**3286**	**217449**
Bangladesh	1906	68000	3220	217275
Nepal	++	++	66	174
Uganda	++	26	-	-

Figures rounded off

Table – 6 : Exports of Asbestos

(By Types)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Total	**1906**	**68026**	**3286**	**217449**
Chrysotile	1905	67961	3220	217275
Others	1	65	66	174

Figures rounded off

Table – 7 : Exports of Asbestos

(By Products)

Products	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Fibre Products	49044	6902347	42269	6866139
Cement Products	116492	1876220	134657	2460411

Figures rounded off

Imports

Imports of asbestos were 4,04,154 tonnes in 2022-23 decreased by only 8% as against 4,37,511 tonnes in the previous year. Almost entire import was that of chrysotile asbestos. Imports of asbestos were mainly from Russia (44%), Brazil (24%), Hungary (12%) & Kazakhstan (11%). A total of 24,267 tonnes asbestos-cement products were also imported in 2022-23 as against 20,721 tonnes in the previous year. Imports of asbestos fibre products were 2,838 tonnes during the year 2022-23 as compared to 3,353 tonnes in previous year. Imports of asbestos chrysotile decreased to 403772 tonne during the year 2022-23 as compared to 436977 tonne in the preceding year and asbestos (others) decreased to 382 tonnes 534 tonnes in the preceding year. (Tables-8 to 10).

Table –8 : Imports of Asbestos

(By Country)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**437511**	**16631390**	**404154**	**22940349**
Russia	151277	5408508	175994	9374000
Brazil	228529	8952770	96718	5459089
Hungary	54	597	49992	3420470
Kazakhstan	-	-	42526	2563287
Poland	25168	935189	20317	1165382
South Africa	-	-	4905	309199
China	16515	726658	5408	204673
USA	10302	333479	3894	199364
Singapore	-	-	2720	151892
UK	67	2302	889	45818
Other countries	5599	271887	791	47175

Figures rounded off

Table – 9 : Imports of Asbestos

(By Types)

Type	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Total	**437511**	**16631390**	**404154**	**22940349**
Chrysotile	436977	16613219	403772	22920593
Others	534	18171	382	19756

Figures rounded off

Table – 10 : Imports of Asbestos

(By Products)

Products	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹)	Qty (t)	Value (₹)
Fibre Products	3353	3130952	2838	3237762
Cement Products	20721	590388	24267	638296

Figures rounded off

FUTURE OUTLOOK

Consumption of asbestos minerals in India & other countries of the world will decline steadily in near future. This decline will be due to health and liability issues associated with asbestos use, leading to the displacement of asbestos from traditional domestic markets by substitutes, alternative materials and technological advancement.

While the economic impact of asbestos mining in India is minimal, mining operations do adversely affect human and environmental health. Globally, asbestos-cement products are expected to continue to be the leading market for asbestos. India's imports of chrysotile asbestos too have been showing significant growth. Owing to continued demand for asbestos products in many regions of the world, global production is likely to remain steady at approximately 2.0 million tonnes per year for the near future as per USGS report on asbestos.

32. Bauxite

Bauxite is basically an aluminous rock that contains hydrated aluminium oxide as main constituent and iron oxide, silica & titania as minor constituents present in varying proportions. Hydrated aluminium oxides present in the bauxite ore are diaspore and boehmite, $Al_2O_3.H_2O$ (Al_2O_3:85%; Al:45%); gibbsite or hydrargillite, $Al_2O_3.3H_2O$ (Al_2O_3: 65.4%; Al:34.6%), and bauxite (containing colloidal alumina hydrogel), $Al_2O_3.2H_2O$ (Al_2O_3:73.9%; Al:39.1%). The iron oxide in bauxite ore is present as haematite or goethite; silica as clay; and free quartz & titania as leucoxene or rutile. Bauxite is the principal ore of aluminium which is one of the most important non-ferrous metals used in the modern industry. It is also an essential ore for Refractory and Chemical industries.

RESERVES/RESOURCES

As per the NMI data, based on UNFC system as on 1.4.2020, all India reserves/resources of Bauxite have been placed at 4958 million tonnes. These resources include 646 million tonnes Reserves and 4311 million tonnes Remaining Resources. The country is endowed with huge quantities of metallurgical grade bauxite. By grades, about 79% resources are of Metallurgical grade (I, II & Mixed). The resources of Refractory and Chemical grades are limited and together account for about 4 %. By States, Odisha alone accounts for 41% of country's resources of bauxite followed by Chhattisgarh (20%), Andhra Pradesh (12%), Gujarat (8%), Jharkhand (6%), Maharashtra (5%) and Madhya Pradesh (4%). Major bauxite resources are concentrated in the East Coast bauxite deposits in Odisha and Andhra Pradesh (Table-1).

Table – 1 : Reserves/Resources of Bauxite as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**646493**	**4311754**	**4958248**
By Grades			
Chemical	6639	15405	22044
Refractory	42363	100709	143072
Chemical/Refractory Mixed with Others	1575	24786	26362
Metallurgical-1	507527	2645493	3153020
Metallurgical-2	37100	585786	622886

Table 1 cont.

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
Metallurgical Mixed	8783	146366	155149
Low grade	26649	521473	548122
Beneficiable	832	79050	79883
Mixed grade Excluding Chem./Refrac.	8403	66576	74979
Abrasive	-	3076	3076
Others	4047	43257	47304
Unclassified	2576	57500	60076
Not - known	-	22276	22276
By States			
Odisha	409740	1647284	2057024
Chhattisgarh	23695	968860	992555
Andhra Pradesh	0	615267	615267
Gujarat	101230	295797	397027
Jharkhand	39972	249272	289244
Maharashtra	38472	193958	232430
Madhya Pradesh	18564	167695	186259
Other states	14819	173622	188441

Figures rounded off

MINING LEASES AND PRODUCTION

The production of bauxite at 23843 thousand tonnes in 2022-23 increased by about 6 % as compared to that of the previous year. There were 160 reporting mines in 2022-23 as against 127 in the previous year. The production of bauxite was reported as an associated mineral by 8 mines during the year. In all, 61 producers reported production of bauxite in 2022-23. Out of these, ten principal producers having 34 mines contributed about 92% of the total production.

NALCO is the leading producer of bauxite and contributed 31% of the total production. The share of Public Sector mines was about 46% of the total production in 2022-23 as against 49% in the previous year.

About 82% of the total production of bauxite was of 40 – 45% Al_2O_3 grade followed by 10% of Cement grade, 6% of 45% to 50% Al_2O_3 grade and the remaining production was reportedin other grades except three grades (50%-55%, 55%-60% and above 60% Al_2O_3) during the year 2022-23.

Odisha emerged as the leading producing State accounting for about 73% of the total production during 2022-23. (Tables - 2 to 5).

Table – 2 : Principal Producers of Bauxite, 2022-23

Name & address of producers	Location of mine: State	Location of mine: Dis trict
National Aluminium Co. Ltd., NALCO Bhawan, P-1, Nayapalli, Bhubaneswar –751061, Odisha	Odisha	Koraput
Utkal Alumina International Ltd., J-6, Jayadev-Vihar, Bhubaneswar-751013, Odisha.	Odisha	Raygada
M/s. The Orissa Minining Corporation Limited. OMC Office, Unit-V, Bhubaneshwar- 751001 Odisha	Odisha	Koraput
M/s. Hindalco Industries Limited, Ahura Centre, First Floor, B Wing Mahakali Caves Road, Andheri(East) Mumbai-400030 Maharashtra	Jharkhand Chhattisgarh	Gumla Lohardaga Surguja
Mr. Alimiya Imamali Saiyed FF/16, Samruddhi Complex, Near L.I.C Office, Himmatnagar, District- Sabarkantha- 383001 Gujarat	Gujarat	Sabar Kantha
M/s. Minerals & Minerals Limited Court Road Lohardaga, Lohardaga – 853502 Jharkhand	Jharkhand	Gumla Lohardaga
Mr. Sanjaykumar Trikamlal Shah 2, Arbudanagar-1 Ratnakar Mata Road, Kapadwanj, Kapadvanj Kheda-386720 Gujarat	Gujarat	Kheda
M/s. Infrastructure logistics private limited 205, 2nd Floor, Kamat Metropolis-I St Inez, North Goa-403004 Goa	Maharashtra	Ratnagiri
Mr. Surendra Tavanappa Kodachwad 34, Corporation Complex Belgaum Belagavi-590011 Karnataka	Maharashtra	kolhapur
M/s. GUJARAT MINERAL DEVELOPMENT CORPORATION LIMITED GMDC Limited,"Khanij Bhavan" 132 Feet Ring Road, Vastrapur - Ahmedabad, PIN:380 052 Gujarat	Gujarat	Jamnagar Kachchh

Table – 3 : Production of Bauxite, 2020-21 to 2022-23 (P)

(By States)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**20380548**	**16793448**	**22494049**	**25284169**	**23843262**	**27884996**
Chhattisgarh	716296	751459	968248	1079736	1056576	1252140
Gujarat	1497716	1198490	2018462	1692854	1667048	1495852
Jharkhand	1497472	1607332	1808750	2352953	2214879	3145924
Madhya Pradesh	632385	479818	608848	486524	601911	598061
Maharashtra	471068	332108	640345	387799	899528	578068
Odisha	15565611	12424241	16449396	19284303	17403320	20814951

(P): Provisional

(Quantity in tonnes)

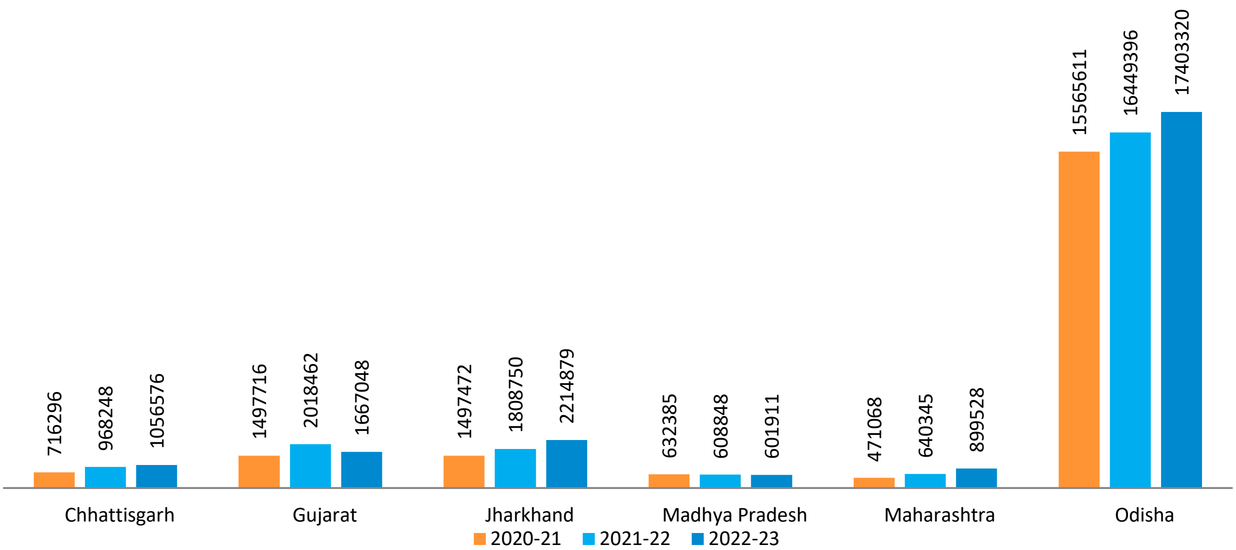


Fig 2: Production of Bauxite

Table – 4 (A) : Gradewise Production of Bauxite, 2021-22

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹ '000)

State/District	For use in Alumina & Aluminium extraction : Al_2O_3 content							For use other than Alumina & Aluminum extraction				Total	
	No. of Mines	60% & above	55– 60%	50–55%	45– 50%	40– 45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value
India	**127(9)**	**-**	**-**	**-**	**1377786**	**18042264**	**75187**	**2495887**	**86184**	**264124**	**152617**	**22494049**	**25284169**
Public Sector	19	-	-	-	80589	10590727	-	115962	113	126330	152387	11066108	15371528
Private Sector	108(9)	-	-	-	1297197	7451537	75187	2379925	86071	137794	230	11427941	9912641
Chhattisgarh	**13**	**-**	**-**	**-**	**802000**	**166248**	**-**	**-**	**-**	**-**	**-**	**968248**	**1079736**
Kabirdham	2	-	-	-	-	127	-	-	-	-	-	127	83
Kondagaon	2*	-	-	-	-	-	-	-	-	-	-	-	-
Surguja	9	-	-	-	802000	166121	-	-	-	-	-	968121	1079653
Goa	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
South Goa	-	-	-	-	-	-	-	-	-	-	-	-	-
Gujarat	59	-	-	-	80589	-	-	1522580	86184	176722	152387	2018462	1692854
Amreli	-	-	-	-	-	-	-	-	-	-	-	-	-
Devbhoomi Dwarka	35	-	-	-	80589	-	-	292755	86184	95562	-	555090	454678
Kheda	9	-	-	-	-	-	-	790176	-	-		790176	589126
Kutch	9	-	-	-	-	-	-	-	-	80060	152387	232447	353562
Porbandar	3	-	-	-	-	-	-	181600	-	1100	-	182700	121332
Sabarkantha	3	-	-	-	-	-	-	258049	-	-	-	258049	174156
Jharkhand	**19**	**-**	**-**	**-**	**456197**	**1300407**	**-**	**-**	**-**	**52146**	**-**	**1808750**	**2352953**
Gumla	13	-	-	-	456197	619614	-	-	-	52146	-	1127957	1460839
Lohardaga	6	-	-	-	-	680793	-	-	-	-	-	680793	892114
Karnataka	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
South Kanara	-	-	-	-	-	-	-	-	-	-	-	-	-
Madhya Pradesh	**18(9)**	**-**	**-**	**-**	**-**	**-**	**-**	**573362**		**35256**	**230**	**608848**	**486524**
Anuppur	-	-	-	-	-	-	-	-	-	-	-	-	-
Jabalpur	2(2)	-	-	-	-	-	-	127030	-	-	-	127030	79448
Katni	7(3)	-	-	-	-	-	-	249696	-	-		249696	172517
Rewa	1	-	-	-	-	-	-	13620	-	-	-	13620	11577
Satna	3(4)	-	-	-	-	-	-	27140	-	8012	230	35382	46118
Shahdol	2	-	-	-	-	-	-	130745	-	-	-	130745	78451
Sidhi	3	-	-	-	-	-		25131	-	27244	-	52375	98413

Table- 4 (A) (Contd)

(Qty in tonnes; Value in ₹ '000)

State/District	For use in Alumina & Aluminium extraction : Al_2O_3 content							For use other than Alumina & Aluminum extraction				Total	
	No. of Mines	60% & above	55– 60%	50–55%	45– 50%	40– 45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value
Maharashtra	**12**	**-**	**-**	**-**	**39000**	**201400**	**-**	**399945**	**-**	**-**	**-**	**640345**	**387799**
Kolhapur	6	-	-	-	39000	201400	-	-	-	-	-	240400	205483
Raigad	3	-	-	-	-	-	-	97880	-	-	-	97880	44046
Ratnagiri	3	-	-	-	-	-	-	302065	-	-	-	302065	138270
Odisha	**6**	**-**	**-**	**-**	**-**	**16374209**	**75187**	**-**	**-**	**-**	**-**	**16449396**	**19284303**
Koraput	4	-	-	-	-	10450506	-	-	-	-	-	10450506	14647161
Raygada	1	-	-	-	-	5923703	75187	-	-	-	-	5998890	4637142
Sundargarh	1*	-	-	-	-	-	-	-	-	-	-	-	-

(*): Only labour reported
Figures in parantheses indicate number of associated mines

Table – 4 (B) : Gradewise Production of Bauxite, 2022-23

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹ '000)

State/District	For use in Alumina & Aluminium extraction : Al_2O_3 content							For use other than Alumina & Aluminum extraction				Total	
	No. of Mines	60% & above	55– 60%	50–55%	45– 50%	40– 45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value
India	**160(8)**	**-**	**-**	**-**	**1479332**	**19544477**	**12042**	**2345081**	**112386**	**227883**	**122061**	**23843262**	**27884996**
Public Sector	19	-	-	-	0	10658614	12042	106445	0	101380	115058	10993539	15836983
Private Sector	141(8)	-	-	-	1479332	8885863	-	2238636	112386	126503	7003	12849723	12048013
Chhattisgarh	**13**	**-**	**-**	**-**	**885050**	**159484**	**12042**	**-**	**-**	**-**	**-**	**1056576**	**1252140**
Kabirdham	2	-	-	-	0	3008	-	-	-	-	-	3008	2816
Kondagaon	2	-	-	-	0	0	-	-	-	-	-	0	0
Surguja	9	-	-	-	885050	156476	12042	-	-	-	-	1053568	1249324
Gujarat	**78**	**-**	**-**	**-**	**-**	**21354**	**-**	**1296988**	**103388**	**130260**	**115058**	**1667048**	**1495852**
Amreli	-	-	-	-	-	0	-	0	0	0	0	0	0
Devbhoomi Dwarka	1	-	-	-	-	0	-	21	0	24	0	45	29
Jamnagar	49	-	-	-	-	5170	-	141133	103346	100668	0	350317	475531
Junagadh	1	-	-	-	-	0	-	0	0	500	0	500	1459
Kachchh	11	-	-	-	-	16184	-	0	0	28492	115058	159734	199417

Table- 4 (B) (Contd)

(Qty in tonnes; Value in ₹ '000)

State/District	For use in Alumina & Aluminium extraction : Al_2O_3 content							For use other than Alumina & Aluminum extraction				Total	
	No. of Mines	60% & above	55– 60%	50–55%	45– 50%	40– 45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value
Kheda	9	-	-	-	-	0	-	521418	0	0	-	521418	392312
Porbandar	4	-	-	-	-	0	-	186096	0	410	-	186506	162546
Sabar Kantha	3	-	-	-	-	0	-	448320	42	166	-	448528	264558
Jharkhand	**21**	**-**	**-**	**-**	**529882**	**1618894**	**-**	**-**	**-**	**66103**	**-**	**2214879**	**3145924**
Gumla	14	-	-	-	529882	649131	-	-	-	66103	-	1245116	1864140
Latehar	-	-	-	-	-	-	-	-	-	0	-	0	0
Lohardaga	7	-	-	-	-	969763	-	-	-	0	-	969763	1281784
Madhya Pradesh	**23(8)**	**-**	**-**	**-**	**-**	**-**	**-**	**563388**	**-**	**31520**	**7003**	**601911**	**598061**
Anuppur	-	-	-	-	-	-	-	0	-	0	0	0	0
Jabalpur	2	-	-	-	-	-	-	75021	-	0	0	75021	63363
Katni	8(4)	-	-	-	-	-	-	284966	-	1106	648	286720	227711
Rewa	6	-	-	-	-	-	-	32912	-	1670	3273	37855	41073
Satna	2(4)	-	-	-	-	-	-	26935	-	23061	3082	53078	132113
Shahdol	2	-	-	-	-	-	-	125774	-	0	-	125774	101245
Sidhi	3	-	-	-	-	-	-	17780	-	5683	-	23463	32556
Maharashtra	**19**	**-**	**-**	**-**	**64400**	**341425**	**-**	**484705**	**8998**	**0**	**-**	**899528**	**578068**
Kolhapur	7	-	-	-	64400	248050	-	0	0	0	-	312450	265967
Raigad	7	-	-	-	-	93375	-	73639	4548	0	-	171562	89453
Ratnagiri	5	-	-	-	-	0	-	411066	4450	0	-	415516	222648
Odisha	**6**	**-**	**-**	**-**	**-**	**17403320**	**-**	**-**	**-**	**0**	**-**	**17403320**	**20814951**
Kendujhar	-	-	-	-	-	0	-	-	-	0	-	0	0
Koraput	4	-	-	-	-	10502138	-	-	-	-	-	10502138	15260643
Raygada	1	-	-	-	-	6901182	-	-	-	-	-	6901182	5554308
Sundargarh	1	-	-	-	-	0	-	-	-	-	-	0	0

Figures in parantheses indicate number of associated mines

Table - (5): Production of Bauxite,2021-22 and 2022-23 (P)

(By Frequency Groups)

(Quantity in tonnes)

Production group	No. of mines		Production		Percentage to total production		Cumulative percentage	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
Total	**127(9)**	**160(8)**	**22494049**	**23843262**	**100**	**100**	**-**	**-**
Upto 1000	46(1)	72(1)	2360	5699	0.01	0.02	0.01	0.02
1001 - 3000	6(1)	3	11814	4408	0.05	0.02	0.06	0.04
3001 - 5000	3	5(1)	11309	18606	0.05	0.08	0.11	0.12
5001 - 10000	6(1)	7(1)	54199	55934	0.24	0.23	0.35	0.35
10001 - 25000	16(3)	23(4)	318922	425201	1.42	1.78	1.77	2.13
25001 - 50000	15(2)	15(1)	661694	555542	2.94	2.33	4.71	4.46
50001 and above	35(1)	35	21433751	22777872	95.29	95.54	100	100

Figures in parantheses indicate number of associated mines

Mine- head closing stocks of bauxite in 2022-23 were 17424 thousand tonnes as compared to 16101 thousand tonnes in the previous year. About 86% of the total stock was held in Gujarat at the end of the year (Tables- 6 'A' & 6 'B').

The average daily employment of labour in bauxite mines was 6,537 in 2022-23 as against 5,275 in the previous year.As per information available from Mining Lease Directory as on 31.03.2023, the total number of mining leases granted for mining of bauxite is 318 covering mining lease area of 22334.73 Hectares.

Table – 6 (A) : Mine-head Closing Stocks of Bauxite, 2021-22

(By States & Grades)

(Quantity in tonnes)

State	For use in Alumina & Aluminium metal Extraction Al_2O_3 Content						For use other than Alumina & Aluminium metal extraction				
	60% & above	55–60%	50–55%	45–50%	40–45%	Below 40%	Cement	Abrasive	Refra-ctory	Chemical	Total
India	**-**			**100433**	**1724516**	**480441**	**12891886**	**416684**	**338296**	**148630**	**16100886**
Chhattisgarh	-	-	-	24562	106322	-	-	94	1255	1261	133494
Goa	-	-	-	-		-		-	-	-	
Gujarat	-	-		9171	447863	48811	12028141	416590	310152	118044	13378772
Jharkhand	-	-	-	28800	154922	12878	-	-	-	-	196600
Karnataka	-	-	-	-		-	9000	-	-	-	9000
Madhya Pradesh	-	-	-		552	296914	465099	-	26889	29325	818779
Maharashtra	-	-	-	24711	125868	111702	389646	-	-	-	651927
Odisha	-	-	-	13189	888989	10136	-	-	-	-	912314

Table – 6 (B) : Mine-head Closing Stocks of Bauxite, 2022-23 (P)

(By States & Grades)

(Quantity in tonnes)

State	For use in Alumina & Aluminium metal Extraction Al_2O_3 Content						For use other than Alumina & Aluminium metal extraction				
	60% & above	55–60%	50–55%	45–50%	40–45%	Below 40%	Cement	Abrasive	Refra-ctory	Chemical	Total
India	**-**			**136658**	**1226784**	**223738**	**14834602**	**544291**	**327648**	**129887**	**17423608**
Chhattisgarh	-	-	-	36750	159118	47700	-	95	1255	1261	246179
Goa	-	-	-	-		-		-	-	-	
Gujarat	-	-		9171	445150	46500	13601819	544196	300260	95777	15042873
Jharkhand	-	-	-	55233	163438	12858	-	-	-	-	231529
Karnataka	-	-	-	-		-		-	-	-	
Madhya Pradesh	-	-	-		421	1036	786958	-	26133	32849	847397
Maharashtra	-	-	-	22315	176129	111649	445825	-	-	-	755918
Odisha	-	-	-	13189	282528	3995	-	-	-	-	299712

The average daily employment of labour in bauxite mines was 6,537 in 2022-23 as against 5,275 in the previous year. As per information available from Mining Lease Directory as on 31.03.2023, the total number of mining leases granted for mining of bauxite is 318 covering mining lease area of 22334.73 Hectares.

USES & CONSUMPTION

Bauxite is primarily used to produce alumina through the Bayer process. Aluminium Industry normally uses bauxite containing minimum 40% Al_2O_3. However, slightly inferior grades with a suitable blend are also used depending upon other characteristics, such as, solubility in caustic soda and absence of silica. The BIS has specified IS:5953-1985(Reaffirmed 2008 & 2014) specifications for metallurgical grade bauxite. Details of the industries are provided in a separate Review 'Aluminium and Alumina'.

In Steel Industry, bauxite is used as a slag corrector in place of fluorite and generally bauxite, containing 45 to 54% Al_2O_3 and 5% SiO_2 (max.) is consumed. Size preference is 25 to 125 mm with a tolerance of 5% (max.) for -25 mm & +100 mm fractions.

BIS has prescribed the specifications of bauxite 'IS : 10817-1984 (Reaffirmed in 2020) for Refractory Industry. The IS specifications of bauxite for consumption in Chemical and Petroleum industries are given in 'IS : 3605-1984 (Reaffirmed 2020).

Apart from the chemical specifications, the physical requirements are that the material passing through 90-micron IS sieve but retained on 212- micron IS sieve should be 90% maximum; that passing through 300-micron IS sieve shall be 1% by mass maximum; and that passing through 212- micron IS sieve but retained on 300-micron IS sieve should be 10% maximum.

The other specifications laid down by BIS are 'IS:8228-1976 (Reaffirmed 2020)' for bauxite sand and 'IS:8988-1978 (Reaffirmed 2019)' for bauxite powder for foundry washes.As per Ministry of Mines Notification dated 25th April 2018, the threshold value of bauxite mineral has been classified into the following two categories:

(i) For Aluminous laterite: Al_2O_3– 20% (min.)

(ii) For Bauxite: Al_2O_3– 30% (min.) and SiO_2 (Total) –7% (max.)

In 2022-23, the apparent consumption of Bauxite was about 27.26 million tonnes as against 25.13 million tonnes during preceding year, which showed an increase of about 8.5%.

SUBSTITUTES

There is no substitute for bauxite as source for aluminium metal extraction carried out on a large scale. However, calcined clay can be substituted for refractory bauxite but only with reduction in time and stock resistance. Sillimanite, alumina, silicon carbide, magnesite–chromite and carbon–magnesite refractories are the other alternatives for high-alumina material but these would entail higher cost. Silicon carbide and diamonds can substitute for fused aluminium oxide in abrasive use but these would entail higher cost. Synthetic mullite is a probable substitute for bauxite-based refractories which is produced from Kyanite, Sillimanite and Kaolin.

Silicon carbide and alumina–zirconia are costlier substitutes for bauxite-based abrasives. The raw material like alunite, anorthosite, coal wastes and oil shales are other potential sources of alumina. The extraction, however, would require new plants with different technology. These non-bauxitic materials could satisfy the demand for primary metal, refractories, aluminium chemicals and abrasives.

TRADE POLICY

As per the Foreign Trade Policy 2015-2020 and policy on export and import, imports of aluminium ores and concentrates including natural bauxite, calcined and activated bauxite and others are permitted free. There are no policy restrictions on the export of bauxite.

WORLD REVIEW

The world bauxite reserves are estimated at 31 billion tonnes and are located mainly in Guinea (24%), Vietnam (19%), Australia (16%), Brazil (9%), Jamaica (6%) , Indonesia (3%) and China, India & Russia (2% each). Countrywise reserves of bauxite are furnished in Table-7.

Table –7: World Reserves of Bauxite

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded off)	31000000
Guinea	7400000
Vietnam	5800000
Australia*	5100000
Brazil	2700000
Jamaica	2000000
Indonesia	1000000
China	710000
India	660000
Russia	500000
Saudi Arabia	180000
Kazakhstan	160000
USA	20000
Other countries	5100000

Figures rounded off
Source: USGS MCS Survey, 2023
**For Australia,Joint Ore Reserves Committee-complaint or equivalent reserves were 1.7 billion tons.*

The world production of bauxite increased by 14% to 402 million tonnes in 2022 as compared to 351 million tonnes in preceding year.

Guinea and Australia together are the top producers which accounted for about 51% (Guinea 26% and Australia 25%) share in the total production, followed by China(19%), Brazil(9%), Indonesia(7%) and India(6%) as mentioned in Table-8.

Table – 8 : World Production of Bauxite 2020 to 2022

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World total (rounded off)	**352600**	**350700**	**401500**
Guinea [(n)]	87766	87439	103526
Australia	103627	103266	102290
China	42000*	40000*	74300*
Brazil	32898	35950	36000
Indonesia	25860	25781	28809
India	21825[(f)]	22494[(f)]	23843
Russia	6944	7045	7859
Saudi Arabia	5227	5488	5500*
Jamaica	7616	5937	4365
Kazakhstan	4058	4370*	4176
Other Countries	14779	12930	10832

Source : BGS world mineral production, 2018-2022.
Footnotes
**) Estimate*
f) Years ended 31 March following that stated
n) No adjustment has been made for moisture content
**India's production of bauxite during 2019-20, 2020-21 and 2021-22 was 21.82 million tonnes, 20.38 million tonnes and 22.49 million tonnes, respectively.*

(In '000 tonnes)

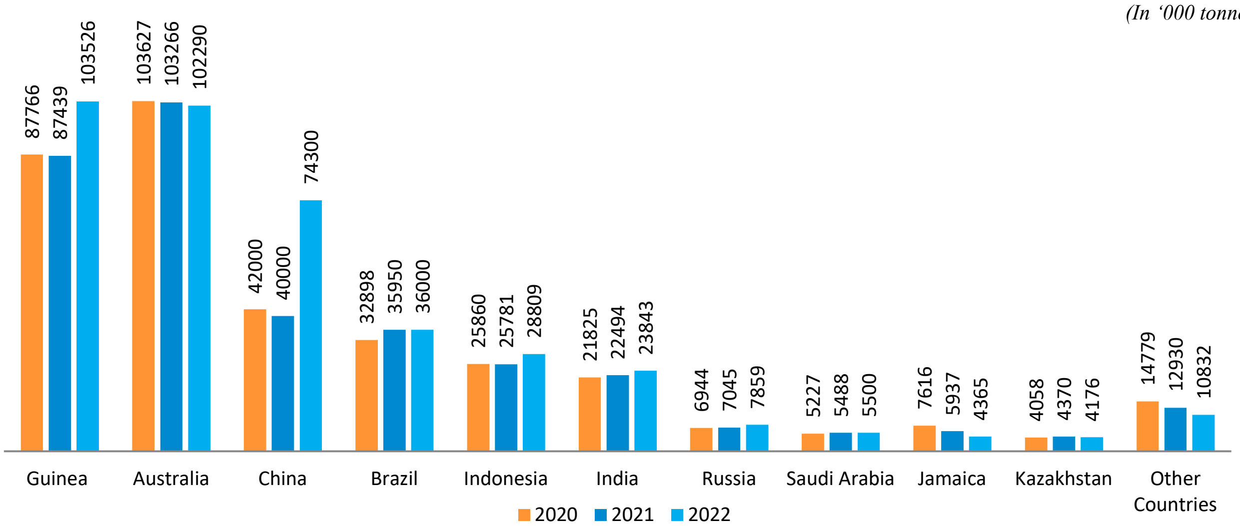


Fig 3: Countrywise Production of Bauxite

FOREIGN TRADE

Exports

In 2022-23, exports of bauxite decreased by 53% to 178 thousand tonnes from 378 thousand tonnes in the previous year. Exports were mainly to Nepal (48%), Kuwait (38%) and Oman & Slovenia (6% each). Exports of bauxite other (aluminium ores & concentrate) decreased by 70% to 82 thousand tonnes from 276 thousand tonnes in the previous year. . Export of bauxite (aluminium & concentrate) also decreased by 7% to 95 thousand tonnes during 2022-23 from 102 thousand tonnes in the preceding year.. (Tables-10 to 11).

Table – 9: Export of Bauxite

(By Country)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**378081**	**1005256**	**177535**	**479019**
Nepal	199669	397096	85474	75855
Kuwait	50650	100735	67300	121398
Slovenia	14754	250302	11220	199431
Oman	59539	96788	11000	30969
Nigeria	883	27269	752	25088
Saudi Arabia	1887	16845	1029	10544
Iran	--	--	80	5808
Bangladesh	239	3765	131	3049
UAE	55	2805	91	1980
Cameroon	--	--	54	1451
Other Countries	50405	109651	404	3446

Figures rounded off

(In '000 tonnes)

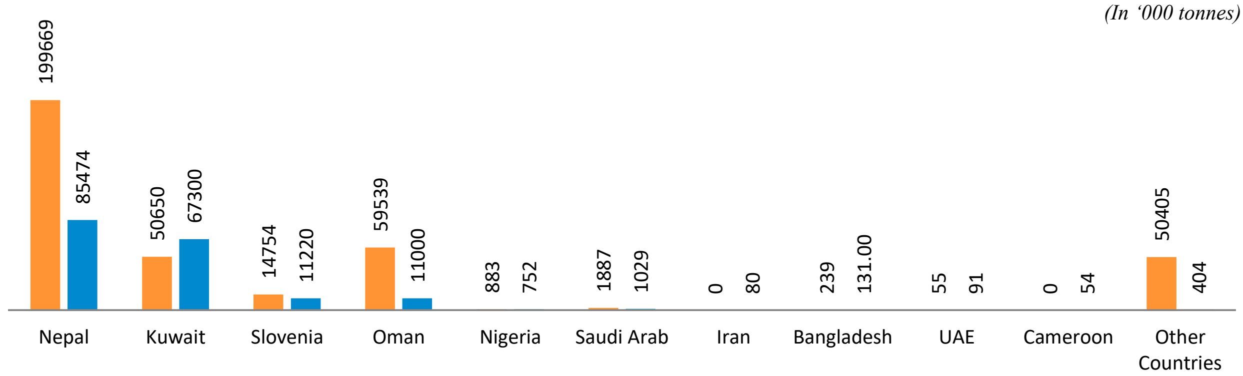


Fig 4: Countrywise Export of Bauxite

Table – 10 : Export of Bauxite: Productwise

By Country

Products	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**378081**	**1005256**	**177535**	**479019**
Bauxite: Other Aluminium Ores & Concentrates	276039	506683	82129	78659
Bauxite: Aluminium & Concentrates	102042	498573	95406	400360

Figures rounded off

Imports

Imports of bauxite increased by 20% to 3596 thousand tonnes during 2022-23 from 3009 thousand tonnes in the previous year and mostly was of the category of Bauxite (Aluminium and Concentrates). Imports were mainly from Guinea (88%) and Sierra Leone (9%). Imports of bauxite other (aluminium ores & concentrates) decreased by 48% to 254 tonnes during 2022-23 from 492 tonnes in the previous year. (Tables-12 to 13).

Table – 11: Imports of Bauxite

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3009079**	**18963241**	**3596098**	**23423723**
Guinea	2857828	15185138	3150600	17945643
China	78724	2513910	76199	2809072
Sierra Leone	++	606	323454	1545058
Trinidad and Tobago	8793	129187	27555	524940

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Hong Kong	14362	352361	7953	279906
Singapore	1075	48924	6200	214629
Guyana	34877	513532	3598	64523
Netherlands	286	14265	409	24609
USA	1952	30680	15	6667
Malaysia	215	2318	50	2649
Other Countries	10967	172320	65	6027

Figures rounded off

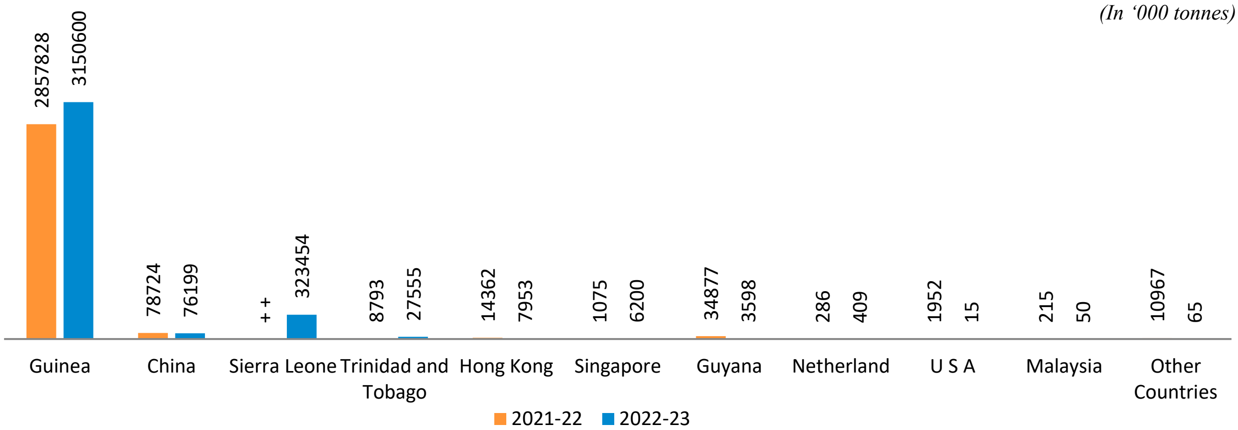


Fig 4: Countrywise Import of Bauxite

Table – 12 : Import of Bauxite: Product wise

By Country

Product	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3009079**	**18963241**	**3596098**	**23423723**
Bauxite: Other Aluminium Ores & Concentrates	492	17181	254	20673
Bauxite: Aluminium & Concentrates	3008587	18946060	3595844	23403050

Figures rounded off

FUTURE OUTLOOK

The total resources of bauxite that comprise various grades, as found to occur in the country as on 1.4.2020, are estimated at 4,958 million tonnes. The resources of Metallurgical grade bauxite are adequate while those of the Chemical and Refractory grade bauxite are relatively limited considering the future requirements. India's strength in aluminium production is due to its rich reserve of bauxite, a core resources used in production of aluminium. As per provision made in Mineral (Auction) Rule 2015, a total of 39 bauxite blocks (including blocks of Bauxite and other associated minerals) were auctioned till 18th Nov 2023 in the State of Madhya Pradesh & Gujarat (10 blocks each), Maharashtra (08 blocks), Chhatisgarh (05 blocks), Odisha (03 blocks), Karnataka (02 blocks) and Jharkhand (01 block).

As per the FITCH Report, the production of bauxite is estimated to grow to 50.7 million tonnes by 2027. Aluminium industry is one of the leading segments of the Indian economy and is expected to play a significant role in the country's future growth. Apart from its potentially large growing market, India is endowed with large deposits of high-quality bauxite ore, resources for power generation (coal) and formidable pool of manpower – both skilled and unskilled. Indian aluminium industry is forging ahead with rapid expansion in both primary metal and downstream sectors.

The demand for aluminium is expected to move upward with shifting demand of consumers towards electric vehicles. Also, the recyclable nature of the metal puts up with goal of reducing carbon emission of many countries. The demand for aluminium will be supported from sectors like aviation, construction, renewable energy production, consumer goods, defence etc.

In the recent trend towards clean technology for need of climate action and sustainable lifestyles, aluminium is one of the critical metal which will help to cater the emerging demand of clean energy solutions, green technologies and sustainable systems. Aluminium is a lightweight material, which is ideal for use in EVs, 'Green Buildings' and power cabling.

33. Boron Minerals

Boron minerals occur mostly as borates which are deposited from volcanic gases or hot springs near volcanic activities. The deposits, predominantly of borax and sassolite are formed as a result of drying up of shallow saline and alkaline tertiary lakes called 'Playa'. The principal boron minerals are borax-hydrated sodium borate ($Na_2O.2B_2O_3.10H_2O$), kernite (rasorite)-hydrated sodium borate ($Na_2O.2B_2O_3.4H_2O$), colemanite-hydrated calcium borate ($Ca_2B_6O_{11}.5H_2O$) and ulexite-hydrated sodium calcium borate ($NaCaB_5O_9.8H_2O$). Besides the above four boron minerals of commercial importance, two minerals, viz., sassolite (H_3BO_3) – the natural boric acid and boracite ($Mg_3B_7O_{13}Cl$) are less important.

Borax is, presently, not produced in India. However, it was obtained since ancient times from the lakes in Jammu & Kashmir in India. The domestic requirements of boron minerals are met solely through imports of crude borate which is refined in the country for producing borax and boric acid.

RESERVES/RESOURCES

Economically viable deposits of borax have not been established in the country so far. The only deposit of little economic significance is reported from Puga Valley in Leh district, Jammu & Kashmir. As per NMI data, based on UNFC system, the total reserves/resources of borax as on 1.4.2020, has been estimated at 74,204 tonnes in Jammu & Kashmir. All resources are of Reconnaissance category viz., UNFC Code 334. (Table-1).

Table – 1 : Reserves/Resources of Borax as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**-**	**74204**	**74204**
By Grades			
Unclassified	-	74204	74204
By States			
Jammu & Kashmir	-	74204	74204

Figures rounded off.

USES & CONSUMPTION

Glass and porcelain industries are the major consumers of borax and boric acid. It is an essential component of heat-resisting boro-silicate glass, glass fibres and industrial & optical glass. In glass, enamels and ceramics, it controls thermal expansion, improves durability, assists melting processes and adds to inorganic colours and decorations.

Borax is used in medicine (boric powder), leather processing, adhesive, corrosion inhibition, ferrous wire manufacture, flame-proofing and timber preservation.

Borax is used as a flux in brazing, welding, soldering and in the manufacture of artificial gems like, cubic boron nitride, (commercially called 'Borazon') which is equal to diamond in hardness and boron carbide, titanium boride and tungsten boride which are next to diamond in hardness. Its easy solubility and property to soften hard water find applications in soaps, cleaners & detergents and for water treatment. Its mild alkalinity and germicidal nature, enable its use in manufacturing toothpastes and mouth washes. Borax is used as an antiseptic and emulsifying agent in Cosmetics Industry. As a decolourising agent, it is used in Vanaspati Industry. In Textile Industry, borax is used as a decolourising agent as well as for maintaining the alkalinity of solutions used for producing rayons. It prevents mould formation in citrus fruits. In agriculture, borax is used as an essential plant nutrient.

Boron compounds are used for fertilizers, algicides, herbicides and insecticides. Borax and boric acid are used in fire-retardant treatment and as food grain preservative, respectively.

Borate ester is used as dehydrating agent, special solvent and catalyst in Chemical Industry. In nuclear reactor, boron acts as neutron absorber. "Boron neutron capture therapy", a form of radiochemotherapy, is becoming increasingly important for treatment of certain forms of cancers and boron neutron capture synovectomy for treatment of arthritis.

Borates are consumed mainly in glass fibre for insulations and textile-grade fibre. They are also used as anti-knock agents in gasoline. Diborane (gas), pentaborane (liquid) and decaborane (solid) are potential jet and rocket engine fuels. Boron hydride also has potential value as rocket fuel. The high energy fuel value imparted by the addition of boron compounds has given considerable strategic significance to borates. Another use of borates is the invention of oxgano-sodium borate (liquibor) for use in hydraulic brake fluids.

Ferroboron is a boron ferroalloy containing 0.2% to 24% boron used primarily to introduce small quantities of boron into speciality steels.

SUBSTITUTES

Substitutes in applications, such as, soaps, detergents, enamels and insulations are available. In detergents, boron compounds can be replaced with chlorine and enzymes. Lithium compounds can be used to make enamels and glass products. Insulation substitutes include cellulose, foams and mineral wools. Substitution of borosilicate glass by plastic materials may reduce the use of boron.

Sodium percarbonate can replace borates in detergents and requires lower temperatures to undergo hydrolysis, which is an environmental consideration. Some enamels can use other glass-producing substances, such as, phosphates. In soaps, sodium and potassium salts of fatty acids can act as cleaning and emulsifying agents.

TECHNICAL POSSIBILITIES

A proprietary process called 'Hydrogen on Demand' has been developed using water and sodium borohydride. Hydrogen from the system can be used in fuel cells or internal combustion engines. A longer-life battery based on boron has also been designed. Synthetic diamond containing about 3% boron which is normally a semiconductor becomes superconductor at 4 K. Boron-doped diamond, thus, has numerous possible applications as it can carry electricity without resistance.

Improvements made in evaporating brine solutions are widening the choice of source. Production of boric acid through solution mining of colemanite is a possibility.

INDUSTRY

In borax manufacturing process, crude sodium borate is dissolved in water, charged, oxidised, crystallised and centrifuged. Centrifuged material is then dried to get borax decahydrate.

Crude calcium borate lumps are crushed and wet-ground with mother liquor to make slurry. This slurry is decomposed with sulphuric acid to give calcium sulphate and boric acid. Boric acid is separated by filtration, purified, cooled and centrifuged to produce boric acid granules which are powdered as per demand.

Borax Morarji Ltd, Ambernath, Thane district, Maharashtra, is engaged in refining of imported crude borates to produce borax and boric acid. The annual production capacity for all grades of borax and boric acid are 24,000 MT at Dahej, GIDC in the State of Gujarat. Apart from two other producers, National Peroxide Limited (NPL) located at Kalyan district, Maharashtra, is the largest producer of Hydrogen Peroxide in the country.

During the year, the Company completed the expansion of its plant situated at Kalyan which resulted in an increase in the plant rated capacity from 95,000 MT per annum to 1, 50,000 MT per annum based on 50% (w/w) Hydrogen Peroxide levels. Indo Borax and Chemical Limited operates borax and boric acid plants at Pithampur, Madhya Pradesh.

WORLD REVIEW

The world reserves of boron in terms of boric oxide are furnished in Table-2. Turkey was the leading producer of borates followed by Russia, USA, Chile, China and Bolivia (Table-3).

Table – 2 : World Reserves of Boron

(By Principal Countries)

(In '000 tonnes of boric oxide)

Country	Reserves
World:Total[(1)]	**xx**
Turkey	1200000
Russia	40000
USA	40000
Chile	35000
China	21000
Peru	4000
Argentina	NA
Bolivia	NA
Germany	NA

Source: USGS, Mineral Commodity Summaries, 2023.
1:World totals can not be calculated because production and reserves are not reported in a consistent manner by all countries.

Table – 3 : World Production of Borates

(By Principal Countries)

(In metric tonnes)

Country	2020	2021	2022
Turkey	2819111	4057299	2452485
USA[(a)]	*1300000	*1300000	*1300000
Kazakhstan	*500000	*500000	*500000
Chile	288103	363032	421935
Peru	43645	246362	308104
Bolivia	258143	312906	295515
China	*130000	*205000	*200000
Argentina	134604	*130000	*130000
Russia*	*80000	*80000	*80000
Iran[(c)]	1300	*1300	*1300

Source: BGS, World Mineral Production, 2018-22,
**: Estimate*
a: Sold or used by producers.
b: B_2O_3 equivalent.
c: Years ended 20 March following that stated.

FOREIGN TRADE

Exports

Exports of borax (total) decreased by 12% to 4151 tonnes in 2022-23 from 4725 tonnes in the previous year. Exports of natural borate in 2022-23 increased substantially to 94 tonnes from 44 tonnes in the previous year. In 2022-23, exports of sodium borate were at 894 tonnes and other borates at 3163 tonnes. Exports of Borax (total) were mainly to USA (39%), Italy (14%) and Saudi Arabia (8%). Exports of boric acid increased by 149% to 3456 tonnes in 2022-23 from 1384 tonnes in the previous year. Exports of boric acid were mainly to Iran (44%), UAE (18%) and USA (4%) (Tables- 4 to 6)

Table – 4 : Exports of Boron

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	++	6093	++	6402
USA	++	5749	++	6368
Korea, Rep. of	++	27	++	34
Australia	++	265	-	-
Austria	++	48	-	-
Nigeria	++	4	-	-
Turkey	++	++	-	-

Figures rounded off

Table – 5 : Exports of Borax

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	4725	656472	4151	818305
USA	1775	364542	1614	454037
Italy	607	86073	599	115008
Bangladesh	255	27515	181	28248
Saudi Arabia	202	10209	304	22290
South Africa	20	3338	101	21708
Spain	140	20941	100	20935
Poland	209	32208	100	19821
Jordan	59	4545	97	18775
Myanmar	72	3426	256	16296
Nepal	404	24618	154	12653
Other Countries	982	79057	645	88534

Figures rounded off

(In tonnes)

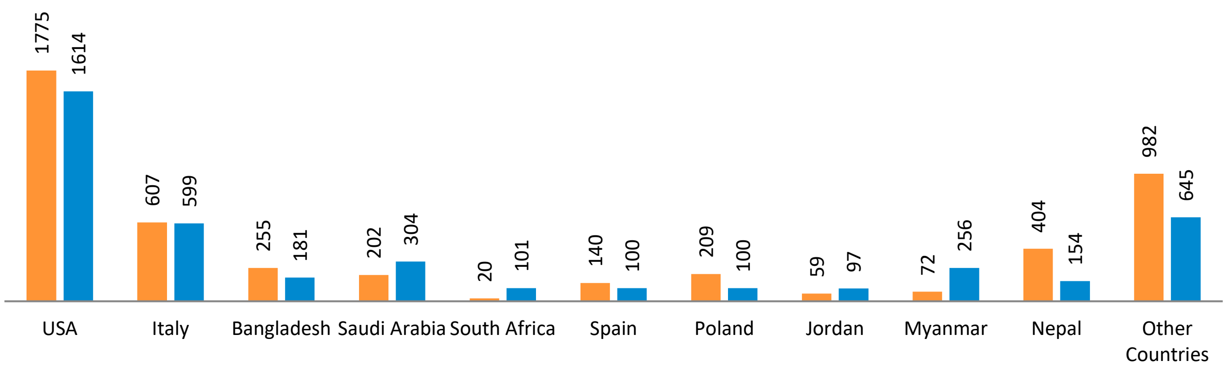


Fig 1: Countrywise Export of Borax

Table – 6 : Exports of Natural Borate

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	44	3489	94	6417
Indonesia	-	-	72	3495
Bangladesh	++	61	++	1478
Kuwait	4	143	20	857
USA	++	71	++	364
UAE	++	4	2	199
Tanzania	-	-	++	24
Nepal	40	3210	-	-

Figures rounded off

Imports

Imports of borax (total) decreased slightly by 11% to 198719 tonnes in 2022-23 from 223368 tonnes in the previous year. Imports of natural borate also decreased by 30% to 70532 tonnes as compared to 101337 tonnes in the previous year. In 2022-23, imports of sodium borate were at 116698 tonnes and other borates 11489 tonnes. Borax (total) was mainly imported from Turkey (77%), USA (19%), Spain (3%) and China (1%). Imports of boric acid decreased to 5478 tonnes in 2022-23 from 7412 tonnes in the previous year. Boric acid was imported mainly from Turkey (67%), Singapore (32%) and USA (1%). Import of boron was negligible in both current and the previous year (Tables-7 to 9).

Table – 7: Imports of Borax

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	223368	7973967	198719	10161598
Turkey	134629	4710621	152023	7304367
USA	47329	1769785	36581	2061857
Spain	7293	305636	5122	251770
China, Rep. of	1041	127636	1100	156426
Singapore	1697	90054	1522	103386
UK	227	79096	628	69095
Peru	952	79257	534	68720
Argentina	2834	105537	512	31450
Austria	143	13923	119	23802
Netherlands	551	41583	134	23210
Other Countries	26672	650839	444	67515

Figures rounded off

(In tonnes)

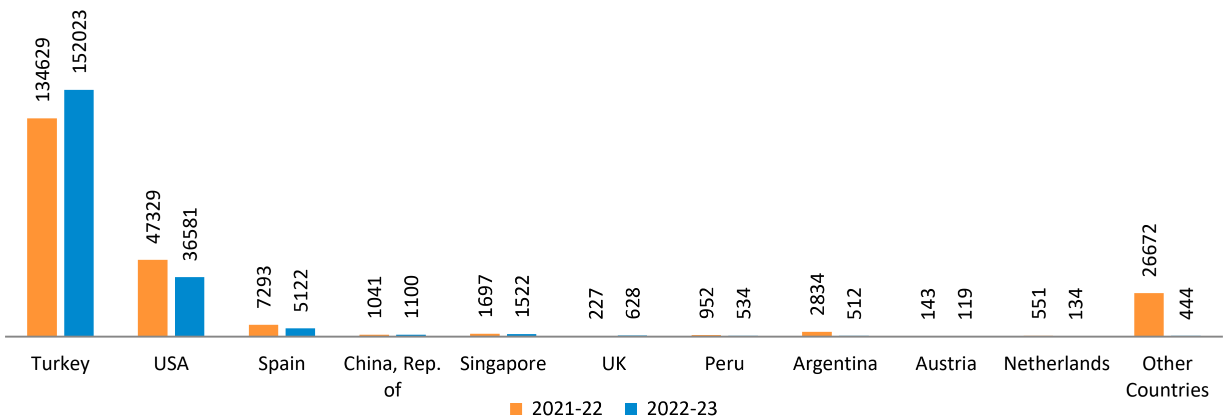


Fig 2: Countrywise Import of Borax

Table – 8 : Imports of Natural Borate

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	101337	2910832	70532	2894632
Turkey	69190	2110887	65351	2647895
Spain	7277	300454	4760	222398
Argentina	2356	73037	368	18226
U A E	16	1491	53	6113
Bolivia	22450	423447	-	-
Montenegro	22	752	-	-
Chile	26	739	-	-
Japan	++	25	-	-

Figures rounded off

Table – 9 : Imports of Boron

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	++	2818	++	6094
China, Rep. of	++	340	++	3026
USA	++	1449	++	2675
Germany	++	997	++	393
UK	++	30	-	-
Belgium	++	2	-	-

Figures rounded off

FUTURE OUTLOOK

Consumption of borates is expected to increase, spurred by strong demand in agriculture, ceramic and glass markets in Asia and South America. Continued investment in new refines and technologies and the continued increase in demand were expected to fuel growth in world production for the foreseeable future. In 2013, the European Union (EU) added borates to the Registration, Evaluation, Authorisation and Restrictions of Chemicals (REACH) Restricted Substances List, following an EU study that determined continuous exposure to humans may be harmful. The ruling required detergent makers to decrease their use of boron (Lismore, 2012). Consumption of boron-based fertilizers is expected to increase as the demand for food and bio-fuel crops is on the rise. Higher crop prices have enabled farmers to invest in advanced farming techniques and higher grade fertilizers.

Consumption of boron nitride is expected to increase owing to the development of high-volume production techniques coupled with the creation of new technologies requiring boron nitride. The properties intrinsic to cubic boron nitride, such as, hardness (second only to diamond), high thermal conductivity, and oxidation resistance, make it an ideal material for a variety of emerging applications. Hexagonal boron nitride is used in producing ceramics, creating intermetallic composites, imparting thermal shock resistance, improving machine ability and reducing friction.

34. Chromite

Chromite is the single commercially viable ore of chromium (Cr) which is chemically known as iron chromium oxide ($FeCr_2O_4$). The properties of chromium that make it most versatile and indispensable are its resistance to corrosion, oxidation, wear & galling and enhancement of hardenability. Chromium is an important alloying metal in ferrous metallurgy, perhaps next only to manganese. It is used in the manufacture of alloys along with other metals, such as nickel, cobalt, molybdenum, copper, titanium, zirconium, vanadium, columbium and selenium. Chromium is traded primarily as chromium ore or as an alloy of chromium and iron, namely, ferrochrome or charge chrome. The name of the element is derived from the Greek word 'chrôma', meaning colour, because many of its compounds are intensely coloured. It is a steely-grey, lustrous, hard and brittle metal which takes high polish, resists tarnishing and has a high melting point.

RESERVES/RESOURCES

As per NMI database based on UNFC system, the total reserves/resources of chromite in the country as on 1.4.2020 has been estimated at 332 million tonnes with 79 million tonnes as "Reserves" (24%) and 253 million tonnes as "Remaining Resources" (76%). More than 96% resources of chromite are located in Odisha, mostly in Jajpur, Kendujhar and Dhenkanal districts. Minor deposits are scattered over Manipur, Nagaland, Karnataka, Jharkhand, Maharashtra, Tamil Nadu, Telangana and Andhra Pradesh. Gradewise, Charge chrome grade accounts for 28% resources followed by Beneficiable grade (24%), Ferrochrome grade (17%), Refractory grade (16%) and Unclassified grade (10%). Low, Others, and Not-known grades together account for remaining 4% (Table- 1).

Table – 1 : Reserves/Resources of Chromite as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**78535**	**253150**	**331685**
By Grades			
Refractory	26663	25675	52338
Charge chrome	31896	61815	93711
Low	4480	6284	10764
Beneficiable	15113	65413	80526
Ferrochrome	-	57429	57429
Others	-	15	15
Unclassified	384	35793	36177
Not-known	-	725	725
By States			
Andhra Pradesh	-	-	-
Jharkhand	-	736	736
Karnataka	499	1317	1817
Maharashtra	5	533	538
Manipur	-	6657	6657
Nagaland	-	3200	3200
Odisha	78031	240237	318269
Tamil Nadu	-	282	282
Telangana	-	186	186

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

MINING LEASES PRODUCTION AND STOCKS

As on 31.03.2023,the total number of mining leases in respect of chromite in force were 19 with an area covered 3293.08 Ha.The production of chromite at 3560 thousand tonnes during 2022-23 decreased by 6% as compared to that in the previous year. Table-3 The number of reporting mines were 18 in 2022-23 as compared to 20 in the preceding year. The share of public sector in total production was 29% in 2022-23 as compared to 31% in the previous year. Table -6.

The share of captive mines in the total production stood at 17% in current as well as the previous year. Odisha continued to be the major producing state of chromite, accounting for the entire production during 2022-23 and nil production was reported from Karnataka.

Grade wise analysis of production during 2022-23 reveals that about 43% of total production of Chromite accounted for 40%-52% Cr_2O_3 (Lumps4 & fines8), followed by 31% accounted for 52% & above Cr_2O_3 (fines11), 25% accounted for Below 40% Cr_2O_3 (Lumps2 & fines6) and the remaining 1% accounted for concentrates 9 grade. (Table-4 & Table 5)

Mine-head closing stocks of chromite in 2022-23 were 2940 thousand tonnes as compared to 2988 thousand tonnes in 2021-22 (Table-7 & Table 8). The average daily employment of labour in chromite mines during 2022-23 was 6435 as against 4480 in the previous year.

Table – 2 : Principal Producers of Chromite, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
Tata Steel Mining Ltd, Bombay House, 24, Homi Mody Street, Fort, Mumbai – 400 001, Maharashtra.	Odisha	Jajpur
The Odisha Mining Corporation Ltd, 'OMC House', Unit 5, Post Box No. 34, Bhubaneswar – 751 001, Odisha.	Odisha	Jajpur Keonijhar

Table- 2 (Concld.)

Name and address of the Producer	Location of the mine	
	State	District
Indian Metals & Ferro Alloys Ltd, IMFA Building, Bomikhal, P.O.-Rasulgarh, Rasulgarh, Bhubaneswar – 751 010,	Odisha	Jajpur
Balasore Alloys Ltd, Balgopalpur, Dist. Balasore - 756 020, Odisha.	Odisha	Jajpur
Ferro Alloys Corporation Ltd., Charge Chrome Plant, D.P.Nagar, Randia, Bhadrak-756135 Odisha.	Odisha	Jajpur

Table – 3 : Production of Chromite, 2020-21- to 2022-23

(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**2830413**	**21862796**	**3785625**	**47969167**	**3560267**	**48045941**
Karnataka	0	0	0	0	0	0
Odisha	2830413	21862796	3785625	47969167	3560267	48045941

(p): Provisional

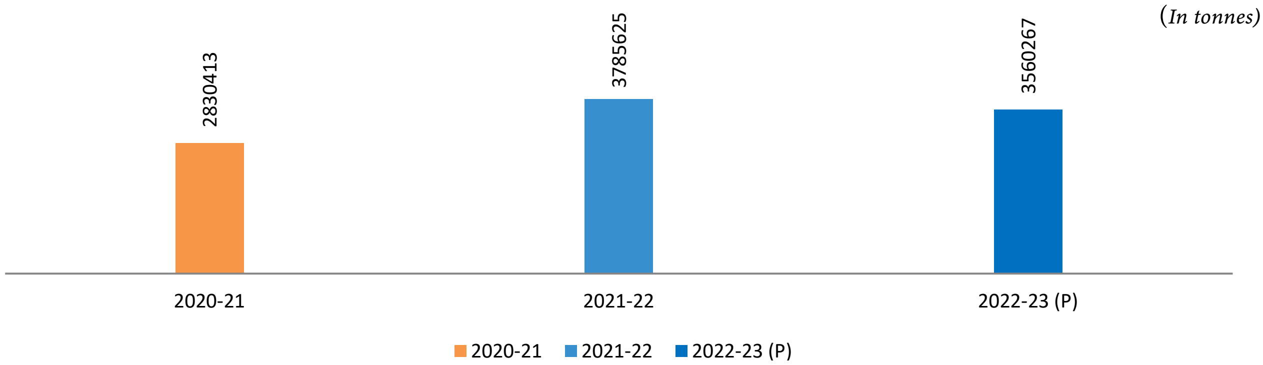


Fig 1: Production of Chromite

Table – 4 : Gradewise Production of Chromite, 2022-23

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹ '000)

State/District	No. of Mines	Production by Grade: Cr_2O_3 content						Concen trates	Total	
		Below 40%		40–52%		52% & Above			Quantity	Value
		Lumps	Fines	Lumps	Fines	Lumps	Fines			
Lumps		**2**	**6**	**4**	**8**	**10**	**11**	**9**		
India	20	69402	991591	168510	1494730	-	1004348	57044	3785625	47969167
Public sector	9	-	159424	-	51176	-	253155	-	1163755	18780640
Private sector	**11**	**69402**	**832167**	**168510**	**743554**	**-**	**751193**	**57044**	**6221870**	**29188527**
Karnataka	2	-	-	-	-	-	-	-	-	-
Hassan	2*	-	-	-	-	-	-	-	-	-
Odisha	**18**	**69402**	**991591**	**168510**	**1494730**	**-**	**1004348**	**57044**	**3785625**	**47969167**
Dhenkanal	3*	-	-	-	-	-	-	-	-	-
Jajpur	14	69402	991591	168510	1494730	-	1004348	57044	3785625	47969167
Keonjhar	1*	-	-	-	-	-	-	-	-	-

** Only labour reported*

Table – 5 : Gradewise Production of Chromite, 2022-23(P)

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹ '000)

State/District	No. of Mines	Production by Grade: Cr_2O_3 content						Concen trates	Total	
		Below 40%		40–52%		52% & Above			Quantity	Value
		Lumps	Fines	Lumps	Fines	Lumps	Fines			
India	**18**	**22537**	**858444**	**204748**	**1328122**	**-**	**1093937**	**52479**	**3560267**	**48045941**
Public sector	7	1593	327453	4809	476480	-	232838	-	1043173	15498653
Private sector	11	20944	530991	199939	851642	-	861099	52479	2517094	32547288
Odisha	**18**	**22537**	**858444**	**204748**	**1328122**	**-**	**1093937**	**52479**	**3560267**	**48045941**
Dhenkanal	3*	-	-	-	-	-	-	-	-	-
Jajpur	14	20944	858444	199939	1327811	-	1093937	52479	3553554	47927641
Kendujhar	1*	1593	-	4809	311	-	-	-	6713	118300

** Only labour reported*

Table – 6 : Production of Chromite, 2021-22 and 2022-23

(By Frequency Groups)

(Quantity in tonnes)

Production Group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2020-21	2021-22 (P)	2020-21	2021-22 (P)	2020-21	2021-22 (P)	2020-21	2021-22 (P)
Total	**20**	**18**	**3785625**	**3560267**	**100**	**100**	**-**	**-**
Up to 10000	10	9	-	9691	-	0.27	-	0.27
10001–100000	3	3	150195	174132	3.97	4.89	3.97	5.16
100001 – 200000	1	1	163764	156240	4.33	4.39	8.3	9.55
200001 – 300000	3	2	761695	560666	20.12	15.75	28.42	25.3
300001 and above	3	3	2709971	2659538	71.58	74.7	100	100.01

Table – 7 : Mine-head closing stocks of Chromite, 2021-22

(By States/Grades)

(In tonnes)

State	Stocks by Grades: Cr_2O_3 Content							Total
	Below 40%		40–52%		52% & Above		Concen trates	Quantity
	Lumps	Fines	Lumps	Fines	Lumps	Fines		
India	**14687**	**2052129**	**24453**	**630291**	**285**	**244124**	**21881**	**2987850**
Karnataka	1331	-	-	-	-	-	-	1331
Odisha	13356	2052129	24453	630291	285	244124	21881	2986519

Table – 8 : Mine-head Closing Stocks of Chromite, 2022-23

(By States/Grades)

(In tonnes)

State	Stocks by Grades: Cr_2O_3 Content							Total
	Below 40%		40–52%		52% & Above		Concen trates	Quantity
	Lumps	Fines	Lumps	Fines	Lumps	Fines		
India	**19883**	**2080919**	**13778**	**403973**	**285**	**399515**	**21615**	**2939968**
Odisha	19883	2080919	13778	403973	285	393515	21615	2939968

USE & CONSUMPTION

The appearent consumption of chromite decreased by about 10 % to 3.63 million tonnes in 2022-23 from 4.02 million tonnes in 2021-22.

In metallurgy, chromite is mainly used in the manufacture of ferrochrome, silicochrome, charge chrome and chromium metal. Chromium imparts additional strength, hardness and toughness to its alloys. It also shows resistance to corrosion & prevents steel abrasion, reduces oxidation and flow of electricity. Stainless steel, high-speed tool steel and corrosion & heat-resistant steel are some of the important varieties of chromium steel.

Chromite is used in Refractory Industry because of its high chemical stability, its high temperature resistance and corrosion resistant properties. Further, its high melting point, ability to withstand sudden temperature changes, its chemically neutral character, moderate thermal expansion and mechanical strength besides abundant availability and reasonable price are added advantages for use in Refractory Industry.

Chromite is used for manufacturingimportant chromium compounds like chromates and bichromates of sodium and potassium, chromium pigments like chromic oxide green and chromicacid, which in turn, are used in chromium-plating solution.

Chromium is an essential trace element for human health. However, some of its compounds are highly toxic and carcinogenic. Environment concerns have reduced the use of chromite refractories and chromium chemicals.

SUBSTITUTES

Development of substitutes for chromium tends to be deterred by cost performance or the customer appeal for chromium. There are no substitutes for chromium in stainless steel or superalloys. Boron, manganese, nickel and molybdenum can be substituted in alloy steels and cast irons. Chromium containing scrap can substitute for ferrochromium in some metallurgical uses. Dolomite is an alternative for some refractory bricks. Cadmium yellow is one of the several alternative pigments. However, it is not environmentally acceptable and nickel and zinc are possible substitutes for the protection of decorative coatings.

INDUSTRY

Chromite is mainly used in Metallurgical Industry for manufacture of ferroalloys, e.g., ferrochrome, charge chrome and silicochrome which are used as additives in making stainless steel and special alloy steel. Ferroalloys are the essential ingredients for the production of high quality special alloy steel as well as mild steel. The demand for ferroalloys is associated with the production of alloy steel.

Production of ferrochrome/charge chrome was mainly reported by Ferro Alloys Corp. Ltd, ShriVasavi Industries Ltd, Balasore Industries Ltd, Tata Steel Ltd, Indian Metals &ferro-Alloys Ltd and Indian Charge-chrome Ltd (merged with Indian Metals & Ferro alloys Ltd in 2006) were amongst the major producers of charge chrome in India. Charge chrome contains 50 to 60% chromium and 6 to 8% carbon. Hard lumpy chromite is used for high-carbon ferrochrome while friable ores and fine briquettes are used for low-carbon ferrochrome. Briquette fines along with lumpy ores were also consumed in charge chrome plants.

The production has been at 1.0 to 1.1 million tonnes over the past 4-5 years. India consumes 15-30% of its production and exports the rest to countries like China, South Korea and Japan. The domestic consumption of ferrochrome has not grown for two main reasons except for the top three ferrochrome players IMFA, Tata Steel and Balasore Alloys others are in financial difficulties; b) Domestic Stainless Steel production which is largely accounted for by the Jindal Stainless Group of late is under severe duress. The Indian Ferrochrome Industry is likely to get consolidated as capacities owned by Rohit Ferro Alloys and FACOR Alloys are to be auctioned through the National Company Law Tribunal (NCLT) shortly. Recently, NCLT released the results of bidding for FACOR's assets.

The important plants which produce chromite based refractories are Tata Steel Ltd (formerly OMC Alloys), Orissa Industries Ltd, Bhilai Refractories Ltd, Burn Standard Co. Ltd, Joglekar Refractories and Ceramics (P) Ltd and Associated Ceramics Ltd.

Ferrochrome when added to steel imparts hardness, strength and augments its stainless characteristics. Carbon content classifies the ferrochrome alloy into high-carbon (6–8%), medium-carbon (3–4%) and low-carbon (1.5–3%), although chromium content in all the three grades is around 60–70 per cent. Around 2.5 tonnes chrome ore with an estimated power consumption of about 4,500 kWh is required to produce one tonne of ferrochrome.

Commercially, chrome ore can be divided into three categories: (i) high-grade, containing >48% chromite, (ii) medium-grade with > 40% chromite and (iii) low-grade containing less than 40% chromite.

Chromium metal and the alloy ferrochromium are commercially produced from chromite by silicothermic or aluminothermic reactions, or by roasting and leaching processes. Chromium metal assumes high value due to its properties, such as, high corrosion resistance and imparting of hardness.

The discovery that steel could be made highly resistant to corrosion and discolouration by adding metallic chromium to form stainless steel led to major developments in the Steel Sector. This application, along with chrome plating (electroplating with chromium) are currently the major commercial use for the element. The element also finds application in the production of chromium compounds, albeit to a minor extent.

The strengthening effect of forming stable metal carbides at the grain boundaries and the strong increase in corrosion resistance has made chromium an important alloying material for steel. The high-speed tool steels contain between 3 and 5% chromium. Stainless steel, the main corrosion-proof metal alloy is formed when chromium is added to iron in sufficient concentrations usually above 11%.

WORLD REVIEW

World reserves of Shipping-grade chromite are about 560 million tonnes in terms of chromiun content. Countries that possess sizeable quantities of reserves are Kazakhstan (41%) and South Africa (36%). These two countries together hold about 77% of world's chromite reserves. India possesses 18% while Turkey accounts for 4% of the world reserves of chromite. The available data on world reserves of chromite (Shipping-grade) is furnished in Table-9

The world mine production of chromite ores & concentrates increased by 2.43% to 37.90 million tonnes in 2022 from 37.00 million tonnes recorded in the previous year. South Africa was the leading producer contributing about 50% to the total world production followed by Kazakhstan (17%), India (10%),Turkey (7%), Zimbabwe & Finland (3% each) and Russia & Albania (2% each) (Table-10).

Upgradation of technology and advan- cement in beneficiation processes, such as, agglomeration of ore, pre-heating and pre-reduction of furnace feed, closed-furnace technology and recovery of chromium from slags have brought about significant changes and are now followed worldwide. For generalised view of the development in various countries.

Table – 9 : World Reserves of Chromite

(By Principal Countries)

(In '000 tonnes of chromium content)

Country	Reserves
World: Total (rounded off)	560000
Kazakhstan	230000
South Africa	200000
India	100000
Turkey	26000
Finland	8300
United States	630
Other countries	NA

*Source: USGS, Mineral Commodity Summaries, 2023 **Shipping grade-Reserves unit are thousand metric tonnes of shipping-grade chromite ore which is deposit quantity and grade normalised to 45% Cr_2O_3except for United States where grade is normalised to 7% Cr_2O_3 and Finland where grade is normalised to 26% Cr_2O_3.*
*NA-Not available. *: Reserves/resources of chromite in the country as on 1.4.2020 as per NMI database based on UNFC system have been placed at 331.69 million tonnes.*

Table – 10 : World Mine Production of Chromium Ores and Concentrates

(By Principal Countries)

(In '000 tonnes)

Country	2020	2021	2022
World:Total (roundedoff)	**30100000**	**37000000**	**37900000**
South Africa	13196880	18435250	19061754
Kazakhstan	6327000	6192000	*6500000
India**	2863869	3785625	3927873
Turkey	2128669	2779467	2477533
Finland	1453332	1464738	1208006
Zimbabwe	1272139	1244300	1154158
Albania	626627	650200	932686
Russia	689000	*689000	*689000
Pakistan	*404800	*467100	*650000
Other countries	1177027	1290421	1334792

Source: BGS World Mineral Production, 2018-22
***: production of chromite in india 2020-21,2021-22 and 2022-23 was 2.83 million tonnes, 3.78 million tonnes and 3.56 million tonnes respectively.*

FOREIGN TRADE

Exports

Exports of chromite increased manyfold to 33.82 thousand tonnes in 2022-23 from 2.62 thousand tonnes in the previous year. Out of total chromite exported in 2022-23, the share of chromite concentrate was 87% while chromite ore (others) accounted for 13%. Exports of chrome ore (others) were almost fully to China in 2022-23. Export of chrome Ore (other) increased to 4,303 tonnes in 2022-23 from 2,614 tonnes in the preceding year.

In 2022-23, 158 tonnes of chromium & alloys were exported to various countries. Exports of chromium & alloys were mainly to USA (74%). The exports of chromium & scrap was 1 tonne. Exports of chromium unwrought (powder) was decreased to 156 tonnes in 2022-23 from 284 tonnes in the preceding year (Tables-11 to 14).

Table – 11: Exports of Chromite : Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**2625**	**89710**	**33881**	**904154**
China, Rep. of	2614	76845	33875	903780
Oman	++	13	5	187
Canada	-	-	1	169
Finland	-	-	++	18
USA	7	12638	-	-
Saudi Arabia	4	200	-	-
Nepal	++	14	-	-

Figures rounded off

Table – 12 : Exports of Chrome Ore Concentrates

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**-**	**-**	**29578**	**780686**
China	-	-	29578	780686

Figures rounded off

Table – 13 : Exports of Chrome Ore (Others)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**2614**	**76859**	**4303**	**123468**
China	2614	76845	4297	123094
Oman	-	-	5	187
Canada	-	-	1	169
Finland	-	-	++	18
Nepal	++	14	-	-
UK	++	++	-	-

Figures rounded off

Table – 14 : Exports of Chrome Ore Lumps

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**11**	**12851**	**-**	**-**
USA	7	12638	-	-
Saudi Arabia	4	200	-	-
Oman	++	13	-	-

Figures rounded off

Imports

Imports of chromite (total) decreased by 55% to 111.29 thousand tonnes in 2022-23 from 245.71 thousandtonnes in the previous year. Imports were mainly from South Africa (72%), Mozambique (23%) and Turkey (3%). Out of total quantity of chromite imported in 2022-23, chrome ore lump accounted for 17%, while concentrate and other forms accounted for 7%. Imports of chrome ore lump were mainly from South Africa (65%), and Turkey (21%). 64% of the imports of chrome ore concentrate were from South Africa only. Imports of chromium & alloys in 2022-23 were at 1,443 tonnes as compared to 1,451 tonnes in the previous year. Imports of chromium & alloys were mainly from China (63%) and Russia (17%). Imports of chromium & scrap were 99 tonnes in 2022-23 as compared to 102 in 2022-23 (Tables-15 to 18).

Table – 15: Imports of Chromite : Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**245710**	**4232459**	**111291**	**2969916**
South Africa	173586	3192808	80492	2193902
Mozambique	-	-	25904	621937
Turkey	4234	91682	4050	103587
China	19	861	49	17167
Netherlands	318	14372	242	13262
Oman	3218	56133	383	12844
UAE	2384	33439	116	3589
USA	18	1958	20	2167
Germany	15	1992	8	809
Belize	-	-	24	301
Other Countries	61918	839214	3	351

Figures rounded off

(In tonnes)

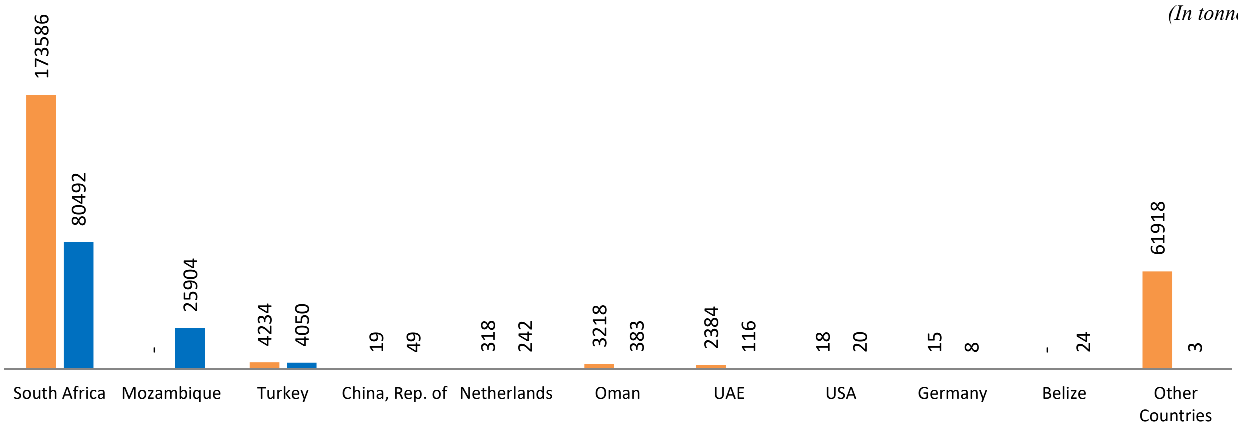


Fig 2: Imports of Chromite

Table – 16 : Imports of Chrome Ore Lump

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**110544**	**1809263**	**19019**	**575665**
South Africa	39295	800963	12433	391027
Turkey	4234	91682	4050	103587
Mozambique	-	-	2106	67373
Oman	3218	56133	383	12844
UAE	1990	24395	22	450
Belize	-	-	24	301
Taiwan	-	-	1	83
Switzerlands	45991	606665	-	-
Austria	6155	108338	-	-
Singapore	7684	96931	-	-
Other Countries	1977	24156	-	-

Figures rounded off

Table – 17 : Imports of Chrome Ore Concentrate

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**4987**	**126819**	**7911**	**215038**
South Africa	4987	126819	5049	138077
Mozambique	-	-	2862	76961

Figures rounded off

Table – 18 : Imports of Chrome Ore Others

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**130179**	**2296377**	**84361**	**2179213**
South Africa	129304	2265026	63010	1664798
Mozambique	-	-	20936	477603
China	19	861	49	17167
Netherlands	318	14372	242	13262
UAE	394	9044	94	3139
USA	18	1958	20	2167
Germany	15	1992	8	809
Brazil	10	585	2	171
Singapore	-	-	++	97
Saudi Arabia	81	1896	-	-
Other Countries	20	643	-	-

Figures rounded off

FUTURE OUTLOOK

The current status of chromite production and consumption is on anticipated lines, but the consumption could increase enormously in the coming years and the country may have to depend on imports even for the domestic needs of chromite. Depletion of reserves is bound to create a serious problem for the future of the Chromite Industry in the country. An Expert Committee constituted by the Ministry of Steel, Government of India, in its recommendations put forth the need for detailed exploration of chromite in all the potential areas in Odisha, Karnataka and in the ophiolite belt of North-Eastern region with a view to prognosticate resources to a depth of 500 m in Sukinda belt and estimate resources in all other potential areas. Addressing concerns in ferrochrome production which is energy intensive segment is also essential. Setting up of such plant must strike a cost balance between raw materials and electrical energy supply. There are other imminent issues like consistent supply of chrome ore at the right cost, steady power supply and other input materials like low phosporous met coke and good market conditions that need redressal in respect of the continuous and unscrupulous exploitation of chromite.

Adherence to stringent pollution control norms, innovations in the process technology and plant equipment design would become inevitable for the future of the industry.

35. Cryolite

Cryolite is a double fluoride of sodium and aluminium and has a stoichiometry very near the formula Na_3AIf_6 and a melting point of about 1,010 °C. It was found to occur in substantial quantities in Greenland, and was mined extensively there in the early twentieth century, but the mine is now essentially exhausted. Synthetic cryolite can be produced by reacting hydrofluoric acid with an alkaline sodium aluminate solution. It is colourless to white but occurs in other shades too, for instance brown, red and sometimes black. It has a specific gravity of about 2.5 to 3. It has a low index of refraction close to that of water. Synthetic cryolite is used as an electrolyte in the reduction of alumina to aluminium due to non-availability of natural cryolite. Composition and properties of synthetic cryolite are the same as that of natural cryolite, but synthetic cryolite is often deficient in sodium fluoride.

INDUSTRY

Synthetic cryolites are obtained by adopting several processes. The selection of the process depends upon the availability and cost of raw materials. The simplest and most common method of obtaining synthetic cryolite is by reacting hydrofluoric acid with soda ash and alumina hydrate. Hydrofluoric acid is produced by reacting acid-grade fluorspar with sulphuric acid and this process also yields gypsum as by-product. In the secondary reaction between hydrofluoric acid and sodium chloride brine, sodium fluoride and hydrochloric acid are produced. In the primary reaction, dry aluminium hydroxide reacts with hydrofluoric acid to produce aluminium fluoride which reacts with sodium fluoride produced earlier and forms synthetic cryolite.

Besides fluorspar, fluorine gas produced as by-product at plants that produces phosphatic fertilizer and phosphoric acid, has emerged as an important alternative source for hydrofluoric acid and other fluorine chemicals including cryolite and aluminium fluoride. Rock phosphate usually contains 7–8% CaF_2. In terms of fluorine, it works out to 3–4% which is liberated at the time of acidulation of rock phosphate with sulphuric acid. Fluorine combines with silica to form silicon tetrafluoride which when scrubbed with water forms fluorosilicic acid. By recycling, 18–24% fluorosilicic acid is obtained, which serves as a raw material for manufacturing various fluoro-chemicals, including synthetic cryolite. From fluorosilicic acid, fluorine values are precipitated as sodium fluorosilicate by treating it with sodium salts. Sodium fluorosilicate becomes starting point for the production of synthetic cryolite.

For manufacturing synthetic cryolite from sodium fluorosilicate, two routes are generally adopted in the country. In the first route, sodium fluorosilicate is reacted with ammonia and in other route; sodium fluorosilicate is reacted with soda ash.

Important known units producing synthetic cryolite are highlighted below:

1. Navin Fluorine International Ltd, Udhana-Navasari Road, Surat, Gujarat-395 023.
2. Navin Fluorine International Ltd, Agra-Mumbai Road, Dewas, Madhya Pradesh-455 002.

3. Tanfac Industries Ltd, Kudikadu, Cuddalore, Tamil Nadu-607 005.
4. Harshil Industries Sarigam, Vapi, Gujarat-396 195.
5. Triveni Interchem Pvt. Ltd, GIDC, Vapi, Gujarat.
6. S.B. Chemicals, GIDC, Char Rasta, Vapi, Gujarat-396 195.
7. J.N. Chemicals, GIDC, Vapi, Gujarat.
8. Balaji Amines Ltd, Solapur, Maharashtra.
9. Arti Chemicals, Ankleshwar, Gujarat.

Navin Fluorine International Ltd is one of the largest manufacturers of speciality fluorochemicals comprising synthetic cryolite Aluminium Fluoride & Fluorocarb gases.

Some important units engaged in manufacturing of synthetic cryolite are - Triveni Chemicals, S.B. Chemicals, Jay Intermediates & Chemicals (Vapi, Gujarat), Madras Fluorine Pvt. Ltd (Manali, Chennai and Tamil Nadu) and Tarun Fluo-Chem Pvt. Ltd (Delhi), they also produce other fluorine chemicals. These units also manufacture potassium cryolite (K_3AlF_6) which is a foundry flux and used in welding, chemicals and explosives.

The total installed capacity of aluminum fluoride in Organised Sector was about 25,600 tonnes per annum.

USES AND CONSUMPTION

The Indian Standard specifications of cryolite for use in Aluminium Industry defined vide IS - 5893: 1989 (Second Revision; reaffirmed 2008) are as follows:

Constituents (on dry basis)	Specification
F	53% min.
Na	31 to 34%
Al	13 to 15%
SiO_2	0.20% max.
Fe_2O_3	0.10% max.
CaF_2	0.06% max.
Al_2O_3	1.00% max.
SO_3	0.50% max.
P_2O_5	0.01% max.
Loss on Ignition (LOI)	0.50% max.
NaF/AlF_3(by mass)	1.45 max. *(Ratio required for maintaining in acidic region)*

Note: i) LOI is to be determined at 550^{O}C for 60 minutes.
ii) Moisture should not be more than 0.20% when determined at 110+50C

The consumption of cryolite is nowadays not estimated because many industries prefer the use of synthetic cryolite instead of natural cryolite. However, consumption was reported earlier in bonded abrasives as a filler, insecticides, porcelaneous glass and salts of sodium & aluminium.

The commercial application of cryolite is confined mainly to aluminium metallurgy where it is used as an electrolyte in the reduction of alumina to aluminium metal by the Hall-Heroult process. Alumina is a bad conductor of electricity and its melting point is 2,348 °C. It is very expensive to carry out electrolysis at this temperature. To facilitate electrolysis, alumina is dissolved in molten cryolite as it lowers the melting point. Further, addition of certain additives, such as, aluminium fluoride improves the physical and electrical properties of the electrolyte, besides lowering the melting point. The amount that is added is, however, limited as it also causes reduction in electrical conductivity. Addition of calcium fluoride (CaF_2) further depresses the melting point with less adverse effect on conductivity. In contrast to this advantage, too much CaF_2 raises the density of the melt closer to that of liquid aluminium metal, thus inhibiting the separation of metal from electrolyte. The substituent, sodium fluoride, though is known to improve the density and conductivity, it also affects current efficiency.

A compromise made on all these factors has led to the following general composition of the bath to be in use —80–85% cryolite, 5–7% AlF_3, 5–7% CaF_2, 0–7% LiF and 2–8% Al_2O_3. The electrolyte bath tends to deplete content of cryolite during the process. Hence, the composition of the electrolyte has to be adjusted regularly by addition of .

In aluminium refining, high density electrolyte capable of floating aluminium is required. For this purpose, barium fluoride is used to raise density. Aluminium fluoride can be used to improve current efficiency of cryolite bath.

Cryolite is obtained as a by-product during the production of phosphatic fertilizer/phosphoric acid. When utilised in the Aluminium Industry, necessary precautions are observed as even 0.01% P in the electrolyte could cause 1–1.5% reduction in current efficiency in the production process of aluminium.

Other metallurgical uses of cryolite are in aluminising steel, in compounding of welding rod coatings and as fluxes. In glass, cryolite functions as a powerful flux because of its excellent solvent power for oxides of silicon, aluminium & calcium and for its ability to reduce melt viscosity at lower melting temperatures. Cryolite is used as filler for resin-bonded grinding wheels in Abrasive Industry to impart longer life. Sodium fluoride (NaF) or fluorosilicic acid is also used for this purpose. Cryolite is used in certain nitrocellulose-based gun propellants required in small-calibre weapons, cannons and small & large rockets.

FOREIGN TRADE

Exports

In 2022-23, exports of cryolite and chiolite decreased substantially by 77% to 29 tonnes from 126 tonnes in the previous year. USA (86%), Iraq (7%), UAE (7%), the main buyers from India in 2022-23 (Table-1).

Table - 1 Export of Cryolite and Chiolite: Total

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	**126**	**12127**	**29**	**4274**
USA	75	8086	25	3414
Iraq	4	82	2	513
UAE	++	20	2	148
South Africa	-	-	++	115
Malaysia	-	-	++	64
Brazil	++	36	++	14
Japan	-	-	++	4
Kenya	-	-	++	1
Uganda	-	-	++	1
Turkey	24	1305	-	-
Other countries	23	2598	-	-

Figures rounded off
Source: DGCI&S, Kolkata
"++ : Negligible

Imports

In 2022-23, imports of cryolite and chiolite decreased drastically by 58% to 1,747 tonnes from 4,167 tonnes in the previous year. Imports were mainly from China (48%), Taiwan (15%), Bahrain (15%) and Mozambique (11%) (Table-2).

Table - 2 Import of Cryolite and Chiolite: Total

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty(t)	Value (₹ '000)	Qty(t)	Value (₹ '000)
All Countries	4167	152877	1747	121744
China	3162	122288	836	79306
Taiwan	29	1770	260	12570
Netherlands	21	3266	63	9960
Germany	78	9012	23	4944
Belgium	42	4852	21	4359
Bahrain	404	6050	264	4303
Mozambique	245	3507	196	2878
Hungary	4	557	7	2294
UAE	-	-	50	734
Oman	++	2	27	396
Other countries	182	1573	-	-

Figures rounded off
Source: DGCI&S, Kolkata
"++ : Negligible

FUTURE OUTLOOK

The future of cryolite is dependent upon its use in the Aluminium Industry. Increased usage of aluminium and high performance fluoropolymers in automobiles will drive growth in inorganic and specially fluorochemicals segments. It is learnt that some US firms have registered success in their research and pilot plant tests for the production of aluminium directly from the mineral bauxite without the intermediate process of reduction cell. Viability of this may probably diminish the use of cryolite in the near future.

36. Diamond

Diamond has been the most valuable among gems for more than 2,000 years. Diamond occurs in two types of deposits, primarily in igneous rocks of basic or ultrabasic composition and in alluvial deposits derived from the primary sources. Its composition is pure carbon and has cubic crystal system and common form octahedron. India is known for its diamond cutting & polishing business especially for small sized diamonds. Most of the world's diamond cutting and polishing business comes to India, particularly to Surat in Gujarat. India depends largely on imports of rough gem diamonds for its Cutting and Polishing Industry as there is no notable production except for two producers in Madhya Pradesh whose limited production is too sparse to meet the Cutting and Polishing Industry's requirements. The cut and polished diamonds are predominantly re-exported

Broadly, industrial diamonds have three varieties viz, 'ballas' which is mass of minute diamond crystals difficult to cleave; 'bort' is yellowish grey to black colour and massive, flawed or irregular in shape and 'carbonado' is black, very hard, opaque and without cleavage.

RESERVES/RESOURCES

Diamond occurrences are reported since prehistoric times in the country. Presently, diamond fields of India are grouped into four regions:

1. South Indian tract of Andhra Pradesh, comprising parts of Anantapur, Kadapa, Guntur, Krishna, Mahabubnagar and Kurnool districts;
2. Central Indian tract of Madhya Pradesh, comprising Panna belt;
3. Behradin-Kodawali area in Raipur district and Tokapal, Dugapal, etc. areas in Bastar district of Chhattisgarh; and
4. Eastern Indian tract mostly of Odisha, lying between Mahanadi and Godavari valleys.

As per the NMI data, based on UNFC system as on 1.4.2020, all India reserves/resources of diamond have been placed at 31.72 million carats with an R/R ratio of 2.75%. By States, Madhya Pradesh accounts for about 90.14% resources followed by Andhra Pradesh 5.74% and Chhattisgarh 4.11% (Table-1).

Table –1 : Reserves/Resources of Diamond as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India:Total	**847559**	**30876432**	**31723991**
By Grades			
Gem	297692	756765	1054457
Industrial	254559	840823	1095382
Unclassified	295308	29278844	29574152
By States			
Andhra Pradesh	0	1822955	1822955
Chhattisgarh	0	1304000	1304000
Madhya Pradesh	847559	27749477	28597036

Figures rounded off

MINING LEASES & PRODUCTION

There were three reporting mines under Public Sector located in district Panna of Madhya Pradesh (Tables - 2 & 3). Production of diamond in 2022-23 was 388 carats which increased by 46% as against 266 carats in the previous year. The principle producer of diamond is Directorate of Geology & Mining, (Diamond Project), Govt. of Madhya Pradesh.

Table No. 2 :Principal Producers of Diamond, 2022-23

Name of producer	Location of the mine	
	State	District
Directorate of Geology & Mining (Diamond Project), Government of Madhya Pradesh,	Madhya Pradesh	Panna

Table – 3 : Production of Diamond, 2020-21 to 2022-23

(By State)

(Quantity in carats; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**13917**	**147696**	**266**	**18051**	**388**	**61473**
Madhya Pradesh	13917	147696	266	18051	388	61473

(in carats)

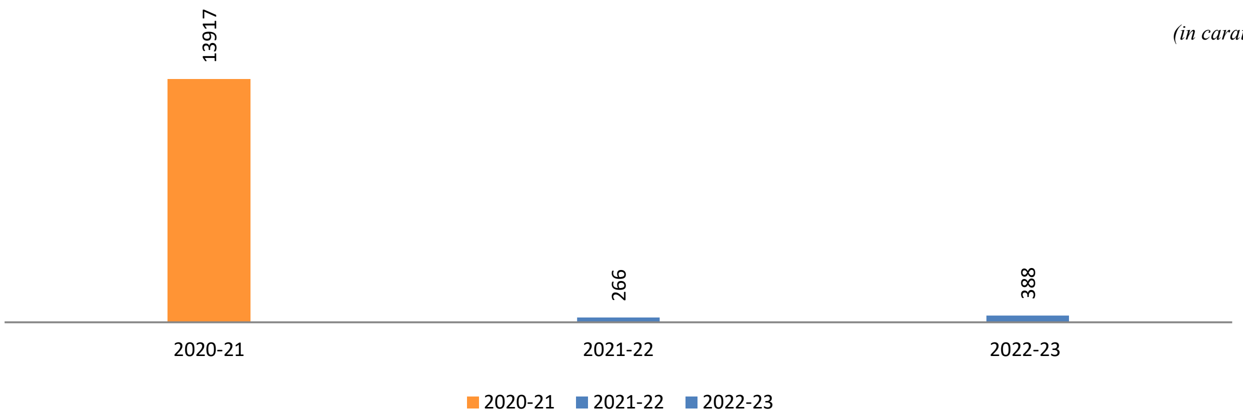


Fig 1: Production of Diamond

Out of the total output, Gem variety covering rough & uncut constituted 74% and the remaining 26% was of Industrial grade and other varieties (Table-4)

The average daily employment of labour during 2022-23 was 871 as against 699 in 2021-22.

Table – 4 : Production of Diamond, 2021-22 & 2022-23

(By Sector/State/District/Grades)

(Quantity in carats; Value in ₹'000)

State/ District	2021-22						2022-23 (P)					
	No.of mines	Quantity				Value	No.of mines	Quantity				Value
		Gem (rough & uncut)	Industrial*	other	Total			Gem (rough & uncut)	Industrial*	other	Total	
India	**3**	**179**	**42**	**45**	**266**	**18051**	**3**	**289**	**28**	**71**	**388**	**61473**
Public Sector	3	179	42	45	266	18051	3	289	28	71	388	61473
Madhya Pradesh	**3**	**179**	**42**	**45**	**266**	**18051**	**3**	**289**	**28**	**71**	**388**	**61473**
Panna	3	179	42	45	266	18051	3	289	28	71	388	61473

** Includes off-colour and dark-brown varieties of diamond.*

Table – 5 : Mine-head Closing Stocks of Diamond, 2021-22 & 2022-23

(By State)

(In carats)

State	2021-22	2022-23 (P)
India	**73**	**255**
Madhya Pradesh	73	255

MINING & PROCESSING

Majhgawan in Madhya Pradesh is a fully mechanised mine operated by National Mineral Development Corporation Ltd. It is worked by opencast method in tuff rock by deploying 4.1 cu. m hydraulic shovel and 40 tonnes dumpers in combination. The mine benches have been designed with a height of about 10 m. A few benches were of 4-5 m in height. Drilling is done by 4-inch diameter drills and charged with slurry explosives, and about 40–50 holes are blasted at a time with delay pattern. At present, the capacity of the mine is about 1,00,000 carats per year. Diamonds are also recovered from conglomerate and gravel beds at shallow depths by small operations on the basis of annual permits granted by Diamond Officer, Government of Madhya Pradesh. At Majhgawan, kimberlite rock, after mining the ore is stockpiled for weathering action and then is fed to crushing plant. It is processed through Heavy Media Separation System in processing plant for recovery of diamond. Recently, X-ray diamond sorter has been installed for sorting of diamonds from ore and this has increased the recovery of raw diamonds to 98%.

Diamond Mining Factors

Grade

Grade is the weight of diamond expressed as carats per tonne (ct/t) of ore. It varies widely from one mine to another but generally falls somewhere between 0.3 and 1.3 ct/t. One carat is equivalent to 0.2 grams.

Size (weight) of Rough Diamonds in Deposit

Individually, rough diamonds can range from micro weight to stones weighing more than 1,000 carats. Depending on the mine, the average size of rough diamond recovered can weigh from 0.01 ct (about 1 mm) to more than 0.7 ct. Many mines in the world show an average of about 0.4 to 0.5 ct per tonne.

INDUSTRY

Indian Diamond Industry enjoys credible standing and reputation in the world market, particularly for small diamonds used in jewellery. Indian diamond manufacturing standards are reckoned as the best in the world. Workmanship & skill of Indian artisans at polishing small diamonds economically and efficiently has been widely acknowledged. Surat in Gujarat is the main centre of the Cutting and Polishing Industry.

The Indian Diamond Industry thrives in the atmosphere of secrecy and informality that envelops the diamond trade and has for long been labeled as an unorganised sector of the economy. However, it resembles a close-knit community composed of thousands of small, medium and large sized CPD (cut and polished diamonds) units and has grown to become one of the highest foreign exchange earners for the country. An in-depth study of the Industry reveals that the so called unorganised sector is in fact highly organised and has great potential to offer useful insights to the field of management in terms of new forms of organising, networking, business processing and conducting international business.

India's predominance as leader in the world market is due to a combination of pragmatic policies of the Government and sustained efforts of exporters. Policy changes, such as, creation of Special Economic Zones (SEZ) is expected to boost the export prospects further. Several diamond polishing companies have already established offices in India for trading in rough & polished diamonds. India obtains rough diamonds from Belgium, UK, Hong Kong, UAE, Israel, etc. Indian diamond traders seek opportunities to establish direct trade ties with mining companies. The expectations of the Indian Diamond

Industry are to access rough diamonds at competitive rates directly from the producers to maintain its lead in the world market.

Tripartite MoU among Government of Madhya Pradesh (MRD, through DGM), MPSMCL & NMDC was signed for geological and geophysical exploration in various Districts of Madhya Pradesh. In this regard, Government of Madhya Pradesh issued Gazette Notifications of 20 diamond prospective blocks which could be applied under MoU for exploration and subsequent reservation.

Remote Sensing Studies have been completed in collaboration with NRSC in Chhattarpur Panna Block 1, Chhattarpur Panna Block 2 and Damoh Block, Panna (5 Prospective Blocks) and Additional 12 Diamond Blocks.

Several target areas were established after conducting ground magnetic, VLF-EM & Gravity surveys and stream sediment sampling and several additional anomalous areas were demarcated in the diamond blocks by processing the Raw Aeromagnetic Data acquired/provided by GSI in Diamond Blocks.

Forest applications for drilling has been prepared and submitted. The matter is being pursued with Forest Department for obtaining permission for drilling.

Proposals were submitted by NMDC to the Government of Chhattisgarh for Baloda–Belmundi Diamond Block over an area of 156.80 km2 in Saraipali tehsil, Mahasamund district for reservation under Section 17(A) (2A) of MM (D&R) Amendment Act, 2015 for undertaking prospecting and exploitation operations. Ministry of Mines, Government of India vide G.S.R.744(E) dt 14.10.2021 granted reservation of Baloda–Belmundi Diamond Block for PL or ML in favour of NMDC-CMDC limited under Section 17A(1A) of MMDR Act, 1957. NCL vide letter dated 13.01.2022, submitted application to Secretary, MRD, Government of Chhattisgarh for grant of Prospecting Licence for Baloda–Belmundi Diamond Block.

Main Mining Lease of Diamond Mining Project, Panna for total excavation of 13.90 LTPA (ROM kimberlite ore @ 8 LTPA and Overburden removal @ 5.90 LTPA) Environment Clearance obtained from Ministry of Environment, Forest & Climate Change (MOEF&CC) on 22.02.2024. Supplementary Mining Lease of Diamond Mining Project, Panna for 0.72 LTPA Over burden removal and processing of Kimberlite ore @ 8 LTPA for production of 1.00 lakh carats of Diamonds per annum Environment Clearance obtained from MOEF&CC on 22.02.2024.

USES & CONSUMPTION

Industrial diamonds are mostly consumed by manufacturers of drill bits, grinding tools and stone cutting & polishing machines and demand of industrial diamonds is mostly met by imports. There are many small-scale sector units that operate in cutting & polishing trade.

SUBSTITUTES

Synthetic Diamond

Today, market for industrial diamond is dominated by synthetic stones, first developed in 1950s. Synthetic diamonds manufactured using high pressure and high temperature methods compete as an abrasive mineral with natural industrial diamonds and also with manufactured materials like silicon carbide (SiC), alumina (Al_2O_3), tungsten carbide (WC) and carbide boron nitrate (CBN). Synthetic diamonds being marketed are mostly 0.6 to 0.8 mm and smaller in size. Synthetic Diamond Abrasives (SDA) are used for sawing, drilling or milling hard stones, concrete aggregate, refractory materials, masonry and asphalt. In general, large crystals are used for cutting softer materials and smaller crystals for tougher jobs. Synthetic diamonds now account for bulk supply of industrial diamonds and are preferred over natural diamonds because their quality can be controlled to suit customer's requirements.

Synthetic diamonds were produced earlier by using graphite with a metal catalyst under very high pressure & temperature.

Of late a new process, such as, Chemical Vapour Deposition (CVD) has been evolved which requires relatively low pressure for production of synthetic diamonds. This process involves depositing tiny crystals of diamond on a film which can be built in complicated shapes and used at desired places or instruments, such as, machine part, heat conductors in micro circuit, shortwave UV, microwave sources and radiation detectors. In future, CVD can be a substitute for silicon in Computer Industry. In USA, developments have taken place in CVD method of growing 100% pure diamond using microwave plasma technology. This method is more economical and also enables production of larger crystals.

TRADE POLICY

Import of diamond under HS Code 7102, Diamonds, whether or not worked, but not mounted or set, fall under 'Free' category as per the Import Policy ITC(HS), 2022 Schedule 1. Foreign Direct Investment (FDI) in diamond mining up to 100% is admissible for automatic approval of Reserve Bank of India.

WORLD REVIEW

The world reserves of industrial diamond are about 1,700 million carats located mainly in Russia (51%), Botswana (16%), Dem. Rep. of Congo and Angola (9% each), and South Africa (6%). The world reserves of diamond are furnished in Table-6

Table – 6 : World Reserves of Diamond

(Industrial)

(By Principal Countries)

(In million carats)

Country	Reserves
World : Total (rounded off)	**1700**
Russia	860
Botswana	280
Angola	150
Dem. Rep. of Congo	150
South Africa	95
Zimbabwe	NA
USA	NA
Other countries	120

Source: Mineral Commodity Summaries,USGS, 2024

The total world production of diamond increased by about 5% to 123.59 million carats in 2022 from 117.45 million carats in 2021.

The principal producers were Russia (34%), Botswana (20%), Canada (14%), Dem. Rep. of Congo (9%), South Africa (8%) and Angola (7%). During the year, increase in diamond production was observed in Russia, Botswana, Zimbabwe, Namibia etc while decrease in production was observed in Dem. Rep. of Congo and South Africa (Table-7).

Table – 7 : World Production of Diamond

(By Principal Countries)

(In '000 carats)

Country	2020	2021	2022
World: Total	**111747**	**117451**	**123597**
Russia	31187	39117	41924
Botswana	16868	22696	24479
Canada	15036	17353	17728
Dem. Rep. of Congo	16560	12179	11683
South Africa	8471	9724	9646
Angola	7734	8723	8763
Zimbabwe	2670	4224	4844
Namibia	1484	1518	2054
Lesotho	481	339	728
Other countries	11255	1577	1747

Source: BGS World Mineral Production, 2018-2022
Figures rounded off

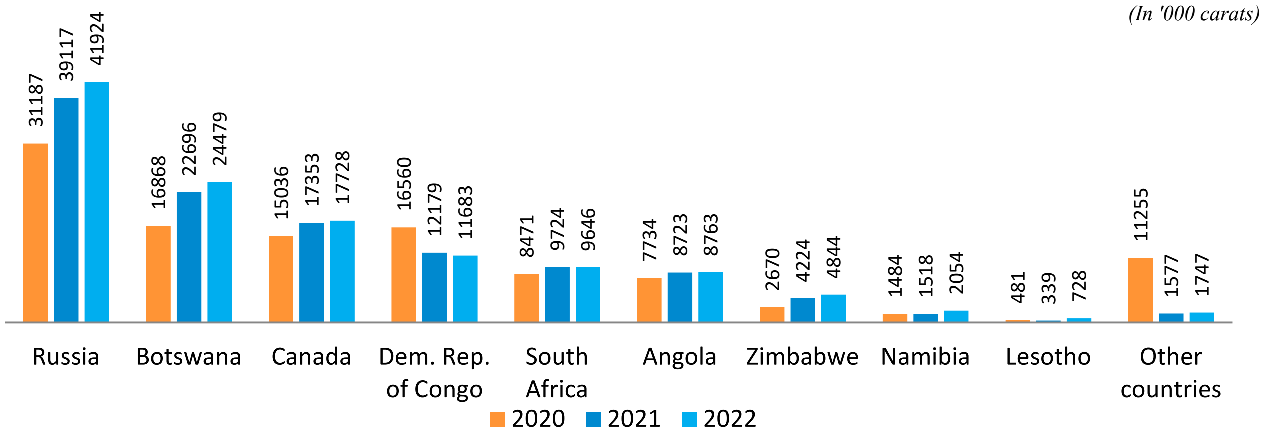


Fig 2: Countrywise Production of Diamond

Natural diamonds are cut in about 52 countries. The major diamond cutting centres in the world are Antwerp in Belgium, Ramat Gan in Israel, New York in USA, Surat in India and Guangzhou & Shenzhen in China.

FOREIGN TRADE

Exports

Value of exports of diamond decreased by 3% to ₹ 1,83,728 crore in 2022-23 against ₹ 1,89,364 crore in the previous year. Diamond (mostly cut) alone accounted for almost cent per cent exports in terms of value during this year. The share of industrial diamonds and diamond powder in terms of value was about ₹ 90 crore and ₹ 31 crore, respectively in 2022-23. In terms of value, exports were mainly to USA (35%), Hong Kong (24%), Belgium (11%) and UAE (10%) (Tables- 8 to 9).

Table-8 Export of Diamond

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (Carats)	Value (₹ '000)	Qty (Carats)	Value (₹ '000)
All Countries	**	**1893641728**	**	**1837280521**
USA	**	730165646	**	637384858
Hong Kong	**	480271367	**	445586325
Belgium	**	195508832	**	205899789
UAE	**	147555721	**	179476958
Israel	**	106610481	**	98138821
Thailand	**	79414507	**	73636392
Singapore	**	7123015	**	50298990
Switzerland	**	9362975	**	21483071
Japan	**	22221449	**	20960492
UK	**	14740939	**	15658219
Other countries	**	100666796	**	88756606

*Figures rounded off. Note:'**'Not additive*

Table-9 Export of Diamond : Productwise

By Country

Product Name	2021-22 (R)		2022-23 (P)	
	Qty (Carats)	Value (₹ '000)	Qty (Carats)	Value (₹ '000)
Diamond (industrial)	**12125962**	**1162179**	**12527927**	**901704**
Diamond (mostly Cut)	40571616	1892188684	32096573	1836070859
Diamond Powder	13991000	290865	16747000	307958

Imports

In 2022-23, imports value of diamond increased by about 1% to ₹ 2,07,769 crore from ₹ 2,05,638 crore in the previous year. Diamond (mostly cut) shared the bulk, i.e., almost cent per cent of the imports in terms of value. Imports of industrial diamond and diamond powder were about 20.01 million carats and 1,166.63 million carats, respectively, valued at ₹ 1678 crore and ₹ 305 crore respectively. In terms of value, imports were mainly from UAE (38%), USA (20%), Belgium (18%), Hong Kong (7%) and Russia (5%) (Tables- 10 to 11).

Table-10 Import of Diamond

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (Carats)	Value (₹ '000)	Qty (Carats)	Value (₹ '000)
All Countries	**	**2056382187**	**	**2077695939**
UAE	**	712821699	**	782076891
USA	**	420102490	**	409814405
Belgium	**	428174842	**	373374794
Hong Kong	**	133013019	**	145599794
Russia	**	60104585	**	96485452
South Africa	**	70089263	**	67268829
Israel	**	96946989	**	59362451
Thailand	**	41225238	**	42503872
Botswana	**	38419662	**	36637526
Singapore	**	9220021	**	30404146
Other countries	**	46264379	**	34167779

*Figures rounded off. Note:'**'Not additive*

Table-11 Import of Diamond : Productwise

By Country

Product Name	2021-22 (R)		2022-23 (P)	
	Qty (Carats)	Value (₹ '000)	Qty (Carats)	Value (₹ '000)
Diamond (industrial)	**16457278**	**10785779**	**20011091**	**16783936**
Diamond (mostly Cut)	155672092	2042729864	120861334	2057858821
Diamond Powder	1238216000	2866544	1166631000	3053182

FUTURE OUTLOOK

The Diamond Industry in the country currently employs over 8 lakh artisans who are experts in cutting and polishing of small diamonds and are now in a position to process full range of sizes and qualities of gemstones using latest technology. With production of about 90% of the world's polished diamonds, the Indian Diamond Industry is at the doorstep of major expansion today.

The Chinese Government has begun to initiate multi-billion dollar deals for rough diamonds in exchange for things that China produces like medicines, oils and industrial goods & services. Also, China's investment in Africa is a large threat to the Indian Diamond Cutting and Polishing Industry. There is a growing preference for polishing diamonds in countries where the diamonds are mined, like in Africa. It means that the Indian sector may face problems as India is not a large producer, and depends on import of rough diamonds from Africa. Low profit margin in the cutting and polishing segment has boosted midstream players' interest in synthetic diamonds, but synthetics have to be contented with only limited acceptance among jewellery retailers and end consumers. Albeit, this technological advancement resulting in enhanced appeal for synthetic diamonds may propel demand in future.

With the support in the form of increasing urbanisation, middle-class expansion and appeal as engagement rings, India will emerge as a third largest market for diamond jewellery leaving behind Europe and Japan. The ever growing jewellery segment in India has prospects to become the market for the world and it can also play a crucial role in Indian economy. Meanwhile, China and the US are expected to remain as the leading diamond jewellery markets.

37. Diatomite

Diatomite is a chalk-like, soft, friable, very-fine-grained siliceous sedimentary rock that is light in colour (white and yellowish) white if pure, commonly buff to grey in situ. It is composed of fossilised remains of unicellular aquatic algae-like plants called diatoms which are both marine & lacustrine in origin. Diatoms are microscopic, single-celled organisms, often appearing as colonial aquatic plants (algae). Diatom cells contain an elaborate internal siliceous skeleton. More than 10,000 living diatom species have been identified, in addition to another 10,000 known diatom fossil forms. Diatomite deposits are the remains from the cell wall of diatoms, which are composed of amorphous hydrous silica. Diatomite has the ability to absorb soluble silica to form a highly porous skeletal framework. The dead remains of these diatoms over the ages have fossilised and formed the deep-bedded deposits in ocean & lake floors. The special properties of diatomite, i.e., light weight (low in density), high porosity and high absorptivity have facilitated its application as filter medium and absorbents. It is chemically inert & highly stable. Diatomite consists of approximately 90 per cent silica and the remainder consists of compounds, such as, aluminium and iron oxides. It is also called 'Kieselguhr'. Diatomaceous earth is a common alternate name, but the term is more appropriate for unconsolidated or less lithified rock of the same origin.

Another lesser known mineral, namely, siliceous earth has many similarities with diatomite in character. Siliceous earth is, however, an inorganic material which has chemical composition of more than 80% of amorphous silica. This amorphous phase is very rare and used widely in industrial-scale because of its high porosity, fine particle size, very low density and its high surface area. Its chemical and physical features are same as diatomites which is also amorphous silica consisting of fossilised remains of diatoms, a type of hard-shelled algae. Siliceous earth differs from diatomite in its origin and seems to be formed from volcanic ash. However, due to the many similarities in both materials, siliceous earth finds similar uses as diatomites, and therefore, has been included in the Review.

RESERVES/RESOURCES

The occurrences of diatomite are reported from Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh and Camorta & Trincat Islands in Andaman and Nicobar archipelago. As per NMI database, based on UNFC system, the total resources of diatomite as on 1.4.2020 has been estimated at 2.89 million tonnes, all of which fall under Remaining Resources. The resources are distributed in Rajasthan (72%) and Gujarat (28%) (Table - 1).

Table – 1: Reserves/Resources of Diatomite as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India: Total	**–**	**2885**	**2885**
By Grade			
Unclassified	–	2885	2885
By States			
Gujarat	–	811	811
Rajasthan	–	2074	2074

Figures rounded off.

PRODUCTION

Diatomite

Production of diatomite has not been reported since 1991-92. Pandava and Khadraliya areas in Bhavnagar district, Gujarat, were the producing areas prior to 1991-92.

Siliceous Earth

The production of siliceous earth was 32,070 tonnes during 2022-23 as against 33,898 tonnes in 2021-22 (Tables- 2 to 4).

There were 14 reporting mines in the year 2022-23 as against 13 reporting mines in 2021-22.

Mine-head closing stocks of siliceous earth in the year 2022-23 were 38,543 tonnes as against 71,321 tonnes in 2021-22 (Table-5).

The average daily employment of labour in 2022-23 was 66 as against 47 in the previous year.

Table No. 2 :Principal Producers of Gold, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
Mr.Narayan Singh Rathore, Chandan Singh ki Dhani, Shiv. Barmer -344 001, Rajasthan.	Rajasthan	Barmer
Mr.Ram Swaroop Meghwal, 359,Gotan, Merta, Nagaur- 341 510, Rajasthan.	Rajasthan	Jaisalmer
Mr.Ishwar Singh Rathore, Vill.Jayani, P.O.Kathoti, Jayal,Nagaur-341001 Rajasthan.	Rajasthan	Jaisalmer
M/s.Seema Minerals & Metals, 203 A, Mewar Industrial Area, Madri, Udaipur-313003, Rajasthan.	Rajasthan	Jaisalmer
Mr.Ashok Kumar Khatri, Inko ki Pol, Pokaran, Jaisalmer-345 021, Rajasthan.	Rajasthan	Jaisalmer

Table - 3 : Production of Siliceous Earth, 2020-21 to 2022-23(P)

(By States)

(Qty. in tonnes; Value in ₹ '000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**23823**	**14686**	**33898**	**22837**	**32070**	**17535**
Rajasthan	23823	14686	33898	22837	32070	17535

(P): Provisional

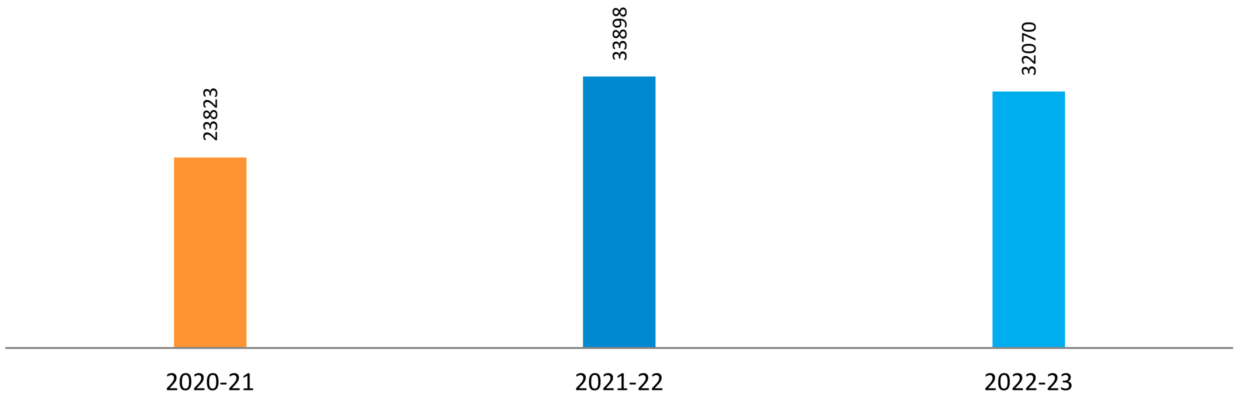


Fig 1: Production of Siliceous Earth

Table – 4 : Production of Siliceous Earth, 2021-22 and 2022-23(P)

(By Sectors/States/Districts)

(Quantity in tonnes; Value in ₹ '000)

State/District	No. of Mines	2021-22 Production		No. of Mines	2022-23 (P)	
		Qty	Value		Production	Value
India	**13**	**33898**	**22837**	**14**	**32070**	**17535**
Private sector	13	33898	22837	14	32070	17535
Rajasthan	**13**	**33898**	**22837**	**14**	**32070**	**17535**
Barmer	6	25775	18818	6	22650	13558
Jaisalmer	7	8123	4019	8	9420	3977

(P): Provisional

Table – 5 : Mine-head closing stocks of Moulding Sand, 2021-22 & 2022-23(P)

(By State)

(In carats)

State	2021-22	2022-23 (P)
India	**71321**	**38543**
Rajasthan	71321	38543

(P): Provisional

USES

Diatomite is commonly used after calcination in plate and frame filter units. Processed diatomite finds a wide range of applications due to its properties like porosity, low bulk density, soluble impurities, and high absorptive capacity for liquids, large surface area, low thermal conductivity, mild abrasive nature and chemical inertness.

Diatomite is an excellent filtering material for many liquids especially beverages, fruit juices, soft drinks, beer and wine. It is used in chemicals like sodium hydroxide, sulphuric acid and gold salts. Filtration of cooking oils (vegetable and animal) and sugar (cane, beet and corn) is an application where diatomite is predominantly used. It is also used as an absorbent of vegetable oil, polyethylene, rayon liquors and as a flattening agent in paint, plastic, rubber, drugs, toothpaste, polishes and chemicals. Diatomite is utilised for safe handling and storage of hazardous chemicals like sulphuric acid. Besides, diatomite is also used as an abrasive in metal polishing in automobiles and toothpastes; as pozzolanic admixtures in Cement Industry; as animal feed stuff conditioners; and in explosives. It is also used as a coating material in the manufacture of ammonium nitrate fertiliser which is hygroscopic. Diatomite clay is the new revolution in hydroponics. In pharmaceuticals, it is used to filter syrups and other bulk drugs in liquid form. It is used as a facial exfoliator to promote skin health. Research has also shown that food-grade diatomaceous earth may offer positive benefits for controlling cholesterol levels which in turn would improve heart health. The cleaning of grease and oils continued to be the largest end-use for diatomite. In Oil Industry, before packing, it is used for filtering oil which not only gives it a shine but also helps in removing any suspended impurity. Wine and beer are filtered through diatomite filters before packing to remove molasses. Filter candles are made from diatomite filter aids for drinking water purification. Processed diatomite granules 15 to 50 mm, are used in denim wash (commonly known as stonewash) to give it shine and design.

Diatomite is also used as caking agent in fertilizers, plastics and as a natural insecticide for organic pest control. Potable water treatment and biological filtration are areas of expansion in diatomite consumption. Siliceous earth is mainly used as filler & filter, heat & sound-resistant material and in Ceramic Industry. Filtration and cleaning of vegetable oils and animal fats and manufacturing of medicines are other uses. In advance applications, it is used as carrier for catalyst in chemical processes and for mineral fertilizers & herbicides, pesticides and fungicides. It is also used as raw material for refination and filtration as well as constituent of synthetic molding mass. It is increasingly used for the removal of microbial contaminants, such as, bacteria, protozoa and viruses, from public water systems. Recently, diatomite derived products included filter aids (50 per cent), filters (15 per cent), absorbents (5 per cent), and other minor uses, including specialised pharmaceutical and biomedical applications (less than 1 per cent).

Siliceous earth, on the other hand, is used in powder form which may vary from 80 mesh to 500 mesh powder. It is also used in granule form in some specific operations and in paint, filler, rubber, catalyst, fertilizer, pesticides, agriculture and many other industries.

Diatomite is increasingly used in agriculture segment in fungicides, insecticides and rodenticide owing to its dehydration properties. Other diatomite applications include its use as a growing medium in hydroponic gardens wherein its characteristics, such as, inertness, water holding capability and porosity allows the soil to breathe.

PROCESSING

Diatomite deposits are usually mined as open pit operations. If necessary, the mined crude is dried and crushed. Dried diatomite is collected in cyclones and fed through air separators to remove coarse material and impurities. Calcination and flux calcination are used to thermally volatise organic material and oxidise iron. Calcination is also used to increase diatomic hardness, specific gravity and refractive index. The fusing of small diatomite particles into clusters can also be accomplished through calcination,which results in increased pore size and volume. Diatomite products are sold as various grades of calcined powders.

INDUSTRY

M/s Seema Minerals & Metals, Udaipur, Rajasthan, produces various grades of diatomaceous earth of which some grades are as follows:

- Diatomaceous Earth for insulation in Fire Proof Cabinets and safes.
- Diatomaceous Earth for calcium silicate boards.
- Diatomaceous Earth for water purification.
- Diatomaceous Earth for Animal Feed.
- Diatomaceous Earth for agriculture crops.
- Diatomaceous Earth for filtration.
- Calcined Diatomaceous Earth.
- Diatomaceous Earth Oil absorbents.
- Diatomaceous Earth for insecticides

SUBSTITUTION

Many materials can be substituted for diatomite. However, the unique properties of diatomite assure its continued use in many applications. Expanded perlite and silica sand compete for filtration. Filters made from manufactured materials, notably ceramic, polymeric, or carbon membrane filters and filters made with cellulose fibers are becoming competitive as filter media. Alternate filler materials include clay, ground limestone, ground mica, ground silica sand, perlite, talc, and vermiculite. For thermal insulation, materials, such as, various clays, exfoliated vermiculite, expanded perlite, mineral wool and special brick can be used. Transportation costs will continue to determine the maximum economic distance that most forms of diatomite may be shipped. Diatomite still remains competitive despite availability of alternative materials. Many alternatives exist for diatomite as a pozzolan, however, its use as an ingredient of portland cement has not diminished but on the cotrary has increased in recent years. The encroachment of natural and synthetic substitute materials into diatomite markets has not been significant.

TRADE POLICY

As per the Foreign Trade Policy, 2015-2020, the imports and the exports of siliceous fossil meals (kieselguhr, tripolite, and diatomite) and similar siliceous earth, whether or not calcined under ITC (HS) Code 251200 (25121010, 25120020, 25120030 and 25120090) are free.

WORLD REVIEW

World reserves/resources of crude diatomite are adequate for the foreseeable future. The USA has the largest reserves at 250 million tonnes followed by China with 150 million tonnes and Turkey with 44 million tonnes. World's largest producing district in terms of volume is near Lompoc, CA in USA (Table- 6).

The world diatomite production was 2.59 million tonnes in 2022. The USA dominated the world production by accounting for 42% output which was followed by China (10%), Turkey (9%) Denmark (5%), Peru, Argentina & Mexico (4% each) and France (3%).Production in Denmark was mostly of molar, an impure diatomite containing a large proportion of clay (Table- 7).

Table – 6: World Reserves of Diatomite

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded)	Large
USA [(1)]	250,000
Argentina	NA
China	150,000
Czechia	NA
Denmark [(5)] (Processed)	NA
France	NA
Germany	NA
Korea, Rep. of	2300
Mexico	NA
Mozambique	NA
Peru	NA
Russia	NA
Spain	NA
Turkey	44,000
Other countries	NA

Source:USGS, Mineral Commodity Summaries,2023
NA - Not available
1 Processed ore sold or used by producers.
5 Include sales of molar production.

Table – 7: World Production of Diatomite

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World: Total	**2247132**	**2485791**	**2590804**
USA([e])	822,000	998000*	1100000*
China[(e)]	274000*	270000*	270000*
Turkey	100,327	207,732	237,267
Denmark (Molar)[(d)]	115,000	120,625	143,125
Peru	85,406	94,860	104,660
Mexico	144,105	140,928	107,060
France	90000*	90000*	80000*
Argentina	99,000	100000*	100000*
Spain [(b)]	59,250	55,982	67,095
Other countries	458,044	407,664	381,597

Source: BGS, World Mineral Production, 2018-2022.
(b) Including the mineral Tripoli,
(c) Sold or used by producers
(d) Molar is an impure diatomite containing a large proportion of clay

FOREIGN TRADE

Exports

Exports of diatomite decreased nominally by 3% to 1,901 tonnes in 2022-23 from 1,964 tonnes in the previous year. Exports were mainly to Taiwan (38%), Sri Lanka (17%),Vietnam (13%),Mexico (9%), Singapore & France (4% each),Tanzania (3%) and Nepal (2%).

On the other hand exports of kieselguhr increased substantially by 46% to 41 tonnes in 2022-23 from 28 tonnes in the previous year. Exports were mainly to Switzerland (63%) and Bangladesh (37%) (Tables -8 & 9).

Table – 8: Exports of Diatomite

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1964**	**58544**	**1901**	**62622**
Taiwan	731	10248	717	11493
France	77	9950	84	10464
Sri Lanka	482	9583	325	7934
USA	100	13623	9	6135
Vietnam	20	199	238	4518
Nepal	12	764	37	4237
Tanzania	60	3992	49	3550
Singapore	16	758	68	3485
Mexico	179	2901	179	3017
Bahrain	--	--	7	1180
Other Countries	287	6526	188	6609

Figures rounded off

(in tonnes)

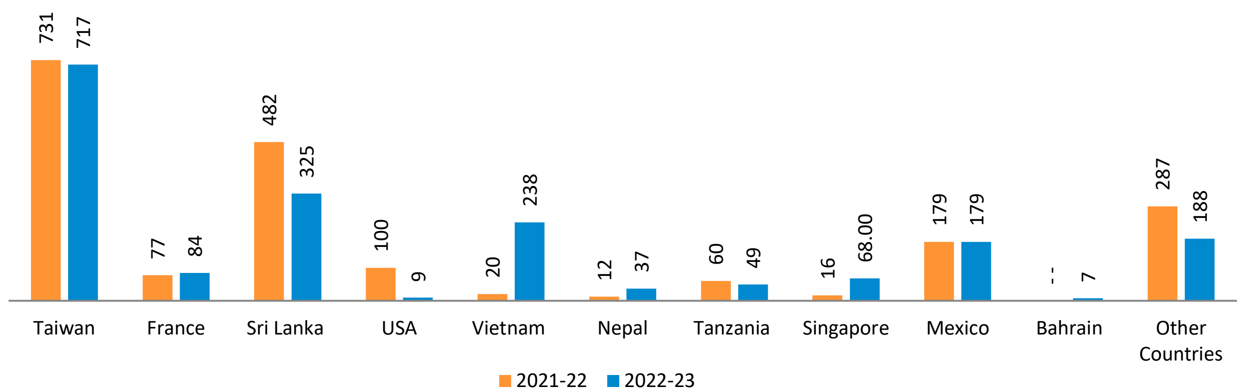


Fig 2: Countrywise Export of Diatomite

Table – 9: Exports of Kieselgurh

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**28**	**516**	**41**	**3329**
Bangladesh	--	--	15	2812
Switzerland	26	472	26	483
Philippines	++	4	++	25
Uzbekistan	--	--	++	5
Colombia	++	1	++	4
China	2	39	--	--

*Figures rounded off. Note:'**'Not additive*

Imports

Unlike exports, imports of diatomite increased drastically by 108 % to 3,722 tonnes in 2022-23 from 1,787 tonnes in the previous year. Imports were mainly from Australia (75%), China (44%), USA (39%), and Mexico (17%).

Imports of kieselguhr were at 6 tonnes in 2022-23 which Increased entirely as compared to negligible in preceding year. Imports of kieselguhr were mainly from USA (83%) and China (17%).

Imports of tripoli earth were nil in 2022-23 as compared to 19 tonnes in the previous year (Table-10-12).

Table – 10 : Imports of Diatomite

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1787**	**94373**	**3722**	**243082**
USA	923	45037	1452	102623
China	489	22920	1625	88052
Mexico	240	14845	616	47695
France	2	683	8	1889
Germany	54	4044	8	1262
Spain	55	5099	10	953
Netherlands	--	--	3	594
Korea, Rp of	--	--	++	14
Australia	24	1745	--	--

Figures rounded off

(in tonnes)

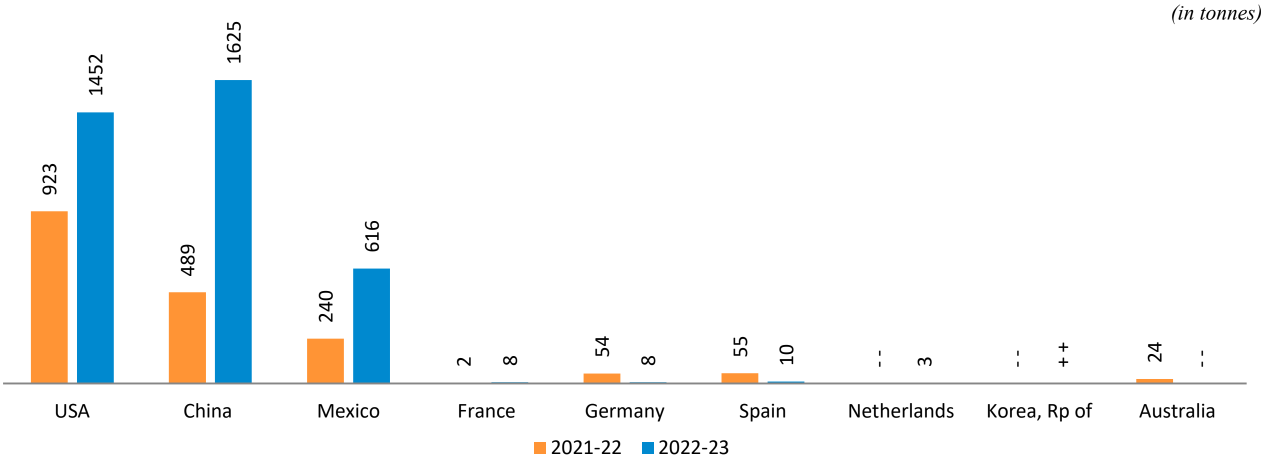


Fig 3: Countrywise Import of Diatomite

Table – 11: Imports of Kieselguhr

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**64**	**6**	**520**
USA	--	--	5	388
China	--	--	1	101
UK	++	59	++	25
Belgium	++	5	++	4
Spain	--	--	++	2

Figures rounded off

Table – 12 : Imports of Tripoli Earth

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**19**	**1174**	**++**	**2**
Spain	--	--	++	2
USA	19	1174	--	--

Figures rounded off

FUTURE OUTLOOK

Diatomite market is expected to witness substantial growth owing to increasing use in industrial applications including filter aid and filler material. Natural filtering characteristics due to its unique honeycomb structure and its rising use in filtration application,in food and beverage industry as well as human blood plasma and other biotechnical applications are key drivers for the growth of diatomite market.

Growing use of diatomite in industries, such Filtration as, paints, plastics, insecticides, pharmaceuticals, chemicals, adhesives, sealants, paper etc. is expected to propel market growth over the forecast period. In addition, its use in Plastic Industry as an anti-blocking agent assists in separation of plastic parts during manufacturing and separation of plastic bags. Growing health and safety concerns associated with inhalation of crystalline silica during diatomite processing is expected to affect market growth.

North America accounted for largest market share in terms of demand owing to large amount of diatomite reserves available in the region. In addition, increasing demand from various industrial applications including water treatment, absorbents and crop protection chemicals is expected to augment market growth. Asia Pacific accounted for second largest market share owing to increasing demand from crop protection chemicals and industrial applications, particularly in China. Furthermore, demand from countries, including India, Korea, Japan and Australia are expected to provide better opportunity for diatomite market. Europe contributed for a significant share of diatomite market owing to increasing demand from crop protection and water treatment particularly in Spain, Germany and United Kingdom. Middle East is expected to witness significant growth owing to increasing use of diatomite in various stages of oil & gas exploration.

The economic stability of diatomite was largely on account of its use as a viable filtration medium. Despite challenging market condition for many industrial commodities, world diatomite production remained stable. The demand for diatomite as filtration medium still remains strong, particularly in the filtration of spirit as well as human blood plasma and in other biotechnical applications.

38. Emerald

Emerald commonly called as 'Panna' in Hindi,is a variety of mineral beryl and is chemically a complex silicate of aluminium and beryllium ($Be_3Al_2(SiO_3)^6$. The hardness of Emerald is about 7.5 to 8 on Moh's scale. Emeralds are rare & precious gemstones that command immense value on account of their cut, colour, clarity and carat. Beauty, rarity and durability are the main virtues of a gemstone. The cut stones are known as gems, while the uncut ones are gemstones. Emeralds occur in hues varying from yellow-green to blue-green. However, emeralds with unique velvety green colour with high degree of transparency are considered as most precious among gemstones. The rose variety of beryl is called morganite, and the golden yellow variety is termed 'golden beryl'. If the colour is bluish green or blue then it is called 'aquamarine'. When emerald contains chromium as an impurity, it imparts the colour green. Emerald is generally found at the contact of pegmatites intruding schists, mainly amphibole schists.

RESERVES/RESOURCES

As per NMI data, as on 01.04.2020 based on UNFC system, the total resources of emerald in the country are estimated at 55.87 tonnes. All resources are placed under Reconnaissance category and Unclassified grade resources have been reported in the State of Jharkhand (Table-1).

Occurrences of emerald are also reported from Rajasthan, Odisha and Chhattisgarh. However, resources have not been estimated so far. In Rajasthan, emeralds have been found to occur at a number of places in districts of Rajsamand and Ajmer. In Ajmer-Rajsamand belt of Rajasthan, emerald occurrences are confined to the upper fringes of pegmatites. Emerald deposit is found in the 221 km long belt stretching from Gam Gurha in Rajsamand district to Bubani and Muhami in Ajmer district. Important localities are Rajgarh, Tikhi and Kalaguman (Rajsamand). The occurrences are highly sporadic and variable.

In Odisha, occurrences of emerald are reported from Bira-Mohorajpur belt in district Bolangir. In Chhattisgarh, occurrences of emerald are reported from Deobhog area in Raipur district. Sporadic and irregular crystals of emerald, aquamarine and amethyst are also reported in a few localities in district Coimbatore, Tamil Nadu.

Table – 1 : Reserves/Resources of Emerald as on 1.4.2020

(By Grades/States)

(In kg.)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	-	**55869**	**55869**
By Grade			
Unclassified	-	55869	55869
By State			
Jharkhand	-	55869	55869

Figures rounded off

PRODUCTION

Production of emerald has not been reported since 1983. The mine-head closing stocks of emerald at the end of the years 2022-23 and 2021-22 were 20 kg each (Table-2). The average daily employment was nil in both the years.

Table – 2: Mine-head Stocks of Emerald, 2021-22 & 2022-23

(By State)

(In kg)

State	2021-22	2022-23 (P)
India	**20**	**20**
Rajasthan	20	20

MINING AND MARKETING

Mining of emerald was mostly undertaken manually by opencast method. The pits were worked at shallow depths. The stones collected during mining were sorted out according to size, shape and quality. The stones so collected were deposited with the State Government under the supervision of DMG officials and mine owners. Worldwide, crude emerald was sold through public auction from time to time.

The beauty of rough stone is enhanced by skillful cutting and polishing into faceted or rounded form for use in jewellery. The rough stones are sorted out to determine the angles to which facets can be cut. They may be sawed or polished in any direction according to shape, size and colour to be retained. After the shape and size are determined, the next process of 'pre-shaping' is done. The third and important process called 'calibration' gives the pre-shaped stone a definite proportion and size.The process that follows is 'faceting' and 'polishing'. The aim of this process is to achieve maximum internal reflection enhancing the beauty of the stones. Emeralds are generally given a step-cut or cabochon-cut.

India is the leading exporter of cut and polished gem, but continued to depend on raw materials. The Diamond and Gem Development Corporation of India has set up Diamond and imported Gem Parks for cutting and polishing of gems in different States. Jaipur in Rajasthan is the major centre for processing emeralds. Like diamonds, uncut emerald is imported and part of it is exported after processing. Emerald is next to diamond (uncut) amongst precious and semi-precious stones, being imported and re-exported after cutting and polishing.Prices are governed by many factors including beauty, clarity, defect, demand, durability and rarity. Prices of precious stones also vary over time.

WORLD REVIEW

There is no information regarding world production and world reserve in BGS & USGS, respectively.

FOREIGN TRADE

MMTC is an authorised agency of the Government of India for import of precious & semi-precious stones including emerald and supply these items to jewellers for domestic sales and exports.

Exports

In 2022-23, exports of emerald (cut & uncut) by value increased substantially by 58% to ₹ 1709.69 crore from ₹ 1080.89 crore in the previous year. Exports were mainly to Hong Kong (27%), USA (25%), Thailand (19%), Italy (7%), Switzerland (6%), Singapore, UAE & France (3% each), Belgium (2%) and UK (1%). Out of the total export value of emerald (cut & uncut), the share of the export value of emerald (cut) was about almost 99 percent and emerald (uncut) 1 percent. The export value of emerald (cut) increased considerably by 60% to ₹ 1700.22 crore in 2022-23 from ₹ 1059.62 crore in the preceding year. In terms of quantity, the export of emerald (cut) increased by nearly 25% to 7,402 thousand carat in 2022-23 from 5,945 thousand carat in the preceding year. On the other hand, the share of the export value of emerald (uncut) was negligible i.e nearly 1 percent. The export value of emerald (uncut) decreased drastically by 55% to ₹ 9.47 crore in 2022-23 from ₹ 21.27 crore in the preceding year. While in terms of quantity, the export of emerald (uncut) increased drastically to 2 tonnes in 2022-23 from negligible quantity in preceding year. (Tables-3 to 4).

Table – 3: Exports Value of Emerald (Cut & Uncut): Total

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (**)	Value (₹ '000)	Qty (**)	Value (₹ '000)
All Countries	**	**10808861**	**	**17096852**
Hong Kong	**	2915677	**	4621626
USA	**	3306692	**	4358699
Thailand	**	1249771	**	3200452
Italy	**	543945	**	1115218
Switzerland	**	312073	**	943427
Singapore	**	56860	**	563185
UAE	**	408946	**	511070
France	**	588629	**	460211
Belgium	**	361469	**	310673
UK	**	244424	**	242666
Other Countries	**	820375	**	769625

Figures rounded off
Note: Quantity not given due to partial coverage; value figures, however, have full coverage.

(Value in ₹ '000)

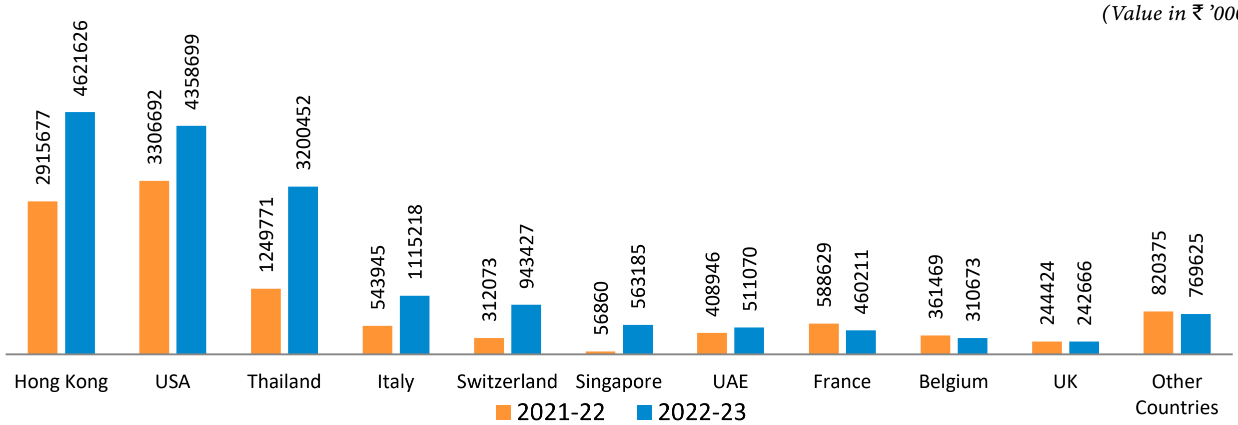


Fig 1: Countywise Exports of Emerald (Cut & Uncut)

Table – 4: Exports of Emerald

By Products

Country	2021-22 (R)		2022-23 (P)	
	Qty ('000'carat)	Value (₹ '000)	Qty ('000'carat)	Value (₹ '000)
Emerald (Cut)	5945	10596194	7402	17002198
Emerald (Uncut)	++	212667	2	94654

Figures rounded off

Imports

In 2022-23, the total imports of emerald (cut and uncut) by value increased substantially by 95% to ₹ 3233.40 crore from ₹ 1656.09 crore in the preceding year. Imports were mainly from Zambia (40%), Hong Kong (17%), USA (11%), UAE (8%), Thailand (7%), Singapore (6%), Belgium & Switzerland (3%each), Brazil (2%) and France (1%). In the total import value of emerald (cut & uncut), the share of import value of emerald (cut) was 28%, while the share of import value of emerald (uncut) was 72%. The import value of emerald (cut) increased by 255% to ₹ 905.46 crore in 2022-23 as compared to ₹ 255.32 crore in the preceding year. In terms of quantity, the imports of emerald (cut) decreased by 16 % to 2,654 thousand carat in 2022-23 from 3,174 thousand carat in the preceding year. The import value of emerald (uncut) also increased by 66% to ₹ 2327.94 crore in 2022-23 as compared to ₹ 1400.77 crore in the preceding year. In terms of quantity, the imports of emerald (uncut) also increased slightly by 10% to 64 tonnes in 2022-23 from 58 tonnes in the preceding year (Tables-5 to 6).

Table –5: Imports of Emerald (Cut & Uncut) : Total

By Countries

Country	2021-22 (R)		2022-23 (P)	
	Qty (**)	Value (₹ '000)	Qty (**)	Value (₹ '000)
All Countries	**	**16560915**	**	**32333990**
Zambia	**	7131002	**	12918166
Hong Kong	**	3034626	**	5406474
USA	**	1375688	**	3435993
UAE	**	2295634	**	2543346
Thailand	**	422600	**	2173187
Singapore	**	592360	**	2033162
Belgium	**	346850	**	1102653
Switzerland	**	222046	**	983918
Brazil	**	286784	**	707479
France	**	254971	**	266385
Other Countries	**	598354	**	763227

Figures rounded off
Note: Quantity not given due to partial coverage; value figures, however, have full coverage.

(Value in ₹ '000)

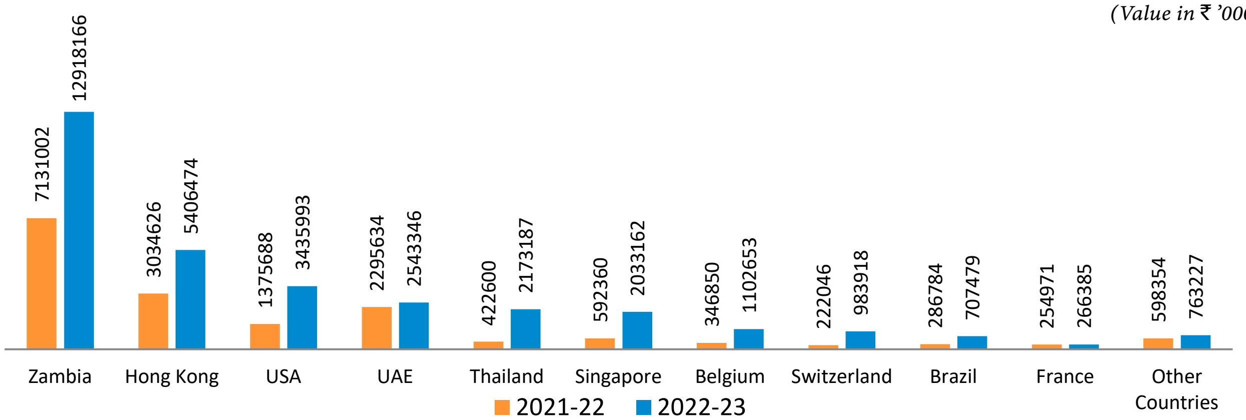


Fig 4: Countrywise Value of Import of Emerald (Cut & Uncut)

Table – 6: Imports of Emerald (Cut)

By Products

Country	2021-22 (R)		2022-23 (P)	
	Qty ('000'carat)	Value (₹ '000)	Qty ('000'carat)	Value (₹ '000)
Emerald (Cut)	3174	2553209	2654	9054590
Emerald (Uncut)	58	14007706	64	23279400

Figures rounded off

FUTURE OUTLOOK

Gems and Jewellery Export Sector has been contributing about 13% - 15% to India's total merchandise exports during the last five years. As per industry estimates, this Sector employs more than 4.64 million employees. With a view to strengthen the Gems & Jewellery Industry in the country, the Government has taken a number of steps, such as, establishment of Special Notified Zone (SNZ); announcement of separate ITC HS Code for lab-grown diamonds; introduction of Gold Monetisation Scheme; amendment of wastage and value addition norms for gems and jewellery items; approved scheme for setting up of Common Facility Centres for Gem and Jewellery Sector; and providing financial assistance for participation in international fairs, organising buyer-seller meets etc. under Market Development Assistance (MDA) and Market Access Initiative (MAI) Schemes of the Department of Commerce.

In the years to come, the demand for emerald gemstones is anticipated to witness a considerable growth given the increase in purchasing power of the growing affluent class in the country.

38. Fluorite

Fluorite is a very popular mineral, and it naturally occurs in all colours of the spectrum. It is one of the most varied coloured mineral in the mineral kingdom. Pure fluorite is colourless and the colours are caused by various impurities, and colour varies from purple to blue, green, yellow, colourless, brown, pink, black and reddish orange. The rich purple colour is by far the most famous and popular colour. It is an important commercial source of fluorine. Fluorite plays a vital role in the manufacturing Industry and major consuming industries are chemical, cement, iron & steel, electrode, etc. It is also used in the production of synthetic cryolite without which aluminium extraction is not possible.

Fluorite is commonly deposited by hydrothermal solution sourced from igneous intrusions. The mineralisation occurs as veins or replacement deposits either by the filling of cavities and fissures or by the replacement of the host rock, typically carbonates.

Mainly two grades of fluorite are involved in consumption and trade, namely, the Acid grade (acidspar) containing more than 97% CaF_2 and the Sub-acid grade containing 97% or less CaF_2. The Sub-acid grade includes Metallurgical (60 to 85% CaF_2 CaF_2) and Ceramic (85 to 95% CaF_2) grades and is commonly known as Metallurgical grade (metspar). Fluorite production in the country is meagre when compared with the world production.

In addition to the natural fluorite production, synthetic fluorite is recovered as byproduct during uranium processing, petroleum alkylation and stainless pickling. The by-product, fluorosilicic acid, obtained from phosphoric acid plants while processing phosphate rock also supplements fluorite as a source of fluorine.

RESERVES/RESOURCES

As per NMI database, based on the UNFC system, the total reserves/resources of fluorite in the country as on 1.4.2020 has been estimated at 20.99 million tonnes. Out of these, 0.40 million tonnes are placed under Reserves category (of which 0.23 million tonnes are under Proved category and 0.18 million tonnes under Probable category). The Remaining Resources comprise 20.59 million tonnes.

By States, Gujarat accounts for 68% of the total reserves/resources having 14.35 million tonnes, followed by Rajasthan with 5.60 million tonnes (27%), Chhattisgarh 0.54 million tonnes (3%) and Maharashtra 0.49 million tonnes (2%). Gradewise, the resources are classified into Marketable grade which accounted for 82% of the total resources followed by low grade (15%), Unclassified grade (2%) and around 2 % not known grade (Table-1).

Table – 1 : Reserves/Resources of Fluorite as on 1.4.2020

(By Grades/States)

(In kg.)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**404241**	**20588239**	**20992480**
By Grades			
Marketable	404241	16731425	17135666
Not Known	-	332057	332057
Low	-	3169481	3169481
Unclassified	-	355276	355276
By States			
Chhattisgarh	-	545455	545455
Gujarat	-	14355280	14355280
Maharashtra	386142	100000	486142
Rajasthan	18099	5587504	5605603

Figures rounded off

* Asper information available from website of IBM as on 31.3.2023(P) total 10 no. of fluorite leases has been distributed covering 89.86 ha .

MINING LEASES & PRODUCTION

The production of fluorite (graded) at 1135 tonnes in 2022-23 decreased by 8% as compared to that in the previous year.

There were four reporting mine in 2022-23 and only one in 2021-22. The entire output was reported from three public sector mines located in Maharashtra and Gujarat and one private sector mine located in Rajasthan.

The mine-head closing stocks of fluorite (graded) was 98177 tonnes in 2022-23 as against 97141 tonnes in 2021-22 (Tables-2 to 5).

The average daily labour employed in fluorite mines in 2022-23 and 2021-22 was 58 and 36 respectively.

The domestic price of fluorite is furnished in the General Review on 'Prices'.

Table – 2 : Producer of Fluorite 2022-23

Name and address of producer	Location of mine	
	State	District
Maharashtra State Mining Corporation Ltd, Plot No. 7, Ajni Square, Wardha Road, Nagpur-440 015, Maharashtra.	Maharashtra	Chandrapur

Table – 3 : Production of Fluorite (Graded), 2020-21 to 2022-23

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**1052**	**8018**	**1237**	**9430**	**1135**	**5831**
Maharashtra	1052	8018	1237	9430	1135	5831

Table – 4 : Production of Fluorite 2021-22 & 2022-23

(By Sector/States/Districts)

(Qty in tonnes; Value in ₹'000)

State	2021-22 No. of Mines	2021-22 Production		2022-23 (P) No. of Mines	2022-23 (P)	
		Qty	Value		Production	Value
India	**1**	**1237**	**9430**	**4**	**1135**	**5831**
Public Sector	1	1237	9430	3	1010	5767
Private Sector	-	-	-	1	125	64

Table- 4 (Concld.)

(Qty in tonnes; Value in ₹'000)

State	No. of Mines	2021-22 Production		No. of Mines	2022-23 (P)	
		Qty	Value		Production	Value
Gujarat	**-**	**-**	**-**	**-**	**100**	**575**
Vadodara	-	-	-	2	100	575
Maharashtra	**1**	**1237**	**9430**	**1**	**910**	**5192**
Chandrapur	1	1237	9430	1	910	5192
Rajasthan	**-**	**-**	**-**	**1**	**125**	**64**
Jalore	-	-	-	1	125	64

(p): Provisional;

(In tonnes)

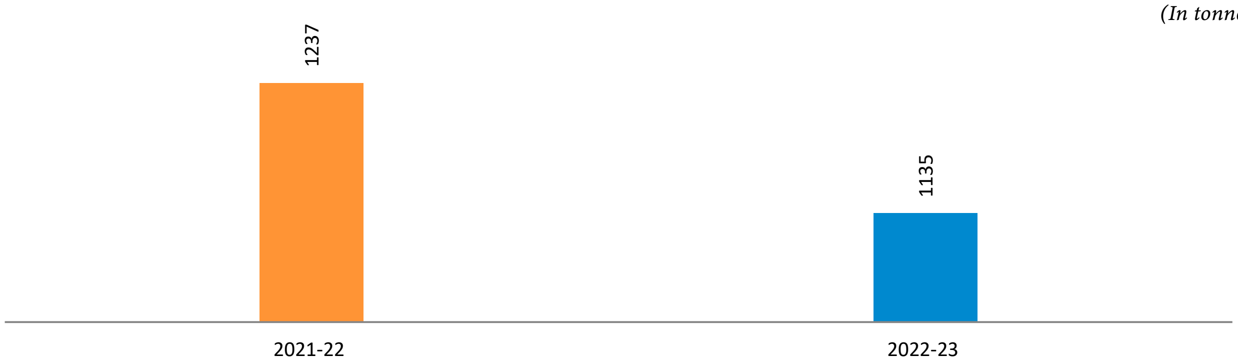


Fig 1: Production of Fluorite in India

Table – 5 : Mine-head Closing Stocks of Fluorite, 2021-22 & 2022-23

(By States)

(In tonnes)

Country	2021-22	2022-23
India	**97141**	**98177**
Gujarat	83372	84396
Maharashtra	13769	13636
Rajasthan	-	145

(p): Provisional

BENEFICIATION

Fluorspar is beneficiated by hand sorting followed by gravity concentration methods, such as, heavy media, jigs and tables in order to separate calcite and silicate mineral impurities. Low-grade fluorite produced is used after beneficiation in the industries. GMDC has a beneficiation plant of 500 tpd capacity located at Kadipani to produce Acid grade (96% CaF_2) and Metallurgical grade (90% CaF_2) fluorite by upgrading the low-grade fluorspar ore from 23–25% CaF_2 by flotation method. Besides, it has facility to produce MFC & MET grade powder analysing 75 to 85% CaF_2 & 85 to 92.5% CaF_2, respectively and other products, such as, starch briquettes (81% CaF_2 min.) and silicate briquettes (79% CaF_2 min.).

USES & CONSUMPTION

The apparent consumption of fluorite was about 3,10,304.13 tonnes in 2022-23, as against the 2,86,616.76 tonnes in 2021-22.

Acid grade fluorite is used as a feedstock in the manufacture of hydrofluoric acid (HF) and to produce aluminium fluoride (AlF_3). The major use of HF is for the production of a wide range of fluorocarbon chemicals, including hydrofluorocarbons (HFCs) hydrochlorofluorocarbons (HCFCs), and fluoropolymers. But, owing to environmental concerns, part of chlorofluorocarbons (CFCs) are replaced by HCFCs. HF is used in the manufacture of uranium tetrafluoride, an important ingredient used for producing nuclear fuel and fission explosives. It is also used in stainless pickling, petroleum alkylation, glass etching, and oil & gas well treatment and as etcher/cleaner in Electronic Industry.

HF is used in the manufacture of a host of fluorine chemicals used in dielectrics, metallurgy, wood preservatives, herbicides, mouthwashes, decay-preventing dentifrices, plastics and water fluoridation. AlF_3 manufactured from Acid grade fluorite is used as a flux in electrolytic recovery of aluminium. On an average, worldwide consumption of fluorides is about 21 kg for every tonne of aluminium produced. This ranged from 10 to 12 kg per tonne in a modern pre-baked aluminium smelter and about 40 kg in an old Soderberg smelter without scrubber.

Ceramic grade fluorite containing 85 to 95% CaF_2 is used in Ceramic Industry as a flux and as an opacifier in the production of flat glass, white or opal glass and enamels. The addition of 10–30% Ceramic grade fluorspar to glass makes it opaque, white and opalescent. It is also used in the manufacture of magnesium, some manganese chemicals and welding rod coating.

Metallurgical grade fluorite is used primarily as fluxing agent by Steel Industry. It is added to slag to make it more reactive through increased fluidity. Fluorite of different grades is used in

the manufacture of aluminium, cement and glass fibres. It is also used in the melt shop by Foundry Industry.

INDUSTRY

Many fluorine-based chemicals like hydrofluoric acid, aluminium fluoride, cryolite, sodium silicofluoride and hydrofluorosilicic acid are produced by Chemical and Fertilizer industries in the country.

In addition to material produced indigenously, substantial quantity of high grade fluorite was also imported to meet the demand of the fluorine-based Chemical Industries.

Tanfac Industries Limited is established as a joint-sector collaboration between Anupam Rasayan India Limited and Tamil Nadu Industrial Development Corporation (TIDCO) at Cuddalore, Tamil Nadu. It is engaged in the manufacture of fluorine chemicals, such as, aluminium fluoride, anhydrous hydrofluoric acid, sodium silicofluoride, ammonium bifluoride, potassium fluoride, and various other fluorine-based chemicals. It is the largest producers of Anhydrous Hydrofluoric Acid and Aluminium Fluoride in India. The Company has an annual installed capacity of 15,600 tonnes each of aluminium fluoride and anhydrous hydrogen fluoride, 67,200 tonnes of sulphuric acid, 14,000 tonnes of hydrofluoric acid and 3,400 tonnes of speciality fluorides. The company plans to expand its production capacity and diversify its product offerings to meet the increasing demand for speciality chemicals. Strategic partnerships, such as the recent agreement with a leading Japanese firm for refrigerant gas supply, will further strengthen Tanfac's market position.

Navin Fluorine International Ltd (NFIL) is an Indian manufacturers of speciality fluorochemicals, established in 1967. Its headquarter is in Mumbai, and manufacturing units in Surat (Gujarat) and Dewas (Madhya Pradesh), along with one unit of Navin Fluorine Advanced Sciences Limited, wholly-owned subsidiary, in Dahej (Gujarat). It belongs to the Padmanabh Mafatlal Group – one of India's oldest industrial houses. NFIL has an installed capacity of about 22,000 tpy of hydrofluoric acid. The Company produces a number of fluorine chemicals, namely, hydrofluoric acid, cryolite, aluminium fluoride and various other organic and inorganic fluorine- based chemicals.

Apatite and rock phosphate containing 3 to 4% CaF_2 was another useful source for recovery of fluorine.

SUBSTITUTES

There is currently a major trend to replace fluorite used in many applications with more environmentally friendly alternatives. There is the possibility to replace fluorite-based chemicals with hydrocarbon-based refrigerants such as butane and propane. In the steel and Iron industry, Olivine or dolomitic limestone can be used as a substitute of fluorite. The by-product of fluorosilicic acid from phosphoric acid production could also be used as a substitute in aluminium fluoride production.

WORLD REVIEW

The world total reserves of fluorite/fluorspar were at 260 million tonnes. World reserves are concentrated mainly in Mexico (26 %), China (19 %), South Africa (16 %), Mongolia (8 %), Spain (4 %) and Vietnam (2%) (Table- 6).

World production of fluorite/fluorspar in 2022 increased marginally by 1.43% to 8.30 million tonnes as compared to 8.18 million tonnes in the previous year (Table-7). China (69 %), Mexico (12 %), South Africa (5 %), Vietnam (3 %), Spain (2 %) & Morocco (2 %) and Mongolia (1 %) were the principal producing countries of fluorite/ fluorspar in 2022.

Table – 6 : World Reserves of Fluorite

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded)	**260,000**
Mexico	68,000
China	49,000
South Africa	41,000
Mongolia	22,000
Spain	10,000
Vietnam	5,000
USA	4000
Iran	3,400
Morocco	NA
Canada	NA
Germany	NA
Pakistan	NA
Other countries	55,000

Source: U.S.G.S., Mineral Commodity Summaries, 2023

Table – 7 : World Production of Fluorite

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
Word Total	**7600000**	**8200000**	**8300000**
China	5400000*	5700000	5700000
Mexico	914597	1007118	990079
South Africa	320000	403000	420000*
Vietnam	219920	215027	217975
Spain	185958	187225	203768
Morocco	83833	189012	189000*
Mongolia	127300	118300	122900
Iran [(b)]	116159	110000*	110000*
Germany	64933	56632	104461
Kazakhstan	77000	77000*	67000*
Other countries	90300	136686	174417

Source : BGS, World Mineral Production, 2018-22
**) Estimate*
b) Years ended 20 March following that stated

FOREIGN TRADE

Exports

Exports of fluorite increased by 21 % to 1024 tonnes in 2022-23 from 844 tonnes in the previous year. Exports were mainly to Indonesia (42 %), Bangladesh (22 %), Egypt (16 %) and Brazil, Saudi Arabia, Kenya & Nepal (each 3 %).

While, exports of aluminium fluoride decreased by 60 % to 391 tonnes in 2022-23 as compared to 984 tonnes in the previous year. Exports were mainly to UAE (51 %), Japan (46 %) and Turkey (3 %). Exports of hydrofluoric acid decreased by 38 % to 824 tonnes in 2022-23 as compared to 1325 tonnes in the preceding year (Tables- 8 to 10).

Table – 8 : Exports of Fluorite

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**844**	**43463**	**1024**	**65899**
Indonesia	335	20073	427	29879
Egypt	5	333	163	10920
Bangladesh	274	8932	227	9426
Brazil	44	3070	29	2554
UAE	10	581	19	2490
Saudi Arabia	47	3194	35	2473
Kenya	23	1410	33	1907
Cameroon	--	--	27	1889
Nepal	2	62	30	1596
Qatar	11	697	9	597
Other Countries	93	5111	25	2168

Figures rounded off
Note: Quantity not given due to partial coverage; value figures, however, have full coverage.

(in tonnes)

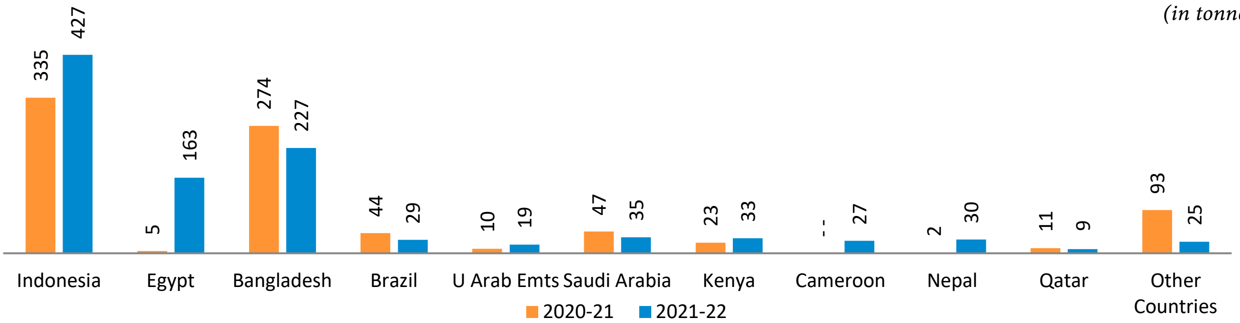


Fig 2: Countrywise Export of Fluorite

Table – 9 : Exports of Aluminium Fluoride

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**984**	**24720**	**391**	**50222**
UAE	500	9216	200	24513
Japan	100	11766	180	24217
Turkey	383	3462	10	1055
Germany	++	128	1	373
Belgium	++	60	++	62
Uganda	-	-	++	2
Australia	1	84	-	-
Malaysia	++	4	-	-

Figures rounded off

Table – 10 : Exports of Hydrofluoric Acid

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1325**	**132129**	**824**	**113899**
Thailand	472	58196	441	63476
Turkey	54	4337	206	31719
USA	195	16708	98	11482
UAE	30	3236	26	3488
Spain	22	1709	12	1452
Nepal	7	405	20	1042
Qatar	-	--	20	394
Guinea	++	2	1	378
Bhutan	++	227	++	168
Nigeria	2	226	++	74
Other Countries	543	47083	++	226

Figures rounded off

Imports

Imports of fluorite increased marginally by 8 % to 310173 tonnes in 2022-23 as compared to 286224 tonnes in the previous year. Imports were mainly from South Africa (72 %), China (11 %), Thailand (10 %) and Hong Kong (3 %). Imports of aluminium fluoride however, decreased substantially by 26 % to 55141 tonnes in 2022-23 from 74348 tonnes in the previous year. Imports were mainly from China (55 %), Qatar (10 %), Indonesia (9 %), Mexico (8 %), UAE (6 %) and Italy (5 %). While imports of hydrofluoric acid more than doubled (232 %) to 3729 tonnes in 2022-23 from 1122 tonnes in the preceding year. Imports were mainly from China (63 %), Taiwan (28 %), Sri lanka (7 %) and U.A.E (3 %) (Tables- 11 to 13).

Table – 11 : Imports of Fluorite

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**286224**	**7792038**	**310173**	**11509548**
South Africa	194063	4875662	223139	8265794
China	10271	419020	35394	1565500
Thailand	23585	601868	30296	890976
Hong Kong	2347	74673	9403	393720
Luxembourg	12502	429968	2458	107292
Vietnam	11659	420973	2879	68286
Turkey	1630	26501	1843	37551
Belgium	2764	90498	988	34161

Table- 11 (Concld.)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Spain	374	13143	1015	27736
Norway	564	18976	670	26055
Other Countries	26465	820756	2088	92477

Figures rounded off

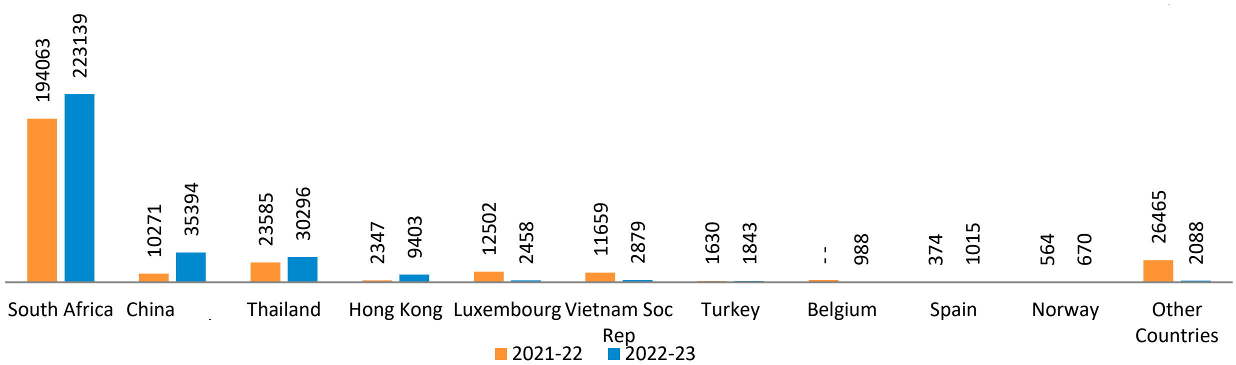


Fig 3: Countrywise Import of Fluorite

Table – 12 : Imports of Hydrofluoric Acidd

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1122**	**133130**	**3729**	**440788**
China	211	33726	2340	288521
Taiwan	724	68597	1035	101288
Sri Lanka	178	22473	247	24602
UAE	--	--	107	22631
Germany	4	2746	++	2292
USA	++	136	++	449
France	++	34	++	438
Belgium	++	32	++	183
Spain	++	252	++	181
Sweden	++	97	++	132
Other Countries	5	5037	++	71

Figures rounded off

Table – 13 : Imports of Aluminium Fluoride

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**74348**	**5287781**	**55141**	**5621747**
China	12793	1317137	30255	3613047
Indonesia	560	46715	5220	506585
Mexico	14625	1273267	4625	485342
UAE	8343	904470	3126	438934
Italy	10638	1101739	2862	403569
Qatar	12084	139754	5570	69390
Lithuania	2500	188104	500	44722
Sweden	163	16887	235	31821
Bahrain	5276	61767	2331	21569
South Africa	--	--	369	4603
Other Countries	7366	237941	48	2165

Figures rounded off

FUTURE OUTLOOK

The major driving factors for fluorite market are the growing Chemical Industry and increasing use of fluorite in Cement, Iron & Steel, and Glass Industries. The Chemical Industry and Glass Industry account for the major share of the fluorite demand globally. Global fluorochemical market is estimated around US$ 28.1 billion in 2023 and as per TANFAC Annual Report 2023-24, expected to grow at a CAGR of 5 % and reach USD 40 billion by 2030. The growth is triggered by robust increase in the sectors like Refrigerants, Automotive, Electronics and Pharma with Asia Pacific region expected to continue its domination. The increasing consumption of fluorochemicals in plasma etching for semiconductors, batteries, and other electronic products and components is boosting their demand. Moreover, the rising application of aluminium in the automotive industry is spurring the demand for fluorochemicals.

In India, the market growth of fluorochemicals is driven by downstream sectors like Automobile, Air Conditioning, Refrigeration, Construction, Cold Storage and Pharma / Life Science segments. Life Science segment has emerged one of the key drivers over the years. India is the 6th largest producer of chemicals in the world and 3rd in Asia. The chemical industry of India is a major industry in the Indian economy and as of 2024, contributes 7% of the country's Gross Domestic Product (GDP). The Indian chemical industry is currently valued at US$ 220 billion and is expected to reach US$ 300 billion by 2030 and US$ 1 trillion by 2040. As on 01.04.2020, the resources of fluorite in India are 20.99 million tonnes which is considered to be limited. Hence, to meet the requirements, the domestic Chemical Industry will have to depend (both qualitatively and quantitatively) on imported fluorite in the coming years, both for direct use and for blending with the domestic Acid grade fluorite.

40. Garnet

Garnet is the collective name for a group of minerals which crystalise in cubic system with different chemical composition. The principal members of the Garnet group are Almandine (Fe-Al), Pyrope (Mg-Al), Spessartine (Mn-Al), Grossularite (Ca-Al), Andradite (Ca-Fe) and Uvarovite (Ca-Cr). Almandine is hardest amongst all varieties and is often used for abrasive purpose. Garnet is dense & hard with sharp angular chisel-edged fracture, containing small amounts of free silica and exhibits high resistance to physical and chemical attacks. It is used both as semi-precious stone and as an abrasive. The hardness of garnet varies from 6.5 to 7.5 on Mohs scale. This allows it to be used as an effective abrasive.

RESERVES / RESOURCES

In India, garnet deposits suitable for use in Abrasive Industry occur in Andhra Pradesh, Chhattisgarh, Jharkhand, Kerala, Odisha, Rajasthan, Tamil Nadu and Telangana. Gem variety of garnet occurs in Ajmer, Bhilwara, Jhunjhunu, Sikar and Tonk districts, Rajasthan; Nellore and Srikakulam districts, Andhra Pradesh; Khammam district, Telangana and Coimbatore, Ramanathapuram, Tirunelveli, Kanyakumari, Tiruchirappalli and Tiruvarur districts, Tamil Nadu. Garnet is found to occur in beach sands along with ilmenite, rutile, sillimanite, etc. in the States of Kerala, Odisha and Tamil Nadu.

The total reserves/resources of garnet in India as on 1.4.2020, as per UNFC system has been placed at 56.01 million tonnes of which Reserves under Proved and Probable categories together constituted 8.60 million tonnes. Of the total resources, about 20.87 million tonnes are of Abrasive grade, whereas resources of Semi-precious grade are mere 8,468 tonnes. Tamil Nadu alone accounted for about 46% of the total resources followed by Andhra Pradesh (31%), Odisha (17%) and Telangana (3%). The remaining States together shared less than 3% (Table- 1).

Table – 1 : Reserves/Resources of Garnet as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**8590472**	**47416654**	**56007126**
By Grades			
Gem	1	46158	46160
Abrasive	8537296	12336249	20873545
Semi-precious	637	7831	8468
Others	-	260982	260982
Unclassified	52538	34325967	34378505
Not-known	-	439466	439466
By States			
Andhra Pradesh	-	17267129	17267129
Chhattisgarh	-	28800	28800
Jharkhand	-	110071	110071
Kerala	-	198861	198861
Odisha	8330046	1177318	9507364
Rajasthan	207888	842923	1050811
Tamil Nadu	52538	25831356	25883894
Telangana	-	1960196	1960196

Figures rounded off

EXPLORATION &DEVELOPMENT

The details about the exploration and development, if any, are covered in the Review on "Exploration and Development" under "General Reviews".

MINING LEASES, PRODUCTION AND STOCKS

Garnet (Abrasive)

Production of garnet (abrasive) was at 10,324 tonnes during 2022-23 and 8,182 tonnes in the preceding year. There were 6 reporting mines during 2022-23 and 7 reporting mines in 2021-22. Three principal producers accounted for about 100% of the total output during the year.

Mine-head closing stock of Garnet (abrasive) for the year 2022-23 was 3,648 tonnes as against 3,259 tonnes for the previous year. (Table 2 to 5)

The average daily employment of labour during 2020-21 was 57 as against 52 in the previous year.

Table – 2 : Principal Producers of Garnet (Abrasive), 2022-23

Name and address of the Producer	Location of the mine	
	State	District
Arun Bagdiya,C/o,Shri Ramdev Bagdiya,Resi No-110,Kendriya Vihar, Sector-8,Bidyadhar Nagar, Jaipur-302039, Rajasthan.	Rajasthan	Ajmer
AKD Gem Garnet Mines, F-203, Near Mahapragya Circle, Azad Nagar, Bhilwara - 311 001, Rajasthan.	Rajasthan	Bhilwara
Ummed Singh Ranawat, Vill-Basda,P.O.Gundali Bhilwara-311001 Rajasthan.	Rajasthan	Bhilwara

**Producing as an associated mineral with sillimanite.*

Table – 3 : Production of Garnet (Abrasive), 2020-21 to 2022-23

(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**7114**	**26378**	**8182**	**24660**	**10324**	**36138**
Odisha	-	-	-	-	-	-
Rajasthan	7114	26378	8182	24660	9863	35815
Tamil Nadu	-	-	-	-	-	-
Telangana	-	-	-	-	461	323

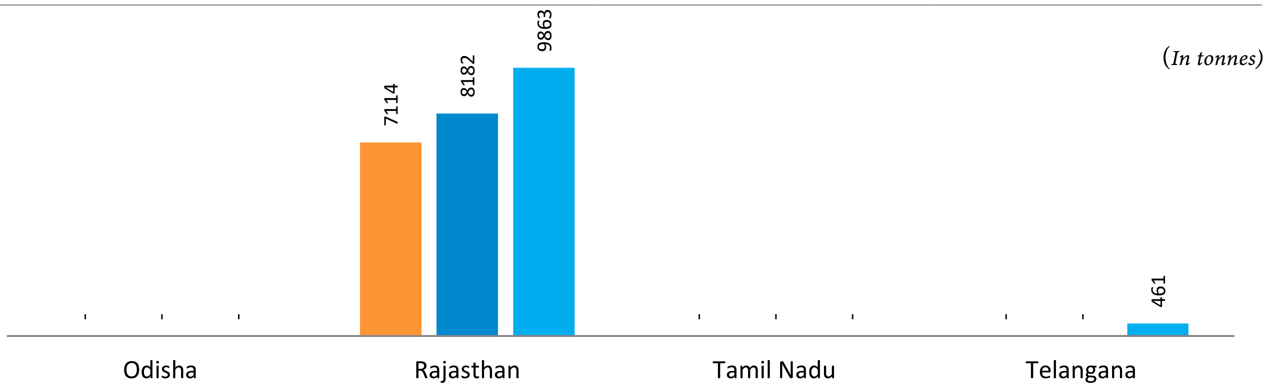


Fig 1: Production of Garnet (Abrasive) in India

Table – 4 : Production of Garnet (Abrasive), 2021-22 & 2022-23

(By Sectors/States/Districts)

(Quantity in tonnes; Value in ₹ '000)

State	2021-22			2022-23 (P)		
	No. of Mines	Qty	Value	No. of Mines	Production	Value
India	**7**	**8182**	**24660**	**6**	**10324**	**33168**
Public Sector	-	-	-	-	-	-
Private Sector	7	8182	24660	6	10324	33168
Rajasthan	**5**	**8182**	**24660**	**5**	**9863**	**35815**
Ajmer	2	2316	6783	2	2328	7026
Bhilwara	2	5850	17829	2	7531	28773
Tonk	1	16	48	1	4	16
Tamil Nadu	**2***	**-**	**-**	**-**	**-**	**-**
Tiruchirapalli	2*	-	-	-	-	-
Telangana	**-**	**-**	**-**	**1**	**461**	**322**
Khammam	-	-	-	1	461	322

Note-The main reason for decrease in number of mines is classification of some Garnet producing mines, such as BSM mines in Andhra Pradesh, Odisha and Tamil Nadu. Earlier, these mines were considered under Garnet (Abrasive) as a part of MCDR mineral as there was no seperate classification of Beach Sand Minerals (BSM) and Non-Beach Sand Minerals (Non-BSM).

Table – 5 : Mine-head Closing Stocks of Garnet (Abrasive) 2021-22 & 2022-23

(By States)

(In tonnes)

State	2021-22	2022-23 (P)
India	**3259**	**3648**
Andhra Pradesh	-	-
Odisha	-	-
Rajasthan	2617	3194
Tamil Nadu	642	-
Telangana	-	454

(P) Provisional

Garnet (Gem)

No production of garnet (gem) was reported since 2018-19.

USES & CONSUMPTION

The most important industrial use of garnet in the form of garnet sand is as an abrasive. About 90% production of abrasive garnet is used for manufacturing of garnet-coated papers, clothes and discs. Garnet-coated abrasives are used in the form of belts, covers for drums, discs or as small sheets. It is used for cleaning spark plugs, paints, polishing and grinding of plate-glass. The remaining 10% output is used in the form of loose grains for surfacing and polishing soft stones (marble, slate, soapstone, etc.). Clear, flawless and rich-coloured crystals of garnet are used as semi-precious stones. The principal variety among them are pyrope, deep-crimson almandine, orange-yellow grossularite, etc. Other uses are in Electronic and Television Industry for polishing glass and TV tubes. Garnet granules are used in 'abrasive blasting'commonly called 'sand blasting'in order to smoothen, clean and remove oxidation products from metals, stone and other material. MMTC's specifications of garnet sand used for sand blasting/jet cutting/other uses for exports to USA, Europe, Middle East and Taiwan are as follows: Al_2O_3: 20.8 to 21.2%, Bulk density: 2.17 kg/m^3, Hardness in Mohs scale should be 7.5 to 8.

Water jet cutting machines generally use finely-ground 80-120 mesh size garnet as cutting medium with high pressure water. Owing to its inertness to a wide range of chemicals and relatively high specific gravity, it is used as filter medium for water and other liquids.

SUBSTITUTES

Other natural and manufactured abrasives can substitute to some extent for all major end uses of garnet. In many cases, however, using the substitutes would entail sacrifices in quality or cost. Fused aluminum oxide and staurolite compete with garnet as a sandblasting material. Ilmenite, magnetite and plastics compete as filtration media. Corundum, diamond and fused aluminum oxide compete for lens grinding and for many lapping operations. Emery is a substitute in nonskid surfaces. Fused aluminum oxide, quartz sand and silicon carbide compete for the finishing of plastics, wood furniture and other products.

WORLD REVIEW

Garnet group of minerals are found throughoutthe world in me ta morphic, igneous and sedimentary rocks.

World resources of garnet are large and occur in a wide variety of rocks, particularly, gneisses and schists. Garnet also occurs in contact metamorphic deposits in crystalline limestones, pegmatites, serpentinites and in vein deposits. In addition, alluvial garnet is present in many heavy mineral sand and gravel deposits throughout the world. Large domestic resources of garnet also are concentrated in coarsely-crystalline gneiss near North Creek, NY; other significant domestic resources of garnet occur in Idaho, Maine, Montana, New Hampshire, North Carolina, and Oregon. In addition to those in the USA, major garnet deposits exist in Australia, Canada, China, India and South Africa, where they are mined for foreign and domestic markets; deposits in Russia and Turkey also have been mined in recent years, primarily for internal markets. Additional garnet resources are in Chile, Czechia, Pakistan, Spain, Thailand and Ukraine; small mining operations have been reported in most of these countries.

In 2022, Australia produced about 38% of total global production of garnet (Industrial), followed by China (31%), South Africa (15%), USA (8%) and the remaining 8 % was contributed by other countries. Russia and Turkey are also mining garnet for domestic markets. Garnet is also mined in Canada, Chile, Czech Republic, Pakistan, South Africa, Spain, Thailand and Ukraine.

Worldwide, the end uses of garnet and market shares are: abrasive blasting media 30%, abrasive grains for water jet cutting 35%, water filtration 20%, abrasive powder 10% and other end uses 5 per cent.

The world reserves/resources and production of industrial garnet are furnished in (Tables-6 and 7).

Table – 6 : World Reserves of Garnet (Industrial)

(By Principal Countries)

(In '000tonnes)

Country	Reserves
World: Total (rounded)	**Moderate to Large**
India	13000000
USA	5000000
China,	2200000
Australia	Moderate to Large
South Africa	NA
Other countries	6500000

Source:USGS Mineral Commodity Summaries, 2023

** In India as per NMI data based on UNFC system the total reserves/resources of garnet as on 1.4.2020 are estimated at 56.01 million tonnes.*

Table – 7 : World Production of Garnet (Industrial)

(By Principal Countries)

(In tonnes)

Country	2021	2022
World:Total	**925000**	**980000**
Australia	321000	370000
China,	310000	310000
South Africa	140000	150000
USA	81700	76000
India	12000	15000
Other countries	60000	60000

Source: USGS, Mineral Commodity Summaries 2023,
Note : Figures are rounded off
** India's production of garnet (abrasive) during 2019-20, 2020-21, and 2021-22 was at 568 tonnes,and 8,182 tonnes respectively.*

FOREIGN TRADE

Exports

In 2022-23, exports of (abrasive) garnet increased by 27% to 1,03,398 tonnes from 81,270 tonnes in the previous year. Exports were mainly to UAE (29%), Saudi Arabia (13%), USA (12%), Malaysia (7%) and Thailand (6%). Exports in terms of value in respect of cut & uncut garnet variety increased by 28% to ₹ 48.40 crore in 2022-23 from ₹ 37.84 crore in the previous year. In terms of value, exports were mainly to Thailand (28%), Hong Kong (23%), USA (16%), Japan (8%) and UAE (5%).

Out of the total exports in terms of value of cut & uncut garnet in 2022-23, cut variety of garnet accounted for 94% share and the remaining 6 % was contributed by the un cut garnet. In terms of value exports of cut variety were mainly to Thailand (29%), Hong Kong (20%),USA (17%), Japan (8%) and UAE(6%). Similarly, exports of uncut garnet were mainly to Hong Kong. (Tables- 8 to 11).

Table -8 : Exports of Garnet (Abrasive)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**81270**	**1433741**	**103398**	**1903765**
UAE	28448	490465	29736	541717
Saudi Arabia	4050	70796	13575	265459
USA	15383	317258	12320	215213
Malaysia	5005	80339	7700	140756
Thailand	4116	71145	6268	120195
Qatar	2931	50204	5992	110643
Singapore	1619	28202	5571	109762
Italy	2380	44063	4620	80356
Kuwait	2904	47549	3975	73499
Oman	2156	36806	1960	36777
Other Countries	12278	196914	11681	209388

Figures rounded off

(In tonnes)

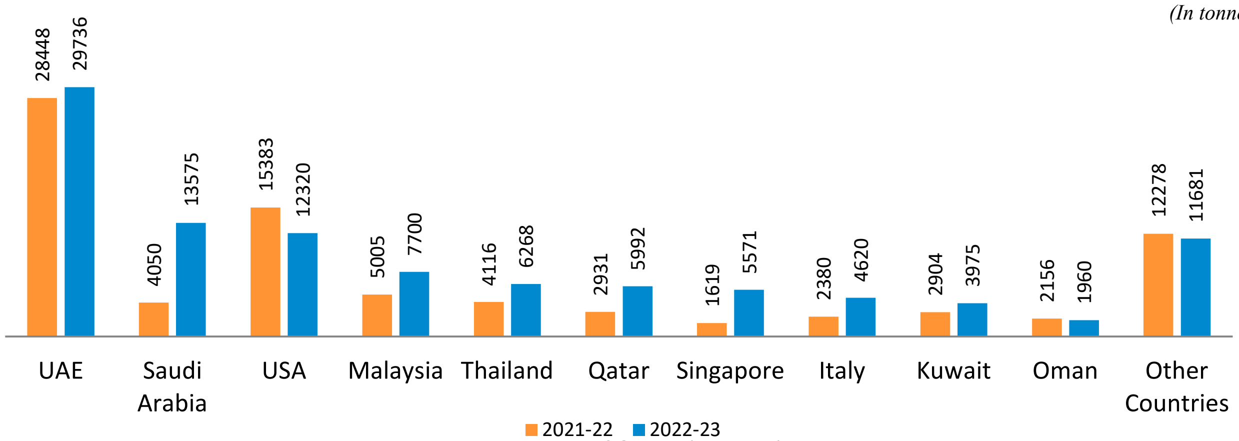


Fig. 2 Exports of Garnet (Abrasive)

Table- 9 : Exports of Garnet (Cut & Uncut)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (**)	Value (₹ '000)	Qty (**)	Value (₹ '000)
All Countries	**	**378455**	**	**484011**
Thailand	**	112575	**	135679
Hong Kong	**	69441	**	111227
USA	**	58670	**	77865
Japan	**	24271	**	37731
UAE	**	9542	**	25452
Germany	**	11356	**	16284
Armenia	**	20890	**	14316
Italy	**	14754	**	11967
UK	**	12531	**	8671
Sri Lanka	**	3219	**	6367
Other Countries	**	41206	**	38452

*Note : ** - Not additive. The total may not tally.*
Figures rounded off

Table – 10 : Exports of Garnet (Cut)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty ('000crt)	Value (₹ '000)	Qty('000crt)	Value (₹ '000)
All Countries	**12258**	**359152**	**60232**	**452710**
Thailand	2081	111039	2555	129615
Hong Kong	1573	53690	1522	89080
USA	4043	57467	5630	77281
Japan	437	24255	428	37703
UAE	166	9542	136	25447
Germany	486	11321	274	16229
Armenia	317	20890	200	14284
Italy	170	14754	399	11967
UK	488	11979	230	8275
Sri Lanka	1	3219	2	6254
Other Countries	2496	40996	48856	36575

Figures rounded off

Table – 11 : Exports of Garnet (Uncut)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**29**	**19303**	**3**	**31301**
Hong Kong	29	15751	2	22147
Thailand	++	1536	++	6064
Tanzania	-	-	++	1161
UA	++	1203	++	584
China	++	173	++	493
UK	++	552	++	396
Turkey	++	3	++	116
Sri Lanka	-	-	++	113
Germany	++	35	++	55
Mexico	++	3	++	50
Other Countries	++	47	1	122

Figures rounded off

Imports

In 2022-23, imports of abrasive garnet decreased by 79% to 30 tonnes from 140 tonnes in the previous year. Imports were from UAE (100%). Imports in terms of value in respect of cut & uncut garnet variety increased drastically by 65% to ₹ 30.30 crore in 2022-23 from ₹ 18.35 crore in the previous year. In terms of value, imports were mainly from Thailand (29%), Hong Kong (19%), Tanzania (16%) and Kenya (13%), & USA (7%).

Out of the total imports in terms of value of cut & uncut garnet in 2022-23, uncut variety of garnet accounted for 70% share and the remaining 30% was contributed by the cut garnet. In terms of quantity, imports of uncut variety were mainly from Madagascar (31%) and Mozambique & Hong Kong (27% each). Similarly, imports of cut garnet were mainly from Thailand (41%) and Hong Kong (23%) (Tables-12 to 15).

Table – 12 : Imports of Garnet (Abrasive)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**140**	**1789**	**30**	**929**
UAE	115	1545	30	929
Kenya	25	244	—	—

Figures rounded off

Table- 13: Imports of Garnet (Cut & Uncut)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (**)	Value (₹ '000)	Qty (**)	Value (₹ '000)
All Countries	**	**183591**	**	**303072**
Thailand	**	38413	**	88744
Hong Kong	**	34614	**	57679
Tanzania	**	28232	**	49873
Kenya	**	44520	**	40247
USA	**	8765	**	20665
South Africa	**	8562	**	19275
Sri Lanka	**	11559	**	5169
Singapore	**	-	**	4729
Mozambique	**	119	**	4558
Madagascar	**	1880	**	2890
Other Countries	**	6927	**	9243

*Note : ** - Not additive. The total may not tally.*
Figures rounded off

(In ₹ '000)

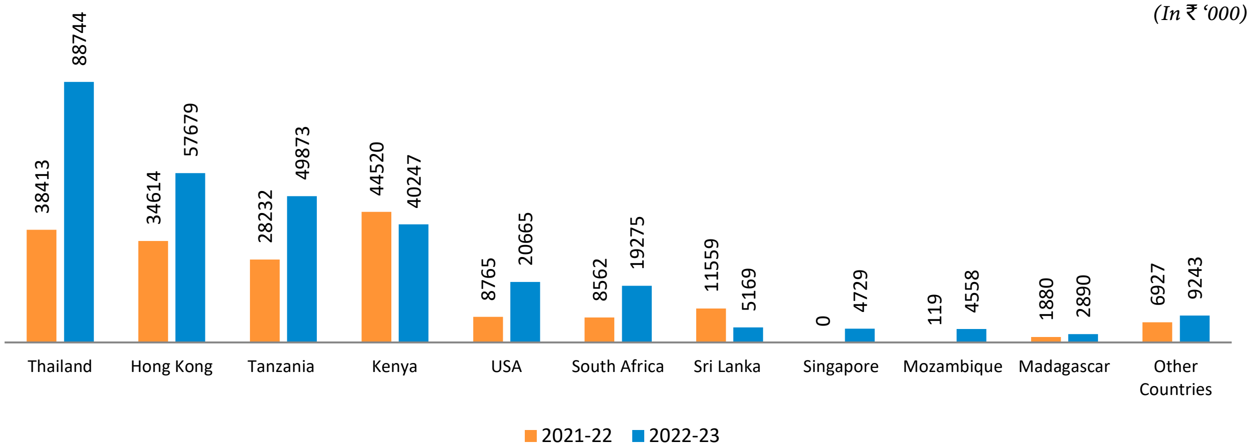


Fig 3 Countrywise Value of Imports of Garnet (Cut & Uncut)

Table – 14 : Imports of Garnet (Cut)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty('000 crt)	Value (₹ '000)	Qty ('000 crt)	Value (₹ '000)
All Countries	**1299**	**42311**	**1102**	**90487**
Thailand	116	7519	455	29957
Hong Kong	175	13712	251	24192
USA	188	6094	147	19538
Sri Lanka	749	11559	110	5169
Singapore	-	-	36	4729
Italy	-	-	39	2017
UK	++	16	11	1368
Switzerland	++	207	++	959
Tanzania	-	-	1	582
Germany	47	1186	15	559
Other Countries	24	2018	37	1417

Figures rounded off

Table – 15 : Imports of Garnet (Uncut)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**23**	**141280**	**52**	**212585**
Thailand	1	30894	2	58787
Tanzania	5	28232	2	49291
Kenya	1	44483	1	40247
Hong Kong	1	20902	14	33487
South Africa	3	8562	1	19275
Mozambique	++	119	14	4558
Madagascar	10	1811	16	2881
Zambia	++	296	2	1276
USA	++	2671	++	1127
Nigeria	1	2043	++	1094
Other Countries	1	1267	++	562

Figures rounded off

FUTURE OUTLOOK

Garnet has a wide range of applications, such as, in production of abrasives, sand blasting, water filtration materials, abrasive blasting media and water-jet cutting. Garnet is expected to continue replacing silica sand blasting media, owing to latter's associated occupational health risks. Moreover, garnet is safer for the environment and cheaper to dispose of after recycling. Hence, the worldwide demand for garnet is expected to increase, especially for waterjet cutting and for abrasive blasting media. China and India are expected to steadily increase garnet production and will become significant garnet sources for other countries. The garnet market is very competitive. To increase profitability and remain competitive with imported material, production may be restricted to only high-grade garnet ores as a by-product of other saleable mineral products that occur with garnet, such as, kyanite, marble, metallic ores, mica minerals, sillimanite, staurolite or wollastonite.

41. Graphite

Graphite, also known as plumbago or blacklead or mineral carbon, is a stable form of naturally occurring carbon. Structurally, graphite is known to crystalise in hexagonal system and occurs in layered & lamellar form with grey-to-black metallic lustre and a greasy feel. Natural graphite is categorised into two commercial varieties (i) crystalline (flaky) graphite and (ii) amorphous graphite. Both flaky and amorphous varieties of graphite are produced in India. The quality of graphite depends upon its physical qualities and carbon content. Besides natural graphite, there is synthetic or artificial graphite which is manufactured on a large-scale in electric furnaces, using anthracite or petroleum coke as raw feed.

RESERVES/RESOURCES

Graphite occurrences are reported from various States but the deposits of economic importance are located in Chhattisgarh, Jharkhand, Odisha and Tamil Nadu.

As per NMI database, based on the UNFC system, the total reserves/resources of graphite as on 1.4.2020 have been placed at about 211.62 million tonnes, out of which 8.56 million tonnes are in the Reserves category and 203.6 million tonnes are placed under Remaining Resources category. Resources containing +40% fixed carbon constitute about 2.91 million tonnes and resources analysing 10–40% fixed carbon constitute 43.98 million tonnes. The balance 164.73 million tonnes fall under Benificiable 'Others', 'Unclassified' and 'Not-known' grades. Arunachal Pradesh accounts for 36% of the total resources which is followed by Jammu & Kashmir (29%), Jharkhand (9%), Madhya Pradesh (5%), Odisha (9%), and Tamil Nadu (4%). However, in terms of reserves, Tamil Nadu has the leading share of about 36% followed by Jharkhand (30%) and Odisha (33%) of the total reserves (Table-1).

Table – 1 : Reserves/Resources of Graphite as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**8563411**	**203060176**	**211623587**
By Grades			
+ 40% F.C.	1387851	1527904	2915755
10-40% F.C.	7175560	36808911	43984471
Benificiable	-	793330	793330
Others	-	19153359	19153359
Unclassified		69486325	69486325
Not-known	-	75290347	75290347
By States			
Andhra Pradesh	-	1138275	1138275
Arunachal Pradesh	-	76318257	76318257
Chhattisgarh	5282	1330	6612
Gujarat	-	3355805	3355805
Jammu & Kashmir	-	62740555	62740555
Jharkhand	2604079	17402288	20006367
Karnataka	-	992632	992632
Kerala	15443	1419532	1434975
Madhya Pradesh	-	12640000	12640000
Maharashtra	-	1160000	1160000
Odisha	2838414	17142707	19981121
Rajasthan	-	1913554	1913554
Tamil Nadu	3100193	6605086	9705279
Telangana	-	219455	219455
Uttarakhand	-	10700	10700

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Review".

PRODUCTION & STOCKS

As on 31.03.2023, the total number of mining leases in respect of graphite in force was 32 with area covered 1314 Ha. Production of graphite at about 89,645 tonnes in 2022-23 increased by 42% as compared to the previous year. There were 11 reporting mines in 2022-23 as compared to 14 in the previous year. Five principal producers accounted for 91.68% during the year. About 83.25% of the total production in 2022-23 was accrued from three mines, each producing more than 5000 tonnes annually, while 16.75% was contributed by eight mines in the production range upto 5000 tonnes per annum. Tamil Nadu was the leading producing state contributing 60.39% to the total outputduring 2022-23, followed by Odisha. Mine-head closing stock in the year 2022-23 was 191057 tonnes as against 1,79,193 tonnes in the previous year. The average daily employment of labour during 2022-23 was 133 against 131 in the previous year (Tables- 2 to 6).

Table – 2: Principal Producers of Graphite, 2022-23

Producer	Location of Mine	
	State	District
Tamil Nadu Minerals Limited. 31, Kamarajar Salaitwad House, Chepauk, Chennai-600 005, Tamil Nadu.	Tamil Nadu	Sivaganga
Pradhan Industries House No 1,Telenga Bazar, Cuttack Sadar – 753009, Odisha .	Odisha	Banibasa
Town hall road,opp. shivajee maidan,, daltonganj (medininagar), Pamalu, Jharkhand, 822101.	Jharkhand,	Betla (MLA 7.21)
Shanti kunjfarm road, modipara sambalpur odisha 768002	Odisha	Gandabahali & Kirkita35
Pradhan Industries House No 1,Telenga Bazar, Cuttack Sadar-753009,Odisha	Odisha	Bandhamundi

Table – 3: Production of Graphite, 2020-21 to 2022-23

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**35386**	**87147**	**62888**	**122147**	**89645**	**162481**
Chhattisgarh	1701	2041				
Jharkhand	5962	6069	54	59	12163	10616
Odisha	17697	46633	26620	69216	23346	97664
Tamil Nadu	10026	32404	36214	52872	54136	54201

(in tonnes)

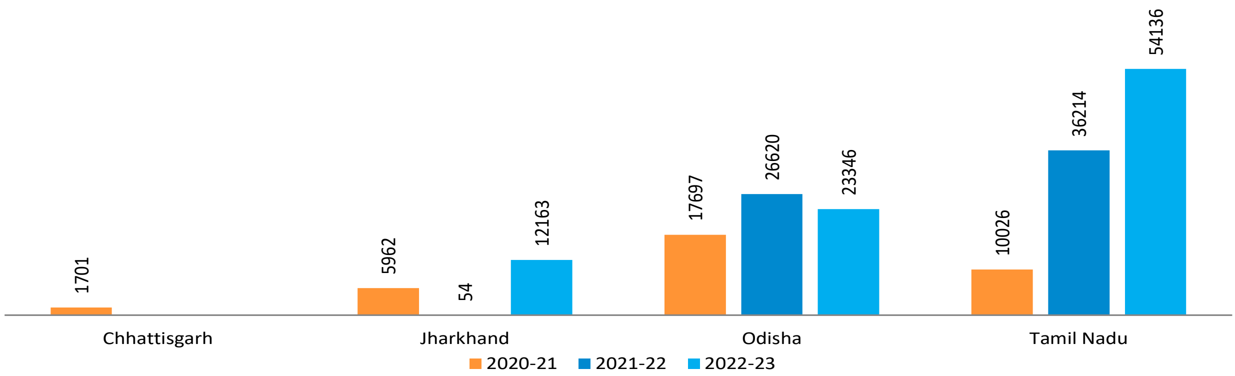


Fig 1: Production of Garphite in India

Table – 4: Production of Graphite, 2021-22 and 2022-23

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹ '000)

State/District	2021-22						2022-23(p)					
	No. of Mines	Grade: Fixed Carbon content			Total		No. of Mines	Grade: Fixed Carbon content			Total	
		80% or more	40% or more but less than 80%	Less than 40%	Qty.	Value		80% or more	40% or more but less than 80%	Less than 40%	Qty.	Value
India	**14**	**1043**	**1130**	**60715**	**62888**	**122147**	**11**	**1407**	**1848**	**86390**	**89645**	**162481**
Public Sector	**1**			**36214**	**36214**	**52872**	**1**			**54136**	**54136**	**54201**
Private Sector	**13**	**1043**	**1130**	**24501**	**26674**	**69275**	**10**	**1407**	**1848**	**32254**	**35509**	**108280**
Chhattisgarh	**1**						**1**					
Surguja	1						1					
Jharkhand	**4**			**54**	**54**	**59**	**2**			**12163**	**12163**	**10616**
Latehar							1			9357	9357	9123
Palamau	4			54	54	59	1			2806	2806	1493
Karnataka	**2***						**1***					
Mysore	2*						1*					
Odisha	**6**			**24447**	**26620**	**69216**	**6**			**20091**	**23346**	**97664**
Nawapara	2			7726	7726	7723	2			5885	5885	7381
Raygada	3	1043	1130	14111	16284	58948	3	1407	1848	12287	15542	87868
Bolangir	1			2610	2610	2545	1			1919	1919	2415
Tamil Nadu	**1**			**36214**	**36214**	**52872**	**1**			**54136**	**54136**	**54201**
Sivaganga	1			36214	36214	52872	1			54136	54136	54201

(p)-provisional

Table – 5 : Production of Graphite, 2021-22 & 2022-23

(By Frequency Groups)

(Qty in tonnes)

Production group	No. of Mines		Production for the group		Percentage in total production		Percentage Percentage	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
India	**14**	**11**	**62888**	**89645**	**100**	**100**		
Up to 1000	7	2	54	0	0.09	0	0.09	0
1001 to 2000	0	3	0	4654	0	5.19	0.09	5.19
2001 to 5000	4	3	12509	10361	19.89	11.56	19.98	16.75
5001 to 10000	2	1	14111	9357	22.44	10.44	42.42	27.19
Above 10000	1	2	36214	65273	57.58	72.81	100	100

Table – 6: Mine-head Closing Stocks of Graphite, 2021-22 & 2022-23

(By States/Grades)

(In tonnes)

State/District	2021-22					2022-23 (P)				
	Grade: Fixed Carbon content					Grade: Fixed Carbon content				
	80% or more	40% or more but less than	Less than 40%	Less than 20%	Total	80% or more	40% or more but less than	Less than 40%	Less than 20%	Total
India	**49**	**160**	**178984**		**179193**	**205**	**258**	**8000**	**182594**	**191057**
Chhattisgarh			6308		6308			6258		6258
Jharkhand			11272		11272				11267	11267
Karnataka			1742		1742			1742		1742
Odisha	49	160	15037		15246	205	258		26119	26582
Tamil Nadu			144625		144625				145208	145208

(p)- provisional

MINING & MARKETING

Graphite mines, barring a few underground mines, are mostly small and opencast. Active mining centres of graphite are in Palamu district in Jharkhand; Nawapara & Balangir districts in Odisha; and Madurai & Sivagangai districts in Tamil Nadu. Disseminated deposits of flaky graphite containing 5 to 20% Fixed Carbon (F.C.) are found in Palamu district of Jharkhand. In Odisha, areas in and around Balangir are the chief mining centres where several graphite grades are produced. At Balangir, a few opencast workings are deeper than 45 m from surface and the r.o.m. from such mines generally contains 10 to 20% F.C. Sargipalli underground mine in Sambalpur district, operated by M/s T.P. Mineral Industries (TPMI), produced graphite that analysed up to 40% F.C. in the past. Water seepage beyond 6 m depth is the main problem faced by almost all mine owners in Odisha.

Graphite of Balangir district is utilised mostly by the Graphite Crucible Industry. The technological changes in recent years have considerably reduced the use of graphite as a lubricant. However, recycled graphite is still used in production of clay bonded graphite crucibles.

The Sivagangai graphite is of flaky variety with 14% average Fixed Carbon (F.C.) used in the manufacture of refractory bricks, expanded graphite, crucibles and carbon brushes. It is being mined by opencast mining method.The mined graphite is subjected to size reduction by crushing, grinding, flotation and dewatering to upgrade the graphite concentrate from other gangue minerals.

Mining is considered to be easy and safe as regards graphite deposits in view of their comparatively soft nature and presence of hard rocks on either side. In order to expose graphite deposit, thickness of 1 to 2 meters of top lateritic soil is dozed out using dozer or removed by excavator and loaded through dumper and transported to separate dump yard located in non-mineralised zone in the lease area. The graphite ore obtained usually is transported to stock yard for blending. In stock yard, both high-grade and low-grade ores are stacked separately. Depending on plant requirements, blending work is carried out and blended ore is despatched for consumption.

Tamil Nadu Minerals Ltd (TAMIN) has over 600 acres of graphite-bearing areas in Pudupatti, Kumaripatti and Senthiudayanathapuram of Sivagangai district, Tamil Nadu.

BENEFICIATION

During graphite beneficiation one of the challenges is to maximise the recovery of flaky graphite from low grade graphite ore without breaking the flakes of graphite. This is because flaky graphite has a huge industrial demand due to its distinct properties such as excellent lubricity and higher thermal conductivity.

Graphite occurs generally admixed with country rocks, and hence, it requires beneficiation for obtaining desired grade for various end-uses. Processes for graphite beneficiation depend upon nature and association of gangue minerals present. The common processes adopted are washing, sorting, tabling, acid leaching and froth flotation. Amongst these, froth flotation process is used widely as it helps in producing a fairly high-grade graphite concentrate. Sometimes, beneficiated concentrate is further enriched by chemical treatment (acid leaching, chlorination, etc.) to obtain a very high-grade concentrate containing 98 to 99% F.C.

Prominent beneficiation plants for graphite in India are Chota Nagpur Graphite Industries and Carbon & Graphite Products, Daltonganj; Agrawal Graphite Industries, Gandhamardhan Graphite Udyog and T. P. Minerals Private Limited, Sambalpur; Tamil Nadu Minerals Ltd (TAMIN), Sivagangai, etc.

The ROM, containing an average of about 10% F.C. has to be invariably beneficiated before marketing. Indigenously fabricated equipment is used generally to upgrade the ROM to produce marketable grade graphite which contains normally 70 to 80% F.C. About 92% F.C. product has been obtained by many producers after repeated cycles of beneficiation. A few plant owners have claimed to have obtained product containing as high as 95% F.C.

Beneficiation plants in Odisha seem to have been designed for treating +10% F.C. graphite (ROM). In practice, it is seen that lower grade graphite having +5% F.C. is blended with higher grades to meet the requirements of beneficiation plant, i.e., +10% F.C. Thus, low-grade ore analysing +5% F.C. also gets used.

Tamil Nadu Minerals Ltd (TAMIN) produces flaky graphite from a mine in Sivagangai district in Tamil Nadu. The beneficiation plant located adjacent to the mine site is designed to produce 8,400 tpy of natural graphite concentrate containing 96% F.C. with 92% recovery from ROM.

USES & CONSUMPTION

Traditional uses of graphite are in crucibles, foundries, pencils, etc. More sophisticated applications of graphite are in refractories that are used in the manufacture of steel, cement and glass, expanded graphite-based sealing gaskets, graphitised grease, braid, brushes, brake lining, etc. It is also used for speciality applications, such as, in the Nuclear Industry, soil conditioners and graphite foils, which is used for sealing in the Chemical and Petrochemical industries as well as in the Energy, Engineering and Automotive industries. It is also used in minor amounts as a vital additive for producing foundry coatings to prevent fusion of liquid metal with sand at the mould or core face. Such coatings are either applied by spraying or painting in the form of suspension or by dusting or by rubbing as dry powders. Graphite used for coating is of high quality which does not peel off as flakes on drying and imparts a smooth surface to the casting. Graphite, a major additive to many coating systems, is known for its multifarious functions, such as, refractory, lubricant, thermal conductor, electrical conductor, UV shield, electromagnetic pulse shield, corrosion shield and pigment. It is also used as moderator in nuclear reactors and in Lithium-ion (Li-ion) batteries which is used in the electric vehicles, that require high purity flake graphite in their anode material. Li-ion battery anode are typically made of graphite, which can absorb and hold the lithium ions between the layers in its atomic structure, while at the same time conducting electric charge.

As per the information received from various graphite consuming units and estimates, the apparent consumption of various grades of graphite during 2022-23 was 138,544 tonnes which was increased by 19% as compared to 116,171 tonnes in the previous year

SUBSTITUTION

In principle, it is possible to substitute graphite by either synthetic graphite, produced primarily from high carbon precursors, such as, petroleum coke and coal tar pitch (e.g. in batteries or for increasing the carbon in steel) or by replacing the product as in the case of pencils or by other compounds as in high temperature applications (e.g. refractories). In the later case, it is difficult to fully substitute graphite as it is tough to replicate the same level of performance that graphite provides. There is a limit to how much charge graphite can store and lithium moves relatively slowly through graphite. Therefore, while considering the improvement required for large scale EV, tin and silicon may be the future competitor because of higher charge capacity and also tin conducts lithium-ion faster.

WORLD REVIEW

The world resources of graphite are believed to exceed 800 million tonnes of recoverable graphite. However, world reserves of graphite have been placed at 330 million tonnes of which Turkey accounts for 27% followed by Brazil (22%), China (15%), Madagascar & Mozambique (7% each), Tanzania (5%), Russia (4%), India & Uzbekistan (2% each) and Mexico (0.9%) (Table-7).

Table – 7 : World Reserves of Graphite (Natural)

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded off)	**330000000**
Turkey	90000000
Brazil	74000000
China	52000000
Madagascar	26000000
Mozambique	25000000
Tanzania	18000000
Russia	14000000

Table- 7 (Concld.)

(In '000 tonnes)

Country	Reserves
India*	8000000
Uzbekistan	7600000
Mexico	3100000
Korea, North	2000000
Korea, Rep. of	1,800,000
Sri Lanka	1500000
Norway	600000
Canada	-4

Source: USGS Mineral Commodity Summaries, 2022
**India's reserves of graphite as per NMI database, based on UNFC system as on 1.4.2020 have been placed at about 8,563 thousand tonnes.*
Austria, Canada, Germany, Pakistan, Russia, Ukraine, United States and Vietnam are included in world total.
Source: USGS Mineral Commodity Summaries, 2022
**India's reserves of graphite as per NMI database, based on UNFC system as on 1.4.2020 have been placed at about 8,563 thousand tonnes.*
Austria, Canada, Germany, Pakistan, Russia, Ukraine, United States and Vietnam are included in world total.

World production of graphite was 1.40 million tonnes in 2022 as compared to 1.3 million tonnes in 2021. China was the leading producer, with a share of about 61% which is followed by Mozambique (11%), Madagascar (0.083%), India (0.06%) and Brazil (0.05%) (Table-8).

Table – 8 : World Production of Graphite

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World Total (Rounded off)	**1052537**	**1275771**	**1435202**
China	762000	820000	850000
Mozambique	18159	77116	165932
Madagascar	48500	91100	116700
India	30168	57264	85873
Brazil	67020	78555	79371
Korea, Rep. of	30000	40000	40000
Turkey	15205	28336	27715
Austria	16500	17000	17000
Russia	25000	27000	15000
Canada	8841	7706	13000
Other countries	31144	31694	24611

Source: BGS World Mineral Production, 2016-20,
a: Crude
b: Material
c: Years ended 31 March following that stated
d: Including flake graphite
f: Years ended 30june of that stated
h:Export
j:Sales India's productiom of graphite during 2018-19, 2019-20 and 2020-21 was at 39 thousand tonnes, 34 thousand tonnes and 30 thousand tonnes, respectively.

FOREIGN TRADE

Exports

In 2022-23, exports of graphite (natural) increased by 293% to 2239 tonnes as compared to 764 tonnes in the previous year. Graphite (natural) was exported mainly to Tanzania (25%), Nepal (15%), Malaysia (11%), and UAE (10.1%).

The exports of graphite (artificial) increased by 46% to 29,522 tonnes in 2022-23 from 28,218 tonnes in the previous year. Graphite (artificial) was exported mainly to Germany (14%), U S A (7%), Bhutan (20.5%), UAE (8%), Saudi Arabia (16%), Bangladesh (6%) and Kuwait (5%). (Table 9 & 10)

Table – 9 : Exports of Graphite (Natural)

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**764**	**46963**	**2239**	**120029**
Nigeria	7	555	1027	33533
Malaysia	106	5470	431	24958
UAE	43	2344	289	20386
Turkey	1	125	191	13639
Tanzania	325	15745	64	4160
Uganda	4	262	12	3627
Kenya	3	1688	5	2846
China	48	3390	29	2599
Bahrain	15	708	30	1853
Sri Lanka	4	1040	6	1506
Other Countries	208	15636	155	10922

Figures rounded off

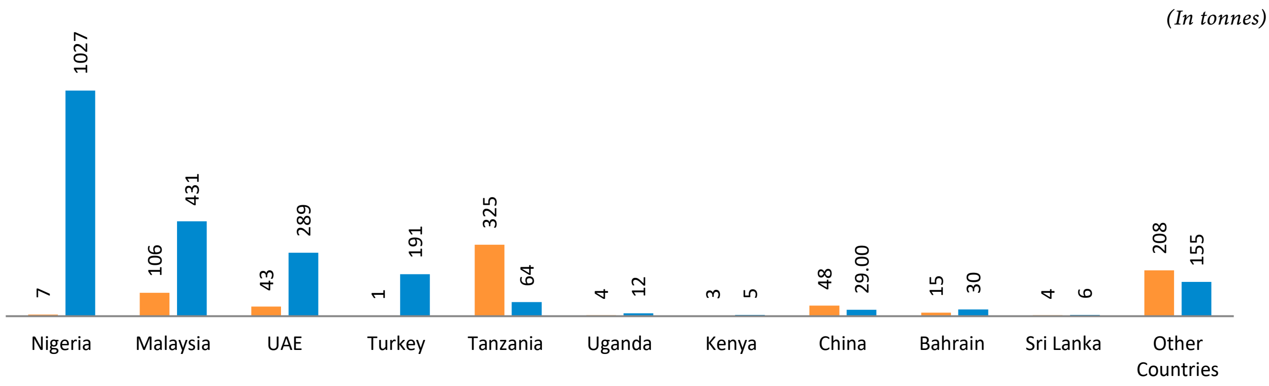


Fig 2: Countrywise Exports of Graphite (Natural)

Table – 10: Exports of Graphite (Artificial)

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	28218	4090984	29522	4136910
USA	1402	441165	6051	740350
Germany	8418	1822595	4702	714833
Saudi Arabia	2058	198248	4166	592070
Bhutan	5539	312029	1565	519734
UAE	2454	172937	2325	237991
Bangladesh	2030	112322	1967	152288
Kuwait	1297	86159	1699	136212
Oman	1288	85480	1622	136210
Zambia	1223	63318	1565	131245
Turkey	89	187488	250	88884
Other Countries	2420	609243	3553	687093

Figures rounded off

Imports

Imports of graphite (natural) decreased by 17% to 45,994 tonnes in 2022-23 from 54,047 tonnes in the preceding year. Graphite (natural) was imported mainly from China (45%), Madagascar (30%), and Mozambique (18%) .

Imports of graphite (artificial) increased by 9.0% to 82,721 tonnes in 2022-23 from 75,657 tonnes in the previous year. Imports of graphite (artificial) were mainly from China (60%), Germany (12%), Poland (4%) and remaining 24% share was contributed by other countries.

Imports of graphite crucibles drastically decreased to nil in 2022-23 from tonnes in the preceding year. 386 tonnes in the previous year. Imports were mainly from China (97%), Germany (2%) and Netherlands (Tables - 14 to 18).

Table – 11 : Imports of Graphite (Natural)

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	54047	2651642	45994	2939533
China	22171	962376	20576	1131934
Madagascar	20850	1095472	13778	940394
Mozambique	8716	301619	8525	503134
Tanzania	248	8284	1500	80522
Germany	284	64377	216	60891
USA	335	59757	186	42368
Austria	258	21001	288	31198
Sweden	52	15746	86	27792
Slovenia	--	--	85	21855
Japan	42	17255	57	20136
Other Countries	1091	105755	697	79309

Figures rounded off

(In tonnes)

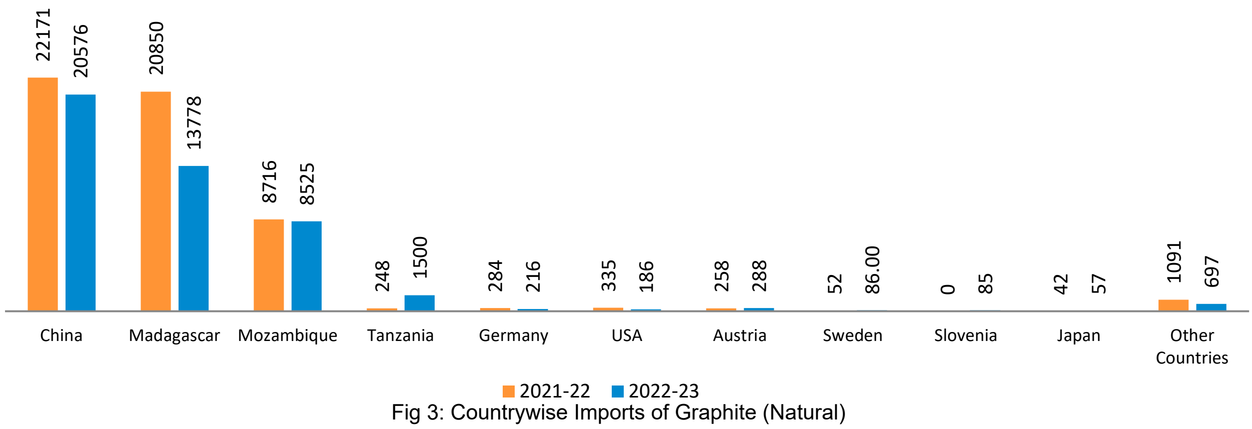


Fig 3: Countrywise Imports of Graphite (Natural)

Table – 12 : Imports of Graphite (Artificial)

By Country

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	75657	8125841	82721	12008937
China	32787	3538380	49331	6034478
Germany	3517	1028785	9699	2521680
Japan	664	222071	2908	783832
UK	4780	1008912	3094	594958
Poland	1990	207385	2998	397432
France	1106	211871	1398	328454
USA	825	344737	379	291362
Netherlands	729	227358	982	244086
Norway	7128	345971	2059	217809
UAE	6311	121630	5550	131136
Other Countries	15820	868741	4323	463710

Figures rounded off

FUTURE OUTLOOK

Worldwide demand for combined natural and synthetic graphite is expected to rise along with improvements in the global economic conditions. Demand is also expected to augment further with the development of non-carbon energy applications, such as, batteries used in electric vehicles, electric devices and energy storage devices that use graphite. The graphite reserves having +40% Fixed Carbon are rather limited in the country. Detailed exploration of graphite deposits in Odisha, Jharkhand, Jammu & Kashmir and Kerala should be carried out. Cost-effective beneficiation technologies for low-grade graphite ore need to be developed. Silicon carbide-graphite crucibles are being diversified and manufactured to improve upon the use of inferior grade material with less quantity and at the same time ensuring longer life of crucible.

Of late, a few emerging & important specialised applications of exfoliated graphite have been reported especially in the manufacture of sealings, gaskets, braids and brushes. New products of synthetic graphite, such as, graphite fibres/ropes and graphite insulation blankets have been introduced.In the world scenario, there seems to be a rapid diversification in respect of potential large-volume end-use for natural graphite, such as, in heat sinks, also called spreader shield, which is a graphite foil material that conducts heat only in two directions. It has thermal conductivity above aluminium and almost equal to copper. These are used for dissipating heat in laptop computers, flat-panel displays, wireless phones, digital video cameras, etc. Such emerging & high growth applications of graphite are certainly causing noticeable impacts on the demand & consumption patterns within the country & globally.

The demand for high purity graphite is increasing exponentially due to increase in the demand of lithium-ion batteries for electric vehicles, laptops, smartphones, home/business applications and traditional uses for expanded graphite foils are also the potential areas that are expected to be major drivers for graphite consumption. It represents 23% of global flake graphite demand. The demand for graphite in the Battery segment is forecasted to double in the next six years. Graphite is mentioned in Part D of the First Schedule to the MMDR Act for critical & strategic minerals which is essential for our country's economic development and national security.

42. Ilmenite & Rutile

India is endowed with large resources of heavy minerals which occur mainly along coastal stretches of the country and also in inland placers. Heavy mineral sands comprise a group of seven minerals, viz, ilmenite, leucoxene (brown ilmenite), rutile, zircon, sillimanite, garnet and monazite. Ilmenite ($FeO.TiO_2$) and rutile (TiO_2) are the two chief minerals of titanium. Titanium dioxide occurs in polymorphic forms as rutile, anatase (octahedrite) and brookite. Though brookite is not found on a large-scale in nature, it is an alteration product of other titanium minerals. Leucoxene is an alteration product of ilmenite and is usually found associated with ilmenite.

RESERVES/RESOURCES

Ilmenite and rutile along with other heavy minerals are important constituents of beach sand deposits found right from Saurashtra coast (Gujarat) in the west to Digha coast, West Bengal in the east. These minerals are concentrated in five well-defined zones:

* Over a stretch of 22 km between Neendakara and Kayamkulam, Kollam district, Kerala (known as 'Chavara' deposit after the main mining centre).
* Over a stretch of 6 km from the mouth of River Valliyar to Colachal, Manavalakurichi and little beyond in Kanyakumari district, Tamil Nadu (known as MK deposit).
* On Chatrapur coast stretching to about 18 km between Rushikulya river mouth and Gopalpur lighthouse with an average width of 1.4 km in Ganjam district, Odisha (known as 'OSCOM' deposit after IREL's Orissa Sands Complex).
* Brahmagiri deposit stretches for 30 km from Girala nala to Village Bhabunia with an average width of 1.91 km in Puri district, Odisha.
* Bhavanapadu coast between Nilarevu and Sandipeta with 25 km length and 700 m average width in Srikakulam district, Andhra Pradesh.

The AMD of the Department of Atomic Energy has been carrying out exploration of these mineral deposits. Of the total, coastal length of 5,921 km spread in Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra, Goa, Gujarat and West Bengal about 451 km, 1,873 km, and 112 km have been covered by detailed exploration, general exploration and preliminary exploration respectively. A coastal length of 2,272 km have not been covered due to various reasons viz., mangrove, port activity etc., leaving an unexplored coastal length of 1,214 km. The distribution of area coverage (sq km) in different geological domains are Beach & Dune (1845), Inland Sand Body (180), Terrace sediments (368), River Channel (32), Inland alluvium (646) and Lake & Sea Beds (38). The ilmenite resource estimation for the areas explored up to March, 2020 has been completed and the resources are up from 629.57 million tonnes (including leucoxene) in the year 2016 to 687.57 million tonnes in the year 2020. The resources include Measured, Indicated and Inferred categories. Though, the latest state-wise /deposit-wise details are not available, the state-wise/ deposit-wise details as received from DAE vide letter dated 26.07.2018 are furnished in Tables-1 & 1A.

Table – 1 : Ilmenite Reserves, Resources/Deposits in India

(In million tonnes)

State/Deposit	Ilmenite reserves
1. Bhavanapadu	10.18
2. Kakinada (Phase I-VIII)	13.81
3. Kalingapatnam	7.03
4. Narasapur	2.92
5. Nizampatnam	19.26
6. Srikurman (South)	8.6
7. Visakhapatnam (Bhimunipatnam)	2.88
8. Amalapuram (Phase I-IV)	4.72
9. Pandurangapuram-Voderevu	
(Bapatla-Chirala coast)	10.38
10. Vetapalem Coast (Chirala coast)	5.31
Kerala	
1. Chavara Barrier beach	13.17
2. Chavara Eastern Extension (Phase-I)	17.02
3. Chavara Eastern Extension (Phase-II)	49.26
4. Trikkunnapuzha-Thotapally Beach	
& Eastern Extension	9.5
5. Alapuzha-Kochi	5.88
Maharashtra	
Ratnagiri	3.68
Munge-Achra-Malvan	1.12
Vijayadura-Mithbav	0.7
Gujarat	
Moti Daman-Umbrat coast	2.77
Odisha	
1. Brahmagiri (Phase I-V and NW extension)	86.04
2. Chatrapur	26.72
3. Gopalpur	6.42
Tamil Nadu	
1. Kudiraimozhi	22.86
2. Ovari-Periyatalai-Manapadu (Teri)	24.01
3. Sattankulam Teris	41.26
4. Cuddalore-Pudupattuchavadi (beach sand)	4.67
5. Vayakallur (beach sand)	4.52
6. Manavalakurichi (beach sand)	3.07
7. Midalam	1.64

Source: As per letter received from Department of Atomic Energy, Mumbai dated 26/07/2018

Table – 1 A : Reserves/Resources of Ilmenite and Rutile

(In million tonnes)

State	Total in situ #
Ilmenite* : Total	629.57
Andhra Pradesh	156.17
Jharkhand	0.73
Gujarat	2.77
Kerala	144.02
Maharashtra	5.5
Odisha	150.62
Tamil Nadu	167.7

Table-1A (Concld)

(In million tonnes)

State	Total in situ#
West Bengal	2.06
Rutile : Total	33.95
Andhra Pradesh	10.55
Jharkhand	0.01
Gujarat	0.02
Kerala	8.74
Maharashtra	0.01
Odisha	6.58
Tamil Nadu	7.85
West Bengal	0.19

*Source: As per letter received from Department of Atomic Energy, Mumbai dated 26/07/2018. The resources of beach sand minerals (BSM) viz. Ilmenite, Rutile, Zircon, Garnet, leucoxene, monazite and Sillimanite were last updated in the year 2016 by AMD. # Inclusive of Indicated, Inferred and Speculative categories. * Including leucoxene.*

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration and Development" under "General Reviews".

PRODUCTION AND PRICES

Ilmenite

The production of Ilmenite at 403 thousand tonnes in 2022-23 increased by 3% as compared to that in the preceding year. Odisha was the leading producer of Ilmenite during the year under review, contributing 61% of the total production followed by Kerala (30%) and Tamil Nadu (9%).

Rutile

The production of Rutile at 14 thousand tonnes in 2022-23 increased by 3% as compared to that in the previous year. Odisha was the leading producer of Rutile accounting for 66% of the total production followed by Kerala (20%) and Tamil Nadu (14%) (Table-2).

Table – 2 : Production of Ilmenite and Rutile

(By States)

(In tonnes)

State	2020-21	2021-22	2022-23* (P)
ILMENITE			
India : Total	**351387**	**390638**	**402686**
Kerala	88110	110654	118906
Odisha	230040	234132	245961
Tamil Nadu	33237	45852	37819
RUTILE			
India : Total	**12845**	**13283**	**13659**
Kerala	2197	2790	2790
Odisha	9409	8856	8974
Tamil Nadu	1239	1637	1895

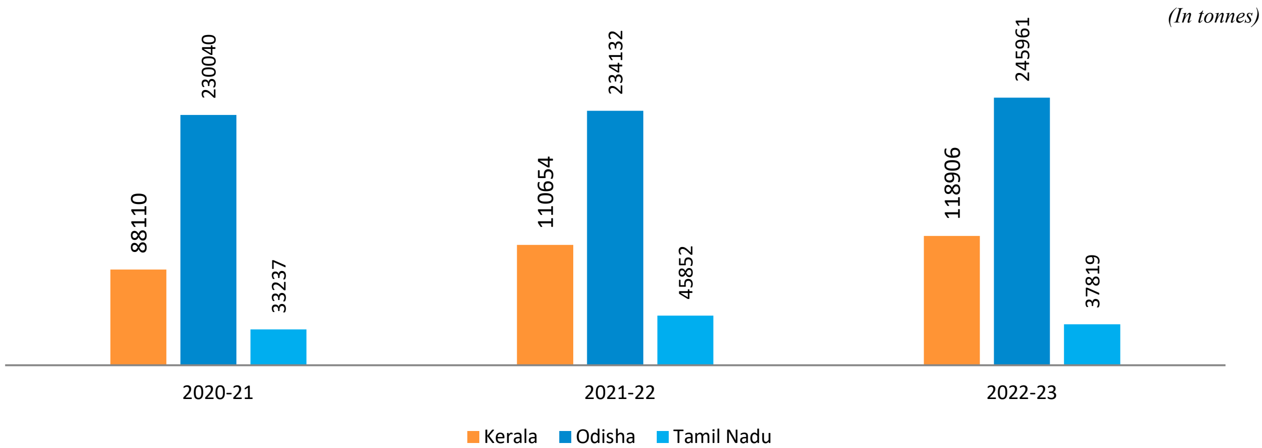


Fig 1: Statewise Production of Ilmenite in India

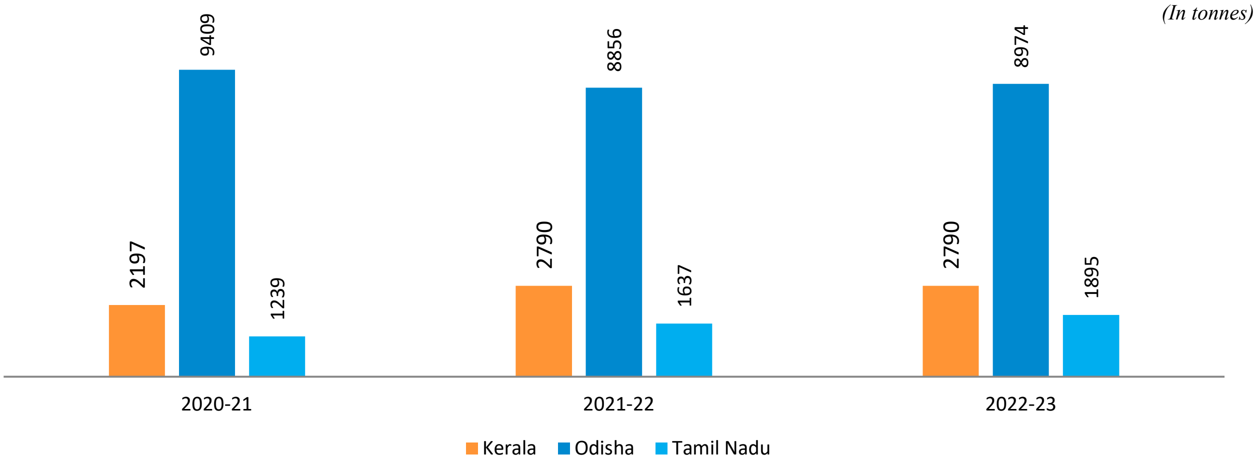


Fig 2: Statewise Production of Rutile in India

MINING & PROCESSING

Mining and processing of beach sand is carried out by the IREL, a Government of India Undertaking and KMML, a Kerala State Government Undertaking. Exploitation work of beach sand deposits located at Chavara in Kerala, Gopalpur in Odisha and Manavalakurichi in Tamil Nadu by IREL is under progress.

At IREL, Chavara, Beach Sand was collected over a stretch of 23 km between Neendakara and Kayamkulam in Kerala and was transported to plant site. The unit has adopted wet mining operations involving use of two Dredge and Wet Concentrator (DWC) of 100 tph capacity each to exploit the inland deposits away from the beaches. Chavara ilmenite is the richest in TiO_2 content (60% TiO_2 Ilmenite) and has great demand in India and abroad for manufacture of pigments.

At Manavalakurichi, the deposit is spread over 300 hectares at Thuthoor-Ezudesam villages, Vilavancode tehsil, district Kanyakumari, Tamil Nadu. All the raw sand required for the mineral separation plant to operate to its full capacity is collected from nearby beaches. Deposits are also exploited by DWC of 100 tph capacity. Manavalakurichi is next to Chavara in terms of TiO_2 content which is more than 55%.

The sand deposits of OSCOM at Chatrapur in district Ganjam extend along the coast of Bay of Bengal with an average width of 1.4 km and average depth of 7.5 m. Mining operations involve suction dredging to 6 m depth below water level on a much larger scale (500 tph) augmented by a smaller sized (100 tph) supplementary. The ilmenite from OSCOM is inferior in grade in terms of TiO_2 content (50%) in comparison to Chavara and Manavalakurichi. The Synthetic Rutile Plant of OSCOM is presently not working. As a result, the majority of OSCOM ilmenite produced of late is routed to the international market as feedstock for production of both slag grade and anatase grade pigment.

In dry mining, beach washings laden with 40-70% Heavy Minerals (HM) are collected through front-end loaders and bulldozers for further concentration to 90% HM at land-based concentrators. Though dry mining is very simple and economic, there is considerable opposition by local people for this form of mining for reasons that removal of sand would expose the land area to sea erosion. Therefore, collection of beach washings has reduced significantly in recent past.

As an alternate approach, IREL has adopted wet mining involving dredging and wet concentration (DWC) from inland areas away from the beach lines. In this mode, an artificial pond is created, the sand bed is cut and the slurry is pumped to spiral concentrator for removal of quartz. Manavalakurichi was the first plant to install a DWC (100 tph) followed by one (500 tph) at OSCOM and two (each 100 tph) at Chavara. The concentrate (90% HM) of beach washing plant from DWC is further upgraded to 97% HM grade at a Concentrate Upgradation Plant (CUP) before sending it to Mineral Separation Plant (MSP).

Execution of Supplimentary Mining Lease deed for OSCOM Mines till a period up to the year 2047 has been completed under the provision of AMCR 2016. IREL received LoI on 11.01.2023 for grant of mining lease for 1487.746 ha from the State Govt of Odisha for Brahmagiri deposit in Puri district of Odisha.

MK unit has received LOI from Govt. of Tamil Nadu on 28.06.2022 towards grant of mining lease for 1144.0618 ha. The Government is showing keen interest in exploiting the resources through a joint venture between IREL and TAMIN, a State PSU. This initiative would be a breather for MK operations as the mineable land within the mining leasehold areas are on the verge of exhaustion. Further, it will also pave way for formation of a new subsidiary of IREL in the same line as that of IREL and IDCOL.

KMML collects seasonal accretions of heavy mineral sand from the beach front. The pit so formed gets filled by fresh accretions of heavy mineral sand. The mineral sand is collected using bulldozers and wheel loaders and transported in tippers to Mineral Separation Plant.

The mineral separation plants use variety of equipment, such as, gravity concentrators, high tension electrostatic separators and magnetic separators. Making use of difference in physical properties like electrical conductivity, magnetic susceptibility and difference in specific gravity, etc., individual minerals like ilmenite, rutile, zircon, sillimanite and garnet are separated. The mined beach sands are pre-concentrated and dried after sieving (30-mesh) to separate the heavies from rejects. The heavy minerals are passed through electrostatic separators where conducting minerals – ilmenite and rutile – are separated from other non-conducting minerals. Ilmenite and rutile are further subjected to low-intensity magnetic separators where magnetic fraction - ilmenite is separated from rutile. Similarly, non-conducting fractions are subjected to high-intensity magnetic separators where weak magnetic fraction (monazite and garnet) is separated from non-magnetic fraction (zircon and sillimanite). The fractions are further processed on wind tables to separate garnet from monazite and sillimanite from zircon.

Installed capacity and production of ilmenite, rutile and other associated heavy minerals by various separation plants are furnished in Table-5.

INDUSTRY

For manufacturing titanium dioxide pigment, ilmenite is first treated chemically to obtain upgraded ilmenite, commonly called as synthetic rutile. There are two major pigment production processes, namely, chloride process and sulphate process depending on different operating characteristics and feedstock requirements. Plants employing chloride process consume high TiO_2 content feedstocks like synthetic rutile and chloride slag. On the other hand, plants employing the sulphate process use lower-grade ilmenite and sulphate slags.

Ilmenite obtained from Mineral Separation Plant (MSP) is chemically treated to remove impurities, such as, iron to obtain synthetic rutile (90% TiO_2) in Synthetic Rutile Plant (SRP). Indian SRP are based on reduction roasting followed by acid leaching with or without generation of hydrochloric acid. Plants of IREL (OSCOM) and KMML depend on acid regeneration from the leach liquor while those of Cochin Minerals & Rutile Ltd (CMRL) and DCW use fresh acid and recover ferric chloride from the leach liquor for its use in water purification.

At OSCOM plant of IREL, reduction-roasting of ilmenite with coal is followed by leaching with HCL to separate iron as soluble ferrous chloride. The leached ilmenite is calcined to yield synthetic rutile and the acidic leach liquor is treated in an acid regeneration plant to recover HCL for recycling with iron oxide as waste. The unit stopped production in 1997, as it was not viable economically. Against the Request for Proposal floated to set up titanium slag plant under Build-Own-Operate (BOO) model, a CPSE has shown keen interest and based on their request, the due date of submission has been extended. Considering the formidable investment and difficulties in sourcing technology in the field, the progress, though slow is in the right direction.

Environment Clearence for setting up nano titania/zirconia facilities have been received. However, in consideration of the stringent norms of Zero Effluent Discharge, work has been taken up to use alternate feed material to meet the stipulations.

The DCW Ltd procures ilmenite from Manavalakurichi which is then roasted with coke fines to convert Fe2O3 into FeO. The reduced ore is leached with concentrated hydrochloric acid to remove oxides of iron and other metals. The leached ore is washed and calcined to get upgraded ilmenite which contains more than 95% TiO_2. The upgraded ilmenite is micronised to 2 microns by using high-pressure steam. This is marketed as Titox. The liquor from ilmenite leaching process contains fine TiO_2 particles and chlorides. The TiO_2 recovered by filtration & washing in filter process is marketed as Utox. The Company has plans to increase the plant capacity to 48,000 tpy and also to install facilities for the manufacture of ferrite grade iron oxide from the effluent of the ilmenite plant.

Cochin Minerals and Rutile Ltd (CMRL), which began production at its 10,000 tpy synthetic rutile plant in Kerala in 1990 as a 100% EOU, has gradually raised the production capacity to around 45,000 tpy since 2008-09 for exports. It also has ferric chloride & ferrous chloride plants having capacities of 24,000 tpy & 72,000 tpy, respectively.

The Travancore Titanium Products Ltd (TTPL), a Kerala State Government Undertaking, manufactures titanium dioxide pigment by sulphate process at its plant at Kochuveli, Thiruvananthapuram. Ilmenite is reacted with sulphuric acid in digesters and a porous cake is formed. The mass in the solid form is dissolved in dilute sulphuric acid to get titanium in solution as titanium oxysulphate along with other metallic ingredients in ilmenite as their sulphate. The liquor is reduced using scrap iron, when ferric iron gets completely reduced to the ferrous state. The liquor is clarified, concentrated and boiled to precipitate the titanium content as hydrated titania which is then filtered by vacuum filters and calcined. Sulphuric acid required for captive consumption is produced at site using elemental sulphur. Till recently, TTPL was the only unit producing anatase grade titanium dioxide pigment in India. TTPL has capacity to produce 17,000 tpy of titanium dioxide, and with plans to modernise and diversify in stages, the Company has chalked out targets to produce both anatase and rutile grades titanium dioxide pigment.

Present domestic titanium metal production is negligible. KMML has setup a 500 tpy titanium sponge plant with Defence Metallurgical Research Laboratory (DMRL) technology and first batch of titanium was delivered in September 2011. The plant will be further expanded to

1,000 tpy. IREL is to setup a 10,000 tpy titanium sponge plant at OSCOM for which proposals have been invited on "build, operate and own" basis. Two forward looking MoUs have been entered by IREL, one with UKTMP, Kazakhstan for setting up of facility for production of titanium slag using ilmenite produced from OSCOM mines, while the other one is with Sultanate of Oman for Co-operation in the field of rare earths. Titanium sponge is imported by Mishra Dhatu Nigam Ltd (MIDHANI) for further processing in the country.

The available data on plantwise installed capacities of synthetic rutile and TiO_2 pigment are furnished in Table-6

USES & CONSUMPTION

About 90% of the world's titanium mineral production is used in the manufacturing of white titanium dioxide pigment. The unique combination of superior properties of high refractive index, low specific gravity, high hiding power and opacity and non-toxicity enable titanium dioxide in its application in the manufacture of all types of white and pastle shades of paints, white-walled tyres, glazed papers, plastics, printed fabrics, flooring materials like linoleum, pharmaceuticals, soaps, face powders and other cosmetic products. Besides, its non-toxic nature facilitate its use in cosmetics, pharmaceuticals, and even in foodstuffs as well as in toothpastes. Titanium dioxide is used in the manufacture of many sunscreen lotions and creams because of its non-toxicity and ultraviolet absorption properties. Synthetic rutile is used for coating welding electrodes as flux component and for manufacture of titanium tetrachloride which in turn is used in making titanium sponge. Synthetic rutile is also used as ingredient of special abrasives. Titanium metal is a versatile material with exceptional characteristics. The lightness, strength and durability of the metal make it an essential metal for the Aerospace Industry. It is also used in desalination and power generation plants and corrosive chemical industries because of its inertness and resistance to corrosion and high thermal conductivity. Its non-reactive property makes titanium metal one of the few materials that can be used in the human body for orthopaedic use and in pacemakers.

The ilmenite consumption is placed at 2,25,100 tonnes in 2019-20 which is lower as compared to the previous year. The bulk of ilmenite is consumed by the Chemical Industry (99 %). Moderate proportions are consumed by Welding Electrode Industry. The consumption of rutile in 2018-19 was 10,500 tonnes as compared to 9,700 tonnes in 2017-18. The entire consumption was reported from Electrode Industry .

POLICY

The specific measures of systemic improvements adopted by the Department of Atomic Energy (DAE) to curb the illegal mining activities in India:

1. In the year 2015, the Govt. of India has brought amendment in MMDR Act, 1957 and a number of new rules were introduced. Under Section 11B of the MMDR Act, the Atomic Minerals Concession Rules, 2016 [AMCR, 2016] was notified. The concept of "Threshold Value" for Atomic Minerals was introduced in the AMCR. In the said notification the threshold value for BSM was 0.75% of monazite in total heavy minerals with a view that monazite-rich deposits remain under the control of Department of Atomic Energy (DAE).
2. All beach sand minerals including Garnet and Sillimanite were notified as 'atomic minerals' under Part B of First Schedule of MMDR Act, 1957 in 2016.
3. The revised Mineral Conservation Development Rules, 2017 designates Director, Atomic Minerals Directorate for Exploration and Research (AMD) as competent authority for Atomic Minerals above the threshold values specified in AMCR, 2016 (Table-3).

Table - 3 : Particulars of Threshold Value for Atomic Minerals

[See Rule 2 (1)(m) and Rule 36]

Uranium-bearing tailings left over from ores after extraction of copper and gold, ilmenite and other titanium ores.	60 ppm U_3O_8 and/or 250 ppm ThO_2.
Zirconium-bearing minerals and ores including zircon.	All cases of zirconium-bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade. In other cases, zircon containing less than 2,000 ppm of Hafnium.
Beach Sand Minerals, i.e., economic heavy minerals found in the teri or beach sand, which include ilmenite, rutile, leucoxene, garnet, monazite, zircon and sillimanite.	All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.

4. Monazite Test Certification (MTC) by AMD has been reintroduced for every export consignments of beach sand minerals as per the Standard Operating Procedures (SOP) for Canalization.
5. As the mining of beach sand minerals by private parties has been terminated, AERB has also not been renewing the license for operation of mineral separation plants by these private parties under Atomic Energy (Radiation

Protection) Rules, 2004 from radiological safety considerations.

6. In view of stockpiled monazite enriched tailings with private BSM operators, AERB has been renewing the approval of Radiological Safety Officer (RSO) in these facilities so as to ensure the radiation surveillance of the plant premises and submission of reports of radiation monitoring to Atomic Energy Regulatory Board (AERB).
7. For licensing of Beach Sand Minerals processing facilities which are not involved in direct mining but procure the raw material from IREL or other countries, AERB issues license from radiation safety considerations only after the facility been licensed by DAE under Atomic Energy (Working of Mines, Minerals and handling of Prescribed Substance) Rules, 1984 for handling of monazite tailings.
8. Rule 45 of the Mineral Conservation and Development Rules, (MCDR) 2017 makes it mandatory for all miners, traders, stockiest, exporters and end-users of minerals to register and report on the production, trade and utilization of minerals to the State Government(s) and Indian Bureau of Mines. It facilitates end-to end national-scale accounting of all minerals produced in the country from pithead to its end-use, reducing the scope for illegal mining, royalty evasion, etc.
9. Penalty for illegal mining was made more stringent by amendment of the MMDR Act. The penalties have been increased from ₹ 25 thousand per hectare to ₹ 5 Lakh per hectare and lhe term of imprisonment has been increased from 2 years to 5 years for contravention of Section 4 (1) and 4 (1A) of the Act. Further, any rule made under the Act may provide that any contravention thereof shall be punishable with imprisonment for a term which may extend to two years or with fine which may extend to five lakh rupees, or with both, and in the case of a continuing contravention, with additional fine which may extend to fifty thousand rupees for everyday during which such contravention continues after conviction for the first such contravention. Section 30B of the Act provide for constitution of Special courts and 30C of the Act provides that such Special Courts shall be deemed to be a Court of Session.
10. State Governments were requested to set up Task Forces at State and District Level to control illegal mining. Subsequently, 22 States including Tamil Nadu have set up Task Forces to control illegal mining and review the action taken by member departments for checking the illegal mining activities at state and district levels so far.
11. The Ministry of Mines (MoM) through Indian Bureau of Mines, has developed the mining Surveillance System (MSS), a satellite based monitoring system which aims to establish a regime of responsive mineral administration, through public participation, by curbing instances of illegal mining activity through automatic remote sensing detection technology.
12. 21 State Governments including Tamil Nadu have framed rules under section 23C of MMDR Act, 1957 to curb illegal mining.
13. Issue of Notification by Ministry of Mines of Atomic Mineral Concession Rules, 2016 (AMCR-2016) towards protecting and conserving the "Atomic Minerals". "Beach Sand Minerals" (which include Ilmenite, Rutile, Zircon, Monazite, Sillimanite, Leucoxene and Garnet) are included to the list of "Atomic Minerals" declared under the MMDR Act, 1957.
14. Directorate General of Foreign Trade, Department of Commerce, Ministry of Commerce and Industry, Government of India issued Notification No. 26/2015-2020 dated 21.08.2018 on export policy on BSM under which export of BSM have been brought under State Trading Enterprise and shall be canalized through IREL, a CPSE under DAE.
15. MoM has issued Notification No. G.S.R. 134(E) dated 20.02.2019 towards ensuring complete government control over "Monazite" and "Zircon" occurring within the "Beach sand Minerals", amended the Threshold value of "Monazite" for BSM occurring in beach sand or placer deposits as "0.00%" in Total Heavy Minerals (THM), which resulted in bringing the overall BSM deposits of the Country under the complete control of the AMCR, 2016 irrespective of Monazite content.
16. In the interest of regulation of mines & minerals development and conservation of BSM resources, MoM vide Order No. 1/1/2019-M.VI dated 01.03.2019 requested all the State Governments to take necessary action for pre-maturely terminating the existing private BSM mining leases under section 4A (1) & 4A(3) of the MMDR Act 1957 towards conservation of Zirconium, Hafnium, Rare Earths and Thorium bearing strategic beach sand minerals.
17. A notification dated July 27, 2019 was issued for reserving the prospecting and mining rights of offshore minerals under Offshore Areas Mineral (Development and Regulation) Act, 2002 exclusively to Government and Government owned companies for curbing illegal mining of atomic minerals by private parties.
18. MoM issued Notifications vide Nos. S.O. 2805 (E) dated 12.07.2021 and S.O. 2807 (E) dated 12.07.2021 under Section 22 (Cognizance of Offences) and Section 24 (Power of entry and inspection) of MMDR Act, 1957 specified under Part B of First Schedule to the MMDR Act, 1957. The above Notifications authorized Director, AMD and other officers of AMD for the purpose.

SUBSTITUTES

There are no cost-effective substitutes for titanium dioxide pigments. Synthetic rutile made from ilmenite can be substituted for natural rutile. Nickel steels, stainless steels and some non-ferrous metal alloys can sometimes replace titanium alloys in industrial uses although at the expense of performance or economics. Tungsten carbide competes with titanium carbide for surface cutting machine tools. Titanium slag competes with ilmenite and rutile.

Environmental awareness indicates that titanium dioxide plants are likely to use chloride technology in future as it produces much less quantity of waste products. Synthetic rutile or slag (made from ilmenite) is likely to be used as feed in increasing amount. There is also a strong pressure to reduce the radioactive content of feedstocks because it affects the marketability of beach sand ilmenite. Titanium alloys could be replaced in aerospace applications by lithium-aluminium alloys or carbon-epoxy composites.

WORLD REVIEW

World resources of anatase, ilmenite and rutile are more than 2 billion tonnes. World reserves of ilmenite are estimated at 750 million tonnes in terms of TiO_2 content. Major reserves are in China with 210 million tonnes (28%) followed by Australia with 180 million tonnes (24%), India with 85 million tonnes (11%), Canada with 52 million tonnes (7%), Brazil with 43million tonnes & Norway with 37 million tonnes (5% each), South Africa 28 million tonnes & Madagascar with 27 million tonnes (3% each) and Mozambique with 22 million tonnes (3%). The world reserves of rutile are 55 million tonnes in terms of TiO_2 content. Major rutile reserves are located in Australia with 35 million tonnes (63%), followed by India with 7.4 million tonnes (13%), South Africa with 6.1 million tonnes (11%) and Ukraine with 2.5 million tonnes (5%).

World production of ilmenite and rutile concentrates was 13.2 million tonnes and 0.60 million tonnes, respectively, in 2022. China and Canada contributed 5.1 million tonnes (38%) and 2.1 million tonnes (13%) of ilmenite production, followed by South Africa with 0.9 million tonnes and Australia 0.5 million tonnes.

Australia produced 0.1 million tonnes of rutile, contributing 16% of world rutile output, followed by South Africa with 0.09 million tonnes (15%), India with 0.01 million tonnes (1.8%), Malaysia with 8359 million tonnes (1.4%), and Sri Lanka with 741 million tonnes (0.1%). World reserves and production of ilmenite and rutile are furnished in Tables-4 & 5.

Table - 4: World Production of Ilmenite,

(By Principal Countries)

(In '000 tonnes)

Country	2020	2021	2022
World: Total (wt of conc)	**13100**	**13700**	**13200**
China	5100	5100	5100
Canada	1900	1700	2100
South Africa	1020	1000	900
Australia	634	519	*500
Vietnam	268	300	331
India	265	265	265
USA	100	100	200
Korea, Rep. of	287	322	137
Other countries	63	184	81

Source : BGS, World Mineral Production,2018-2022.

Table – 5 : World Production of Rutile

(By Principal Countries)

(In '000 tonnes)

Country	2020	2021	2022
World: Total (wt of conc)	**600**	**600**	**600**
Australia	156	138	99
South Africa	86	95	95
India	*11	*11	*11
Malaysia	5	11	8
Sri Lanka	1	1	-
Other countries	-	-	-

Source : BGS, World Mineral Production,2018-2022.

Metal

Commercial production of titanium metal involves the chlorination of titanium-containing mineral concentrates to produce titanium tetrachloride ($TiCl_4$), which is reduced with magnesium (Kroll process) or sodium (Hunter process) to produce a commercially pure form of titanium metal. The metal formed has a porous appearance and is referred to as sponge. Titanium ingot and slab are produced by melting titanium sponge or scrap or a combination of both, usually with various other alloying elements.

Pigment

Global TiO_2 pigment production capacity was estimated to be 5.7 million tonnes per year. TiO_2 pigment produced is categorised by crystal form as either anatase or rutile. Rutile pigment is less reactive with the binders in paint when exposed to sunlight than the anatase pigment and is preferred substance in outdoor paints. Anatase pigment has a bluer tone than rutile, is somewhat softer and is used mainly in indoor paints and in paper manufacturing. Depending on the manner in which it is produced and subsequently finished, TiO_2 pigment can exhibit a wide range of functional properties, including dispersion, durability, opacity and tinting.

FOREIGN TRADE

Exports

Exports of titanium ores & conc. Decreased to 0.14 million tonnes during 2022-23 from 0.21 million tonnes in the preceding year. Exports were mainly to Japan (39%) and China (26%).

Exports of titanium and alloys (including waste & scrap) were at 252 tonnes, registering an increase of 92% from 131 tonnes in the previous year. Exports were mainly to USA (36%) and Republic of Korea (10%). Exports of titanium oxide and dioxide (total) decreased by 26% to 35393 tonnes in 2022-23 from 48003 tonnes in the preceding year. Out of the total exports in 2022-23, those of titanium dioxide were 4930 tonnes and exports of titanium oxides (other than titanium dioxides) were 30463 tonnes (Tables-6 to 13).

Table-6: Exports of Titanium Ores And Conc.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**215910**	**6155343**	**143607**	**7288953**
Japan	57056	1529493	56422	3318834
China	77066	2179331	37778	1543591
Taiwan	7789	631441	5859	877685
Netherlands	10000	230296	20000	574130
Malaysia	4186	403064	2548	364424
Turkey	--	--	10000	320190
Korea, Rep. of	29760	611186	11000	290098
Russia	--	--	++	1
Belgium	30000	564140	--	--
Uganda	52	6223	--	--
Other Countries	1	169	++	++

Figures rounded off

(In tonnes)

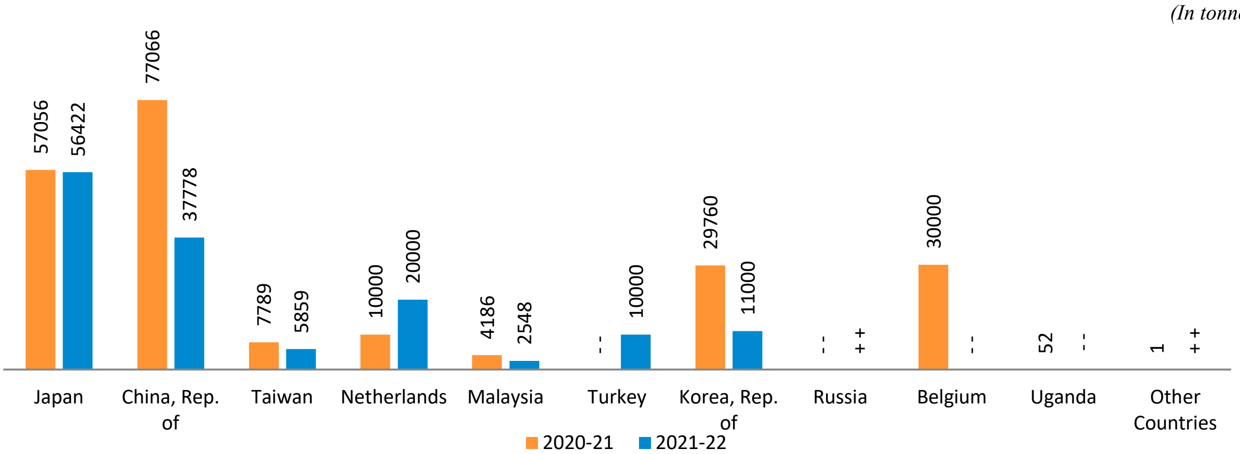


Fig 3: Countrywise Exports of Titanium Ores & Conc.

Table.-7: Exports of Titanium Ores And Conc.(ileminite)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**215857**	**6148952**	**143607**	**7288953**
Japan	57056	1529493	56422	3318834
China	77066	2179331	37778	1543591
Taiwan	7789	631441	5859	877685
Netherlands	10000	230296	20000	574130
Malaysia	4186	403064	2548	364424
Turkey	--	--	10000	320190
Korea, Rep. of	29760	611186	11000	290098
Russia	--	--	++	1
Belgium	30000	564140	--	--
UAE	++	1	--	--

Figures rounded off

Table.-8: Exports of Titanium Ores And Conc.(rutile)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**52**	**6239**	**--**	**--**
Uganda	52	6223	--	--
UAE	++	15	--	--
Austria	++	1	--	--

Figures rounded off

Table.9: Exports of Titanium Ores And Conc.(others)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1**	**152**	**--**	**--**
UAE	1	152	--	--

Table.10: Exports of Titanium And Alloys (Incl. Waste And Scrap)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**131**	**386027**	**252**	**576880**
USA	13	24282	92	111981
Korea, Rep. of	34	50431	23	70160
Turkey	9	26095	17	68749
UK	2	7417	5	61606
China	20	41062	22	37974
Finland	++	7360	2	31239
France	1	12374	3	30178
Australia	++	3434	8	27805
Germany	8	26303	8	21106
Malaysia	++	601	4	15350
Other Countries	44	186668	68	100732

Table.11: Exports of Titanium Oxide And Dioxide: Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**48003**	**5320220**	**35393**	**5961366**
Taiwan	14896	1419131	12106	2026835
USA	3010	768905	9199	1848649
China	7714	596012	8195	1065077
Japan	16208	1418229	3582	420677
Italy	984	287687	664	162858
Mexico	6	10708	98	72202
Nigeria	71	14895	180	44243
Nepal	130	36308	150	42468
Egypt	109	24455	93	26961
Bangladesh	68	21404	85	24898
Other Countries	4807	722486	1041	226498

Table.12: Exports of Titanium Dioxide

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6049**	**1538174**	**4930**	**1276988**
USA	3010	768719	2585	673734
Italy	984	287660	664	162858
Japan	776	139629	558	115447
Nepal	125	35070	148	42059
Nigeria	47	12249	156	40537
Egypt	109	24455	93	26961
Bangladesh	67	20960	84	24641
Brazil	60	9846	75	21460
UAE	75	20548	79	19096
Sri Lanka	49	11704	64	17372
Other Countries	747	207334	424	132823

Table-13: Exports of Titanium Oxides(other Than Titanium Dioxides)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**41954**	**3782046**	**30463**	**4684378**
Taiwan	14872	1413664	12096	2023752
USA	++	186	6614	1174915
China	7714	595959	8195	1065041
Japan	15432	1278600	3024	305230
Mexico	++	42	97	70930
Malaysia	3844	352627	300	21130
Turkey	2	575	80	9972
South Africa	6	2122	14	4820
Nigeria	24	2646	24	3706
Kenya	++	35	9	1447
Other Countries	60	135590	10	3435

Imports

Imports of titanium ores & conc. decreased drastically by 39% to 68,000 tonnes in 2022-23 from 1,11,653 tonnes in the preceding year. Imports were mainly from Mozambique (29%), Malaysia (13%), China (7%) and Australia (7%).

Imports of titanium and alloys (including waste & scrap) were 9970 tonnes in 2022-23 as compared to 9369 tonnes in the previous year. Imports were mainly from China (28%), USA (12%) and Germany (2%). Imports of titanium oxide and dioxide (total) were 18,654 tonnes in 2022-23 as compared to 15,233 tonnes in the preceding year. Imports were mainly from China (31%), Korea Rep. of (29%), and Germany (10%). Bulk of these imports were of titanium dioxide (18,503 tonnes) and titanium oxides (other than titanium oxides) were 151 tonnes in 2022-23 (Tables–14 to 21).

Table.14: Imports of Titanium Ores And Conc.: Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**111653**	**5292058**	**68000**	**4969119**
Mozambique	56981	1606498	20003	870731
Malaysia	2117	91581	8607	795381
China	4656	509355	4932	769209
Australia	5356	572465	4888	677059
Netherland	8686	268024	13143	336467
Vietnam	851	96689	3741	331216
Sri Lanka	2610	361301	3298	268126
Thailand	16792	508296	3503	236277
South Africa	908	97956	1400	224759
Senegal	1722	161533	1540	221855
Other Countries	10974	1018360	2945	238039

In tonnes

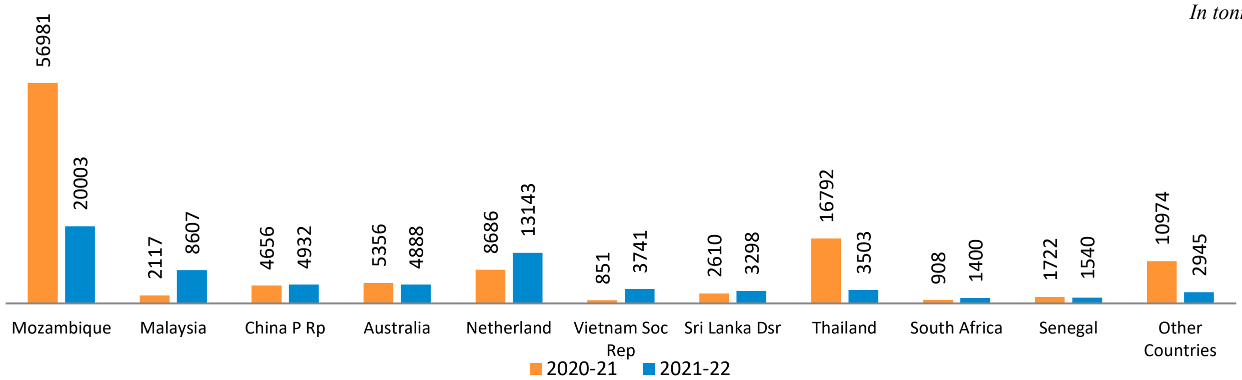


Fig 5: Countrywise Imports of Titanium Ores & Conc. : Total

Table.15:Imports of Titanium Ores And Conc. (ilmenite)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**77003**	**2326341**	**32126**	**1398364**
Mozambique	56955	1603973	20003	870731
Sri Lanka	1306	224589	2227	152602
Malaysia	1461	31875	4450	143491
Thailand	14940	322721	2496	107340
UAE	696	79546	1997	71399
Vietnam	--	--	594	22143
Netherlands	--	--	160	19866
China	244	20915	101	8466
Somalia	--	--	92	1147
USA	--	--	3	695
Other Countries	1401	42722	3	484

Table.16: Imports of Titanium Ores And Conc. (rutitle)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**22960**	**2479934**	**19468**	**2774144**
China	3632	400387	4544	722369
Australia	4602	495710	4134	572022
Malaysia	460	55400	2745	422971
Vietnam	831	94392	3122	304633
South Africa	908	97956	1400	224759
Senegal	922	86951	940	135038
Thailand	1852	185575	1007	128937
Sri Lanka	836	120640	571	95160
Kenya	252	42714	281	51648
Netherlands	828	100239	308	48433
Other Countries	7837	799970	416	68174

Table.17: Imports of Titanium Ores And Conc. (others)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**11690**	**485783**	**16406**	**796611**
Netherlands	7858	167785	12675	268168
Malaysia	196	4306	1412	228919
Australia	754	76755	754	105037
Senegal	800	74582	600	86817
UAE	--	--	150	40104
China	780	88053	287	38374
Sri Lanka	468	16072	500	20364
Vietnam	20	2297	25	4440
Italy	2	2101	3	4329
USA	96	7145	++	54
Other Countries	716	46687	++	5

Table.18: Imports of Titanium And Alloys (Incl. Waste And Scrap)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**9369**	**7998954**	**9970**	**10442098**
China	2343	2732094	2825	4183002
USA	1680	1403772	1194	1466434
Germany	269	633005	211	743307
Japan	955	540478	1325	590550
UK	282	527532	265	555951
Singapore	1069	338799	1247	538896
Taiwan	427	225495	986	458815
France	34	249094	56	409088
Korea, Rep. of	745	245255	638	322153
Kazakhstan	75	42718	290	243731
Other Countries	1490	1060712	933	930171

Table.19: Imports of Titanium Oxide And Dioxide: Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**15233**	**3695149**	**18654**	**5508817**
China	4838	1055368	5771	1440940
Korea, Rep. of	4450	1022230	5540	1419606
Germany	768	257108	1941	752775
Netherland	1492	441845	2102	735064
Japan	1850	446664	1446	475343
Belgium	453	135595	808	310687
USA	110	29426	312	122072
Taiwan	85	24794	249	90639
Hong Kong	486	103147	257	71399
France	6	5708	25	28676
Other Countries	695	173264	203	61616

Table.20: Import of Titanium Dioxide

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**15135**	**3623000**	**18503**	**5392495**
China	4838	1054969	5771	1439918
Korea, Rep. of	4450	1022115	5540	1419606
Germany	763	235700	1940	738334
Netherlands	1476	437507	2102	735063
Japan	1774	404048	1348	399456
Belgium	453	135450	757	294146
USA	110	29420	312	121284
Taiwan	85	24794	249	90639
Hong Kong	486	103147	257	71262
Singapore	85	27162	66	21989
Other Countries	615	148688	161	60798

Table.21: Imports of Titanium Oxides(other Than Titanium Dioxides)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**98**	**72149**	**151**	**116322**
Japan	76	42616	98	75887
Belgium	++	145	51	16541
Germany	5	21408	1	14441
France	1	2470	1	7193
China	++	399	++	1022
USA	++	6	++	788
Luxembourg	--	--	++	164
Hong Kong	--	--	++	137
Spain	++	160	++	77
UK	++	115	++	60
Other Countries	16	4830	++	12

FUTURE OUTLOOK

As per Technology Vision Document 2035, the demand for titanium in India would be approximately 1,000 tonnes by 2035. The contribution to the demand would be from Space Sector (100 tonnes), General Engineering (50 tonnes), Atomic Energy (125 tonnes), Aeronautical (50 tonnes), Power Generation (150 tonnes), Petroleum Refinery (50 tonnes) and Chemical Industry (475 tonnes).

Construction activity has gathered momentum and the real estate industry has witnessed new housing projects being taken up. The Government has planned large infrastructure spends. These are likely to have a positive impetus on paint, ceramics, welding electrodes, steel, cement and allied industries which will reflect on better demand for Ilmenite in domestic market.

As per data available, the defence, atomic energy and space research which are critical sectors have been assigned targets to increase communication set-up, safeguard India's security with modern arms, ammunitions & control and to increase power generation by three-fold. For meeting these targets, Indian Engineering Industry will depend on input materials like titanium sponge. Titanium sponge was not available in India till 2012, the first ever commercially indigenously made Ti-sponge was released as late as 2013 at KMML, Kerala, with the support of ISRO.

Titanium Sponge Industry is get to come out of the input of the pandemic as its demand is mainly dependent on the aviation sector which is badly affected due to the pendemic restrictions.Global demand growth for TiO_2 is expected to trend with the prospects of economic growth and production of paint, paper and plastics.

Aerospace, defence and industrial uses are expected to strongly influence the consumption of titanium metal in the near future.

The impetus by the Government for renewal energy and infrastructure, however, augurs well for demand for steel and that for IREL's rutile which finds application in production of welding electrodes.

43. Iron Ore

Iron & steel is the driving force behind industrial development in any country. The vitality of the Iron & Steel Industry largely influences a country's economic status. The mining of iron ore, an essential raw material for Iron & Steel Industry, is arguably of prime importance among all mining activities undertaken by any country. With the total resources of over 35.29 billion tonnes of haematite (Fe_2O_3) and magnetite (Fe_3O_4), India is one of the leading producers of iron ore in the world.

RESERVES/RESOURCES

Haematite and magnetite are the most important iron ores in India. About 79% haematite ore deposits are found in the Eastern Sector (Assam, Bihar, Chhattisgarh, Jharkhand, Odisha & Uttar Pradesh) while about 93% magnetite ore deposits occur in Southern Sector (Andhra Pradesh, Goa, Karnataka, Kerala & Tamil Nadu). Karnataka alone contributes 72% of magnetite deposit in India. Of these, haematite is considered to be superior because of its higher grade. Indian deposits of haematite belong to the Precambrian Iron Ore Series and the ore is within banded iron ore formations occurring as massive, laminated, friable and also in powdery form.

As per NMI database based on UNFC system, the total reserves/resources of haematite as on 1.4.2020 have been estimated at 24,057 million tonnes of which 6,209 million tonnes (25.80%) are under 'Reserves' category and the balance 17,848 million tonnes (74.20%) are under 'Remaining Resources' category. By grades, Lumps constitute about 45% followed by Lumps with Fines (26%), Fines (13%), and the remaining 15% are Black Iron ore, Beneficiable grade, Others, Unclassified, Not-known and Lumps & fines & blue dust unclassified grade. Major reserves/resources of haematite are located in Odisha (9,409 million tonnes or 39%), Jharkhand (4,710 million tonnes or 20%), Chhattisgarh (4,592 million tonnes or 19%), Karnataka (2,835 million tonnes or 12%) and Goa (1,197 million tonnes or 5%). The balance 5% resources of haematite are spread in Andhra Pradesh, Assam, Bihar, Madhya Pradesh, Maharashtra, Meghalaya, Rajasthan, Telangana and Uttar Pradesh (Table-1).

Table – 1 : Reserves/Resources of Iron Ore (Haematite) as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	6209034	**17848870**	**24057905**
By Grades			
Lump, high grade	832185	940095	1772279
Lump, medium grade	1432585	4188788	5621372
Lump, low grade	686331	2388547	3074877
Lump, unclassified grade	210	246248	246459
Fines, high grade	146830	67192	214022
Fines, medium grade	147829	1204201	1352029
Fines, low grade	148301	1208318	1356619
Fines, unclassified grade	490	115885	116375
Lumps & fines high grade	471678	478709	950387
Lumps & fines medium grade	1016424	1141559	2157983
Lumps & fines low grade	698544	2435597	3134141
Lumps & fines unclassified	188144	153661	341805
Black iron ore	-	19106	19106
Beneficiable grade	270521	1118438	1388959
Others	23905	53585	77490
Unclassified	86138	329906	416044
Not-known	1569	1728782	1730351
Lumps & fines & blue dust low grade	-	1847	1847
Lumps & fines & blue dust unclassified grade	57351	28408	85759
By States			
Andhra Pradesh	44744	350872	395616
Assam	-	30890	30890
Bihar	-	55	55
Chhattisgarh	1593732	2998379	4592111
Goa	117235	1080322	1197557
Jharkhand	534677	4175469	4710146
Karnataka	1043212	1792781	2835992
Madhya Pradesh	54129	302870	356999
Maharashtra	15241	286304	301544
Meghalaya	-	225	225
Odisha	2798749	6610582	9409331
Rajasthan	7314	28166	35480
Telangana	-	105627	105627
Uttar Pradesh	-	86330	86330

figures rounded off

Magnetite is another principal iron ore that also occurs in the form of oxide, either in igneous or metamorphosed banded magnetite-silica formation. As per NMI database based on UNFC system, the total reserves/resources of magnetite as on 1.4.2020 have been estimated at 11,227 million tonnes of which 'Reserves' constitute 202 million tonnes while 11,024 million tonnes are placed under 'Remaining Resources'. Classification on the basis of grades shows that 20% resources are of Metallurgical grade while 80% resources belong to grades that are categorised as Unclassified, Not-known and Coal Washery. The resources of others and Foundry grades constitute meagre proportions. India's 96.70% magnetite reserves/resources are located in five States, namely Karnataka (7,802 million tonnes or 69.50%) followed by Andhra Pradesh (1,472 million tonnes or 13.10%), Rajasthan (794 million tonnes or 7.10%), Tamil Nadu (528 million tonnes or 4.70%) and Goa (266 million tonnes or 2.30%). Assam, Bihar, Chhattisgarh, Jharkhand, Kerala, Maharashtra, Meghalaya, Nagaland, Odisha and Telangana together account for the remaining 3.30% resources (Table-2).

Table – 2 : Reserves/Resources of Iron Ore (Magnetite) as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	202823	**11024791**	**11227614**
By Grades			
Metallurgical	315	2238244	2238559
Coal washery	118678	124368	243045
Foundry	-	836	836
Beneficiable	-	36798	36798
Others	1351	6923	8274
Unclassified	82479	8264559	8347038
Not-known	-	353064	353064
By States			
Andhra Pradesh	-	1472383	1472383
Assam	-	15380	15380
Bihar	-	49439	49439
Chhattisgarh	75876	30045	105921
Goa	4990	261345	266336
Jharkhand	-	10667	10667
Karnataka	318	7801853	7802171
Kerala	-	83435	83435
Maharashtra	578	1210	1788
Meghalaya	-	3380	3380
Nagaland	-	5280	5280
Odisha	-	242	242
Rajasthan	121060	673866	794926
Tamil Nadu	-	528901	528901
Telangana	-	87366	87366

Figures rounded off

MINING LEASES & PRODUCTION

The production of iron ore constituting lumps, fines, calibrated lump ore (CLO) and concentrates was at 257.859 million tonnes in the year 2022-23, showing an increase of about 1.48% as compared to that in the preceding year.

There were 242 reporting mines in 2022-23 as against 255 in the previous year. (Table 5A & Table 5B). Among them, 43 mines were in the public sector and 199 in private sector. Besides, production of iron ore was reported as associated mineral by 13 mines in 2022-23 which is four less than the year 2021-22. The contribution of public sector to the total production was about 41.22% as against about 39.28% in the preceding year. The remaining 58.78% of the production in 2022-23 was from private sector. Among 43 iron ore mines in public sector, 23 iron ore mines each producing more than one million tonnes annually accounted for about 96.07% of the total output in public sector during 2022-23. Out of 199 iron ore mines and 13 associated mines in private sector, 38 iron ore mines each producing more than one million tonnes annually accounted for about 85.42% of the total output of private sector during the year. Thus, 61 iron ore mines, each producing more than one million tonnes of iron ore annually, contributed about 89.84% of the total output in 2022-23. The captive mines reported production of 96.92 million tonnes comprising about 37.58% of total production and non-captive mines reported production of 160.93 million tonnes i.e. about 62.42% during 2022-23. Gradewise analysis of the current year's output reveals that, out of total output of 257.859 million tonnes, iron ore lumps constituted 38.05 million tonnes (i.e. about 14.76%), fines constituted 181.99 million tonnes (i.e. about 70.58%), CLO constituted 36.10 million tonnes (i.e. about 14.00%) and concentrates constituted 1.70 million tonnes (i.e. about 0.66%).

Among the states, Odisha recorded the highest production of 140.43 million tonnes i.e. about 54.46% of the country's production in 2022-23. Chhattisgarh was at the second place with a production of 42.55 million tonnes i.e. about 16.50% of the total production followed by Odisha with a production of 39.82 million tonnes i.e. about 15.44%, Jharkhand 23.09 million tonnes i.e. about 8.95% of the country's production. The remaining 11.97 million tonnes i.e. 4.6 4% production was reported from Andhra Pradesh, Madhya Pradesh, Maharashtra and Rajasthan. (Table-3 to 6)

Table - 3 :Principal Producers of Iron ore 2022-23

Name and address of the Producer	Location of the mine	
	State	District
National Mineral Development Corporation Ltd 10-3-311/A, Khanij Bhavan, Castle Hills, Masab Tank, Hyderabad –500 028	Chhattisgarh Karnataka	Dantewada Ballari
Steel Authority of India Ltd Ispat Bhavan, Lodhi Road, New Delhi – 110 003	Chhattisgarh Jharkhand Odisha	Durg Singhbhum (West) Keonjhar Sundargarh
Odisha Mining Corporation Ltd, OMC House, Unit-5, P.B. No.34 Distt Khurda, Bhubaneswar-751 001, Odisha	Odisha	Keonjhar Sundargarh
Tata Steel Ltd, Bombay House, 24, Homi Mody Street, Fort, Mumbai – 440 001, Maharashtra	Jharkhand Odisha	Singhbhum (West) Keonjhar
JSW Steel Ltd, Jsw Centre Bandra Kurla Complex, Bandra (East) - Mumbai-400 051, Maharashtra	Karnataka	Ballari
Rungta Sons (P) Ltd, 8A Express Tower, 42 A-Shakespeare Sarani, Kolkata – 700 017, West Bengal	Odisha	Keonjhar
Jindal Steel & Power Ltd O.P. Jindal Marg, Delhi Road, Hissar - 125 005 Haryana	Odisha	Sundargarh
Vedanta Ltd Sesa Ghor, EDC complex, Patto, Panaji, Tisavadi-403 001 Goa	Goa Karnataka	North Goa South Goa Chitradurga
M/s Lloyds Metals And Energy Limited A-2, 2nd Floor, Madhu Estate, Pandurang Budhkar Marg, Lower Parel, Mumbai – 400013	Maharashtra	Gadchiroli
Arcelor Mittal India Pvt. Ltd office No.126 101-104,GCP Business Centre Opp.Memnagar Fire Station, Vijay Cross Road,Memnagar, Ahmedabad-380014 Gujarat	Odisha	Sundargarh
M/s. ESL Steel Limited Lohanchal Colony, Plot No. 10, Beside Sector 12, Bokaro Steel City - 827013	Odisha	Sundargarh
Geetarani Mohanty C 59 Palashpalli Bhubaneswar 751020	Odisha	Keonjhar

Table- 3 (Concld.)

Name and address of the Producer	Location of the mine	
	State	District
M/s. Godawari Power & Ispat Ltd Plot No. 428/2, Phase I,,Industrial Area, Raipur District Chattisgarh 493111	Chhattisgarh Odisha	Kanker Sundargarh
M/s. Arcelor MittaL Nippon Steel India Limited Raheja Towers, 6th & 7th Floor, BKC, Bandra East, Mumbai - 400051, Maharashtra, India	Odisha	Sundargarh
Tata Steel Long Products ltd. R55P+JCV, Northern Town, Jamshedpur, Jharkhand 831001	Jharkhand Odisha	Singhbhum (West) Sundargarh

Table – 4 : Production of Iron Ore, 2020-21 to 2022-23

(By States)

(Quantity in '000 tonnes; Value in ₹ '000)

States		2020-21		2021-22		2022-23(p)	
		Qty	Value	Qty	Value	Qty	Value
India	**Total**	**205041**	**527292469**	**254099**	**1008264608**	**257859**	**799284510**
	Lumps	61917	198763643	72872	367124174	38054	141360592
	Fines	141934	323013422	179833	633761585	181991	490869779
	CLOs	-	-	-	-	36106	159600521
	Concentrates	1190	5515404	1394	7378849	1708	7453618
Andhra Pradesh	**Total**	**349**	**260233**	**319**	**237855**	**185**	**125683**
	Lumps	213	181601	197	166143	95	74142
	Fines	136	78632	122	71712	90	51541
	CLOs	-	-	-	-	-	-
	Concentrates	-	-	-	-	-	-
Chhattisgarh	**Total**	**36839**	**132201316**	**41333**	**222498723**	**42546**	**169935753**
	Lumps	12710	52033594	14564	89901192	12277	51550804
	Fines	24129	80167722	26769	132597531	27303	99378274
	CLOs	-	-	-	-	2966	19006675
	Concentrates	-	-	-	-	-	-
Goa	**Total**	**1003**	**897737**	**-**	**-**	**-**	**-**
	Lumps	331	333817	-	-	-	-
	Fines	672	563920	-	-	-	-
	CLOs	-	-	-	-	-	-
	Concentrates	-	-	-	-	-	-
Jharkhand	**Total**	**21434**	**28520399**	**24728**	**55168902**	**23091**	**54869828**
	Lumps	4827	7279890	5680	13628848	3456	9736537
	Fines	16607	21240509	19048	41540054	17342	40353747
	CLOs	-	-	-	-	2293	4779544
	Concentrates	-	-	-	-	-	-
Karnataka	**Total**	**34500**	**94390860**	**40333**	**160324539**	**39821**	**116250944**
	Lumps	10108	36892352	11707	57045697	11311	40550875
	Fines	24392	57498508	28626	103278842	28510	75700069
	CLOs	-	-	-	-	-	-
	Concentrates	-	-	-	-	-	-
Madhya Pradesh	**Total**	**4094**	**2146870**	**7375**	**4727826**	**4354**	**2509988**
	Lumps	859	463231	1173	756699	808	478506

Table- 4 (Concld.)

(Quantity in '000 tonnes; Value in ₹ '000)

States		2020-21		2021-22		2022-23(p)	
		Qty	Value	Qty	Value	Qty	Value
	Fines	3235	1683140	6202	3971127	3546	2031482
	CLOs	-	-	-	-	-	-
	Concentrates	++	499	-	-	-	-
Maharashtra	**Total**	**1249**	**1732866**	**1984**	**6653399**	**6110**	**20675345**
	Lumps	113	253928	742	4264350	2082	11319051
	Fines	1136	1478938	1242	2389049	4028	9356294
	CLOs	-	-	-	-	-	-
	Concentrates	-	-	-	-	-	-
Odisha	**Total**	**104485**	**262035370**	**136792**	**553095800**	**140431**	**428633112**
	Lumps	32699	101296238	38675	201277779	8018	27630719
	Fines	71626	160300893	97821	349910387	101169	263996248
	CLOs	-	-	-	-	30847	135814302
	Concentrates	160	438239	296	1907634	397	1191843
Rajasthan	**Total**	**1088**	**5106818**	**1235**	**5557564**	**1321**	**6283857**
	Lumps	57	28992	134	83466	7	19958
	Fines	1	1160	3	2883	3	2124
	CLOs	-	-	-	-	-	-
	Concentrates	1030	5076666	1098	5471215	1311	6261775
Telangana	**Total**	**-**	**-**	**-**	**-**	**-**	**-**
	Lumps	-	-	-	-	-	-
	Fines	-	-	-	-	-	-
	CLOs	-	-	-	-	-	-
	Concentrates	-	-	-	-	-	-

(p) : Provisional ++: Negligible

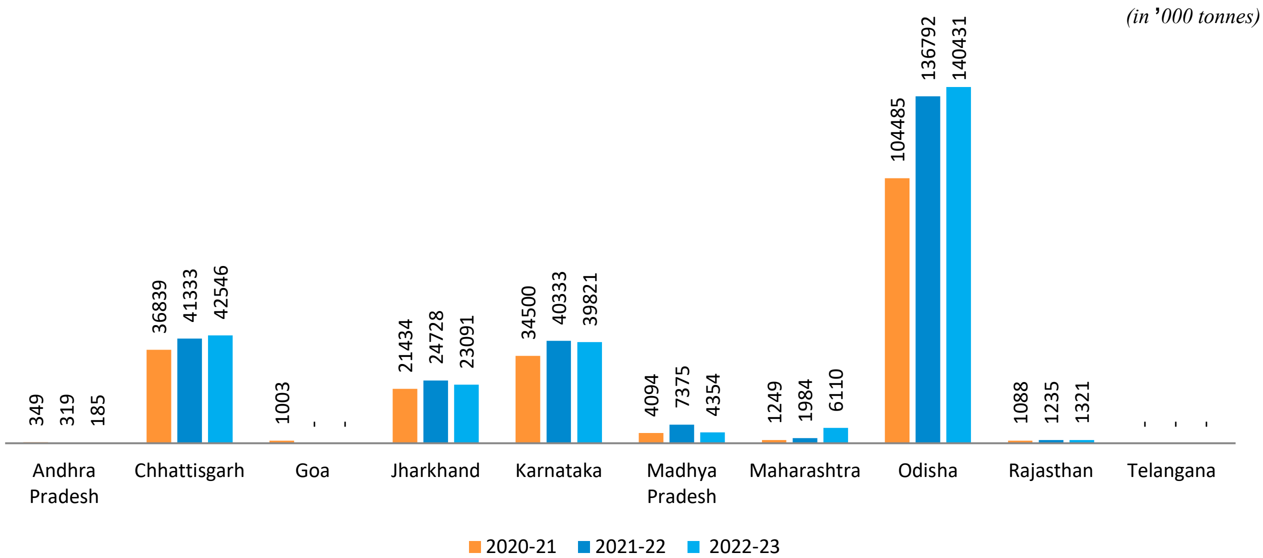


Fig 1: Statewise Production of Iron ore

Table – 5 (A) : Production of Iron Ore, 2021-22

(By Sectors / States / Districts/Grades)

(Quantity in '000 tonnes; Value in ₹'000)

State/District	Lumps									Fines								Concentrates		Total	
	No. of Mines	Below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% Fe and above	Total	Value	Below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% Fe and above	Total	Value	Total	Value	Total	Value
India	**255(9)**	**5871**	**2826**	**9247**	**10707**	**26469**	**17752**	**72872**	**367124174**	**19377**	**24957**	**19574**	**44166**	**48141**	**23618**	**179833**	**633761585**	**1394**	**7378849**	**254099**	**1008264608**
Public Sector	43	121	268	1053	5113	18263	9838	34656	199829813	281	2620	4193	27230	26243	4586	65153	276686241	0	0	99809	476516054
Private Sector	212(9)	5750	2558	8194	5594	8206	7914	38216	167294361	19096	22337	15381	16936	21898	19032	114680	357075344	1394	7378849	154290	531748554
Andhra Pradesh	**15**	**190**	**7**	**-**	**-**	**-**	**-**	**197**	**166143**	**122**	**-**	**-**	**-**	**-**	**-**	**122**	**71712**	**-**	**-**	**319**	**237855**
Anantapur	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Krishna	1	-	-	-	-	-	-	-	-	++	-	-	-	-	-	++	80	-	-	++	80
Kurnool	8	30	-	-	-	-	-	30	26143	15	-	-	-	-	-	15	10639	-	-	45	36782
Nellore		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prakasam (O	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Y.S.R. Cuddapah	4	160	7	-	-	-	-	167	140000	107	-	-	-	-	-	107	60993	-	-	274	200993
Chhattisgarh	**21**	**352**	**256**	**297**	**724**	**3394**	**9541**	**14564**	**89901192**	**1174**	**1403**	**783**	**4231**	**14044**	**5134**	**26769**	**132597531**	**-**	**-**	**41333**	**222498723**
Dantewara	7	-	-	31	++	182	9539	9752	81285355	4	6	119	1444	12895	4405	18873	117623917	-	-	28625	198909272
Durg	4	21	85	113	613	3110	-	3942	7135818	27	369	105	2313	1148	0	3962	7550271	-	-	7904	14686089
Kanker	6	113	106	94	107	102	-	522	729096	1063	964	535	466	-	729	3757	7061675	-	-	4279	7790771
Narayanpur	2	-	-	42	-	-	2	44	98418	14	11	-	-	-	-	25	39930	-	-	69	138348
Rajnandgaon	2	218	65	17	4	-	-	304	652505	66	53	24	8	1	-	152	321738	-	-	456	974243
Goa	**33****	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
North Goa	12**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Goa	21**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jharkhand	**17**	**35**	**87**	**897**	**2264**	**849**	**1548**	**5680**	**13628848**	**77**	**788**	**1678**	**5631**	**2366**	**8508**	**19048**	**41540054**	**-**	**-**	**24728**	**55168902**
Singhbhum (west)	17	35	87	897	2264	849	1548	5680	13628848	77	788	1678	5631	2366	8508	19048	41540054	-	-	24728	55168902
Karnataka	**56(1)**	**2352**	**793**	**2246**	**2520**	**3377**	**419**	**11707**	**57045697**	**4896**	**7831**	**5848**	**3805**	**5285**	**961**	**28626**	**103278842**	**-**	**-**	**40333**	**160324539**
Bagalkot	2	163	-	-	-	-	-	163	543025	107	-	-	-	-	-	107	250341	-	-	270	793366
Bellary	49	2020	699	1581	2200	3206	419	10125	48500563	4162	3055	4702	3800	5285	961	21965	82815330	-	-	32090	131315893
Chitradurga	5	169	87	665	320	171	-	1412	7972230	614	4776	1146	5	-	-	6541	20204833	-	-	7953	28177063

Table- 5(A) (Concld.)

(Quantity in '000 tonnes; Value in ₹ '000)

State/District	No. of Mines	Lumps								Fines								Concentrates		Total	
		Below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% Fe and above	Total	Value	Below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% Fe and above	Total	Value	Total	Value	Total	Value
Tumkur	(1)	-	7	-	-	-	-	7	29879	13	-	-	-	-	-	13	8338	-	-	20	38217
Madhya Pradesh	**23(7)**	**1168**	**5**	**-**	**-**	**-**	**-**	**1173**	**756699**	**6054**	**139**	**-**	**9**	**-**	**-**	**6202**	**3971127**	**-**	**-**	**7375**	**4727826**
Chhatarpur	1	80	-	-	-	-	-	80	35861	22	-	-	-	-	-	22	9914	-	-	102	45775
Gwalior	1	-	-	-	-	-	-	-	-	121	-	-	-	-	-	121	48368	-	-	121	48368
Jabalpur	20(7)	1050	5	-	-	-	-	1055	667653	5888	139	-	9	-	-	6036	3894147	-	-	7091	4561800
Katni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sagar	1	38	-	-	-	-	-	38	53185	23	-	-	-	-	-	23	18698	-	-	61	71883
Maharashtra	**11**	**56**	**53**	**55**	**23**	**555**	**-**	**742**	**4264350**	**594**	**182**	**126**	**264**	**76**	**-**	**1242**	**2389049**	**-**	**-**	**1984**	**6653399**
Chandrapur	1	10	7	6	3	-	-	26	85216	23	7	11	-	-	-	41	78033	-	-	67	163249
Gadchiroli	1	++	-	4	20	555	-	579	3842737	-	-	-	264	76	-	340	1165346	-	-	919	5008083
Gondia	3	11	-	-	-	-	-	11	22928	6	-	-	-	-	-	6	4017	-	-	17	26945
Sindhudurg	6	35	46	45	-	-	-	126	313469	565	175	115	-	-	-	855	1141653	-	-	981	1455122
Odisha	**69(1)**	**1589**	**1620**	**5752**	**5176**	**18294**	**6244**	**38675**	**201277779**	**6457**	**14614**	**11139**	**30226**	**26370**	**9015**	**97821**	**349910387**	**296**	**1907634**	**136792**	**553095800**
Keonjhar	39	1107	865	2976	1660	12904	5978	25490	126336363	2921	7113	6389	19940	15365	8930	60658	194550526	-	-	86148	320886889
Mayurbhanj	4	257	209	3	9	42	8	528	1985169	1062	-	9	19	4	12	1106	1270238	-	-	1634	3255407
Sundargarh	26(1)	225	546	2773	3507	5348	258	12657	72956247	2474	7501	4741	10267	11001	73	36057	154089623	296	1907634	49010	228953504
Rajasthan	**10**	**129**	**5**	**-**	**-**	**-**	**-**	**134**	**83466**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**2883**	**1098**	**5471215**	**1235**	**5557564**
Bhilwara	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1098	5471215	1098	5471215
Jaipur	3	59	-	-	-	-	-	59	18127	1	-	-	-	-	-	1	545	-	-	60	18672
Jhunjhunu	3	28	-	-	-	-	-	28	29845	-	-	-	-	-	-	-	-	-	-	28	29845
Sikar	2	42	5	-	-	-	-	47	35494	2	-	-	-	-	-	2	2338	-	-	49	37832
Telangana	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Khammam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*++: Negligible, *: Only labour reported*

***: Only labour reported, Production activity stopped by S.C. Order.*

Table – 5 (B) : Production of Iron Ore, 2022-23 (p)

(By Sectors / States / Districts/Grades)

(Quantity in '000 tonnes; Value in ₹'000)

State/ District	No. of mines	Lumps: Below 45% Fe (For Magne- tite Ore)	Lumps: 45% to below 51 % Fe	Lumps: 51% to below 55 % Fe	Lumps: 55% to below 58 % Fe	Lumps: 58% to below 60% Fe	Lumps: 60% to below 62 % Fe	Lumps: 62% to below 65% Fe	Lumps: 65% and above Fe	Lumps: Total	Lumps: Value	Fines: Below 45% Fe (For Mag-netite Ore)	Fines: 45% to below 51% Fe	Fines: 51% to below 55% Fe	Fines: 55% to below 58% Fe	Fines: 58% to below 60% Fe	Fines: 60% to below 62% Fe	Fines: 62% to below 65% Fe	Fines: 65% and above Fe	Fines: Total	Fines: Value
India	**242(13)**	**93**	**1791**	**3213**	**1824**	**4407**	**5568**	**13502**	**7656**	**38054**	**141360592**	**50**	**3899**	**15198**	**26561**	**13353**	**47784**	**52164**	**22982**	**181991**	**490869779**
Public	43	-	20	355	312	1346	3909	9355	7454	22751	87569776	-	12	615	2588	4507	29229	25984	5995	68930	232883840
Private	199(13)	93	1771	2858	1512	3061	1659	4147	202	15303	53790816	50	3887	14583	23973	8846	18555	26180	16987	113061	257985939
Andhra-Pradesh	**13(1)**	-	**20**	**75**	-	-	-	-	-	**95**	**74142**	-	**22**	**68**	-	-	-	-	-	**90**	**51541**
Ananta-pur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Krishna	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kurnool	8(1)	-	20	38	-	-	-	-	-	58	43859	-	22	44	-	-	-	-	-	66	37508
Nellore	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prakasam	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Y.S.R. -Cudda-pah	3	-	-	37	-	-	-	-	-	37	30283	-	-	24	-	-	-	-	-	24	14033
Chhattis-garh	**21**	-	**28**	**664**	**256**	**506**	**1327**	**2622**	**6874**	**12277**	**51550804**	-	**253**	**1904**	**1126**	**1243**	**3485**	**12674**	**6618**	**27303**	**99378274**
Dante-wada	7	-	-	-	-	44	-	132	6874	7050	43016517	-	-	-	22	24	542	12033	5739	18360	83497097
Durg	4	-	20	69	32	89	1236	2406	-	3852	6353768	-	12	128	277	157	2581	604	-	3759	6709627
Kanker	6	-	8	417	117	53	79	46	-	720	789604	-	241	1241	695	569	308	37	879	3970	7005361
Narayan-pur	2	-	-	-	35	290	7	38	++	370	713722	-	-	229	84	477	51	-	-	841	1225141
Rajnand-gaon	2	-	-	178	72	30	5	++	-	285	677193	-	-	306	48	16	3	++	-	373	941048
Goa	**28****	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North Goa	10**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Goa	18**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jhar-khand	**14**	-	-	**188**	**110**	**808**	**1527**	**795**	**28**	**3456**	**9736537**	-	-	**8**	**2011**	**2770**	**3200**	**2146**	**7207**	**17342**	**40353747**
West Singh-bhum	14	-	-	188	110	808	1527	795	28	3456	9736537	-	-	8	2011	2770	3200	2146	7207	17342	40353747

State/ District	CLO: Below 62% Fe (CLO any size)	CLO: 62% to below 65% Fe (5-18 mm size CLO)	CLO: 62% to below 65% Fe (10-40 mm size CLO)	CLO: 62%to below 65% Fe (CLO others)	CLO: 65% and above Fe (5-18 mm size CLO)	CLO: 65% and above Fe (10-40 mm size CLO)	CLO: Total	CLO: Value	Concentrates: Total	Concentrates: Value	Total: Total	Total: Value
India	**10929**	**3809**	**11488**	**242**	**111**	**9527**	**36106**	**159600521**	**1708**	**7453618**	**257859**	**799284510**
Public	596	1854	9218	-	-	2933	14601	86161597	-	-	106282	406615213
Private	10333	1955	2270	242	111	6594	21505	73438924	1708	7453618	151577	392669297
Andhra-Pradesh	-	-	-	-	-	-	-	-	-	-	**185**	**125683**
Ananta-pur	-	-	-	-	-	-	-	-	-	-	-	-
Krishna	-	-	-	-	-	-	-	-	-	-	-	-
Kurnool	-	-	-	-	-	-	-	-	-	-	124	81367
Nellore	-	-	-	-	-	-	-	-	-	-	-	-
Prakasam	-	-	-	-	-	-	-	-	-	-	-	-
Y.S.R. -Cudda-pah	-	-	-	-	-	-	-	-	-	-	61	44316
Chhattis-garh	-	-	**52**	-	-	**2914**	**2966**	**19006675**	-	-	**42546**	**169935753**
Dante-wada	-	-	52	-	-	2914	2966	19006675	-	-	28376	145520289
Durg	-	-	-	-	-	-	-	-	-	-	7611	13063395
Kanker	-	-	-	-	-	-	-	-	-	-	4690	7794965
Narayan-pur	-	-	-	-	-	-	-	-	-	-	1211	1938863
Rajnand-gaon	-	-	-	-	-	-	-	-	-	-	658	1618241
Goa	-	-	-	-	-	-	-	-	-	-	-	-
North Goa	-	-	-	-	-	-	-	-	-	-	-	-
South Goa	-	-	-	-	-	-	-	-	-	-	-	-
Jhar-khand	**813**	-	-	-	-	**1480**	**2293**	**4779544**	-	-	**23091**	**54869828**
West Singh-bhum	813	-	-	-	-	1480	2293	4779544	-	-	23091	54869828

Table- 5(B) (Concld.)

(Quantity in '000 tonnes; Value in ₹'000)

State/ District	No. of mines	Lumps: Below 45% Fe (For Magne- tite Ore)	Lumps: 45% to below 51 % Fe	Lumps: 51% to below 55 % Fe	Lumps: 55% to below 58 % Fe	Lumps: 58% to below 60% Fe	Lumps: 60% to below 62 % Fe	Lumps: 62% to below 65% Fe	Lumps: 65% and above Fe	Lumps: Total	Lumps: Value	Fines: Below 45% Fe (For Mag-netite Ore)	Fines: 45% to below 51% Fe	Fines: 51% to below 55% Fe	Fines: 55% to below 58% Fe	Fines: 58% to below 60% Fe	Fines: 60% to below 62% Fe	Fines: 62% to below 65% Fe	Fines: 65% and above Fe	Fines: Total	Fines: Value	Calibrated Lump Ore (CLO): Below 62% Fe (CLO any size)	CLO: 62% to below 65% Fe (5-18 mm size CLO)	CLO: 62% to below 65% Fe (10-40 mm size CLO)	CLO: 62%to below 65% Fe (CLO others)	CLO: 65% and above Fe (5-18 mm size CLO)	CLO: 65% and above Fe (10-40 mm size CLO)	CLO: Total	CLO: Value	Concentrates: Total	Concentrates: Value	Total: Total	Total: Value
Karna- taka	**54(2)**	**93**	**1037**	**1596**	**677**	**1724**	**1479**	**4330**	**375**	**11311**	**40550875**	**43**	**1539**	**5099**	**6569**	**4132**	**3442**	**7045**	**641**	**28510**	**75700069**	-	-	-	-	-	-	-	-	-	-	**39821**	**116250944**
Bagalkote	2	-	10	94	-	-	-	-	-	104	265326	-	10	11	84	-	-	-	-	105	154713	-	-	-	-	-	-	-	-	-	-	209	420039
Bellary	45	93	997	1254	442	1061	1344	4131	375	9697	33430489	43	1481	3141	2131	3513	3398	7045	641	21393	59515122	-	-	-	-	-	-	-	-	-	-	31090	92945611
Chitra- durga	6(1)	-	28	240	232	662	135	199	-	1496	6820848	-	10	1947	4344	619	44	-	-	6964	15968966	-	-	-	-	-	-	-	-	-	-	8460	22789814
Tumakuru	1(1)	-	2	8	3	1	-	-	-	14	34212	-	38	-	10	-	-	-	-	48	61268	-	-	-	-	-	-	-	-	-	-	62	95480
Madhya Pradesh	26(9)	-	695	113	-	-	-	-	-	808	478506	-	1061	2413	57	10	5	-	-	3546	2031482	-	-	-	-	-	-	-	-	-	-	4354	2509988
Chhatar- pur	1	-	-	90	-	-	-	-	-	90	40590	-	-	7	-	-	-	-	-	7	2424	-	-	-	-	-	-	-	-	-	-	97	43014
Gwalior	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jabalpur	23(9)	-	690	22	++	-	-	-	-	712	433588	-	1061	2406	57	10	5	-	-	3539	2029058	-	-	-	-	-	-	-	-	-	-	4251	2462646
Sagar	1	-	5	1	-	-	-	-	-	6	4328	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	4328
Mahara- shtra	11	-	-	14	72	-	36	1960	-	2082	11319051	-	-	271	329	-	574	2854	-	4028	9356294	-	-	-	-	-	-	-	-	-	-	6110	20675345
Chandra- pur	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gadchiroli	1	-	-	-	-	-	36	1960	-	1996	11083198	-	-	-	-	-	574	2854	-	3428	8325886	-	-	-	-	-	-	-	-	-	-	5424	19409084
Gondia	3	-	-	11	-	-	-	-	-	11	19489	-	-	10	-	-	-	-	-	10	5448	-	-	-	-	-	-	-	-	-	-	21	24937
Sindhu durg	6	-	-	3	72	-	0	-	-	75	216364	-	-	261	329	-	-	-	-	590	1024960	-	-	-	-	-	-	-	-	-	-	665	1241324
Odisha	65(1)	-	7	563	706	1369	1199	3795	379	8018	27630719	7	1021	5435	16469	5198	37078	27445	8516	101169	263996248	10116	3809	11436	242	111	5133	30847	135814302	397	1191843	140431	428633112
Kendujhar	36	-	-	237	519	396	613	2123	-	3888	13394962	-	117	3323	7907	2666	23724	15828	8133	61698	158235488	4731	2067	8982	19	-	5074	20873	92524894	-	-	86459	264155344
Mayur- bhanj	3	-	1	178	-	-	-	-	-	179	558277	7	676	163	45	-	2	1	++	894	652523	122	++	-	-	-	-	122	473754	-	-	1195	1684554
Sundar- garh	26(1)	-	6	148	187	973	586	1672	379	3951	13677480	-	228	1949	8517	2532	13352	11616	383	38577	105108237	5263	1742	2454	223	111	59	9852	42815654	397	1191843	52777	162793214
Rajasthan	10	-	4	-	3	-	-	-	-	7	19958	-	3	-	-	-	-	-	-	3	2124	-	-	-	-	-	-	-	-	1311	6261775	1321	6283857
Bhilwara	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1311	6261775	1311	6261775
Jaipur	3	-	3	-	-	-	-	-	-	3	4100	-	2	-	-	-	-	-	-	2	1156	-	-	-	-	-	-	-	-	-	-	5	5256
Jhunj- hunu	3	-	1	-	-	-	-	-	-	1	2357	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2357
Sikar	2	-	-	-	3	-	-	-	-	3	13501	-	1	-	-	-	-	-	-	1	968	-	-	-	-	-	-	-	-	-	-	4	14469
Telangana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Khammam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table – 6 : Production of Iron Ore, 2021-22 and 2022-23(p)

(By Frequency Groups)

Production Group (In tonnes)	No. of mines		Production (In '000 tonnes)		Percentage in total production		Cumulative percentage	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
Total	**255(9)**	**242(13)**	**254099**	**257859**	**100**	**100**	**-**	**-**
Up to 50,000	119(7)	110(12)	736	709	0.29	0.27	0.29	0.27
50,001 - 100,000	18	13(1)	1374	1176	0.54	0.46	0.83	0.73
100,001 - 500,000	38(2)	42	10032	11085	3.95	4.30	4.78	5.03
500,001 - 1,000,000	19	16	14523	13231	5.72	5.13	10.49	10.16
1,000,001 -1,500,000	16	14	19613	17014	7.72	6.60	18.21	16.76
1,500,001 - 2,000,000	7	7	12420	12082	4.89	4.69	23.10	21.44
2,000,001 and above	38	40	195401	202562	76.90	78.56	100.00	100.00

(p): provisional ( ) : No. of mines reported as associated mineral

STOCKS AT MINE-HEAD

The mine-head closing stock of iron ore for year 2022-23 was 97.38 million tonnes as compared to 118.59 million tonnes in 2021-22 (Tables- 7(A) & (B)).

Table-7 (A) : Mine-head closing stocks of Iron Ore, 2021-22

(By States)

(In '000 tonnes)

State	Lumps							Fines							Concentrates	Total Lumps & concentrate
	Below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% Fe and above	Total	Below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% Fe and above	Total	Total	
India	**8059**	**1679**	**4934**	**3444**	**6970**	**2104**	**27190**	**17846**	**41842**	**4801**	**12662**	**12374**	**1794**	**91319**	**86**	**118595**
Andhra Pradesh	474	13	-	-	-	-	487	1090	-	-	1	-	-	1091	-	1578
Chhattisgarh	3	26	152	14	132	667	994	151	288	19	366	1495	940	3259	-	4253
Goa	26	149	11	++	1	-	187	205	61	++	++	++	-	266	**5**	**458**
Jharkhand	358	440	118	230	276	85	1507	1336	37560	1323	911	1761	126	43017	-	44524
Karnataka	5206	370	572	558	932	200	7838	2275	740	683	700	1163	110	5671	-	13509
Madhya Pradesh	333	26	9	17	-	-	385	3060	21	4	1	-	-	3086	-	3471
Maharashtra	85	25	13	17	164	-	304	745	66	15	162	56	-	1044	-	1348

Table- 7(A) (Concld.)

(In '000 tonnes)

State	Lumps							Fines							Concentrates	Total Lumps & concentrate
	Below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% Fe and above	Total	Below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% Fe and above	Total	Total	
Odisha	1293	630	4059	2608	5465	1152	15207	8970	3106	2757	10521	7899	618	33871	70	49148
Rajasthan	281	-	-	-	-	-	281	14	-	-	-	-	-	14	11	306
Telangana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

++: Negligible (p): provisional

Table-7 (B) : Mine-head closing stocks of Iron Ore, 2022-23 (p)

(By States)

(In '000 tonnes)

States	Lumps									Fines									Calibrated Lump Ore (CLO)								Concen trates	
	Below 45% Fe (For Magn-etite Ore)	45% to below 51% Fe	51% to below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% and above Fe	Total	Below 45% Fe (For Magne tite Ore)	45% to below 51% Fe	51% to below 55% Fe	55% to below 58% Fe	58% to below 60% Fe	60% to below 62% Fe	62% to below 65% Fe	65% and above Fe	Total	Below 62% Fe (CLO any size)	62% to below 65% Fe (5-18 mm size CLO)	62% to below 65% Fe (10-40 mm size CLO)	62% to below 65% Fe (CLO others)	65% and above Fe (5-18 mm size CLO)	65% and above Fe (10-40 mm size CLO)	65% and above Fe (CLO others)	Total	Total	Total
India	**37**	**2401**	**2477**	**931**	**1180**	**756**	**1978**	**1957**	**11717**	**46**	**3618**	**11597**	**11674**	**4632**	**16337**	**12085**	**2079**	**62068**	**11302**	**1934**	**8212**	**107**	**31**	**1946**	**41**	**23573**	**27**	**97385**
Andhra Pradesh	-	95	333	19	-	-	-	-	447	-	107	983	34	-	-	-	-	1124	-	-	-	-	-	-	-	-	-	1571
Chhattisgarh	-	1	124	28	238	76	179	1661	2307	-	212	167	318	109	216	1445	1642	4109	-	-	9	-	-	588	-	597	-	7013
Goa	-	-	21	112	-	-	-	-	133	-	59	46	6	-	-	-	-	111	-	-	-	-	-	-	-	-	-	244
Jharkhand	-	-	39	273	175	261	169	20	937	-	264	791	5370	1751	1054	1756	172	11158	415	-	-	5	-	262	-	682	-	12777
Karnataka	37	1249	1306	403	655	267	1320	219	5456	43	1321	2047	1474	576	672	689	8	6830	-	-	-	-	-	-	-	-	-	12286
Madhya Pradesh	-	217	456	30	9	17	-	-	729	-	691	1591	27	14	6	-	-	2329	-	-	-	-	-	-	-	-	++	3058
Maharashtra	-	10	36	26	5	3	1	-	81	-	102	346	65	16	++	++	-	529	-	-	-	-	-	-	-	-	-	610
Odisha	-	800	161	40	98	132	309	57	1597	3	847	5624	4380	2166	14389	8195	257	35861	10887	1934	8203	102	31	1096	41	22294	19	59771
Rajasthan	-	29	1	++	-	-	-	-	30	-	15	2	-	-	-	-	-	17	-	-	-	-	-	-	-	-	8	55
Telangana	-	-	++	-	-	-	-	-	++	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	++

(p): provisional, ++: Negligible

EMPLOYMENT

The average daily employment of labour was 30,310 during 2022-23 as against 48,934 in the preceding year.

MINING, MARKETING & TRANSPORT

Iron ore mining is carried out by opencast method through manual, semi-mechanised and mechanised operations.The method of mining and deployment of machinery vary from place to place depending upon characteristics of iron ore as per geological set up. Large mechanised mines are mostly in the Public Sector. Manual and semi-mechanised mines are mainly in Private Sector. Some mechanised mines in Jharkhand and Odisha are also operated by the Private Sector.

Manual Mines

Generally, these mines are confined to float ores where mining is done by digging the ore with pick axes, crow bars, chisels and spades. The mined material is screened manually to separate +10 mm float ore which is then stacked separately. The waste is backfilled into the pits. In some reef workings, 35 – 40 mm diameter holes are drilled to 0.6 m depth by hand-held jackhammers at a spacing of about 0.6 m and each hole is charged with 150 –200 g gunpowder or special gelatine cartridges. Blasted tonnage per kg gunpowder is usually 2.5 – 3 tonnes. Blasted ore is manually loaded into trucks for transport to either railway sidings or to buyer's destination directly.

Mechanised Mines

Most of the mechanised mines are captive belongings of different steel plants and have been developed to cater to specific requirements. Mining is done by formation of systematic benches in overburden and ore. The height of the benches normally varies from 10 to 12 m and width up to 20 m in the ore. Drilling holes of 300 mm diameter and till 12 m depth by crawler drills and use of explosives, such as, ANFO, SMS and emulsion explosives for blasting are in practice. Loading is done by earth-moving machinery powered by diesel or electric engines, such as, hydraulic excavators in the range from 1.9 cu. m to 10 cu. m. Ripper dozers and motor graders are also deployed for excavation and levelling purposes.

Mines, where ore is predominantly in powdery form, hydraulic shovels with boom height of around 9 m may be used for excavation and loading. Heavy-duty Ripper-Dozers are preferred for such mining as the ores are soft. Height of the benches is restricted to 7 m for safe and efficient operations. Width of working benches is maintained at more than 15 m and bench slope is maintained at about 80°. The ore produced is transported to short distances by dumpers up to 40 tonnes capacity. For longer distances and barge loading, dumpers/trucks up to 10 tonnes capacity are used. The barges carry the ore to harbours. The ore from the barges is loaded on to ships either through berth or through transshippers.

Almost all the Public Sector mines including Kiriburu, Barsua, Gua, Bailadila, Donimalai, Daitari and Dalli-Rajhara operated by SAIL, NMDC and OMC are fully mechanised. In Private Sector, most of the captive mines are mechanised. Approximately, 90% iron ore production comes from mechanised mines. NMDC operates a couple of large mechanised iron ore mines in the country at Bailadila (Chhattisgarh) and Donimalai (Karnataka). The Company has three highly-mechanised iron ore mine complexes. Two are located in Chhattisgarh and one in Karnataka.

The processing of iron ore in the country involves crushing, screening, washing and in some cases beneficiation and agglomeration. Crushing and screening are adopted mainly for sizing the ore and also for removing the adherent gangue minerals. Dry and wet grinding is also resorted to in some cases.

The lumps and fines of iron ore are marketed after screening and beneficiation. Fines are converted into sinters for use in steel plants while pellets made from concentrates/fines are exported and also are utilised for internal consumption in domestic iron & steel industries.

ENVIRONMENTAL FACTORS

Afforestation, waste dump management, top soil management, management of sub-grade minerals, mechanical beneficiation, dust suppression, monitoring of water & air quality, vibration survey, publicity and propaganda are some common environmental restoration efforts pursued by all mechanised and semi-mechanised iron ore mines. Mining and beneficiation of ores carried out on large-scale cause environmental problems. A specific problem in iron ore mining is the disposal of tailings and other deleterious silica minerals and phosphorous. To safeguard the environment and prevent ecological degradation, thrust has been laid on green belt development, solid waste management, monitoring of liquid & air effluents and other crucial environmental parameters.

Goa region is prone to siltation of agricultural fields, nallahs, riverbeds and creeks due to wash off from iron ore dumps in rainy season. Loss in crop yield and reduction in fish population in streams and navigation difficulties are the problems caused by silting. To overcome these problems, check dams and water filter beds at higher contours have been constructed. Tailing ponds are also being maintained at some mines. Afforestation is the mainstay in reclaiming the mined out areas in Goa. In a few cases, pits are used as water reservoir for pisciculture. But, in early 2018, the apex court had quashed 88 mining leases for violation of mining procedures and asked the state government of Goa to issue fresh leases instead of renewing existing ones. February 2021 marked three years since India's apex court stopped iron ore miming in Goa.

In Ballari-Hosapete area, Karnataka, dust concentration (suspended particulate matter) is the main environmental problem. In Bailadila Sector, Chhattisgarh, forest is fairly widespread and dense, supported by good rainfall and rich flora and fauna. The deforestation taking place due to mining and waste dumping needs to be compensated continuously by afforestation at suitable slopes and in township areas. In Jharkhand, afforestation of land is the main recourse adopted for reclamation of degraded lands or improvement in land uses.

INDUSTRY

Iron ore is the basic raw material used for making pig iron, sponge iron and finished steel. The iron ore is used mainly in blast furnaces, mini-blast furnaces (MBF), DRI & sintering and pelletisation plants.

Pelletisation

In general, the pelletisation process involves mixing of iron ore and required limestone with water which later is ground in ball mills to the desired size. The discharged slurry from ball mills is filtered in pressure filters. The filter cake from filters is then mixed with dry-ground coke fines to which bentonite is mixed in suitable proportion to form green pellets in pelletising discs. The coke fines and bentonite are ground separately. The green pellets are then dried, heated and fired in indurating machine to produce iron ore pellets. There is an increasing trend for utilisation of pellets or sinters in the recent years. The use of pellets as feed in the blast furnace has several advantages because of their uniform size, known composition and strength. Iron ore pellet is a kind of agglomerated fines which has better tumbling index as compared to that of parent ore and can be used as a substitute used in blast furnaces in countries where lump ore is not available.

As per the Pellet Manufacturers Association of India the fifty-five pelletisation plants in the country about which information is available, have a total capacity of 146.1 million tonnes per annum. The JSW Steel Ltd has a manufacturing capacity of 17.20 million tonnes of pellets annually at Vijayanagar, Bellary, Karnataka. Amba River Coke Limited, a wholly owned subsidiary Company of JSW Steel, has set up a 13.3 million tpy pellet plant (Dolvi unit 1 and 2) at Dolvi. The pellets produced are primarily supplied to the Dolvi unit of the company. During the year 2022-23, all India production of pellets as per the Pellet Manufacturers Association of India was 83.96 million tonnes.

With a strong belief in prudent forward and backward integrations, JSPL established India's largest 10 MTPA Pelletisation Complex at Barbil, Odisha. The plant includes dry grinding facility that harnesses recuperation type of straight grate technology. The Company's Barbil Plant is India's largest single-location pellet manufacturing facility with 4.5 MTPA Dry Grinding Unit and a 4.5 MTPA Wet Grinding Unit. JSPL pellet plant helps to process low-cost iron ore fines as against expensive lumps, thereby handing a cost advantage. Laced with state-of-the-art technology backed with proximity to iron-ore access, JSPL's Barbil Plant has emerged as India's largest pellet exporter in recent years.

Arcelor Mittal Nippon Steel India, i.e. , ('AM/NS India'), (formerly known as Essar Steel was acquired jointly by Arcelor Mittal and Nippon Steel in December 2019) has 8 MTPA iron ore pellet plant in Visakhapatnam, Andhra Pradesh to cater to the pellet requirements of the HBI plant in Hazira, Gujarat. The plant has an assured supply of high-quality iron ore from the beneficiation plant at Bailadilla, Chhattisgarh. The plant is capable of producing both DR and BF grade pellets and is linked to the Visakhapatnam port through conveyors to enable easy material movement in and out of the plant. The plant is located strategically near a deep draft, all-weather port that ensures the movement of large vessels to supply pellets throughout the year to the Hazira steel-making facility. A 6 million tpy pellet plant is located at Paradip in the iron ore rich State of Odisha. The plant has an assured supply of high-quality iron ore from the beneficiation plant at Dabuna, Odisha. The Paradip Pellet plant may add another 6 million tpy to its capacity which is under completion. After completion of this plant AM/NS India's total pelletisation capacity at Paradip would get augmented to 12 million tpy and supported by a 20-million-tonnes pellet-making capability, the Company is on its way to become the largest pellet producer in India.

NMDC has forayed in pellet-making through setting up of a 1.2 MTPA pellet plant at Donimalai. Another 2 MTPA pellet plant is in the process of being set up at Nagarnar, Chhattisgarh.

KIOCL is currently engaged in the business of manufacturing and selling of iron ore pellets. The state-of-the-art pelletisation plant with 3.5 million tpy rated capacity and 0.216 million tpy Blast Furnace Unit is located at Mangaluru.

Steel plants are likely to increase usage of pellets in their production process to reduce pollution and increase productivity. Moreover, the forecast of spike in growth in Infrastructure, Real Estate and Automobile Sectors in the ensuing years are expected to augment demand for steel, which in turn would raise the demand and prices of pellets in the near future.

Sintering

In sintering process, iron ore fines, other iron- bearing wastes and coke dust are blended and combusted. The heat fuses the fines into course lumps that can be charged to a blast furnace. There are about thirty-nine sintering plants in the country about which information is available and have a total capacity of about 96.131 million tonnes per annum. Most of the Integrated Steel Plants (ISP) in the country have their own sintering plants. Sinter plants receive raw material mostly from their captive mines. Information on capacity and production of pellets and sintering plants is provided in Table-8.

Table – 8 :Name, location and Installed Capacity of Pellets and Sinters Plants

(By Plants)

(In million tonnes)

Name & location of plant	Annual installed capacity
A) Pellet Plants	
1. Amba River Coke Ltd, (A wholly owned subsdiary co. of JSW Steel Ltd), Dolvi, Maharashtra	12
2. Atibir Industries Co. Ltd. Unit-II, Bhorandiha, Jharkhand	0.3
3. Ardent Steel Ltd, Phulj Keonjhar, Odisha	0.8
4. Arya Iron and Steel Company (AISCO) Barbil, Odisha	1.2
5. Pellet Sponge Iron Plant BMM Ispat, Karnataka	2.4
6. Arcelor Mittal Nippon Steel India, Visakhapatnam, Andhra Pradesh	8
7. Arcelor Mittal Nippon, Steel India, Paradip Port,Odisha.	12
8. Godawari Power & Ispat Ltd Siltara, Chhattisgarh	2.7
9. Jindal Steel & Power Ltd, Barbil, Odisha	10
10. Jindal Saw Ltd, Bhilwara, Rajasthan	1.5
11. JSW Steel Ltd, Tornagallu, Toranagally, Ballariy, Karnataka	17.2
12. Jayaswal Neco Industries Ltd, Siltara, Raipur, Chhattisgarh	1.5
13. KIOCL Ltd, Panambur, Mangaluru, Karnataka	3.5
14. Mandovi Pellets Ltd, Near Borim Bridge, Shiroda, Goa – 403 103	1.8
15. Minera Steel & power Private Ltd, Ballari, Karnataka	0.6

Table- 8 (Cont.)

(In million tonnes)

Name & location of plant	Annual installed capacity
16. MSP Steel & Power Ltd, Raigarh, Chhattisgarh	0.9
17. NMDC Ltd, Donimalai, Karnataka.	1.2
18. Orissa Metalics Private Ltd, Paschim Mednapore, West Bengal	3.6
19. Rashmi Metaliks Ltd, Shyamraipur, Gokulpur, West Midnapore, West Bengal	1.2
20. Sarda Energy and Minerals Ltd, Siltara, Mandhar, Raipur, Chhattisgarh	0.8
21. Shri Bajarang Power & Ispat Ltd, Borjhara, Tilda & Gondwara, Raipur, Chhattisgarh	1.4
22. Tata Steel Limited, Jamshedpur, East singbhum, Jharkhand	8
23. Xindia Steels Ltd, Kunikere & Hirebaganal Ginigera, Koppal, Karnataka	0.8
24. Bhushan Power & Steel Ltd Sambalpur, Odisha	3.85
25. Shyam Metalics And Energy Ltd Sambalpur, Sambalpur, Odisha	3
26. MSP Metallics Ltd, Jharsuguda, Odisha	0.6
27. River Pellets Limited, jaipur, Odisha	4
28. Sree Metaliks Ltd-Keonjhar keonjhar, Odisha	0.6
29. MSP Sponge Iron Ltd, Keonjhar, Odisha	0.75
30. Rungta Mines, kamanda, Sundergarh, Odisha	3
31. Essel Mining & Industries Lyd. Keonjhar, Odisha	1
32. Shri Jagannath Steels&Power Ltd (KJS Group), Keonjhar, Odisha	1.2

Table- 8 (Cont.)

(In million tonnes)

Name & location of plant	Annual installed capacity
33. Shri Mahavir Ferro Alloys Ltd. Sundergarh, Odisha	1.6
34. MSPL Limited, Koppal, Karnataka	1.2
35. Janki Corporation Ltd Bellary, Karnataka	0.6
36. Rashmi Udyog Private Ltd (Rashmi Group), Paschim Midnapur, West Bengal	1.2
37. Orissa Alloy Steel Pvt. Ltd. (Rashmi Group), Kharagpur, West Bengal	3
38. Shakambhari steel, Purulia, West Bengal	2
39. Super Smelters Sponge P Ltd, Jamuria, Paschim Bardhman West Bengal	1.2
40. Bravo Sponge Iron P Ltd Purulia, West Bengal	0.85
41. Shyam Sel And Power Ltd (Jamuria), Paschim Bardhman, West Bengal	3
42. Ankit Metal And Power Ltd. Bankura, West Bengal	0.6
43. Tata Sponge Iron Ltd Main Plant-1& 2, Gamharia, Jharkhand	1.2
44. Rungta Mines, Chaliyama, Saraikela Jharkhand	3
45. Amalgam Steel Private Limited (Formerly Adhunik Alloys), Saraikela\ Jharkhand	1.2
46. JSW Ispat Special Products Ltd. (Raigarh), Raigarh, Chhattisgarh	2.2
47. Raipur Power & Steel Durg, Durg, Chhattisgarh	0.6
48. Rashi Steel And Power Ltd, Bilaspur, Chhattisgarh\	0.4
49. Sal Steel Ltd (Shah Alloys Ltd), Gandhinagar, Gujarat	0.6

Table- 8 (Cont.)

(In million tonnes)

Name & location of plant	Annual installed capacity
50. Vinayak Steels Ltd, Mehboobnagar, Telangana	0.07
51. Gullantt Ispat Ltd, Gorakhpur, Uttar Pradesh	0.79
B) Sintering Plant 1. Atibir Industries Co. Ltd. Unit-II, Bhorandiha, Jharkhand	680
2.Bokaro Steel Plant, Jharkhand	6900
3.Bhilai Steel Plant, Bhilai, Durg, Chhattisgarh.	6334
4.Bhushan Steel Ltd, Dhenkanal, Odisha	6680
5.Durgapur Steel Plant, West Bengal	3009
6.Electrosteel Casting Ltd Khardah, Barrackpore, West Bengal	365
7.Electrosteels Ltd, Siyaljori, Jharkhand	2980
8.Gerdau Steel India Ltd, Tadipatri, Anantpur, A.P.	470
9.IISCO Steel Plant, SAIL Burnpur, West Bengal	3880
10.Jayaswal Necco Industries Ltd, Siltara Growth Centre, Raipur-493 221, Chhattisgarh	729
11.Jindal Steel & Power Ltd, Raigarh, Chhattisgarh	2300
12.Jindal Saw Ltd, Mundra, Gujarat	900
13.JSW Steel Ltd, Tornagallu, Toranagallu, Ballari, Karnataka	12950
14.JSW Steel Ltd, Dolvi Works, Raigad, Maharashtra	5400
15.JSW Steel Ltd Salem works, Mkalipatti, Metturdam, Tamil Nadu	1106

Table- 8 (Cont.)

(In million tonnes)

Name & location of plant	Annual installed capacity
16.Jai Balaji Industries Banskopa, West Bengal	608
17.Kalyanigerdua Steels Ltd, formerly sjk steel plant, Jambulapadu, Tadipatri, Andhra Pradesh	500
18.Kirloskar Ferrous Industries Ltd, Bevinahalli, Koppal, Karnataka.	500
19.KIC Metaliks Ltd, Raturia, Angadpur, Durgapur. West Bengal	336
20.Monnet Ispat and Energy Raigarh, Chhattisgarh	962.3
21.Mukund Ltd, M/s Hospet Steel Ltd, Ginigera, Koppal, Karnataka	500
22.Neometaliks Ltd, Gopalpur, Durgapur, West Bengal	316
23.Neelachal Ispat Nigam Ltd, Kalinga Nagar, Industrial Complex, Duburi-755 026, Distt Jajpur, Odisha.	1710
24.Rashmi Metaliks Ltd, Shyamraipur, Gokulpur, West Midnapore, West Bengal.	1440
25.RINL, Visakhapatnam Steel Plant No. -1& 2 , Visakhapatnam, Andhra Pradesh	5256
26.RINL, Visakhapatnam Steel Plant No. -3, Andhra Pradesh	3600

Table- 8 (Concld.)

(In million tonnes)

Name & location of plant	Annual installed capacity
27.Rourkela Steel Plant, Odisha	5300
28.SBQ Steel Ltd, Gudur, Nellore, Andhra Pradesh	240
29. Sri Kalahasthi Pipes Ltd, Chitoor, Andhra Pradesh	500
30.SLR Metaliks Ltd, Ballari, Karnataka	350
31.Sesa Goa Ltd, Vedanta Ltd,	1000
North Goa 32.Sunflag Iron & Steel Co. Ltd, Warrthy, Bhandara, Maharashtra	450
33.Tata Steel Ltd, Jamshedpur, Jharkhand	8000
34.Tata Metaliks Ltd, Kharagpur, West Bengal	528
35.Tata Steel Ltd, Kalingnagar, Odisha	5750
36.Usha Martin Ltd (Usha Alloys and Steel Division), Jamshedpur.	715
37.Uttam Galva, Metallics Ltd, Wardha, Maharashtra	887
38.Vedanata Ltd. Amona, Goa	1000
39.Value Added business, Amona, Goa	1000

Pig Iron

Pig iron is one of the basic raw materials required by Foundry and Casting Industry for manufacturing various types of castings for the engineering section. The post-liberalisation regime has witnessed Expression of Interest from a large number of entrepreneurs for setting up mini-blast furnaces for production of hot metal/pig iron. Commissioned pig iron units are mostly of stand-alone type.

The production of pig iron has increased from 1.6 million tonnes in 1991-92 to 5.86 million tonnes in 2022-23. As per Ministry of Steel Annual Report 2023-24, the production of pig iron in 2021-22 was 6.26 MT, a decline of 6.40% over that of last year. As per Ministry of Steel, Annual Report- 2023-24, the Private Sector accounted for 93% (5.46 MT) and remaining 7% (0.401 MT) by Public Sector of the total production of pig iron (5.86 MT) in the country in 2022-23. As per National Steel Policy 2017, the demand for pig iron for merchant use, such as, for castings and supplementary metallic in the electric arc or induction furnaces is projected to increase to 17 million tonnes by 2030-31.

Sponge iron

India is the world's largest producer of sponge iron or Direct Induced Iron (DRI) with a host of coal-based units located in the mineral-rich States of the country. Over the years, the coal-based route has emerged as a key contributor and accounted for 81% of total sponge iron production in the country in 2022. India has been the world's largest sponge iron producer every year since 2003. The growth of Sponge Iron Industry during the last few years in terms of capacity has been substantial. The installed capacity of sponge iron increased from 1.52 million tonnes per annum in 1990-91 to around 47.85 million tonnes in 2019-2020. Production has increased from 0.9 million tonnes in 1990-91 to 43.621 million tonnes in 2022-23. As per National Steel Policy 2017, the demand for sponge iron is projected to increase to 80 million tonnes by 2030-31. It is projected that the sponge iron capacity may increase to 114 million tonnes by 2030-31 with around 30% share of gas-based capacities on account of increased environmental considerations and long-term availability of gas.

Sponge iron is a good substitute for scrap which is required by the electric arc furnaces and induction furnaces or mini-steel plants in the country. The availability of indigenous metal scrap is scarce, and therefore, to meet the domestic demand, scrap is usually imported. Sponge iron is a viable alternative for scrap and is produced by direct reduction of high-grade iron ore or pellets to metallic iron ore in solid state by using coal or natural gas as reductant. It is also known as Direct Reduced Iron (DRI) or Hot Briquetted Iron (HBI).

Iron & Steel

The details of the Iron & Steel Industry are provided in the Review on "Iron, Steel & Scrap and Slag".

Ferroalloys

Iron is an important constituent of ferro-alloys, like ferromanganese (high carbon, medium carbon and low carbon), ferrosilicon, ferrochrome (high carbon and low carbon)/charge chrome, ferromolybdenum, ferrovanadium, ferrotungsten, ferro-silicon-magnesium, ferroaluminium, ferro-silicon-zirconium, ferrotitanium, etc. Ferroalloys are used in Steel Industries to impart some special qualities in steel making process also. They are consumed in domestic industries and are also exported. The details about the Ferroalloys Industry are provided in the Review on 'Ferroalloys'.

Cement

Iron ore lumps and powder containing +58% Fe are normally used in the Cement Industry as they improve burning properties, impart colour and balance the composition of the mix. Further details about the Cement Industry are provided in the Review on 'Cement'.

USES & CONSUMPTION

Iron ore is mainly used for manufacturing pig iron, sponge iron and steel. It is also used in Cement, Coal Washeries, Ferroalloys, Foundry and Glass Industries. In 2022-23, the apparent consumption of iron ore was about 238.98 million tonnes, as against 234.28 million tonnes in the previous year. The specifications of iron ore consumed by major sponge iron plants & steel iron plants are furnished in (Table-9 and 10).

Table - 9 : Specifications of Iron Ore Consumed by Major Sponge Iron Plants

Sl. No.	Name of the Plant	Specifications				
		Size	Fe	$Al_2O_3 + SiO_2$	P	S
1	Orissa Sponge Iron Plant	5– 18 mm	65% min.	4.5% max.	0.03% max.	N. A.
2	Welspun Max Steel Ltd	9– 16 mm	66%	2.6% max.	0.05%	0.01%
3	Sunflag Iron & Steel Ltd	5– 20 mm	67.50%	–	–	–
4	NMDC Ltd (Sponge iron unit)	6– 20 mm	55–58% &	–	–	–
					64–66%	
5	Essar Steel Ltd	10– 40 mm	67%	2.60% max.	0.05%	0.01%
6	Jindal Steel & Power Ltd	10– 30 mm	65% min.	3% max. (SiO_2)	0.05%	–
7	Tata Sponge Iron Ltd	5– 18 mm	65% min.	5% max.	–	–
8	Steel Exchange India Ltd	10– 40 mm	62%	–	–	–
9	Sarda Energy & Minerals Ltd	5– 18 mm	65–66%	–	–	–
10	OCL Iron & Steel Ltd	Sized	62% min.	–	–	–
11	Nalwa Steel & Power Ltd	5– 20 mm	63% min.	–	–	–
12	Shri Bajrang Power & Ispat Ltd	5– 18 mm	64% min.	–	–	–
13	Jai Balaji Industries Ltd	5– 18 mm	65%	5%	0.05%	0.03%
		10– 30 mm	–	–	–	–
		10-150 mm	–	–	–	–

Table – 10 : Specifications of Iron ore

(By Steel Plants)

Steel plant	Specifications
Bokaro Steel Plant, Bokaro, Jharkhand	Lumps: Fe-63.40%, SiO_2:2.25%, Al_2O_3 2.39%, Size: 10-40 mm Fines: Fe - 62.24%, SiO_2 - 3.36%,
Durgapur Steel Plant, Durgapur, West Bengal	Lumps : Fe - 62.48%, Size: 10-50 mm Fines: Fe - 62.8%, SiO_2 - 2.28%, Size : -10 mm
IISCO Steel Plant, Burnpur, West Bengal	Lumps: Fe - 62.86%, Al_2O_3 - 2.56% (max.),
Bhilai Steel Plant, Chhattisgarh	-
Rourkela Steel Plant SAIL, Rourkela,Odisha	-

Table- 10 (Concld.)

Steel plant	Specifications
JSW Steel Ltd Dolvi Works Raigad, Maharashtra.	-
JSW Steel Ltd Tornagallu, Sandur, Ballari Karnataka	-
JSW Steel Ltd Salem works, Mkalipatti, Metturdam, Tamil Nadu	-
Tata Steel Limited, Jamshedpur	-
RINL Vishakhapatnam Steel Plant, Andhra Pradesh	Lumps : Fe 65.5 % min. SiO_2 2.25 % max., Al_2O_3 2.25 % max. Fines : Fe 64.5 % min. SiO_2 3.00 % max. Al_2O_3 3.00 % max.

TRADE POLICY

To ensure easy availability of raw material in domestic market at reasonable prices, export duty on iron ore is @ 30% for both lumps and fines varieties of 58% Fe content and above. The export duty is @ 0% for both lumps and fines varieties of iron ore less than 58% Fe content. The export duty on iron ore pellets is NIL. Export duty on iron ore originated from NMDC is @ 10% when exported by MMTC Ltd under LTA to Japan and South Korea.

As per the Foreign Trade Policy (FTP) for 2015-20 and the amended Export and Import Policy incorporated in the FTP, the present export policy for iron ore as construed is furnished below in brief. As per the policy, imports of iron ore lumps, fines, concentrates and agglomerated pellets are freely allowed.

HSCode	Item	ExportPolicy
2601	Iron ore and concentrates, including roasted iron pyrites	Free
260111	Iron ore and concentrates, other than roasted iron pyrites: Non-agglomerated	Free
26011111	60% Fe or more but below 62% Fe	Free
26011112	62% Fe or more but below 65% Fe	Free
26011119	65% Fe and above	Free
26011121	Iron ore lumps (below 60% Fe, including black iron ore containing up to 10%Mn) – Iron Ore lumps below 55% Fe	Free
26011122	Iron ore lumps (below 60% Fe, including black iron ore containing up to 10% Mn)–Iron Ore lumps 55% Fe or more but below 58% Fe	Free
26011129	Iron ore lumps (below 60% Fe, including black iron ore containing upto 10% Mn)–Iron Ore lumps 58% Fe or more but below 60% Fe	Free
26011131	Iron ore fines (62%Fe or more)–62%Fe or more but below 65% Fe	Free
26011139	Iron ore fines (below 62% Fe or more)–65% Fe and above	Free
26011141	Iron ore fines (below 62% Fe)–below 55% Fe	Free
26011142	Iron ore fines (below 62% Fe)–55% Fe or more but below 58% Fe	Free
26011143	Iron ore fines (below 62% Fe)–58% Fe or more but below 60% Fe	Free
26011149	Iron ore fines (below 62% Fe)–60% Fe or more but below 62% Fe	Free

HSCode	Item	ExportPolicy
26011150	Iron ore concentrates	Free
26011190	Others	
260112	Iron ore and concentrates other than roasted iron pyrites: Agglomerated	Free
26011210	Ironorepellets	Free
26011290	Other	Free
26012000	Roasted iron pyrites	Free

Source: ITC (HS), 2018, Schedule 2 Export Policy; STE: State Trading Enterprise

WORLD REVIEW

The world reserves of crude iron ore are estimated to be around 190 billion tonnes. In terms of iron content, the iron ore reserves are estimated to be around 87 billion tonnes. The world reserves of crude iron ore and iron content by principal countries are furnished in Table - 11.

Table – 11 : World Reserves of Iron Ore

(By Principal Countries)

(In million tonnes)

Country	Reserves	
	Crude ore	Iron content
World : Total (rounded off)	**190,000**	**87,000**
Australia [(a)]	58000	27000
Brazil	34000	15000
Canada	6000	2300
Chile	NA	NA
China	20000	6900
India*	5500	3400
Iran	3300	1500
Kazakhstan	2500	900
Mauritania	NA	NA
Mexico	NA	NA
Peru	2600	1200
Russia	29000	14000
South Africa	990	620
Sweden	1300	600
Turkey	152	99
Ukraine[(b)]	6500	2300
USA	3,100	1,300
Other countries	18000	9500

Source: USGS, Mineral Commodity Summaries, 2024.
(a): For Australia Joint Ore Reserves Committee compliant reserves were about 23 billion tonnes for crude ore and 11 billion tonnes for iron content.
(b): For Ukraine, reserves consist of the A and B categories of the Soviet reserves classification system.
** As per UNFC system as on 1.4.2020, India's reserves/resources of Iron ore (Haematite) and Iron ore (Magnetite) were estimated at 24,057 million tonnes and 11,227 million tonnes respectively.*
NA - Not available.

In 2022, the world production of iron ore was 2,516 million tonnes as against 2,574 million tonnes in the previous year. Australia 944 million tonnes (38%), Brazil 403 million tonnes (16%), China 260 million tonnes (10%), India 252 million tonnes (10%), Iran 105 million tonnes (4%), Russia 101 million tonnes (4%), Kazakhstan 66 million tonnes (3%), Canada 65 million tonnes (3%) and South Africa 64 million tonnes (3%) were the principal producers. These nine countries accounted for about 90% of the world production of iron ore and remaining 10% was contributed by the other countries. The world production of iron ore is provided in Table-12.

Table – 12 : World Production of Iron Ore

(By Principal Countries)

(In '000 tonnes)

Country	2020	2021	2022
World : Total (rounded off)	**2455000000**	**2574000000**	**2516000000**
Australia	918063223	922158512	944052390
China	270500000	266000000	260000000
Brazil	388639076	423185073	403024748
India [(h)]	204481000	253973000	252317000
Russia	100200000	100600000	100600000
Iran [(i)]	104818915	105000000	105000000
Ukraine	78837700	83888800	40000000
Kazakhstan	62865000	64089700	66000000
Canada [(f)]	60059572	57491803	64666561
South Africa [(e)]	55635421	73090918	63711254
Other countries	210900093	224522194	216628047

Source: BGS World Mineral Production, 2018-2022
Note : World Total may not tally as data has been rounded off
(h) Years ended 31st March following that stated
(i) Years ended 20nd March following that stated
(f) Including by-product iron ore
(e) Including by-product magnetite; (e) estimated
** India's production of iron ore in 2020-21, 2021-22 and 2022-23 was 205.04 million tonnes, 254.09 million tonnes and 257.85 million tonnes, respectively.*

FOREIGN TRADE

Exports

Exports of iron ore decreased by 20 % to 21.16 million tonnes in 2022-23 from 26.49 million tonnes in the previous year. Exports were mainly to China (86%) and Indonesia (3%). The total exports of iron ore in 2022-23, in terms of quantity comprised iron ore fines 14.45 million tones (68%), iron ore pellets 6.43 million tonnes (30%), iron ore lumps 0.18 million tonnes (1%) and negligible quantity of iron ore non-agglomerated concentrate and iron ore pyrites (Tables- 13 to 18).

Table – 13 : Exports of Iron Ore : Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**26494**	**241480427**	**21168**	**144299670**
China	21861	184557519	18286	113191493
Indonesia	912	10908862	662	5927616
Turkey	++	2857	316	4812713
Germany	156	2429644	159	2695903
Malaysia	365	4188281	337	2537472
Croatia	160	2352901	158	2221951
Finland	--	--	108	1829500
Italy	332	4792480	131	1775512
Brazil	212	3044805	119	1627941
Netherlands	236	3391731	112	1547345
Other Countries	2260	25811347	780	6132224

Figures rounded off

Table – 14: Exports of Iron Ore : Lumps

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**433**	**1876849**	**183**	**696000**
China	415	1779342	130	637341
Qatar	--	--	52	55025
Tanzania	++	1912	++	2047
UAE	--	--	1	1476
Nepal	++	224	++	90
Germany	++	3599	++	19
Brazil	--	--	++	2
Singapore	18	88567	--	--
Congo D. Rep.	++	2850	--	--
Australia	++	355	--	--

Figures rounded off

Table – 15: Exports of Iron Ore: Fines

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**14570**	**83677314**	**14457**	**71125032**
China	13846	81327260	13767	68584846
Indonesia	53	197685	177	876643
Malaysia	81	466654	194	787012
Qatar	78	558398	109	685489
Nepal	294	260198	149	110737
Kenya	48	104826	48	55068
UAE	50	174887	13	25033
Saudi Arabia	--	--	++	106
Norway	--	--	++	56
Germany	++	5	++	18
Other Countries	120	587401	++	24

Figures rounded off

Table – 16 : Exports of Iron Ore: Pyrites

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**30702**	**++**	**32492**
Netherlands	++	4615	++	5982
UAE	++	1817	++	4365
Thailand	++	2627	++	3551
Saudi Arabia	++	2855	++	3135
Philippines	++	2439	++	1999
Bangladesh	++	3187	++	1952
Australia	--	--	++	1766
Myanmar	++	2475	++	1689
Korea Rep. of	++	2659	++	1402
Malaysia	++	626	++	1022
Other Countries	++	7402	++	5629

Figures rounded off

Table – 17: Exports of Iron Ore: Concentrates Non-agglomerated

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**100**	**669724**	**102**	**913160**
Vietnam	--	--	102	913113
China	50	356302	++	32
Germany	++	86	++	5
UK	--	--	++	5
Austria	--	--	++	3
USA	--	--	++	2
Bhutan	++	3	++	++
Indonesia	47	310748	--	--
Nepal	3	2522	--	--
Other Countries	++	63	--	--

Figures rounded off

Table – 18 : Exports of Iron Ore: Pellets

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**11391**	**155225838**	**6426**	**71532986**
China	7550	101094123	4389	43969274
Indonesia	812	10399695	485	5050973
Turkey	--	--	316	4811866
Germany	156	2425954	159	2695861
Croatia	160	2352901	158	2221951
Finland	--	--	108	1829500
Italy	332	4792480	131	1775512
Malaysia	284	3721001	143	1749438
Brazil	212	3044805	119	1627939
Netherlands	236	3387116	112	1541363
Other Countries	1649	24007763	306	4259309

Figures rounded off

Imports

Imports of iron ore decreased substantially to 1.79 million tonnes in 2022-23 from 6.68 million tonnes in the previous year. Imports of iron ore were from Brazil (39%), Canada (27%), Australia (21%), USA (8%), South Africa (4%) and negligible amount from other countries. The total imports in 2022-23 comprised non-agglomerated concentrates (74%), iron ore fines (19%), and iron ore lumps (7%) (Tables-19 to 24).

Table – 19: Imports of Iron Ore: Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6683**	**35 389345**	**1790**	**15947473**
Brazil	3156	16798568	696	6366826
Canada	++	140	483	5108079
USA	++	1821	137	2102779
Australia	2382	7932560	367	1262142
South Africa	928	8854187	63	606072
Uruguay	--	--	38	332386
Turkey	2	21446	4	79605

Table- 19 (Concld.)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Croatia	1	12082	2	39105
Sweden	++	6080	++	27147
Russia	1	8143	++	7954
Other Countries	213	1754318	++	15378

Figures rounded off

Table – 20: Imports of Iron Ore: Concentrates Non-agglomerated

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	1446	9469224	1316	13603285
Brazil	1264	7914628	696	6366720
Canada	++	140	483	5108079
USA	++	1100	137	2102145
Sweden	++	5868	++	26034
Singapore	--	--	++	262
Guinea	--	--	++	34
Dominic Rep	--	--	++	8
Mauritania	--	--	++	3
Ukraine	152	1283813	--	--
South Africa	30	263094	--	--
Other Countries	++	581	--	--

Figures rounded off

Table – 21: Imports of Iron Ore: Pellets

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	170	874034	--	--
Brazil	170	874034	--	--

Figures rounded off

Table – 22 : Imports of Iron Ore : Pyrites

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	65	512049	6	138772
Turkey	2	21446	4	79605
Croatia	1	12082	2	39105
Russia	1	8143	++	7954
Italy	++	3704	++	7397
China	++	6565	++	3970
USA	++	698	++	634
Brazil	--	--	++	106
UK	--	--	++	1
Finland	61	459404	--	--
Oman	++	7	--	--

Figures rounded off

Table – 23: Imports of Iron Ore Lumps

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	927	8903226	131	1262348
South Africa	898	8591093	63	606072
Uruguay	--	--	38	332386
Australia	29	311671	30	319074
France	--	--	++	3463
Sweden	++	212	++	1113
Germany	++	36	++	230
Congo D. Rep.	--	--	++	10
Senegal	++	185	--	--
UAE	++	29	--	--

Figures rounded off

Table – 24: Imports of Iron Ore: Fines

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	4075	15630812	337	943068
Australia	2353	7620883	337	943068
Brazil	1722	8009906	--	--
USA	++	23	--	--

Figures rounded off

FUTURE OUTLOOK

India is one of the leading producers of iron ore in the world. Among the consuming industries, Cement Industry is the second major consumer of iron ore after Iron & Steel Industry (including Sponge Iron Industry).

The Ministry of Steel under Government of India has introduced the new National Steel Policy, 2017 and with the roll-out of the National Steel Policy, 2017 and the DMI & SP policy, it is envisaged that the industry can be steered with appropriate policy support in creating an environment for promoting domestic steel and thereby ensuring a scenario where production meets the anticipated pace of growth in consumption. Thus, the Indian Steel Sector is all set to achieve its vision thereby setting a global benchmark in terms of quality, standards and technology. It is anticipated that crude steel capacity of 300 million tonnes will be required by 2030-31 and to fulfill this capacity, about 437 million tonnes of iron ore is required. However, achieving crude steel capacity up to 300 million tonnes will require extensive mobilisation of natural resources, finances, manpower and infrastructure including land. To address the concerns regarding availability of raw material (iron ore), intensive & deeper exploration would have to be promoted for augmentation of resource base. Eco-friendly viable underground mining techniques for optimal utilisation of magnetite ore deposits locked in Western Ghats would also have to be explored in collaboration with mining research institutes. The Government has already promulgated the Mines and Minerals (Development and Regulation) Amendment Act, 2015 and therein has laid great emphasis on time-bound mine development with increased stress on mineral exploration and sustainable mining operations which may support ore output growth.

The Act has brought clarity on mine allocation process (through auction) and procedures for mining lease renewal. The Act, further, provides for reservation of any particular mine for a particular end use and put conditions permitting auction among such eligible end users.

44. Kyanite, Sillimanite and Andalusite

Kyanite, sillimanite and andalusite are unhydrous aluminosilicate minerals that have the same chemical formula Al_2O_3 but differ in crystal structure and physical properties. When calcined at high temperature around 1,350 ^{0}C to 1,380 0C for kyanite and slightly higher for andalusite and sillimanite, these minerals are converted to mullite, ($3Al_2O_3.2SiO_2$) and silica (SiO_2) which are refractory minerals.

Synthetic mullite is made by heating mixtures of alumina and silica or bauxite and kaolin at around 1,550 0C to 2,000 0C. Refractories are heat resistant materials used in high temperature applications, such as, furnaces, ladles, kilns, in the metallurgical, glass, chemical, cement and other industries.

The aluminosilicates andalusite, kyanite and sillimanite are metamorphic minerals, which are formed in aluminium-rich rocks by orogenic or contact metamorphism. Andalusite is generally preferred to kyanite, because it can be used without calcination, thus saving energy. Most of the world production of andalusite in 2021 originated from France and South Africa.

RESERVES/RESOURCES

Kyanite

The total reserves/resources of kyanite as per NMI database, based on UNFC system as on 1.4.2020 in the country has been placed at 105.68 million tonnes. Out of these resources, only 0.84 million tonnes are Reserves and 104.83 million tonnes are under Remaining Resources. Out of total resources, high and medium-grade resources together account for merely 1.44%, low-grade 8.17%, mixed-grade 0.52%, quartz kyanite rock, kyanite gneiss rock & kyanite schist 88.21% and granular, others & not-known grades 1.63%. Statewise, share of Telangana is 45.75% of the total resources followed by Andhra Pradesh (30.28%), Karnataka (12.46%) and Jharkhand (7.83%). The remaining 3.69% resources are in Kerala, Maharashtra, Rajasthan, Tamil Nadu and West Bengal collectively (Table-1).

Table – 1 : Reserves/Resources of Kyanite as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Total Reserves (A)	Total Remaining Resources (B)	Total Resources (A+B)
All India : Total	846865	**104835455**	**105682321**
By Grades			
High grade	-	438700	438700
Medium grade	368562	716745	1085307
Low grade	67554	8577045	8644599
High & medium mixed	-	141390	141390
Medium & low mixed	-	48000	48000
High, medium & low mixed	-	368378	368378
Granular	1620	247829	249449
Quartz kyanite rock	330202	82550736	82880938
Kyanite gneiss rock	-	5370800	5370800
Kyanite schist	-	4974625	4974625
Unclassified	63	-	63
Others	78865	990854	1069719
Not-known	-	410353	410353
By States			
Andhra Pradesh	-	32004228	32004228
Jharkhand	331193	7943367	8274560
Karnataka	181600	12991460	13173060
Kerala	-	184733	184733
Maharashtra	332389	3063615	3396004
Rajasthan	-	23703	23703
Tamil Nadu	1683	247829	249512
Telangana	-	48350000	48350000
West Bengal	-	26520	26520

figures rounded off

Sillimanite

The total reserves/resources of sillimanite as per NMI database, based on UNFC system in the country as on 1.4.2020 has been placed at 72.26 million tonnes. Out of these resources, 8.26 million tonnes are under Reserves Category, while about 64.00 million tonnes are under the Remaining Resources. Out of total resources, 73.89% are granular high-grade, while quartz sillimanite rocks and sillimanite-bearing rocks are about 21.03%. Resources of massive sillimanite of all grades are about 4.80%. The resources are located mainly in Odisha (24.49%), Tamil Nadu (24.01%), Uttar Pradesh (15.84%), Andhra Pradesh (15.31%), Kerala (9.57%) and Assam (6.37%). The remaining 4.38% resources are in Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Rajasthan and West Bengal (Table-2).

Table – 2 : Reserves/Resources of Sillimanite as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Total Reserves (A)	Total Remaining Resources (B)	Total Resources (A+B)
All India : Total	**8262300**	**64005091**	**72267391**
By Grades			
Massive high grade	163557	11903	175460
Massive medium grade	62703	33705	96408
Massive low grade	38000	3139605	3177605
Massive high & medium	-	19800	19800

Table- 2 (Concld.)

(In tonnes)

Grade/State	Total Reserves (A)	Total Remaining Resources (B)	Total Resources (A+B)
Massive high medium & low	-	38	38
Granular high	7994582	45404791	53399373
Quartz sillimanite rock	-	3748000	3748000
Sillimanite-bearing rock	-	11450000	11450000
Others	-	11070	11070
Unclassified	3458	84000	87458
Not-known	-	102180	102180
By States			
Andhra Pradesh	1670025	9395739	11065764
Assam	-	4604700	4604700
Jharkhand	-	83000	83000
Karnataka	-	982725	982725
Kerala	553000	6366167	6919167
Madhya Pradesh	-	101600	101600
Maharashtra	181748	30580	212328
Meghalaya	82512	55807	138319
Odisha	5640985	12062208	17703193
Rajasthan	-	819	819
Tamil Nadu	134030	17218747	17352777
Uttar Pradesh	-	11450000	11450000
West Bengal	-	1653000	1653000

Figures rounded off

Andalusite

The total reserves/resources of andalusite in the country as on 1.4.2020 as per NMI database, based on UNFC system has been placed at 126.05 million tonnes. Most of the resources are of Reconnaissance category located in Uttar Pradesh (Table-3).

Table – 3 : Reserves/Resources of Andalusite as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Total Reserves (A)	Total Remaining Resources (B)	Total Resources (A+B)
All India : Total	**-**	**126050**	**126050**
By Grades			
Low	-	126050	126050
By States			
Jharkhand	-	11800	11800
Uttar Pradesh	-	114250	114250

Figures rounded off

MINING LEASES AND PRODUCTION

Kyanite

The production of kyanite at 2,765 tonnes in 2022-23, decreased by 70.33% as compared to the previous year 2021-22. There were 5 reporting mines in 2022-23 as well as in the previous year. Three producers contributed the entire production of kyanite during 2022-23. The total production 2,765 tonnes of kyanite was of grade below 40% Al_2O_3 in the year 2022-23. About 87% of the total production was reported by the public sector (Table-4 to 6). Mine-head closing stock of kyanite for 2022-23 was 12,214 tonnes as against 13,745 tonnes in 2021-22 (Table-7). The average daily employment of labour was 99 in 2022-23 as against 95 in the previous year.

As per Mineral Wise Summary of Mining Lease Distribution (Other than Atomic, Hydro Carbons Energy & Minor Minerals) as on 31/03/2023(P), kyanite has 14 no. of mining leases with 223.81 hectare lease area.

Table – 4 : Principal Producers of Kyanite, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
JSMDC Ltd Khanij Bikash Nigam, Nepal House Area Doranda,Ranchi-834002, Jharkhand	Jharkhand	East Singhbhum
Mohammad Akram Rasheed 3 Marcha Halli, H.D. Kote Mysore-571125, Karnataka	Karnataka	Mysore
Maharashtra State Mining Corporation Ltd, Plot No. 7, Ajani Chowk, Wardha Road, Nagpur- 440 015, Maharashtra.	Maharashtra	Bhandara

Table-5: Production of Kyanite, 2020-21 to 2022-23

(By States)

(Qty. in tonnes; Value in ₹ '000)

States	2020-21		2021-22		2022-23(P)	
	Qty	Value	Qty	Value	Qty	Value
India	**4925**	**9251**	**9320**	**17267**	**2765**	**5319**
Jharkhand	-	-	2785	5152	2071	3832
Karnataka	3780	7397	5075	9084	360	644
Maharashtra	1145	1854	1460	3031	334	843

(p) : Provisional

In tonnes

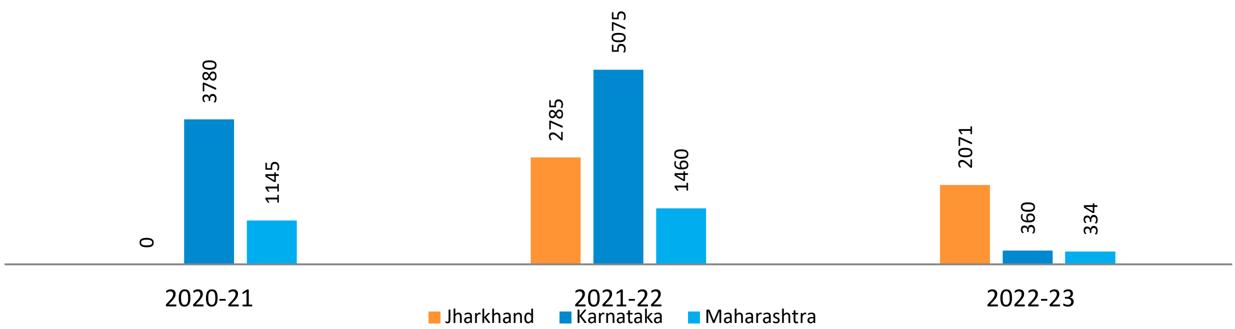


Fig 1: Production of Kyanite in India

Table-6: Production of Kyanite, 2021-22 and 2022-23

(By Sectors/States/Districts/Grades)

(Quantity in tonnes; Value in ₹ '000)

State/District	2021-22					2022-23 (P)				
	Quantity					Quantity				
	No. of mines	40% Al_2O_3 & above	Below 40% Al_2O_3	Total	Value	No. of mines	40% Al_2O_3 & above	Below 40% Al_2O_3	Total	Value
India	**5**	**-**	**9320**	**9320**	**17267**	**5**	**-**	**2765**	**2765**	**5319**
Public Sector	2	-	4245	4245	8183	2	-	2405	2405	4675
Private Sector	3	-	5075	5075	9084	3	-	360	360	644
Jharkhand	**1**	**-**	**2785**	**2785**	**5152**	**1**	**-**	**2071**	**2071**	**3832**
Singhbhum East	1	-	2785	2785	5152	1	-	2071	2071	3832
Karnataka	**1**	**-**	**5075**	**5075**	**9084**	**1**	**-**	**360**	**360**	**644**
Mysore	1	-	5075	5075	9084	1	-	360	360	644
Maharashtra	**3**	**-**	**1460**	**1460**	**3031**	**3**	**-**	**334**	**334**	**843**
Bhandara	3	-	1460	1460	3031	3	-	334	334	843

(p): Provisional

Table-7: Mine-head closing stocks of Kyanite, 2021-22 and 2022-23

(By States/Grades)

(Qty in tonnes)

State	2021-22			2022-23(p)		
	40% Al_2O_3 & above	Below 40% Al_2O_3	Total	40% Al_2O_3 & above	Below 40% Al_2O_3	Total
India	**321**	**13424**	**13745**	**321**	**11893**	**12214**
Jharkhand	-	790	790		1541	1541
Karnataka	-	11789	11789		9649	9649
Maharashtra	321	845	1166	321	703	1024

(p): Provisional

Sillimanite

The production of sillimanite is 1,437 tonnes in 2022-23 decreased by 58.12% as compared to the previous year 2021-22. Two mines reported production of sillimanite as an associated mineral with kyanite during the year 2022-23. The whole production of Sillimanite was reported by private sector during the year 2022-23. Maharashtra is the only state which contributed to total production of Sillimanite during the year 2022-23 (Table-8 to 10). Mine-head closing stock for the year 2022-23 was 3,898 tonnes as against 2,906 tonnes in the previous year (Table-11)

As per Mineral Wise Summary of Mining Lease Distribution (Other than Atomic, Hydro Carbons Energy & Minor Minerals) as on 31/03/2023(P), Sillimanite has 2 no. of mining leases with 33.34 hectare lease area.

Table – 8 : Principal Producers of Sillimanite, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
*Pavri Kyanite Mine, A-1, Indra Sagar, Ravindranath Tagore Marg, Civil Line, Nagpur-440001, Maharashtra.	Maharashtra	Bhandara
*Dighori Kyanite Mine, Apna Nagar, Tkiya Ward, Nagpur Road Bhandara, Bhandara-441904, Maharashtra.	Maharashtra	Bhandara

** Producing as an associated mineral with kyanite*

Table-9: Production of Sillimanite, 2020-21 to 2022-23

(By States)

(Qty. in tonnes; Value in ₹ '000)

States	2020-21		2021-22		2022-23(p)	
	Qty	Value	Qty	Value	Qty	Value
India	**11110**	**13987**	**3432**	**8283**	**1437**	**4249**
Andhra Pradesh	-	-	-	-	-	-
Kerala	-	-	-	-	-	-
Maharashtra	11110	13987	3432	8283	1437	4249
Meghalaya	-	-	-	-	-	-
Odisha	-	-	-	-	-	-

(p): Provisional

In tonnes

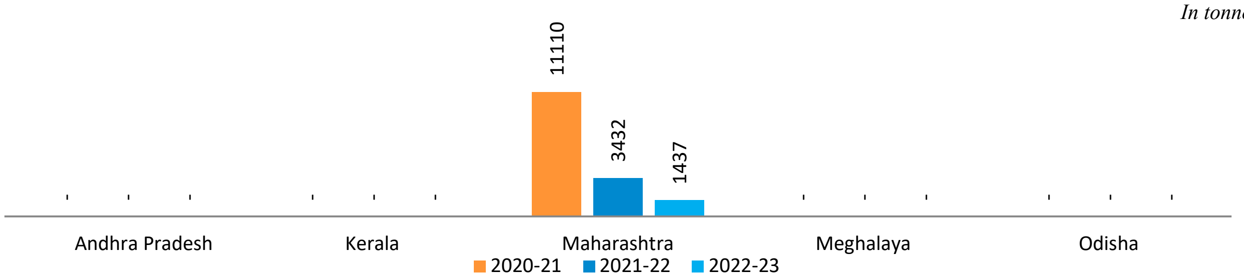


Fig 2: Production of Sillimanite in India

Table-10: Production of Sillimanite 2021-22 and 2022-23

By Sectors/States/Districts)

(Qty. in tonnes; Value in ₹ '000)

State	No. of Mines	2021-22 Production		No. of Mines	2022-23 (P)	
		Qty	Value		Production	Value
India	**(2)**	**3432**	**8283**	**(2)**	**1437**	**4249**
Public Sector	-	-	-	-	-	-
Private Sector	(2)	3432	8283	(2)	1437	4249
Andhra Pradesh		**-**	**-**	**-**	**-**	**-**
Srikakulam	-	-	-	-	-	-
Kerala	**-**	**-**	**-**	**-**	**-**	**-**
Kollam	-	-	-	-	-	-
Maharashtra	**(2)**	**3432**	**8283**	**(2)**	**1437**	**4249**
Bhandara	(2)	3432	8283	(2)	1437	4249
Meghalaya	**-**	**-**	**-**	**-**	**-**	**-**
Khasi Hills West	-	-	-	-	-	-
Odisha	**-**	**-**	**-**	**-**	**-**	**-**
Ganjam	-	-	-	-	-	-

(p): Provisional
( ): Figures in parenthesis indicates the number of associate mines with Kyanite.
(#): The data of 2021-22 has been taken from the monthly returns which is provisional published in last year IMYB due to MCP database has been crashed and no annual data is available at present.

Table – 11: Mine-head Closing Stocks of Sillimanite, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22	2022-23(P)
India	**2906**	**3898**
Andhra Pradesh	-	-
Kerala	-	-
Meghalaya	188	188
Maharashtra	2718	3710
Odisha	-	-

(p): Provisional

Andalusite

There was no production of andalusite reported since 1988.

USES & CONSUMPTION

Kyanite, sillimanite and andalusite are mainly used in refractories and ceramic products because of their ability to form mullite phase at high temperature. Mullite is an essential component of high-alumina refractories forming the inner lining of furnaces and high temperature vessels widely used in the production of metals, ceramics, glass and cement. These are used in manufacturing refractory products like dense bricks, insulating bricks, monolithic & castables. Sillimanite refractory bricks are extensively used in steel and glass industries and also in ceramics, cement kilns, heat treatment furnaces and petrochemical industries.

The apparent availability of kyanite during 2022-23 is 3,822 tonnes.

WORLD REVIEW

World reserve of kyanite and related minerals is largely in the USA. Andalusite is limited to only a few countries. The main producer and exporter of andalusite is South Africa and France while USA and India are the main producers of kyanite. India is the leading producer of sillimanite. World production of kyanite and related minerals is indicated in Table-12.

The availability of inexpensive refractory-grade bauxite from China served to increase demand for refractories from alternative raw material, such as, andalusite. Demand for refractories in iron and steel production is expected to have larger increases in countries with higher growth rates in steel production. Increased demand also is anticipated for refractories used for producing other metals and in the industrial mineral market because of increasing production of cement, ceramics, glass, and other mineral products.

Table – 12 : World Production of Minerals (Kyanite, Sillimanite & Andalusite)

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
France			
Andalusite [(a)]	*65000	*65000	*65000
South Africa			
Andalusite	*180000	*170000	*160000
USA			
Kyanite [(b)]	67100	*186000	*100000
India			
Kyanite [(c)]	4925	9432	5507
Sillimanite[(c)]	11110	3432	1828
Nepal			
Kyanite [(d)]	0	–	–

Source: BGS World Mineral Production, 2018-2024, BGS.
(a) May Include other sillimanite minerals.
(b) Including related minerals.
(c) Years ended 31st March following that stated.
(d) Years ending 15th July of the stated.
**India's production during 2020-21, 2021-22 and 2022-23 in respect of kyanite is 4,925 tonnes, 9,320 tonnes & 2,765 tonnes respectively and in respect of sillimanite is 11,110 tonnes, 3,432 tonnes & 1,437 tonnes respectively.*

FOREIGN TRADE

Exports

Exports of kyanite during 2022-23 at 297 tonnes decreased drastically by 82% from 1,655 tonnes in the previous year. Exports were mainly to Turkey (38%), Greece (24%) and France (18%). Similarly, exports of sillimanite decreased by 31% to 2,161 tonnes in 2022-23 from 3,120 tonnes in the previous year. Sillimanite was exported mainly to China (73%), Japan (18%) and Nepal (5%), Kenya (2%), Thailand & Uganda (1% each). Exports of andalusite during 2022-23 increased by 6% to 19 tonnes from 18 tonnes in the previous year. Andalusite was exported solely to UAE (Tables - 13 to 15).

Table – 13: Exports of Kyanite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1655**	**15376**	**297**	**8631**
Turkey	46	1234	112	3123
France	--	--	52	2103
Greece	48	933	71	1859
UK	--	--	20	671
UAE	1353	11164	12	450
China	--	--	25	358
Oman	--	--	2	39
Tanzania	--	--	2	14
Nigeria	52	195	1	8
Sudan	2	131	++	4
Other Countries	154	1719	++	2

Figures rounded off

(In tonnes)

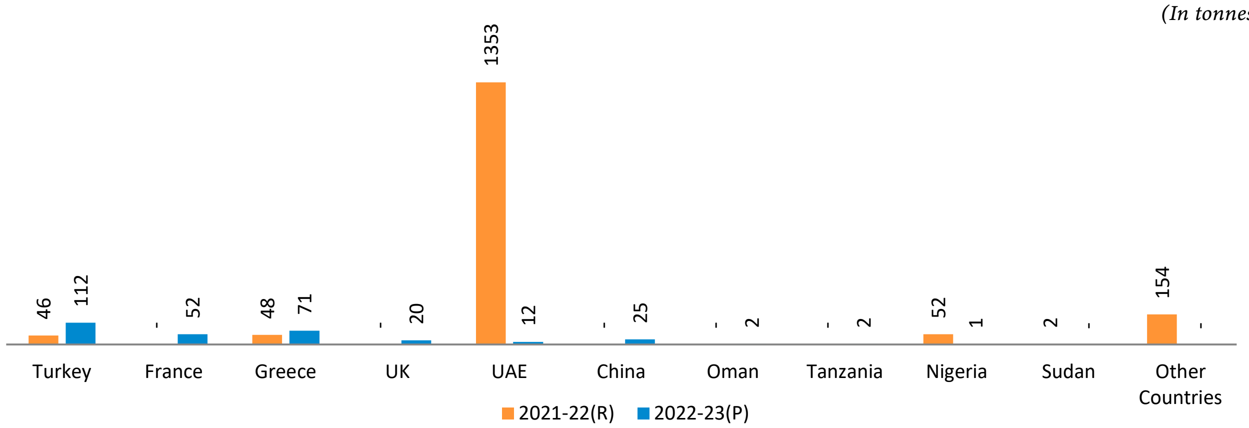


Fig 3: Countrywise Exports of Kyanite

Table – 14: Exports of Sillimanite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3120**	**64355**	**2161**	**73954**
China	2576	50244	1568	56393
Japan	314	10405	394	13509
Nepal	116	1234	109	1422
Kenya	--	--	39	1131
Thailand	25	525	25	765
Uganda	--	--	22	592
UAE	--	--	4	128
Baharain	--	--	++	6
Nigeria	--	--	++	6
Canada	++	15	++	1
Other Countries	89	1932	++	1

Figures rounded off

Table- 15: Export of Andalusite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**18**	**1233**	**19**	**1515**
UAE	18	1233	19	1515

Figures rounded off

Imports

In 2022-23, imports of kyanite were at 1,354 tonnes as against 1,668 tonnes in the previous year registering a decrease of 19%. The imports of kyanite were from USA (94%) and China (6%). Imports of sillimanite were at 58 tonnes which decreased by 93% during 2022-23 as compared to 801 tonnes in the previous year. Somalia (86%), USA & Poland (7% each) were the main suppliers of sillimanite. Imports of andalusite at 14,168 tonnes increased by 36% during 2022-23 from 10,419 tonnes in previous year. South Africa (86%), France (12%), USA & Peru (1% each) were the main suppliers of andalusite (Tables - 16 to 18).

Table – 16: Imports of Kyanite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1668**	**53418**	**1354**	**63110**
USA	1298	49554	1276	61455
China	370	3864	78	1655

Figures rounded off

Table – 17 : Imports of Sillimanite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**801**	**13972**	**58**	**3424**
USA	41	946	4	1849
Somalia	--	--	50	451
Poland	3	204	4	343
Japan	--	--	++	255
Germany	++	58	++	229
Algeria	--	--	++	189
Belgium	++	2	++	44
Thailand	--	--	++	31
China	3	265	++	25
France	--	--	++	6
Other Countries	754	12497	++	2

Figures rounded off

Table – 18 : Imports of Andalusite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**10419**	**344730**	**14168**	**599795**
South Africa	8191	252706	12192	497613
France	1992	81675	1749	91716
USA	160	6001	140	6150
Peru	--	--	82	3895
UAE	--	--	5	421
Spain	48	3657	--	--
Ukraine	28	681	--	--
China	++	10	--	--

Figures rounded off

FUTURE OUTLOOK

The demand for high quality raw and calcined sillimanite minerals is closely linked to the need for high performance refractories with increased operational lifespans. As the predominant consumer of refractory products, the Steel Manufacturing Industry provides a reliable market indicator of the demand for sillimanite minerals.

The Asia-Pacific region remains the largest market for refractories. The production of sillimanite is likely to increase in the coming years to meet the demand. China will remain the leading market on global front. Demand for refractory minerals in India is likely to scale up in commensurate with steel production which is also likely to show an increasing trend.

45. Limestone

Limestone is a calcareous sedimentary rock primarily composed of the mineral calcite ($CaCO_3$). The majority of cave systems are through limestone bedrock, which makes up around 10% of sedimentary rocks. Dolomite and calcite are the two main components of limestone. Magnesite ($MgCO_3$) combined with calcite or dolomite ($CaMg(CO_3)_2$) are two common forms of magnesium carbonate found in limestone.

Dolomitic' or'magnesian' limestone is the name given to such rocks. Stones transformed by dynamic or contact metamorphism become crystalline and are called "crystalline limestone" and "marble." Other common forms of limestone include travertine, onyx, hydraulic limestone, lithographic limestone, "marl", "oolite" (oolitic limestone), shelly limestone, algal limestone, coral limestone, pisolitic limestone, and so forth. Nonetheless, the limestone that is utilized in large quantities by enterprises is sedimentary limestone of the bedded variety.

The thick calcareous shells of molluscs that are deposited as beds and found in shallow oceans and ancient lakes are another type of calcareous material utilized in industry. This material is known as "limeshell." The quantity of silt and clay in "marl", a mud rich in lime, varies.

"Flagstone" is the name given to a limestone rock that splits well along the strata into a slab that is only a few centimeters thick. Dimensional limestone is utilized in both architectural and decorative stone applications.

RESERVES/RESOURCES

As on 1.4.2020, the total reserves/resources of limestone of all grades and categories according to the NMI database based on the UNFC system have been estimated at 2,27,589 million tonnes, of which 2,08,560 million tonnes (92%) are classified as remaining resources and 19,028 million tonnes (8%) as reserves.

With 24% of the total resources, Karnataka leads all other states, including Andhra Pradesh (13%), Rajasthan (12%), Gujarat (10%), Meghalaya (10%), Telangana (7%), Chhattisgarh (5%) and Madhya Pradesh (4%). Other states shared the remaining 15 per cent. Regarding grades, Portland's Cement grade has the largest proportion at roughly 68%, followed by BF grade (6%), Unclassified grades (11%) and other grades. The remaining 15% is shared by various other grades [Table-1 (A)].

The total reserves/resources of marl of all categories and grades as per NMI database based on UNFC system as on 1.4.2020 has been estimated in Gujarat at 99.20 million tonnes of which 68.15 million tonnes (69%) are under Reserves category and 31.05 million tonnes (31%) are under Remaining Resources category [Table- 1 (B)]

Table – 1(A) : Reserves/Resources of Limestone as on 01.04.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India: Total	**19028470**	**208560789**	**227589259**
By Grades			
Chemical	254835	5197825	5452660
S.M.S.(O.H.)	103570	4845398	4948968
S.M.S.(L.D.)	27379	591243	618622
S.M.S.(O.H. & L.D. mixed)	143912	236642	380554
B.F.	746646	13426453	14173099
S.M.S. & B.F. mixed	21580	1240926	1262506
Cement (portland)	16712957	139641159	156354115
Cement (white)	28006	46798	74804
Cement (portland & white)	55411	1044164	1099575
Cement (blendable beneficiable)	588507	7051343	7639850
B.F. & cement mixed	19864	617408	637273
S.M.S., chemical & paper	182	1234096	1234278
Paper	56274	841137	897411
Blendable (CaO 34-38%)	-	883884	883884
Others	48714	3440357	3489071
Unclassified	165092	26382988	26548080
Not-known	55542	1838969	1894511
By States			
Andhra Pradesh	3256690	26582132	29838822
Arunachal Pradesh	-	482796	482796
Assam	188130	1683540	1871670
Bihar	11807	994188	1005995
Chhattisgarh	1486351	11724867	13211218
Daman & Diu	-	128670	128670
Gujarat	903115	21929169	22832284
Haryana	-	74677	74677
Himachal Pradesh	1022012	5597134	6619146
*Jammu & Kashmir	185490	2242071	2427561
Jharkhand	10687	610078	620765
Karnataka	2271221	53899236	56170457
Kerala	10540	184059	194599
Madhya Pradesh	1692431	7960747	9653178
Maharashtra	701349	3107044	3808392
Manipur	-	46053	46053
Meghalaya	251043	23583945	23834988
Nagaland	-	1752200	1752200
Odisha	468580	1727424	2196004
Puducherry	-	15732	15732
Rajasthan	4804154	24157095	28961249
Sikkim	-	2380	2380
Tamil Nadu	547024	1577025	2124049

Table- 1 (Concld.)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
Telangana	1214127	16438327	17652454
Uttar Pradesh	3720	439723	443443
Uttarakhand	-	1575771	1575771
West Bengal	-	44706	44706

Figures rounded off
** Notified as Union Territory and is to be known as Union Territory of Jammu & kashmir comprising the territory of the existing State of Jammu & Kashmir (Gazette Notification No. 53, New Delhi, Friday, August 9, 2019)*

Table – 1 (B) : Reserves/Resources of Marl as on 01.04.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**68145000**	**31053477**	**99198477**
By Grade			
Unclassified	68145000	31053477	99198477
By State			
Gujarat	68145000	31053477	99198477

Figures rounded off

MINING LEASE AND PRODUCTION

Limestone

The production of limestone in 2022-23 at 406 million tonnes increased by about 3.68% as compared to that of the previous year. There were 747 reporting mines in 2022-23 as against 676 during the previous year. Thirty five mines, each producing more than 3 million tonnes per annum, contributed 46% of the total production of limestone in 2022-23. The share of 25 mines, each in the production range of 2 to 3 million tonnes, was 15 % of the total production. 18% of the total production was contributed by 50 mines, each producing 1 to 2 million tonnes annually. The remaining 21% of the total production was reported by 521 mines and 6 associated mines during the year. Ten principal producers contributed about 61% of the total production. About 4.96 % of the production was reported by public sector mines as against 2.87% in the previous year. About 97.31% of the total production of limestone during 2022-23 was of cement grade and remaining 2.69 % by other grades. Rajasthan was the leading producing state accounting for 23% of the total production of limestone, followed by Andhra Pradesh (13%), Madhya Pradesh (12%), Chhattisgarh (11%), Karnataka (10%), Telangana (7%), Tamil Nadu (6%) , Gujarat (6%), and remaining 12% was contributed by Maharashtra, Himachal Pradesh, Meghalaya, Odisha, Uttar Pradesh, Assam, Jammu And Kashmir, Bihar, Kerala and Jharkhand. Mine-head closing stocks of limestone for the year 2022-23 was 28.52 million tonnes and for the year 2021-22 was 27.23 million tonnes. Average daily labour employment in limestone mines in 2022-23 was 21,640 as against 20,343 in the previous year (Tables- 2 to 6).

Table -2 Principal Producers of Limestone, 2022-23

Name & address of producers	State	District
"M/S. Ultratech Cement Limited 'B' Wing, Ahura Centre, 2nd Floor, Mahakali Caves Road, Andheri (E), Mumbai - 400 093, Maharashtra."	Andhra Pradesh Andhra Pradesh Chhattisgarh Chhattisgarh Gujarat Gujarat Gujarat Himachal Pradesh Karnataka Madhya Pradesh Madhya Pradesh Madhya Pradesh Madhya Pradesh Madhya Pradesh Madhya Pradesh Maharashtra Rajasthan Rajasthan Rajasthan Rajasthan Tamil Nadu Tamil Nadu Uttar Pradesh	Krishna Kurnool Baloda Bazar Raipur Amreli Bhavnagar Kachchh Solan Kalaburagi Dhar Katni Neemuch Rewa Satna Sidhi Chandrapur Chittorgarh Jaipur Nagaur Pali Ariyalur Perambalur Sonbhadra

Name & address of producers	State	District
"M/S. Shree Cement Limited Post Box No.33, Bangur Nagar, Beawar - 305 901, Rajasthan."	Andhra Pradesh Chhattisgarh Chhattisgarh Gujarat Karnataka Rajasthan Rajasthan Rajasthan	Guntur Baloda Bazar Raipur Kachchh Kalaburagi Ajmer Jhunjhunu Pali
"M/S. M/S Ambuja Cements Limited Elegant Business Park, MIDC Cross Road B, Off Andheri- Kurla Road, Andheri East, Mumbai - 400 059, Maharashtra."	Chhattisgarh Chhattisgarh Gujarat Himachal Pradesh Maharashtra Rajasthan Rajasthan	Baloda Bazar Raipur Junagadh Solan Chandrapur Nagaur Pali
"M/S. Acc Limited Cement House, 121, Maharshi Karve Road, Mumbai - 400 020, Maharashtra."	Chhattisgarh Chhattisgarh Himachal Pradesh Jharkhand Karnataka Madhya Pradesh Maharashtra Odisha Rajasthan Tamil Nadu	Bilaspur Durg Bilaspur West Singhbhum Kalaburagi Katni Yavatmal Bargarh Bundi Coimbatore
"M/S. Dalmia Cement (Bharat) Limited Dalmiapuram, Main Road, Kallakudi, Lalgudi, Thiruchirapalli - 621 651, Tamil Nadu."	Andhra Pradesh Andhra Pradesh Bihar Karnataka Madhya Pradesh Meghalaya Odisha Tamil Nadu Tamil Nadu	Kurnool Y.S.R. Rohtas Belagavi Satna East Jaintia Hills Sundargarh Ariyalur Tiruchirappalli
"M/S. J.K. Cement Limited Kamla Tower, Kanpur - 208 001, Uttar Pradesh"	Karnataka Madhya Pradesh Rajasthan Rajasthan	Bagalkote Panna Chittorgarh Nagaur
"M/S. The Ramco Cements Limited 5th Floor, Auras Corporate Centre, 98-A, Dr.Radhakrishanan Salai, Mylapore, Chennai - 600 004, Tamil Nadu."	Andhra Pradesh Andhra Pradesh Karnataka Karnataka Tamil Nadu Tamil Nadu Tamil Nadu Tamil Nadu	Krishna Kurnool Chitradurga Tumakuru Ariyalur Perambalur Tuticorin Virudhunagar
"M/S. The India Cements Limited Coromandel Towers, No: 93, Santhome High Road, Karpagam Avenue, R.A.Puram, Chennai - 600028. Tamil Nadu."	Andhra Pradesh Rajasthan Tamil Nadu Tamil Nadu Tamil Nadu Tamil Nadu Tamil Nadu Tamil Nadu Telangana Telangana Telangana	Y.S.R. Banswara Ariyalur Namakkal Perambalur Salem Tirunelveli Tuticorin Hyderabad Nalgonda Ranga Reddy
"M/S. Wonder Cement Limited 17, Old Fatehpura Near Seva Mandir Udaipur-313004 Rajasthan-313004"	Rajasthan Rajasthan	Chittorgarh Jaisalmer

Table (3) : Production of Limestone, 2020-21 to 2022 -23

(By States)

(Qty in tonnes; Value in ₹'000)

MINERAL: LIMESTONE State	Unit	2020-21		2021-22		2022-23(p)	
		Production	Value	Production	Value	Production	Value
India		**349120**	**86484948**	**392034**	**102022622**	**406462**	**108788978**
Andhra Pradesh	THT	41148	8685149	50278	10865618	52848	11760096
Assam	THT	1552	469810	1681	540157	1522	493373
Bihar	THT	1000	301961	987	348399	929	333949
Chhattisgarh	THT	40378	10139974	41889	11523823	44735	12753977
Gujarat	THT	22227	5080904	23250	5212323	22853	6528265
Himachal Pradesh	THT	12018	2618878	13810	2983883	11839	2692145
Jammu & Kashmir	THT	1175	300656	1156	286892	1238	298346
Jharkhand	THT	324	233245	72	103729	3	952
Karnataka	THT	33188	6095069	39395	7893558	38942	7817554
Kerala	THT	376	331191	379	370969	347	318457
Madhya Pradesh	THT	46099	12879609	49807	15833338	50591	16041163
Maharashtra	THT	13943	3476065	15758	3884495	16655	3927677
Meghalaya	THT	6029	2689713	6399	2974757	8112	4110595
Odisha	THT	7186	2118507	7059	2574534	6551	2320890
Rajasthan	THT	74266	19449722	87483	23336293	95051	25548161
Tamil Nadu	THT	21144	5813723	21323	6505610	24545	7529571
Telangana	THT	24493	4904676	28499	5932307	27118	5636954
Uttar Pradesh	THT	2574	896096	2809	851937	2583	676853

(p) : Provisional

Table (4): Production of Limestone, 2021-22 & 2022-23(p)

(By Frequency Groups)

(Qty in tonnes)

Production group	No. of Mines		Production for the group		Percentage in total production		Percentage Percentage	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
All Groups	**676 (6)**	**747(6)**	**392034**	**406462**	**100**	**100**		
Up to 10000	221 (5)	269 (5)	391	335	0.1	0.08	0.1	0.08
10001 - 50000	99	116	2850	3300	0.73	0.81	0.83	0.89
50001 - 100000	79	63	5745	4599	1.47	1.13	2.29	2.03
100001 -200000	47 (1)	59 (1)	7010	8621	1.79	2.12	4.08	4.15
200001 -300000	26	35	6527	8953	1.66	2.2	5.75	6.35
300001 -400000	20	22	7278	7667	1.86	1.89	7.6	8.24
400001 -500000	23	15	10381	6675	2.65	1.64	10.25	9.88
500001 -600000	10	9	5566	4978	1.42	1.22	11.67	11.1
600001 -700000	12	16	7848	10384	2	2.55	13.67	13.66
700001 -800000	11	17	8419	12948	2.15	3.19	15.82	16.84
800001 -900000	9	8	7584	6773	1.93	1.67	17.75	18.51
900001-1000000	9	8	8767	7745	2.24	1.91	19.99	20.41
1000001-2000000	53	50	77593	73356	19.79	18.05	39.78	38.46
2000001 -3000000	22	25	55684	62679	14.2	15.42	53.99	53.88
3000001 & above	35	35	180391	187449	46.01	46.12	100	100

(p): provisional

( ): Figure in parenthesis indicates mines of chalk, dolomite& shale with limestone as an associate mineral.

No. of Mines does not include those mines who have reported only labor, without reporting any production.(Only mines reporting production are included)

Table 5 (A) : Production of Limestone, 2021-22

(By Sectors/States/Districts/Grades)

(Qty. in '000 tonnes; Value in ₹ '000)

State	Grades				Total	
	No. of Mines	Cement	LD, SMS & BF	Chemical	Production	Value
India	**676 (6)**	**380677**	**9225**	**2132**	**392034**	**102022622**
Private	**654(6)**	**373627**	**4953**	**2132**	**380712**	**97018216**
Public	**22**	**7050**	**4272**	**-**	**11322**	**5004406**
Andhra Pradesh	**74 (1)**	**49701**	**577**	**-**	**50278**	**10865618**
Anantapur	9	5192	9	-	5201	1005761
Guntur	13	5424	-	-	5424	1121171
Krishna	11	11921	301	-	12222	3159908
Kurnool	36(1)	15061	267	-	15328	2961242
Y.S.R. (Cuddapah)	5	12103	-	-	12103	2617536
Assam	**2**	**1681**	**-**	**-**	**1681**	**540157**
Dima Hasao(North Cachar Hills)	1	1493	-	-	1493	476093
Karbi Anglong	1	188	-	-	188	64064
Bihar	**1**	**987**	**-**	**-**	**987**	**348399**
Rohtas	1	987	-	-	987	348399
Chhattisgarh	**64**	**40984**	**905**	**-**	**41889**	**11523823**
Baloda Bazar	4	7161	-	-	7161	1628270
Bastar	10	2	-	-	2	785
Bilaspur	3	231	627	-	858	368316
Durg	27	7016	278	-	7294	2271968
Janjgir-Champa	2	1604	-	-	1604	566406
Kabirdham	1	30	-	-	30	18618
Raipur	17	24940	-	-	24940	6669460
Gujarat	**80 (1)**	**21459**	**-**	**1791**	**23250**	**5212323**
Amreli	4	3611	-	-	3611	832942
Bhavnagar	2	53	-	-	53	65151
Jamnagar	15	1619	-	313	1932	467958
Junagarh	30	8052	-	798	8850	1902510
Kutch	3	5906	-	-	5906	1154088
Porbandar	24(1)	1934	-	680	2614	668407
Rajkot	1	77	-	-	77	33257
Surat	1	207	-	-	207	88010
Himachal Pradesh	**22**	**13723**	**87**	**-**	**13810**	**2983883**
Bilaspur	1	4194	-	-	4194	859729
Sirmour	19	906	87	-	993	395090
Solan	2	8623	-	-	8623	1729064
Jammu & Kashmir	**10**	**1156**	**-**	**-**	**1156**	**286892**
Anantnag	1	-	-	-	0	-
Pulwama	6	614	-	-	614	130986
Srinagar	3	542	-	-	542	155906
Jharkhand	3	72	-	-	72	103729
Ranchi	1	-	-	-	0	-
West Singhbhum	2	72	-	-	72	103729
Karnataka	**54**	**39035**	**360**	**-**	**39395**	**7893558**
Bagalkot	34	3299	339	-	3638	1187134
Belagavi (Belgaum)	6	2326	21	-	2347	540517
Chitradurga	1	-	-	-	0	-

Table- 5 (A) (Cont.)

(Qty. in '000 tonnes; Value in ₹ '000)

State	Grades				Total	
	No. of Mines	Cement	LD, SMS & BF	Chemical	Production	Value
Kalaburagi (Gulbarga)	11	33410	-	-	33410	6165907
Shivamogga(Shimoga)	1	-	-	-	0	-
Tumkur	1	-	-	-	0	-
Kerala	**1**	**379**	**-**	**-**	**379**	**370969**
Palakkad	1	379	-	-	379	370969
Madhya Pradesh	**166 (3)**	**45145**	**4570**	**92**	**49807**	**15833338**
Balaghat	1	-	-	-	0	-
Damoh	1	3883	-	-	3883	1017285
Dhar	13	3741	-	-	3741	750426
Jabalpur	1	-	2	-	2	639
Katni	57 (3)	4377	3647	92	8116	2778188
Narsinghpur	1	-	80	-	80	58393
Nimach	5	4178	-	-	4178	841230
Panna	1	++	-	-	++	199
Rewa	10	3813	5	-	3818	1750472
Satna	72	22968	836	-	23804	7400025
Sidhi	4	2185	-	-	2185	1236481
Maharashtra	**19**	**15758**	**-**	**-**	**15758**	**3884495**
Chandrapur	6	11493	-	-	11493	2543340
Yavatmal(Yeotmal)	13	4265	-	-	4265	1341155
Meghalaya	**16**	**6399**	**-**	**-**	**6399**	**2974757**
East Jaintia Hills	14	3922	-	-	3922	1178864
East Khasi Hills	2	2477	-	-	2477	1795893
Odisha	**6 (1)**	**6992**	**67**	**-**	**7059**	**2574534**
Bargarh	1	957	-	-	957	578352
Koraput	1	183	-	-	183	55058
Sundargarh	4(1)	5852	67	-	5919	1941124
Rajasthan	**41**	**84596**	**2638**	**249**	**87483**	**23336293**
Ajmer	2	2337	-	-	2337	604400
Banswara	1	1277	-	-	1277	303890
Bundi	1	1071	-	-	1071	381160
Chittorgarh	11	34240	-	-	34240	8490996
Jaipur	1	4697	-	-	4697	1399796
Jaisalmer	2	1065	2638	-	3703	2050063
Jhunjhunu	1	1	-	-	1	47800
Kota	1	2968	-	-	2968	738963
Nagaur	9	3491	-	249	3740	1311625
Pali	6	19131	-	-	19131	4098076
Sikar	1	2	-	-	2	949
Sirohi	3	12438	-	-	12438	3387913
Udaipur	2	1878	-	-	1878	520662
Tamil Nadu	**85**	**21302**	**21**	**-**	**21323**	**6505610**
Ariyalur	40	11419	21	-	11440	3154582
Dindigul	4	2490	-	-	2490	713025
Karur	1	634	-	-	634	203386
Perambalur	16	2207	-	-	2207	673704
Salem	3	524	-	-	524	231594
Thoothukudi (Tuticorin)	5	1079	-	-	1079	614873

Table- 5 (A) (Cont.)

(Qty. in '000 tonnes; Value in ₹ '000)

State	Grades				Total	
	No. of Mines	Cement	LD, SMS & BF	Chemical	Production	Value
Tiruchirappalli	9	2501	-	-	2501	680103
Tirunelveli	3	160	-	-	160	75332
Virudhunagar	4	288	-	-	288	159011
Telangana	**30**	**28499**	**-**	**-**	**28499**	**5932307**
Adilabad	3	3477	-	-	3477	678121
Karimnagar	2	1300	-	-	1300	542100
Nalgonda	21	18715	-	-	18715	3568795
Ranga Reddy	4	5007	-	-	5007	1143291
Uttar Pradesh	**2**	**2809**	**-**	**-**	**2809**	**851937**
Sonbhadra	2	2809	-	-	2809	851937

(p): provisional (++): Negligible

( ): Figure in parenthesis indicates mines of chalk, dolomite and shale with limestone as an associate mineral. (*) Only labour reported.

Table 5 (B) : Production of Limestone, 2022-23(p)

(By Sectors/States/Districts/Grades)

(Qty. in '000 tonnes; Value in ₹ '000)

State	Grades				Total	
	No. of Mines	Cement	LD, SMS & BF	Chemical	Production	Value
India	**747 (6)**	**395529**	**8583**	**2350**	**406462**	**108788978**
Public Sector	**31**	**15971**	**3907**	**269**	**20147**	**8078749**
Private Sector	**716 (6)**	**379558**	**4676**	**2081**	**386315**	**100710229**
Andhra Pradesh	**79 (2)**	**52510**	**338**	**-**	**52848**	**11760096**
Anantapur	7 (1)	3798	17	-	3815	746836
Guntur	14	5704	-	-	5704	1187202
Krishna	11	13240	125	-	13365	3420444
Kurnool	41 (1)	16249	196	-	16445	3313403
Y.s.r.	6	13519	-	-	13519	3092211
Assam	**3**	**1522**	**-**	**-**	**1522**	**493373**
Dima Hasao	2	1331	-	-	1331	428483
Karbi Anglong	1	191	-	-	191	64890
Bihar	**1**	**929**	**-**	**-**	**929**	**333949**
Rohtas	1	929	-	-	929	333949
Chhattisgarh	**75**	**43762**	**973**	**-**	**44735**	**12753977**
Baloda Bazar	6	8652	-	-	8652	2170716
Bastar	11	1	1	-	2	1829
Bilaspur	3	249	671	-	920	408242
Durg	31	7261	301	-	7562	2566565
Janjgir-Champa	3	1405	-	-	1405	431366
Kabirdham	1	32	-	-	32	21343
Raigarh	1(*)	-	-	-	-	-
Raipur	19	26162	-	-	26162	7153916
Gujarat	**95 (1)**	**20828**	**-**	**2025**	**22853**	**6528265**
Amreli	4	5080	-	-	5080	1134037
Bhavnagar	2	++	-	-	-	710
Devbhumi Dwarka	1 (*)	-	-	-	-	-
Gir Somnath	1(*)	-	-	-	-	-
Jamnagar	25	1715	-	295	2010	1636103
Junagadh	30	7828	-	457	8285	1889563

Table- 5 (B) (Cont.)

(Qty. in '000 tonnes; Value in ₹ '000)

State	Grades				Total	
	No. of Mines	Cement	LD, SMS & BF	Chemical	Production	Value
Kachchh	3	4074	-	-	4074	841778
Porbandar	26 (1)	1878	-	1273	3151	918870
Rajkot	2	2	-	-	2	652
Surat	1	251	-	-	251	106552
Himachal Pradesh	**23**	**11722**	**115**	**2**	**11839**	**2692145**
Bilaspur	1	2852	-	-	2852	584219
Mandi	1(*)	-	-	-		
Sirmaur	19	915	115	2	1032	466514
Solan	2	7955	-	-	7955	1641412
Jammu & Kashmir (Ut)	**19**	**1238**	**-**	**-**	**1238**	**298346**
Anantnag	9	++	-	-	-	9
Pulwama	7	642	-	-	642	122364
Srinagar	3	596	-	-	596	175973
Jharkhand	**5**	**3**	**-**	**-**	**3**	**952**
Ranchi	2	3	-	-	3	952
West Singhbhum	3(*)	-	-	-	-	-
Karnataka	**58**	**38566**	**376**	**-**	**38942**	**7817554**
Bagalkote	37	3341	361	-	3702	971721
Belagavi	6	2346	15	-	2361	578825
Chitradurga	2	31	-	-	31	14699
Kalaburagi	11	32848	-	-	32848	6252309
Shivamogga	1(*)	-	-	-	-	-
Tumakuru	1(*)	-	-	-	-	-
Kerala	**1**	**347**	**-**	**-**	**347**	**318457**
Palakkad	1	347	-	-	347	318457
Madhya Pradesh	**178 (3)**	**46190**	**4347**	**54**	**50591**	**16041163**
Damoh	1	3492	-	-	3492	982169
Dhar	9	4988	-	-	4988	922190
Indore	2	391	-	-	391	85169
Katni	62 (2)	4820	3376	54	8250	3154346
Narsinghpur	1	-	64	-	64	32958
Neemuch	6	4562	-	-	4562	1078315
Panna	3	853	-	-	853	229370
Rewa	11	3318	-	-	3318	1450058
Satna	79 (1)	21268	907	-	22175	7023879
Sidhi	4	2498	-	-	2498	1082709
Maharashtra	**26**	**16655**	**-**	**-**	**16655**	**3927677**
Chandrapur	13	13376	-	-	13376	3011696
Yavatmal	13	3279	-	-	3279	915981
Meghalaya	18	8112	-	-	8112	4110595
East Jaintia Hills	16	4659	-	-	4659	1429742
East Khasi Hills	2	3453	-	-	3453	2680853
Odisha	**7**	**6498**	**53**	**-**	**6551**	**2320890**
Bargarh	1	699	-	-	699	372934
Koraput	1	98	-	-	98	46108
Sundargarh	5	5701	53	-	5754	1901848

Table- 5 (B) (Cont.)

(Qty. in '000 tonnes; Value in ₹ '000)

State	Grades				Total	
	No. of Mines	Cement	LD, SMS & BF	Chemical	Production	Value
Rajasthan	**45**	**92403**	**2379**	**269**	**95051**	**25548161**
Ajmer	2	2378	-	-	2378	663978
Banswara	1	1389	-	-	1389	342489
Bundi	1	995	-	-	995	371419
Chittorgarh	11	37899	-	-	37899	9572048
Jaipur	2	4329	-	-	4329	1436880
Jaisalmer	3	1312	2379	-	3691	1996728
Jhunjhunu	1	1	-	-	1	208
Kota	1	3001	-	-	3001	861232
Nagaur	9	4922	-	269	5191	1576199
Pali	6	21182	-	-	21182	5093617
Sikar	1	1	-	-	1	755
Sirohi	5	13051	-	-	13051	3097639
Udaipur	2	1943	-	-	1943	534969
Tamil Nadu	**80**	**24543**	**2**	**-**	**24545**	**7529571**
Ariyalur	39	13877	2	-	13879	3849471
Dindigul	4	2485	-	-	2485	859509
Karur	1	648	-	-	648	222548
Perambalur	15	2341	-	-	2341	724294
Salem	2	527	-	-	527	198434
Tiruchirappalli	10	2834	-	-	2834	721682
Tirunelveli	3	379	-	-	379	174104
Tuticorin	5	1243	-	-	1243	670887
Virudhunagar	1	209	-	-	209	108642
Telangana	**31**	**27118**	**-**	**-**	**27118**	**5636954**
Adilabad	2	3331	-	-	3331	792370
Hyderabad	2	1298	-	-	1298	277909
Karimnagar	2	1150	-	-	1150	541031
Nalgonda	21	17618	-	-	17618	3257440
Ranga Reddy	4	3721	-	-	3721	768204
Uttar Pradesh	**3**	**2583**	**-**	**-**	**2583**	**676853**
Sonbhadra	3	2583	-	-	2583	676853

(p): provisional (++): Negligible
( ): Figure in parenthesis indicates mines of chalk, dolomite and shale with limestone as an associate mineral. (*) Only labour reported.

Table(6) : Mine-head closing Stocks of Limestone, 2021-22 and 2022-23

(By States/Grades)

(In '000 tonnes)

State	2021-22				2022-23 (p)			
	Grades				Grades			
	Cement	LD, SMS & BF	Chemical	Total	Cement	LD, SMS & BF	Chemical	Total
INDIA	22722	3165	1348	27235	23732	3092	1698	28522
Andhra Pradesh	215	114	-	329	299	83	-	382
Assam	21	-	-	21	29	-	-	29
Bihar	-	-	-	-	-	-	-	-
Chattisgarh	2384	328	-	2712	2100	96	-	2196
Gujrat	1416	-	1261	2677	1272	-	1647	2919
Himachal Pradesh	696	11	-	707	614	14	-	628
Jammu & Kashmir	82	-	-	82	596	-	-	596

Table- 6 B (Cont.)

(In '000 tonnes)

State	2021-22				2022-23 (p)			
	Grades				Grades			
	Cement	LD, SMS & BF	Chemical	Total	Cement	LD, SMS & BF	Chemical	Total
Jharkhand	16	-	-	16	12	-	-	12
Karnataka	3111	558	-	3669	3054	512	-	3566
Kerala	1	-	-	1	5	-	-	5
Madhya Pradesh	5492	1492	23	7007	5512	1784	-	7296
Maharashtra	678	-	-	678	495	-	-	495
Meghalaya	71	-	-	71	42	-	-	42
Orissa	408	475	-	883	566	434	-	1000
Rajasthan	6859	78	64	7001	8063	80	51	8194
Tamil Nadu	915	109	-	1024	707	89	-	796
Telangana	357	-	-	357	366	-	-	366
Uttar Pradesh	-	-	-	-	-	-	-	-

(p) : Provisional

Limeshell

The production of limeshell was 250 tonnes during 2022-23 and 100 tonnes in the preceding year. Mine-head closing stocks of limeshell in the year 2022-23 was 711 tonnes as against 590 tonnes in the previous year. The average daily employment of labour during the year 2022-23 was 23 as against 9 in the previous year (Tables-7 to 9).

Table – (7) : Production of Limeshell, 2020-21 to 2022-23

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**-**	**-**	**100**	**231**	**250**	**658**
Karnataka	-	-	100	231	250	658
Kerala	-	-	-	-	-	-
Tamil Nadu	-	-	-	-	-	-

(p): Provisional

Table(8) Production of Limeshell, 2021-22 and 2022-23

(By Sectors/States/Districts)

(Qty. in tonnes; Value in ₹ '000)

State	2021-22			2022-23 (P)		
	No. of Mines	Qty	Value	No. of Mines	Production	Value
India	**1**	**100**	**231**	**2**	**250**	**658**
Public sector	-	-	-	-	-	-
Private sector	1	100	231	2	250	658
Karnataka	**1**	**100**	**231**	**2**	**250**	**658**
North Kanara	1	100	231	2	250	658
Kerala	-	-	-	-	-	-
Kottayam	-	-	-	-	-	-
Tamil Nadu	**-**	**-**	**-**	**-**	**-**	**-**
Cuddalore	-	-	-	-	-	-

(p): Provisional

Table-(9): Mine head closing stocks of Limeshell, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22	2022-23(p)
India	**590**	**711**
Karnataka	590	711
Kerala	-	-
Tamil Nadu	-	-

(p):Provisional

Marl

Production of marl during 2022-23 was 1,452 thousand tonnes as compared to 1,853 thousand tonnes in the preceding year. The entire production of marl was reported as associated mineral with limestone in both the years. There were 10 associate mines reporting production of marl during 2022-23 as compared to 8 associate mines in the previous year. The entire production was reported by private sector mines. The entire production of marl during 2022-23 was reported from Gujarat and Tamil Nadu states. Mine-head stock at the end of 2022-23 was 478 thousand tonnes as against 469 thousand tonnes in the previous year (Tables-10 to 13).

The total number of mining lease of Limestone was 1815 with the lease area 1,65,118.97 hectare, while the total number of mining lease of limeshell was 25 with the lease area 1,072.15 hectare as on 31/03/2023.

Table-10 Principal Producers of Marl, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
"*UltraTech Cement Limited, 'B' Wing, 2nd Floor, Ahura Center, Mahakali Caves Road, Andheri (E), Mumbai- 400 093"	Gujarat	Amreli
"*The Ramco cements Ltd., 3rd Floor, Auras corporate Centre 98-A, Dr.Radhakrishanan salai, Mylapore, Chennai - 600 004"	Tamil Nadu	Ariyalur
"*Chettinad Cement Corpn. Ltd., 4th floor ,Rani Seethai Hall Building 603, Anna Salai Chennai-600006"	Tamil Nadu	Ariyalur
*Saurashtra Cement Ltd., N.K.Mehta International House, 178-Backbay Reclamation, Mumbai-400020	Gujarat	Porbandar
*Gujarat Sidhee Cement Ltd N.K.Mehta International House 178, Backbay Reclamation,, Mumbai-400020	Gujarat	Junagarh
*Vasai Limestone Mine Ashapura Society,Near Sbisurajkaradi, Okhamandal, Jamnagar , 361347	Gujarat	Jamnagar

** Producing as an associated mineral with Limestone*

Table (11): Production of Marl, 2020-21 to 2022-23(p)

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**2216414**	**417184**	**1853481**	**326498**	**1452489**	**307699**
Gujarat	1300333	243556	900560	133211	875309	177911
Tamil Nadu	916081	173628	952921	193287	577180	129788

(p): Provisional

Table (12): Production of Marl, 2021-22 & 2022-23 (p)

(By Sectors/States/Districts)

(Qty. in tonnes; Value in ₹ '000)

State	2021-22			2022-23 (P)		
	No. of Mines	Qty	Value	No. of Mines	Production	Value
India	**(8)**	**1853481**	**326498**	**(10)**	**1452489**	**307699**
Private Sector	(8)	185341	326498	(10)	1452489	307699
Gujarat	**(4)**	**900560**	**133211**	**(5)**	**875309**	**177911**
Amreli	(2)	532155	97161	(2)	725895	153159
Jamnagar		-	-	(1)	7459	1688
Junagadh	(1)	39130	8391	(1)	63901	13176
Porbandar	(1)	329275	27659	(1)	78054	9888
Tamil Nadu	**(4)**	**952921**	**193287**	**(5)**	**577180**	**129788**
Ariyalur	(4)	952921	193287	(5)	577180	129788

Table (13): Mine-head stocks of Marl, 2021-22 & 2022-23 (p)

(By States)

(In tonnes)

State	2021-22	2022-23(p)
India	**468771**	**477696**
Gujarat	262383	258751
Tamil Nadu	206388	218945

( ): Figures in Parentheses indicate associated mines with limestone.
(p): Provisional

USES & CONSUMPTION

Limestone used for industrial purpose falls under 'major mineral', while the use of limestone in lime kilns and for building purposes comes under 'minor mineral' as per Mines and Minerals (Development and Regulation) Act, 1957.

The threshold value of limestone as per the revised Notification issued by IBM vide No.C- 284/3/CMG/2017 dated 25th April 2018 is CaO 34% (min.) and MgO 5% (max.).

The principal use of limestone is in the Cement Industry. Other important uses are as raw material in the manufacture of quicklime (calcium oxide), slaked lime (calcium hydroxide) and mortar. Pulverised limestone is used as a soil conditioner to neutralize acidic soils (agricultural lime). It is used in sculptures because of its suitability for carving. It is often found in medicines and cosmetics. In some circumstances, limestone is used for glass making. As a reagent in fuel-gas desulphurization, it reacts with sulphur dioxide which enables air pollution control. It can suppress methane explosions in underground coal mines. It is added to toothpaste, paper, plastic, paint, tiles and other materials as both white pigment and cheap filler. In blast furnaces, limestone binds with silica and other impurities and facilitates their removal from iron.

Lime is prepared by heating limestone in kilns up to 1,000 $^{\circ}$C. The CO released is effluxed and 'quicklime' (CaO) formed remains as hard white lumps. This, when slaked with water and mixed with sand, forms mortar or plaster.

Commonly, the commercial lime is prepared as dry hydrated lime Ca(OH)2 by adding to quicklime the right amount of water (18 parts to 56 parts of CaO). The value of lime for most purposes depends upon its CaO (or CaO + MgO) content.

The manufacture of metallic calcium is one of the latest uses of lime. Calcium is used in reducing organic compounds, desulphurising petroleum, debismuthising lead production of hard lead alloys and calcium-silicon alloys, and in the manufacture of calcium hydride which is further used as an efficient hydrogen carrier.

Limeshell is used mainly in Chemical and White Cement Industries. It is also used in the manufacture of polyfibre and in Tanning Industry. Marl is used as lithographic stone.

In the year 2022-23, the apparent consumption of limestone was 433.11 million tonnes which increased marginally by 6.3% from 407.45 million tonnes in the preceding year (Tables-14).

Table – 14 : Broad Chemical Specifications of Cement Grade (Run-of-Mine) Limeston(Clause 6.1.1)

Oxide component/ Other Constituents	Acceptable range for manufacture of Ordinary Portland Cement (33, 43 & 53 Grade) (per cent)	Limiting values taking into consideration other types of cements, scope of beneficiation and blending (per cent)
CaO	44-52	40 (min.)
MgO	3.5 (max.)	5.0 (max.)
SiO_2	To satisfy LSF, silica	–
Al_2O_3	Modules and alumina	–
Fe_2O_3	Modules	–
TiO_2	<0.5	<1.0
Mn_2O_3	<0.5	<1.0
R2O (Na_2O + K_2O)	<0.6	<1.0
Total S as SO_3	<0.6	<0.8
P_2O_5	<0.6	<1.0
Cl	<0.015	<0.05
Free silica	<8.0	<10.0

Source: Report on Norm for limestone deposits for cement manufacture by National Council for Cement and Building Materials, New Delhi, May 2001

FOREIGN TRADE

Exports

Exports of limestone decreased by 79.3% to 2.5 million tonnes in 2022-23 from 12.16 million tonnes in the previous year. Limestone in bulk was exported mainly to Bangladesh (98%). On the other hand, exports of chalk decreased marginally by 6.4% to 1,057 tonnes in 2022-23 from 1,129 tonnes in the previous year. Chalk was exported mainly to Nepal (93%) and Bangladesh (4%).

Exports of bleaching powder decreased by 6% at 28,840 tonnes in 2022-23 as compared to 30,919 tonnes in the previous year. Bleaching powder was exported mainly to Bangladesh (78%), Nepal and USA (6% each), and Sri Lanka (4%) besides other countries.

In the year 2022-23, exports of calcium carbide also decreased marginally by 6% to 735 tonnes as compared to 787 tonnes in the previous year. Exports were mainly to Bangladesh (71%), Angola (12%), Nepal and Bhutan (6% each) (Tables-15 to 18).

Table - 15: Export of Limestone

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ ’000)	Qty (t)	Value (₹ ’000)
All Countries	**12160342**	**4551537**	**2515714**	**3124865**
Bangladesh	12112717	3474832	2476791	2618881
Nepal	17272	105575	15082	105736
UK	6187	93047	4186	67550
China	1499	28727	1798	37989
Ireland	3049	40362	2162	29272
UAE	641	22522	478	26521
USA	5607	607975	1254	26495
Belgium	2129	24420	1854	22878
Korea Rep. of	3416	30926	2133	21350
Bhutan	753	11792	1237	20762
Other countries	7072	111359	8739	147431

Figures rounded off

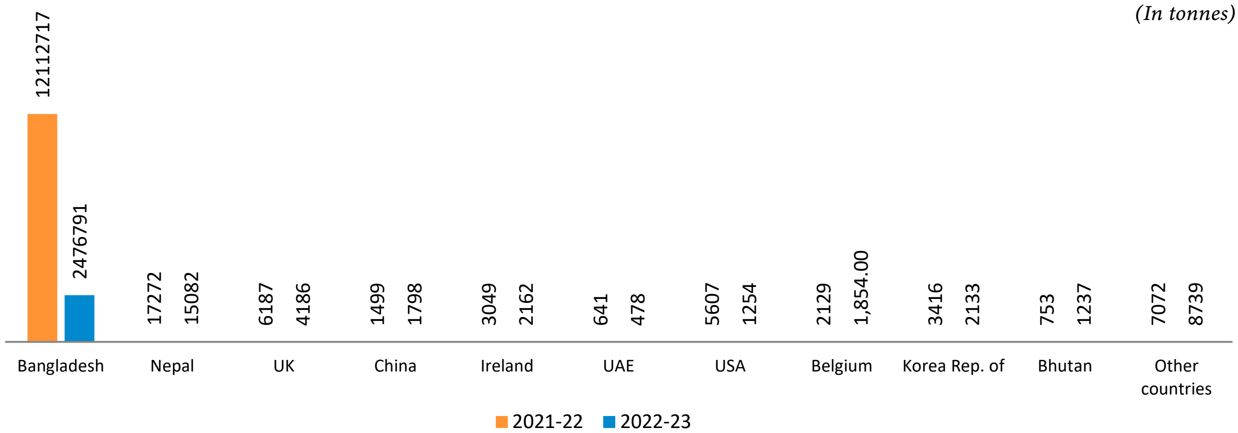


Fig 1: Countrywise Export of Limestone

Table - 16: Export of Chalk

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1129**	**7557**	**1057**	**7330**
Nepal	1039	5628	979	5595
Egypt	28	451	16	388
Bangladesh	33	292	38	286
Congo D. Rep.	21	645	10	236
Malaysia	++	4	3	233
UAE	1	21	7	207
Tanzania	1	6	1	87
USA	++	44	++	53
Seychelles	--	--	1	51
Bhutan	2	149	++	36
Other countries	4	317	2	158

Figures rounded off

Table-17: Export of Bleaching Powder

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**30919**	**931596**	**28840**	**1014781**
Bangladesh	26059	697795	22642	620889
USA	732	65150	1752	206219
Sri Lanka	1228	44202	1087	43556
UAE	244	21504	343	40778
Nepal	1374	23553	1855	26152
Malaysia	357	18041	359	16770
Israel	105	10312	97	11832
Kenya	--	--	73	8636
Egypt	40	3336	81	8361
Canada	--	--	43	6759
Other countries	780	47703	508	24829

Figures rounded off

Table-18: Export of Calcium Carbide

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**787**	**97371**	**735**	**84151**
Bangladesh	701	89402	519	62245
Angola	--	--	87	10069
Bhutan	16	2059	47	5354
Congo Rep.of	--	--	36	3804
Nepal	48	3202	46	2545
Germany	++	319	++	80
USA	--	--	++	23
Maldives	--	--	++	13
China	--	--	++	9
South Africa	--	--	++	6
Other countries	22	2389	++	3

Figures rounded off

Imports

Imports of limestone increased slightly by 8% to 29.73 million tonnes in 2022-23 from 27.58 million tonnes in the previous year. On the other hand, imports of chalk in the year 2022–23 decreased moderately by 36% to 41 tonnes as against 64 tonnes in the previous year.

Limestone was imported mainly from UAE (83%), Oman (13%), and Malaysia (2%), while chalk was imported mainly from France & Spain (49% each).

Imports of calcium carbide increased marginally by 0.6% to 22,133 tonnes in 2022-23 from 22,008 tonnes in the previous year. Calcium carbide was imported mainly from China (88%) and Indonesia (12%). The imports of bleaching powder during 2022- 23 decreased by 45% to 17 tonnes as against 31 tonnes in the previous year. Imports were mainly from USA (70%) and Argentina (29%) (Tables-19 to 22).

Table-19: Import of Limestone

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**27582767**	**49014650**	**29736036**	**62593636**
UAE	24281405	39309027	24851743	48778721
Oman	2337928	4191555	3836422	8243536
Malaysia	648596	3627260	674307	3428226
Vietnam	114659	747183	102092	626056
Egypt	91165	376224	131341	560984
China	7563	244462	12151	296565
Thailand	7952	181001	8742	156213
UK	3002	70607	26363	133859
Bhutan	15509	35764	39731	101344
Belgium	93	2771	1276	59448
Other countries	74895	228796	51868	208684

Figures rounded off

(In tonnes)

Fig 2: Countrywise Import of Limestone

Table-20: Import of Chalk

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**64**	**2197**	**41**	**2191**
Spain	--	--	20	1118
France	60	1719	20	647
Taiwan	--	--	++	248
Germany	--	--	1	100
Italy	4	376	++	62
UK	++	2	++	16
Seychelles	++	53	--	--
China	++	30	--	--
USA	++	17	--	--

Figures rounded off

Table-21: Import of Calcium Carbide

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**22008**	**1576090**	**22133**	**1715011**
China	17400	1274224	19550	1529340
Indonesia	4590	299912	2583	183783
Switzerland	--	--	++	1850
Germany	--	--	++	38
USA	18	1954	--	--

Figures rounded off

Table-22: Import of Bleaching Powder

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**31**	**6228**	**17**	**5096**
Argentina	1	1400	5	3187
USA	30	4824	12	1909
Japan	++	4	--	--

Figures rounded off

FUTURE OUTLOOK

India has huge resources of limestone distributed over different parts of the country. It is comfortably placed in terms of annual capacity and production of cement. Cement-grade limestone occurs in all the limestone-bearing areas, while SMS, BF and Chemical-grade limestones occur in selective areas. Concerted efforts to locate SMS and BF grade limestone along with Cement-grade limestone are imperative to meet the growing demand.

The demand of raw materials for cement, such as, limestone and gypsum is expected to cause disruptive growth in the next few decades. The second largest Cement Industry in the world, the Indian Cement Industry, is expected to grow to an extent of 550 million tonnes per annum of capacity by FY2025.

The demand for paper in India is expected to rise at a healthy rate mainly due to the Packaging Industry and the increasing number of schools. The increasing number of construction projects is expected to lead to a thriving Building and Construction Industry in India. This is expected to contribute 10% to the GDP of India. Also with rising growth in Indian pharmaceutical and Food & Beverage industries, the consumption of calcium carbonate (limestone) in India is expected to increase.

India's domestic demand is being fulfilled as per the Government of India's new policy of allotment of mining blocks through auctioning. Up to 2022-23, a total of 241 blocks were auctioned. Out of these 241 blocks, 74 blocks were limestone blocks.

46. Magnesite

Magnesite, or $MgCO_3$, is a magnesium carbonate. This mineral is typically found in serpentine ultramafic rocks and other magnesium-rich rocks that have replaced dolomite and dolomitic limestone. It can be found as bedded deposits or irregular veins. Magnesite deposits in India are often crystalline, amorphous, or massive. The main impurities found in magnesite are calcium, silica, Fe_2O_3, and Al_2O_3. This mineral is essential for producing basic refractories, which are widely utilised in the steel industry. In business, the term 'magnesite' refers not only to the mineral but also to several products derived by calcining natural carbonate, such as caustic magnesite (magnesia obtained by calcining crude magnesite at comparatively low temperatures, 700 to 1,000 °C, and retaining 2 to 7% CO_2 as carbonate) and dead-burnt or refractory magnesite (magnesia obtained by calcining magnesite at high temperatures, 1,500 to 1,800 °C, usually containing less than 0.5% CO_2). In the trade, 'periclase' (MgO) is pure magnesite that has been calcined at higher temperatures (1,600-1,800 °C) to totally remove carbon dioxide. Dead burnt magnesite and fused magnesia are used in the refractory industry to produce various products. Caustic magnesia, also known as low calcined magnesite, is used as animal feed and to make oxichloride cement. The refractory industry is the primary consumer of magnesite.

RESERVES AND RESOURCES

According to the NMI database based on the UNFC system, the total reserves/resources of magnesite as of 1st April, 2020 are approximately 459 million tonnes, with 66 million tonnes in reserves and 393 million tonnes in remaining resources. Uttarakhand holds the most resources (52%), followed by Tamil Nadu (34%), and Rajasthan (12%). Resources are also found in Andhra Pradesh, Himachal Pradesh, Jammu and Kashmir, Karnataka, and Kerala.

Occurrences of magnesite in Tamil Nadu are low in lime and high in silica, whereas those of Uttarakhand are high in lime and low in silica. The gradewise and statewise reserves and resources of magnesite are furnished in Table - 1.

Table – 1 : Reserves/Resources of Magnesite as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	66070	393047	459118
By Grades			
High Grade	-	3336	3336
Medium Grade	63849	106968	170818
Beneficiable/Low	2154	153537	155691
High & Medium Mixed	-	2339	2339
Medium & Low Mixed	-	115910	115910
Others	6	7258	7264
Unclassified	-	83	83
Not-known	60	3617	3677
By States			
Andhra Pradesh	-	80	80
Himachal Pradesh	-	298	298
Jammu & Kashmir	-	4145	4145
Karnataka	1027	4516	5543
Kerala	-	40	40
Rajasthan	-	54091	54091
Tamil Nadu	55084	100402	155486
Uttarakhand	9959	229476	239434

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Review".

MINING LEASES & PRODUCTION

The total number of mining leases granted for Magnesite was 34 as on 31st March, 2023 with a cumulative lease area of 2303.79 ha. Production of magnesite in 2022-23 was 107526 tonnes as compared to 113495 tonnes in the previous year, a decreased of 5.26%. There were 10 reporting mines in 2022-23 which remained same as that of preceding year. Five principal producers accounted for about 98.48 % of the total output during the year 2022-23. Out of total production, about 56% of Magnesite was contributed by the Public Sector and the remaining 44% by Private Sector during 2022-23. Major magnesite producing mines in Salem area belong to Tamil Nadu Magnesite Ltd (TANMAG a State Government Undertaking), Ponkumar Magnesite Mines, Mysore Minerals, Dalmia Magnesite Corporation (a Private Sector Enterprise) and SAIL Refractory Co. Ltd (a Central Government Undertaking).Tamil Nadu is the major producing State with maximum contribution of 57.77% to the total output during 2022-23 followed by Uttarakhand and Karnataka. Mine-head closing stocks of magnesite for the year 2022-23 was 51357 tonnes as against 54360 tonnes in the previous year. The average daily employment of labour in magnesite mines during the year 2022-23 was 692 as against 656 in the previous year (Tables- 2 to 5).

Table-2: Principal Producers of Magnesite, 2022-23

Name & address of producer	Location of mine	
	State	District
Almora Magnesite Ltd	Uttarakhand	Bageshwar
S. Sundararajan,	Tamil Nadu	Salem
Tamil Nadu Magnesite Limited	Tamil Nadu	Salem
N.Rajashekar Talooru Magnesite Mines	Karnataka	Mysore

Table (3): Production of Magnesite, 2020-21 to 2022-23

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**74661**	**314676**	**113497**	**554772**	**107526**	**467062**
Karnataka	6611	39237	7057	51412	8197	64413
Rajasthan	-	-	-	-	1	5
Tamil Nadu	43613	227494	81013	454667	62123	329344
Uttarakhand	24437	47945	25427	48693	37205	73300

(In tonnes)

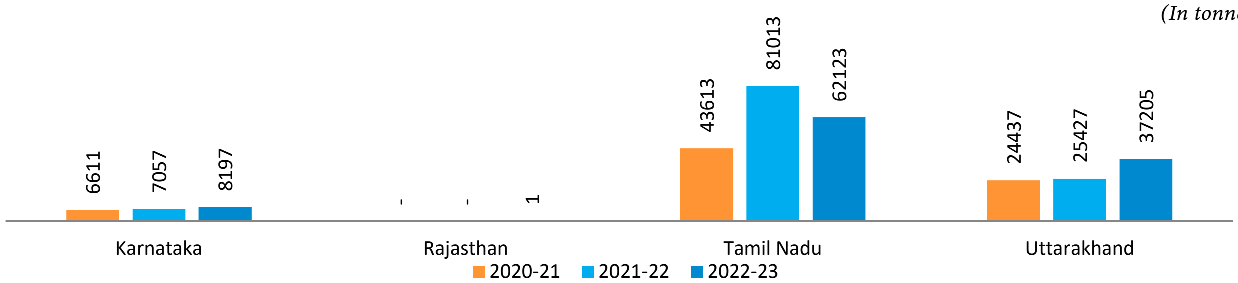


Fig 1 : Statewise Production of Magnesite

Table (4): Production of Magnesite, 2021-22 and 2022-23

(By Sectors/States/Districts)

(Qty. in tonnes; Value in ₹ '000)

State	2021-22			2022-23 (P)		
	No. of Mines	Qty	Value	No. of Mines	Production	Value
India	**10**	**113497**	**554772**	**10**	**107526**	**467062**
Public Sector	5	61324	288988	5	60461	215698
Private Sector	5	52173	265784	5	47065	251364
Jammu & Kashmir	-	-	-	-	-	-
Udhampur	-	-	-	-	-	-
Karnataka	3	7057	51412	3	8197	64413
Mysore	**3**	**7057**	**51412**	**3**	**8197**	**64413**
Tamil Nadu	5	81013	454667	5	62123	329344
Salem	5	81013	454667	5	62123	329344
Uttarakhand	1	25427	48693	1	37205	73300
Bageshwar	1	25427	48693	1	37205	73300
Rajasthan	1*	-	-	1	1	5
Pali	1*	-	-	1	1	5

(p) : Provisional
** : Only Labour reported.*
 # The data of 2021-22 has been taken from the monthly returns of the previous year

Table .(5): Mine-head closing stocks of Magnesite, 2021-22 and 2022-23

(By States)

(In tonnes)

State	2021-22	2022-23 (P)
India	**54360**	**51357**
Jharkhand	-	-
Karnataka	1786	3614
Rajasthan	30	31
Tamil Nadu	48521	41209
Uttarakhand	4023	6503

USES AND CONSUMPTION

The bulk of magnesite mined (about 98%) is converted into calcined form, which has numerous applications. Raw magnestite is also utilised in mosaic tiles, electrodes, chemicals, and magnesium metal manufacturing. Magnesite is also utilised in fertilisers and the food processing industry. As per the Industries Department of the Tamil Nadu Government's Policy Note 2016-17, producing one tonne of Dead Burnt Magnesite (DBM) requires around 2.7 tonnes of raw magnesite and 220 litres of furnace oil. Raw magnesite is dead-burned for making basic refractory bricks, basic refractory mortars, ramming mass, tar/pitch impregnated magnesite, magnesia-carbon bricks, slide-gate plates and other refractories.

The refractory industry is a major consumer of magnesite in India. Adverse components in the manufacture of refractories include SiO_2, CaO, Fe_2O_3, and Al_2O_3. The acceptable limits for these components are determined by their final use. The refractory bricks are created from Dead Burnt Magnesite by carefully blending several types of raw magnesite before dead-burning, or by blending different quality of Dead Burnt Magnesite prior to brick making.

The apparent consumption of magnesite in 2022-23 declined to around 604560 thousand tonnes from 619011 thousand tonnes the previous year.

INDUSTRY

Dead Burnt Magnesite (DBM)

Raw magnesite when calcined at temperatures in the range of 1,660–1,800 °C in the rotary kiln, carbon dioxide gets expelled completely and a dense product 'Dead Burnt Magnesite' is obtained. Dead Burnt Magnesite refers to the magnesite that is chemically unreactive or 'dead', therefore, enabling it to be used in brick making or monolithic hearths without undue difficulty arising out of hydration or shrinkage.

Caustic Calcined Magnesite (CCM)

Low calcined magnesite also known as Caustic Calcined Magnesite is obtained by calcining magnesite in a shaft or rotary kiln at temperature ranging between 800 °C and 1,000 °C. The incomplete dissociation causes retention of 8 to 10% carbon dioxide as carbonate. Low calcined magnesia when mixed with water forms a feebly plastic paste. Industries like paper, rubber, ceramic, asbestos products, glass, etc. use caustic magnesia.

Fused Magnesia

Fused magnesia is produced by the fusion of the high-grade magnesite in Higgin's or electric arc tilt furnaces between 2,500 °C and 3,000 °C. It is resistant to the action of molten metals, and fluxes and high temperatures. It is used in the form of moulded vessels and as compressed material for covering resistant elements of the furnaces used in the melting of lead, tin, etc.

As per the available information, presently there are seven major plants that manufacture Dead Burnt Magnesite, while there are four plants that produce calcinedmagnesite and one that produces fused magnesia (Table-7). By-product magnesium carbonate and other magnesium salts were also produced during salt manufacturing from sea water. Dalmia Magnesite Corporation and Tamil Nadu Magnesite Ltd are the major producers of DBM and caustic calcined grades.

As per Annual Report of National Mineral Development Corporation (NMDC) 2018-19, J &K Mineral Development Corporation Ltd, a subsidiary of NMDC has decided to set up a 30,000 TPA DBM plant at Panthal, Jammu. The Ministry of Environment, Forest and Climate Change granted Environment Clearance vide letter dated 03.05.2011. However, MoEF subsequently vide their letter dated 28.10.2016 had withdrawn the EC granted maintaining the earlier status..

Sea Water Magnesia (SWM)

Sea water or lake bitterns are an alternative source to obtain magnesia by chemical reaction. The main raw materials required other than sea water are dolomite or limestone, fresh water and sulphuric acid.

The magnesia content of sea water is about 0.2%, and even by enrichment with dolomite, around 300 kilograms sea water need to be processed to obtain one kilogram of magnesia. The sea water magnesia can be used to manufacture Dead Burnt Magnesite, caustic magnesia and other magnesium compounds.

Marine By-products

Carbonates, chlorides and sulphates of magnesium are obtained as by-products in the production of common salt by solar evaporation. Salt Commissioner, Jaipur, reported 8,101 tonnes production of magnesium chloride and 24 tonnes of by-product magnesium sulphate in 2018-19. The production is normally reported from the salt pans in Jamnagar–Gandhidham, Gujarat.

Magnesium Metal

Magnesium metal is a fairly strong, silvery-white, light-weight metal (about one-third lighter than aluminium). It is traditionally produced in ingot form of approximately 7 kg each with purity close to 99.9%. Its chief applications are, in die casting (alloyed with zinc), to remove sulphur in the production of iron and steel, for production of titanium in the Kroll process. The other application field of magnesium is in electronic devices. Defence equipment and nuclear reactor materials also consume magnesium.

Magnesium technology and its commercial production in India are still at its infancy. India has developed silico-thermic reduction process as well as fused salt electrolytic process, with capacity of 600 t/year for each process. However, the cost of production is very high as compared to the landed cost of imported magnesium metal. Hence, its production has been stopped by one of the companies. The production is only about 15–20% of the rated capacity.

SUBSTITUTES

In some refractory applications, alumina, chromite, and silica are used as substitutes for magnesium.

TRADE POLICY

In accordance with the ITC (HS) 2022 import policy in schedule-1 and export policy in schedule-2, natural magnesium carbonate (Magnesite), fused magnesia, dead-burned (Sintered) magnesia, whether or not containing small qualities of other oxides added before sintering, and other magnesium oxide, whether or not pure, are allowed freely with no restrictions.

WORLD REVIEW

Global magnesite reserves were 6800 million tonnes in terms of magnesium oxide content, omitting huge quantities of magnesium-bearing replacements such as dolomite, brucite, and olivine. Furthermore, magnesium compounds could be economically collected from well and lake brines, as well as from seawater. The latter, which contained 0.13% magnesium by weight, was an important source of magnesium metal and related derivatives. Russia held the largest percentage of global reserves (34%), followed by China (9%), Slovakia (5%), Australia and Greece (4% each), Brazil (3%), and Turkey (2%) Table 6 summarises the country wise world reserves of magnesite.

In 2022, the world production of magnesite was 32.2 million tonnes. China continued to be the biggest producer, accounting for over 59% of output, followed by Australia (8.39%), Russia (8.1%), Brazil (6.2%), and Turkey (5.65%). Table-7 summarises global magnesite production. China, Brazil, Australia, Turkey and Russia had the biggest magnesite production capacity, accounting for around 87% of total global production. The world's largest magnesite processing facilities are in China; Australia and Russia. These countries produced more 75% of the magnesia from magnesite globally in the year 2022.

The world production capacity for Caustic Calcined Magnesia was approximately 3.32 million tonnes per year, whereas Dead Burnt Magnesite was approximately 8.62 million tonnes per year. Over 98% of raw ore producers worldwide convert DBM to magnesia for commercial applications, primarily in the refractory industry (75%) for lining furnaces used in steel production, non-ferrous metals, cement, glass, ceramics, and petrochemicals. The United States, China, and Russia were the primary manufacturers of magnesium metal and alloys. Aluminium alloying, die-casting, and desulphurisation are the major market segments

Table – 6: World Reserves of Magnesite

(By Principal Countries)

(In '000 tonnes of magnesium oxide (MgO) content)

Country	Reserves
World : Total (rounded off)	6,800,000
Australia*	290,000
Austria	49,000
Brazil	200,000
China	580,000
Greece	280,000
India	82,000
Iran	12,000
Russia	2,300,000
Slovakia	370,000
Spain	35000
Turkey	110000
USA	35000
Other countries	2,500,000

Source: USGS, Mineral Commodity Summaries, 2023

**For Australia, Joint Ore Reserves Committee-compliant reserves were 37 million tonnes*

Table–7: World Production of Magnesite

(By Principal Countries)

(In tonnes metric)

Country	2020	2021	2022
World Total (rounded off)	**29 700 000**	**31 300 000**	**32 200 000**
China	* 19 000 000	* 18 000 000	* 19 000 000
Russia	* 2 600 000	* 2 600 000	* 2 600 000
Brazil [(c)]	1 993 600	* 2 000 000	* 2 000 000
Turkey	1 560 818	1 927 280	1 820 068
Australia	820 057	2 739 388	* 2 700 000
Austria	816 370	844 226	771 043
Spain	626 055	703 834	676 699
Slovakia	516 900	576 700	512 000
Greece	275 100	309 600	322 391
Other countries	1491100	1598972	1797799

Source: BGS, World Mineral Production, 2018-22.
** Estimated*
c: Including beneficiated and directly shipped material
g: Magnesium chloride

FOREIGN TRADE

Exports

The export of magnesite decreased by 2.25% to 5263 tonnes in 2022-23 from 5384 tonnes in the preceding year. Exports were mainly to Malaysia (23.4%), UAE (17.8%), Bangladesh (14.2%), and Vietnam (13.1%). Out of the total exports in 2022-23, those of fused magnesia was at 1 tonne as compared to 2 tonnes in the preceding year: calcined magnesite were at 401 tonnes as compared to 117 tonnes; non-calcined magnesite were at 460 tonnes as compared to 436 tonnes; other magnesite 2279 tonnes as compared to 2735 tonnes; and magnesium oxide 1260 tonnes as compared to 1886 tonnes in the preceding year. The export data of magnesite is given in Tables-8 & 9.

Table 8 Exports of Magnesite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**5384**	**173809**	**5263**	**239139**
UAE	294	9781	936	39773
Bangladesh	857	36145	747	27251
UK	45	12431	72	24144
Pakistan	1	489	34	20300
Thailand	378	21512	244	17140
Malaysia	1809	19347	1229	14913
Iran	--	--	45	11903
Vietnam	283	3001	691	7485
Singapore	318	14831	140	7250
Turkey	21	1083	67	6852
Other Countries	1378	55189	1058	62128

Figures rounded off

(In tonnes)

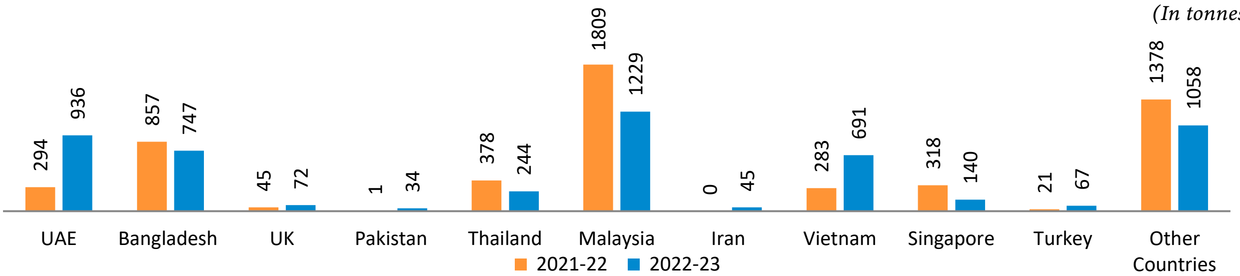


Fig 2:Countrywise Exports of Magnesite

Table 9 Exports of Magnesite

(Product Wise)

Product Name	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Total	**5384**	**173809**	**5263**	**239139**
Magnesia (fused)	2	585	1	781
Magnesite (calcined)	117	5014	401	14462
Magnesite (not Calcined)	436	11483	460	10164
Magnesite:dead-burntMagnesia	208	6829	862	37034
Magnesium Oxide	1886	110791	1260	139762
Others	2735	39107	2279	36936

Figures rounded off

Imports

The imports of magnesite decreased by 1.58% to 502837 tonnes in 2022-23 from 510898 tonnes in the year 2021-22. Imports were mainly from China (59.4%), Norway (14.4), UAE (6.8%), Turkey (5.7%) and Australia (5.2%). Out of the total imports in 2022-23, those of fused magnesia were at 47972 tonnes as compared to 42306 tonnes in the preceding year; calcined magnesite were at 48,967 tonnes as compared to 44231 tonnes in the previous year; non-calcined magnesite were at 27279tonnes as compared to 136894 tonnes in the previous year; other magnesite 135823 tonnes as compared to 49392 tonnes; magnesium oxide 63286 tonnes as compared to 67331 tonnes; and Dead burnt magnesite were at 179510 tonnes as compared to 170744 tonnes in the year 2021-22. The import data of magnesite is given in table-10 &11.

Table 10 Import of Magnesite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**510898**	**13106490**	**502837**	**15431256**
China	243309	7987513	298601	10055774
Australia	30489	1548995	26339	1524297
Turkey	50385	1383189	28795	1047026
Japan	2205	266456	3359	388153
Norway	--	--	72499	382034
Saudi Arabia	21979	346323	12108	290079
UAE	142056	407036	34385	220036
USA	1035	85916	2224	216903
Netherlands	2770	162528	2179	170450
Hong Kong	2266	65829	5827	138745
Other Countries	14404	852705	16521	997759

Figures rounded off

(In tonnes)

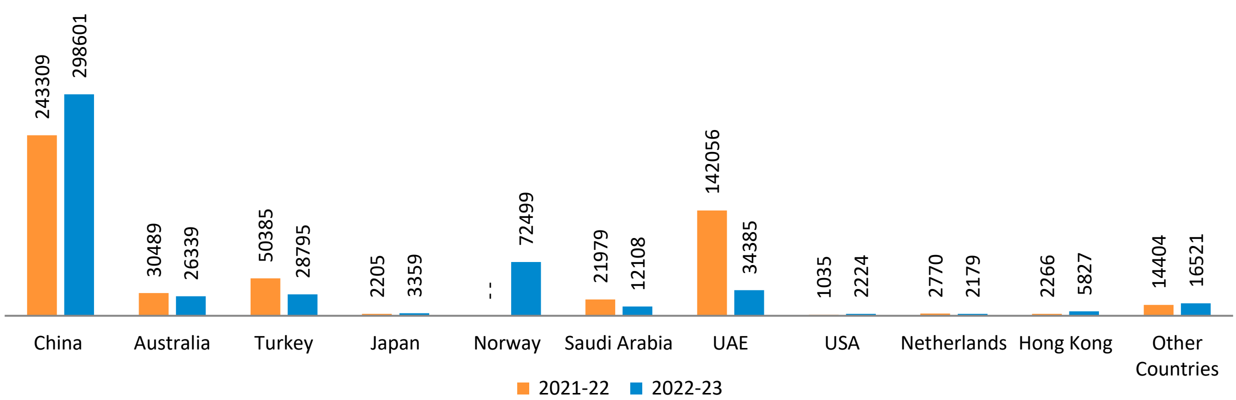


Fig 2:Countrywise Import of Magnesite

Table 11 Import of Magnesite

(Product Wise)

Product	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Total	**510898**	**13106490**	**502837**	**15431256**
Magnesia (fused)	42306	2614441	47972	3095460
Magnesite (calcined)	44231	940743	48967	1109909
Magnesite (not Calcined)	136894	317688	27279	140613
Magnesite:dead-burnt Magnesia	170744	5340576	179510	6135407
Magnesium Oxide	67331	2067467	63286	2443589
others	49392	1825575	135823	2506278

Figures rounded off

FUTURE OUTLOOK

In recent years, the global magnesite market has been steadily growing due to rising demand from different industries. The magnesite market size was estimated at USD 8.86 billion in 2021 and is expected to grow from USD 9.32 billion in 2022 to USD 13.98 billion in 2030, at a compound annual growth rate (CAGR) of 5.2% during the forecast period (2023-2030). Magnesite-based refractories are crucial for lining furnaces, kilns, and other high-temperature industrial equipment due to their high resistance to heat, corrosion, and mechanical stress. The increasing construction sector, specifically in developing countries like India, has also led to a need for magnesite-based refractories.

Asia-Pacific dominates the market because of various reasons like abundant magnesite reserves, widespread industrialization, and a thriving construction industry. Nations such as, India, China and South Korea play a significant role in the manufacturing and use of magnesite in the area. The increasing need for magnesite in steel production, refractories, cement manufacturing, and chemical industries continues to solidify Asia-Pacific's leading position in the global market.

In future, Middle East and Africa are projected to be the fastest-growing region in the worldwide magnesite market. The area is experiencing a rise in infrastructure growth, especially in nations such as Saudi Arabia, UAE, and South Africa. Magnesite is widely used in the construction sector for fireproofing, as well as in manufacturing magnesium-based chemicals and refractory materials. Rising construction projects and infrastructure investments are fuelling the need for magnesite in the Middle East and Africa, leading to its rapid growth in the market.

As India embarks on achieving its mission of being a developed nation by the middle of this century, the demand for magnesite is expected to rise in lockstep. Indian refractory industry is expected to expand further, benefiting from the government's series of policies aimed primarily at stimulating infrastructure development in the country. As demand for magnesite is likely to rise, major efforts to discover and utilise magnesite to fulfil future demand would be prudent.

47. Manganese Ore

Manganese occurs as silvery grey in colour and is very hard and brittle in nature. It is always available in combination with iron, laterite and other minerals. Manganese in alloy form is an essential inputin steel making and steel is one of the most important indicators of growth in the industrial economy of any country. In recent years, the trade volume of manganese ore has grown worldover. Presently, India is one of the major importers of manganese ore in the world. Manganese ores of major commercial importance are: (i) pyrolusite (MnO_2, Mn about 63.2%); (ii) psilomelane (manganese oxide, containing water and varying amounts of oxides of Ba, K and Na as impurities; Mn commonly 45–60%); (iii) manganite ($Mn_2O_3.H_2O$, Mn about 62.4%); and (iv) braunite ($3Mn_2O_3$, $MnSiO_8$, Mn about 62% and SiO_2 about 10%).

Indian manganese ore deposits occur mainly as metamorphosed bedded sedimentary deposits associated with Gondite Series (Archaeans) of Madhya Pradesh (Balaghat, Chhindwara & Jhabua districts), Maharashtra (Bhandara & Nagpur districts), Gujarat (Panchmahal district), Odisha (Sundargarh district) and with Kodurite Series (Archaeans) of Odisha (Ganjam&Koraput districts) and Andhra Pradesh (Srikakulam& Visakhapatnam districts).

RESERVES/RESOURCES

The total reserves/resources of manganese ore in the country as on 1.04.2020 has been placed at 503.62 million tonnes as per NMI database, based on UNFC system. Out of these, 75.04 million tonnes are categorised as Reserves and the balance 428.58 million tonnes are in the Remaining Resources category. Gradewise, Ferromanganese grade accounts for 8%, Medium grade 6%, BF grade 29% and the remaining 57% are of Mixed, Low, Others, Unclassified and Not-known grades including 0.16 million tonnes of Battery/ Chemical grade.

Statewise, Odisha tops the total reserves/resources with 34% share followed by Karnataka (24%), Madhya Pradesh (12%), Maharashtra (12%), Goa (7%), Andhra Pradesh (6%) and Jharkhand (3%). Rajasthan, Gujarat, Telangana and West Bengal together shared the remaining 2% resources (Table-1).

Table – 1 : Reserves/Resources of Manganese Ore as on 01.04.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**75041**	**428583**	**503624**
By Grades			
Battery/Chemical	-	167	167
Ferromanganese	16816	25251	42067
Medium	3850	30581	34430
BF	9892	138545	148437
Mixed	1517	23848	25365
Medium & BF mixed	6207	44877	51084
Ferromangane medium & BF mixed	24512	59696	84208
Ferromanganese & BF	2039	19197	21236
Low (-)25% Mn	2271	28485	30756
Beneficiable	2506	26826	29332
Others	4167	14772	18939
Unclassified	1265	14160	15425
Not-Known	-	2178	2178
By States			
Andhra Pradesh	8088	21756	29844
Goa	65	34436	34501
Gujarat	695	2180	2875
Jharkhand	1059	13691	14749
Karnataka	15464	108508	123972
Madhya Pradesh	19558	40499	60057
Maharashtra	17733	41303	59036
Odisha	11469	160058	171528
Rajasthan	568	1790	2359
Telangana	342	4162	4503
West Bengal	-	200	200

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION AND STOCKS

The production of manganese ore at 2,827 thousand tonnes during 2022-23 increased by 5% as compared to the previous year. There were 133 reporting mines during the year 2022-23 as against 134 in the previous year. Besides, manganese ore production was reported asassociate mineral by 11 mines in 2022-23. In 2022-23, thirty public sector mines jointly accounted for around 46% of the total production. The contribution of captive mines was around 15% of the total production. As regards gradewise composition of production in 2022-23, around 69% of the total production was of lower grade (Below 35% Mn), around 22% of medium grade (35-46% Mn) and around 8% was of higher grade (Above 46% Mn). Production of manganese dioxide was 24706 tonnes (0.87%) during the year (Tables- 2 to 7B).

Table – 2 : Principal Producers of Manganese Ore, 2022-23

Name & address of producer	Location of mine	
	State	District
MOIL Ltd., MOIL Bhavan, 1A – Katol Road, Nagpur -440013, Maharashtra.	Madhya Pradesh Maharashtra	Balaghat Bhandara Nagpur

Name & address of producer	Location of mine	
	State	District
Tata Steel Ltd., Bombay House, 24, Homi Mody Street, Fort, Mumbai – 400001 Maharashtra.	Odisha	Kendujhar
The Sandur Manganese & Iron Ores Ltd., Satyalaya, Door No. 266 (Old no.80), Ward No. 1, Behind Taluk office, Sandur- 583119, Karnataka.	Karnataka	Ballari
R.B.S.S. Durga Prasad & F.N.Das, Mor Bhavan, Ramdaspeth, Nagpur-440010, Maharashtra.	Andhra Pradesh	Vizianagaram
Mr. Debabrata Behera, 1234/P Govind Prasad, Bomikhal, Rasulgarh, Bhubaneswar-751010, Odisha.	Odisha	Kendujhar
Yazdani Steel & Power Ltd. 5th Floor, Fortune Tower, A- Wing, Bhubaneswar-751023, Odisha.	Odisha	Sundargarh
Patnaik Minerals Pvt. Ltd., Boneikalajoda, Barbil - 758038 Distt. Kendujhar, Odisha.	Odisha	Sundargarh
S.K. Sarawagi & Co. Private Limited, 10/1/31, Signature Towers, Level-4, Waltair Uplands, Visakhapatnam - 530003, Andhra Pradesh.	Andhra Pradesh	Vizianagaram
Krishnaping Alloys Ltd., Pinnacle Corporate Park, A-402, Next to Trade Centre, BKC, Bandra East, Mumbai – 400051, Maharashtra.	Madhya Pradesh	Chhindwara
A.P. Trivedi Sons, Main Road, Balaghat – 481001, Madhya Pradesh.	Madhya Pradesh	Balaghat

Table – 3 : Principal Producers of Manganese Dioxide Ore, 2022-23

Name & address of producer	Location of mine	
	State	District
MOIL Ltd., MOIL Bhavan, 1A – Katol Road, Nagpur -440013, Maharashtra.	Maharashtra	Bhandara

Table – 4 : Production of Manganese Ore, 2020-21 to 2022-23

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**2703313**	**17415461**	**2692408**	**22067826**	**2826964**	**22909630**
Andhra Pradesh	250255	848621	204002	1115138	213790	1377386
Jharkhand	0	0	0	0	0	0
Karnataka	371045	2359787	380004	3167390	344731	2553838
Madhya Pradesh	934548	5684482	845351	6842478	855874	7491347
Maharashtra	646513	6485961	732018	8425784	751104	8382578
Odisha	482915	1948077	512591	2429734	644218	2999142
Rajasthan	6940	20820	8008	25626	6437	22528
Telangana	11097	67713	10434	61676	10810	82811

(In tonnes)

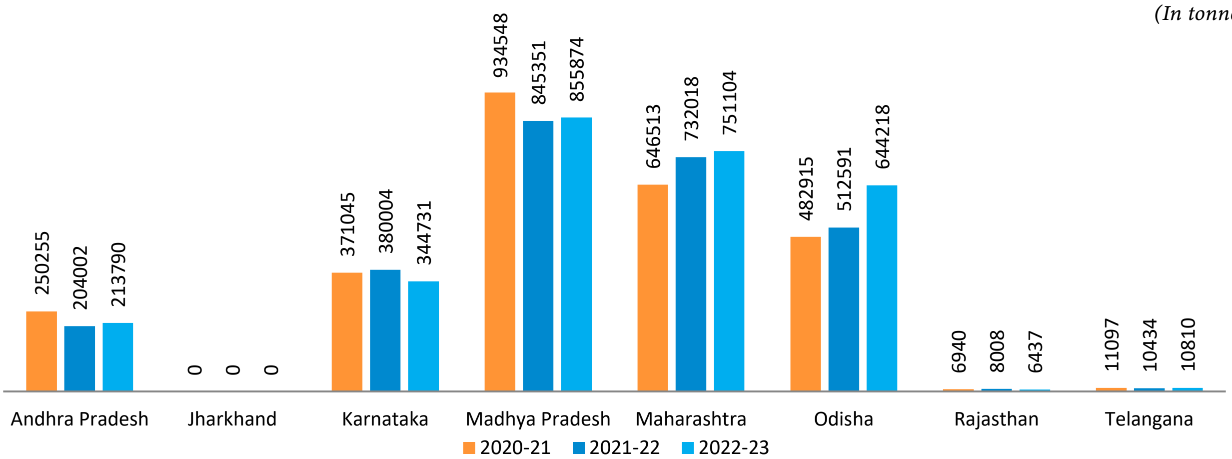


Fig 1: Production of Manganese ore

Table – 5 (A): Gradewise Production of Manganese Ore, 2021-22

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹ '000)

State/District	No. of mines	Production By Grades: Mn Content					Total	
		MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Quantity	Value
India	**134(14)**	**11848**	**219170**	**612347**	**1070987**	**778056**	**2692408**	**22067826**
Public Sector	33	20701	138321	405780	602046	80814	1238812	13502028
Private Sector	101(14)	-	80849	206564	468941	697242	1453596	8565798
Andhra Pradesh	**20**	**-**	**-**	**26050**	**48134**	**129818**	**204002**	**1115138**
Vizianagaram	20	-	-	26050	48134	129818	204002	1115138
Goa	**2***	**-**	**-**	**-**	**-**	**-**	**-**	**-**
South Goa	2 *	-	-	-	-	-	-	-
Karnataka	**8(3)**	**-**	**-**	**62021**	**199186**	**118797**	**380004**	**3167390**
Ballari	1(2)	-	-	62021	182231	47767	292019	2885676
Chitradurga	1	-	-	-	4200	9300	13500	53130
Davanagere	4	-	-	-	12755	50430	63185	208446
Tumakuru	2(1)	-	-	-	-	11300	11300	20138
Madhya Pradesh	**46(7)**	**-**	**109234**	**107580**	**390378**	**238159**	**845351**	**6842478**
Balaghat	35	-	109234	104812	342131	95875	653042	6162985
Chhindwara	4	-	-	1266	2631	15464	19361	91854
Jabalpur	6(7)	-	-	200	-	123425	123625	326537
Jhabua	1	-	-	1302	44626	3395	49323	261102
Maharashtra	**28**	**11848**	**29465**	**326144**	**321315**	**43246**	**732018**	**8425784**
Bhandara	5	11848	2249	251088	181732	22336	469253	5384472
Nagpur	23	-	27216	75056	139583	20910	262765	3041312
Odisha	**21(4)**	**-**	**80471**	**90552**	**97957**	**243611**	**512591**	**2429734**
Kendujhar	13(3)	-	80471	88183	82822	174094	425570	2039699
Raygada	1	-	-	-	225	-	225	1283
Sundargarh	7(1)	-	-	2369	14910	69517	86796	388752
Rajasthan	**1**	**-**	**-**	**-**	**8008**	**-**	**8008**	**25626**
Banswara	1	-	-	-	8008	-	8008	25626
Telangana	**8**	**-**	**-**	**-**	**6009**	**4425**	**10434**	**61676**
Adilabad	8	-	-	-	6009	4425	10434	61676

Figures in parentheses indicate associate mines of iron ore, laterite, limestone and clay (others)
** Only labour reported.*

Table – 5 (B) : Gradewise Production of Manganese Ore, 2022-23 (P)

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹ '000)

State/District	No. of mines	Production By Grades: Mn Content					Total	
		MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Quantity	Value
India	**133(11)**	**24706**	**221112**	**613699**	**1186250**	**781197**	**2826964**	**22909630**
Public Sector	30	24581	145318	383171	645695	110520	1309285	14116929
Private Sector	103(11)	125	75794	230528	540555	670677	1517679	8792701
Andhra Pradesh	**19**	**-**	**-**	**46970**	**34182**	**132638**	**213790**	**1377386**
Vizianagaram	19	-	-	46970	34182	132638	213790	1377386
Goa	**2***	**-**	**-**	**-**	**-**	**-**	**-**	**-**
South Goa	2*	-	-	-	-	-	-	-
Karnataka	**10(2)**	**125**	**105**	**55584**	**184668**	**104249**	**344731**	**2553838**
Ballari	2(2)	-	105	55584	182039	56344	294072	2442203
Chitradurga	2	125	-	-	874	2000	2999	13713
Davanagere	4	-	-	-	1755	36005	37760	77736
Tumakuru	2	-	-	-	-	9900	9900	20186
Madhya Pradesh	**50(5)**	**-**	**118483**	**95437**	**410702**	**231252**	**855874**	**7491347**
Alirajpur	1		-	-	-	766	766	2854
Balaghat	38(5)	-	118085	91132	363295	132543	705055	6832353
Chhindwara	4	-	398	2870	17608	24840	45716	246870
Jabalpur	6	-	-	-	-	73103	73103	213298
Jhabua	1	-	-	1435	29799	0	31234	195972
Maharashtra	**29**	**24581**	**27756**	**316466**	**343447**	**38854**	**751104**	**8382578**
Bhandara	5	24581	2557	241473	180025	14185	462821	5319675
Nagpur	24	-	25199	74993	163422	24669	288283	3062903
Odisha	**15(4)**	**++**	**74768**	**99242**	**198127**	**272081**	**644218**	**2999142**
Kendujhar	9(3)	++	74768	98167	179366	182172	534473	2569869
Rayagada	1	-	-	1	74	-	75	542
Sundargarh	5(1)	-	-	1074	18687	89909	109670	428731
Rajasthan	**1**	**-**	**-**	**-**	**6437**	**-**	**6437**	**22528**
Banswara	1	-	-	-	6437	-	6437	22528
Telangana	**7**	**-**	**-**	**-**	**8687**	**2123**	**10810**	**82811**
Adilabad	7	-	-	-	8687	2123	10810	82811

Figures in parentheses indicate associated mines of iron ore, laterite, limestone and quartz.
** Only labour reported.*

Table – 6 : Production of Manganese Ore, 2021-22 and 2022-23

(By Frequency Groups)

(Qty in tonnes)

Production	No. of mines		Production		Percentage in total Production		Cumulative percentage	
	2021-22	2022-23 (P)	2021-22	2022-23 (P)	2021-22	2022-23 (P)	2021-22	2022-23 (P)
Total	**134(14)**	**133(11)**	**2692408**	**2826964**	**100**	**100**	**-**	**-**
Up to 1000	63(2)	58(1)	12357	8666	0.46	0.31	0.46	0.31
1001 – 5000	24(4)	33(4)	74869	95537	2.78	3.38	3.24	3.69
5001 – 10000	12(2)	11(1)	106347	92583	3.95	3.27	7.19	6.96
10001 – 20000	13(1)	8(1)	186682	133941	6.93	4.74	14.12	11.7
20001 – 30000	2(1)	1(1)	80942	41524	3.01	1.47	17.13	13.17
30001 – 40000	4(2)	5(1)	202876	205535	7.54	7.27	24.67	20.44

Table- 6 (Concld.)

(Qty in tonnes)

Production	No. of mines		Production		Percentage in total Production		Cumulative percentage	
	2021-22	2022-23 (P)	2021-22	2022-23 (P)	2021-22	2022-23 (P)	2021-22	2022-23 (P)
40001 – 50000	3(1)	4	184442	189918	6.85	6.72	31.52	27.16
50001 and above	13(1)	13(2)	1843893	2059260	68.48	72.84	100	100

Figures in parentheses indicate associated mines of iron ore, laterite, limestone and clay (others)

Table – 7 (A) : Mine-head Closing Stocks of Manganese Ore, 2021-22 (P)

(By States/Grades)

(In tonnes)

State	Grades : Mn content					
	MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Total Quantity
India	**10490**	**15746**	**69597**	**385992**	**2344928**	**2826753**
Andhra Pradesh	-	-	2054	41408	41694	85156
Goa	-	-	-	250	-	250
Jharkhand	-	1	-	120	-	121
Karnataka	-	-	6441	85957	232984	325382
Madhya Pradesh	-	10338	18096	42623	847849	918906
Maharashtra	10108	2488	17145	22621	27927	80289
Odisha	382	2919	25861	192306	1193489	1414957
Rajasthan	-	-	-	103	-	103
Telangana	-	-	-	604	985	1589

Table – 7 (B) : Mine-head Closing Stocks of Manganese Ore, 2022-23(p)

(By States/Grades)

(In tonnes)

State	Grades : Mn content					
	MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Total Quantity
India	**20510**	**24768**	**68023**	**336141**	**2600505**	**3049947**
Andhra Pradesh	-	-	762	28999	72542	102303
Goa	-	-	-	-	-	-
Jharkhand	-	-	-	28	-	28
Karnataka	125	-	2112	35455	296158	333850
Madhya Pradesh	-	15653	21891	48557	881831	967932
Maharashtra	20179	5737	14593	41855	50631	132995
Odisha	206	3378	28665	179567	1298522	1510338
Rajasthan	-	-	-	1078	-	1078
Telangana	-	-	-	602	821	1423

Madhya Pradesh is the leading producing State of manganese ore which accounted for 30.28% of total production in 2022-23 followed by Maharashtra 26.57% and Odisha 22.79%. The mine-head closing stock was 3,050 thousand tonnes for the year 2022-23 as against 2,827 thousand tonnes for the previous year. The average daily employment of labour in manganese ore mines was 12,542 in 2022-23 as against 10,600 in the previous year.

MINING, PROCESSING, MARKETING & TRANSPORT

Manganese ore mining in the country is carried out by opencast as well as by underground methods. Of the 135 mines, 8 are underground (3 in Madhya Pradesh and 5 in Maharashtra). Seven underground mines were operated by MOIL Ltd, a Public Sector company, and one by M/s J.K. Minerals, Balaghat (Madhya Pradesh), a private company. All the underground mines are mechanised or semi-mechanised and adopt cut-and-fill method of stoping. In Kandri mine, hydraulic sand stowing has been introduced in place of manual filling system. This system is faster, cheaper and requires less manpower. Conventional timber supports are replaced by cable bolting pre-mining support to increase safety and productivity. In Balaghat underground mechanised mine, overhand flat back cut-and-fill method with rock bolting support and sand stowing is being practised to fill up the voids with a level interval of

30 m and size of stope block as 30 m x 30 m to 60 m x 30 m. Side Dump Loaders (SDL) of 0.66 cu. m bucket capacity were also deployed in underground levels for mechanised loading of run-of-mine (r.o.m.) in stopes. Tyre mounted Rocker shovel was also introduced in Balaghat mine for mechanised loading of ore from ore drive at stripping area. Deepening of high speed vertical shaft up to 750 m in Balaghat, up to 169 m in Chikla mine, up to 245 m in Kandri mine and up to 160 m in Mansar mine of MOIL is in progress. Sinking of high speed vertical shafts up to 160 m, 330 m and 324 m is in progress at Mansar, Gumgaon and Ukwa mines, respectively. MOIL has also plans to increase its production from present level of 1.2 million tonnes to 3.00 million tonnes by 2030.

The open-pits are usually worked manually by benching method, using portable compressors, jackhammers and dumper trucks. Tirodi mine of MOIL is worked by opencast mechanised method. Height of the benches in overburden is kept at 7.5 m and that in the ore at 6 m. Drills of 100 mm dia. with 0.9 to 1.7 m3 capacity of shovels and 20–25 tonnes dumpers are used for production, loading and transport.

The workings vary from shallow depth in lateritoid-type deposits in Odisha, Karnataka and Goa to deep operations in deposits of a more regular nature found in Madhya Pradesh, Maharashtra and Andhra Pradesh. Bulldozers are used where the overburden is soft. In a few cases, tramways are laid up to the working face and loaded tubs are pushed manually to the dumping ground. In Odisha, Goa and Karnataka, ore is worked by loosening the ground either with crowbars or by blastings. After picking up manganese ore, the waste is removed to the dumping ground. Mining of bedded ore in Madhya Pradesh and Maharashtra is generally carried out by drilling and blasting.

Hand sorting and visual grading are adopted widely to upgrade the ore. Scrubber is also used for washing the ore at some mines. Manual as well as mechanised jigging is done in a few mines.

MOIL has set up an integrated manganese ore beneficiation plant at Dongri Buzurg Mine in Bhandara district, Maharashtra, with 4 lakh tonnes annual capacity to process r.o.m. The plant is equipped with handling, crushing, wet screening, drying and magnetic separation facilities in one complex. It has also installed a manganese ore beneficiation plant of 5,00,000 tonnes per annum capacity at Balaghat mine in order to conserve mineral and profitably utilise the low/medium- grade ore. The plant facilities include crushing, wet screening, classification and jigging operations.

The plant upgrades the low/medium-grade fines into high grade and the value addition is around 3-4 times, in case of low-grade fines. The Company has plans to set up a sintering plant for agglomeration of these fines. After agglomeration, these fines will be utilised

in ferroalloys production.

Most of the producers market manganese ore directly to the industrial units. In a few cases, especially in case of supplies of special type of ore or a semi-processed product, middlemen are found to be involved in marketing. Ore from mines is usually sold to the domestic consumers, either at the rail-head or ex-plant. In cases of Integrated Iron & Steel and Ferromanganese Industry, the units draw their supplies largely from captive mines. However, special ore types for specific purposes are obtained from other producers. In case of ore meant for exports, producers other than MOIL Ltd supply it to MMTC, the canalising agency, either at rail-head or at the port.

Transport of manganese ore from mines to rail-head is generally done by trucks from where it is transported to ports by rail wagons. From the mine of MOIL in Balaghat district, Madhya Pradesh, the ore is transported by aerial ropeways to the loading bins at the rail-heads. Battery loco was introduced for underground transport of r.o.m. tub from ore pass chute to skip bunker. In Goa, ore in bulk is carried by road-cum-river routes up to Mormugao harbour and in a few cases by rail where the mines are close to the railways. The ore loading at river-head into barges is carried out mechanically.

USES & CONSUMPTION

Manganese ore is an important material in iron and steel metallurgy, where it is used both in the ore form and as ferromanganese. Manganese improves strength, toughness, hardness and workability of steel, acts as a deoxidiser and desulphuriser, and also helps in getting ingots free from blowholes. About 90 to 95% world production of manganese ore is used in metallurgy of iron and steel. High amount of phosphorous makes the manganese ore unsuitable for its metallurgical use, whereas, high phosphorous and high iron contents make it unsuitable for Battery Industry. Manganese has no satisfactory substitute in its major applications.

For manganese ore used in Ferromanganese Industry, besides manganese content, other important considerations are high manganese to iron ratio and a very low content of deleterious phosphorous. Manganese dioxide is used for manufacturing dry cell batteries in which it functions as a depolariser of hydrogen. Suitability of ore depends not only on manganese dioxide content but also on its crystallographic structure. Ore having predominant gamma structure is required. The ore must have high manganese dioxide and low iron content, a certain degree of porosity and moderate hardness. It should be free from metallic compounds, such as, copper, nickel, cobalt, arsenic, lead and antimony, which are electronegative to zinc (container).

Pyrolusite is used generally to impart glaze to the pottery and to make coloured bricks. It also finds use as driers for oils, varnishes and paints. Manganese sulphide is used in the manufacture of salts and in calico printing. Manganese chloride is used in cotton textile as a bronze dye. Manganese salts are used in photography and in leather and matchbox industries.

The apparent consumption of manganese ore was about 7.46 million tonnes in 2022-23 as against 9.07 million tonnes in 2021-22.

INDUSTRY

Manganese alloys are the largest produced ferroalloys in the world with a share of about 41% of the global production of ferroalloys. For production of one tonne of ferromanganese, about 2.6 tonnes of manganese ore, 0.5 tonne of reductant and 3 MWh of electricity inputs are required. As per Indian Ferro Alloys Producers' Association (IFAPA), the total installed capacity of manganese alloys including ferromanganese/silicomanganese in the country was estimated to be around 3.16 million tonnes per annum.

MOIL had set up a High Intensity Magnetic Separation Plant and 1,500 tpy Electrolytic Manganese Dioxide (EMD) Plant at Dongri Buzurg Mine.

Dry Battery

Dry battery Industry also consumes EMD along with natural manganese dioxide ore. The only one plant of 1,500 tpy capacity producing EMD is owned by MOIL and is located in Bhandara district of Maharashtra. Sale quantity of EMD has increased from 996 tonnes in the year 2021-22 to 1448 tonnes in the year 2022-23.

SUBSTITUTES

Cost and technology militate against substitution in major applications. However, for economic reasons, there is only limited substitution in minor applications in Chemical and Battery industries. The Steel Industry has, however, made great strides in economising the use of manganese, largely through changes in steel-making techniques.

TECHNICAL POSSIBILITIES

The deep-sea nodules can be a potential resource of manganese in the next decades to come. There is a trend towards using lower grades of ores in ferromanganese production. New steel-making practices and techniques are reducing the amount of manganese consumed in the process. However, counter balancing this to some extent is a trend towards higher manganese specifications for modern steels.

TRADE POLICY

Export Policy

The Foreign Trade Policy, 2015-20 and the policy on export as per ITC (HS), 2018 schedule 2 as follows:

HS Code	Item description	Policy
2602 00	Manganese ores and concentrates including ferruginous Manganese ores and concentrates with Manganese content of 20% or more calculated on the dry wet.	Free

Import Policy

Imports of manganese ore and concentrates including ferruginous manganese ores and concentrates containing 20% or more manganese (calculated on dry weight basis), agglomerated manganese ore sinters, etc. are freely allowed.

WORLD REVIEW

The total world reserves of manganese ore is approximately 1700 million tonnes of metal content which is unevenly distributed (Table-11). Reserves are located in South Africa (38%), China (16%), Brazil (16%), Australia (16%) and Ukraine (8%). Only a small fraction of global manganese reserves is economical. This fact continues to prompt and support interests in deep-sea manganese nodules, which constitute an enormous untapped resource (Table-8).

World production of manganese ore in 2022 was estimated to be around 54 million tonnes same as that in 2021. South Africa was the leading producer contributing about 35% followed by Gabon (19%), Australia (11%), China (9%) and Ghana (6%) (Table-9). The production of manganese ore is linked with the production of steel. The Steel Industry consumes it in the form of ore and manganese alloys.

Table – 8 : World Reserves of Manganese Ore

(By Principal Countries)

(In '000 tonnes of metal content)

Country	Reserves
World: Total (rounded off)	1700000
South Africa	640000
China,	280000
Australia	270000
Brazil	270000
Ukraine (concentrate)	140000
Gabon	61000
India*	34000
Ghana	13000
Kazakhstan, (concentrate)	5000

Table- 8 (Concld)

(In '000 tonnes of metal content)

Country	Reserves
Mexico	5000
Other countries	Small

Source: USGS Mineral Commodity Summaries, 2022.
(a): Joint Ore Reserve Committee compliant reserves were about 76 million tonnes gross weight.
NA: Not Available; - : Zero
**: India's total reserves/resources of manganese ore as per NMI database based on UNFC system have been estimated at 503.62 million tonnes as on 1.4.2020.*

Table – 9 : World Production of Manganese Ore

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World:Total	**52100000**	**54000000**	**54200000**
South Africa	16198506	19156479	18966594
Gabon	8147000	9241000	10200000
Australia	6425848	6188587	6665707
China	*6600000	*5000000	*5000000
Ghana	2357515	3336273	3171722
India[(a)]	*2688038	*2695991	*2798694
Brazil	2469313	1435561	1344155
Kazakhstan	813500	1248700	1100000
Ivory Coast	1325525	928930	*929000
Ukraine	*1850000	*1850000	*900000
Other countries	*3224755	*2918479	*3124128

Source: BGS, World Mineral Production, 2018-2022.
(a): Years ended 31st March following that stated.
**Estimate*

FOREIGN TRADE

Exports

Exports of manganese ore (total) decreased by 98% to 1,557 tonnes in 2022-23 from 1,13,606 tonnes in 2021-22. Out of the total exports in 2022-23, 1,337 tonnes of manganese ore having +46% Mn was exported. Exports of manganese ore (others) were at 190 tonnes as compared to 70,636 tonnes in the preceding year. About 88% of exports of Manganese ore total were to UAE followed by Nepal with 12%. (Tables- 10 to 14).

Table – 10 : Exports of Manganese Ore : Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**113606**	**588189**	**1557**	**21566**
UAE	18363	320917	1367	20371
Nepal	15	906	190	1164
Tanzania	4	41	++	24
Spain	--	--	++	7
China,	70569	203405	--	--
Indonesia	24620	61977	--	--
Bangladesh	22	667	--	--
Germany	13	257	--	--
Djibouti	++	19	--	--

Figures rounded off

(In tonnes)

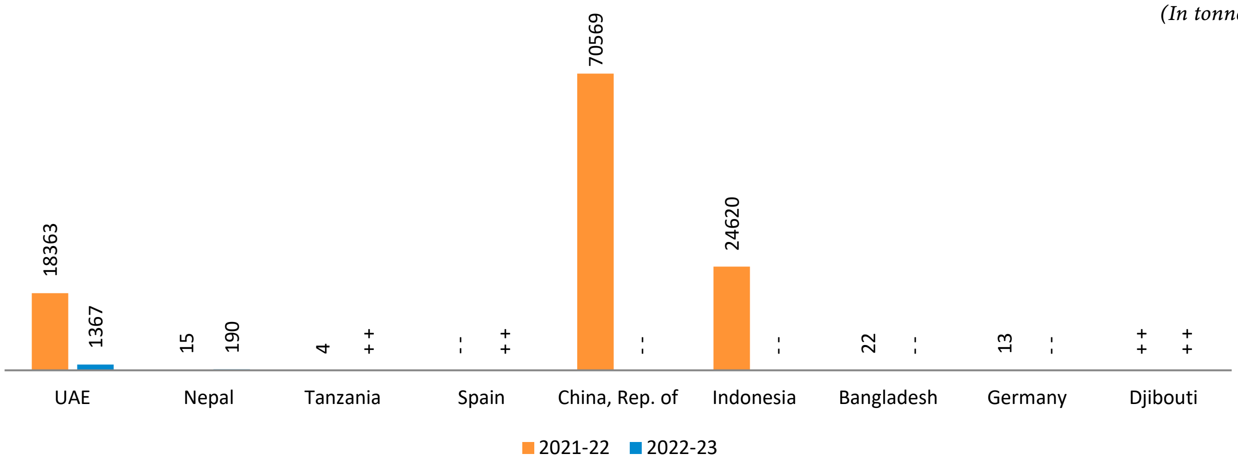


Fig. 2: Countrywise Export of Manganese Ore

Table – 11 : Exports of Manganese Ore (46% or more Mn)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**18379**	**321424**	**1367**	**20378**
UAE	18363	320917	1367	20371
Spain	--	--	++	7
Bangladesh	16	507	--	--

Figures rounded off

Table – 12 : Exports of Manganese Ore (Others)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**70636**	**206256**	**190**	**1164**
Nepal	++	26	190	1164
China	70569	203405	--	--
Indonesia	50	2527	--	--
Germany	13	257	--	--
Tanzania	4	41	--	--

Figures rounded off

Table - 13 : Exports of Manganese Ore (35% or More but Below 46% Mn)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**21**	**1059**	**++**	**24**
Tanzania	--	--	++	24
Nepal	15	880	--	--
Bangladesh	6	160	--	--
Djibouti	++	19	--	--

Figures rounded off

Table – 14 : Exports of Manganese Ore (Ferruginous, 10% or More but Below 30% Mn)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**24570**	**59450**	**--**	**--**
Indonesia	24570	59450	--	--

Figures rounded off

Imports

Imports of manganese ore (total) decreased drastically by 28% to 4.64 million tonnes in 2022-23 from 6.50 million tonnes in the previous year. South Africa (40%), Gabon (18%), Australia (10%) and Singapore (9%) were the main suppliers of manganese ore in 2022-23. Out of the total manganese ore imported, the contribution of manganese ore having +46% Mn was 47,028 tonnes (1%), manganese ore having 35-46% Mn was 37,84,373 tonnes (82%), manganese ore having 30 to 35% Mn was 1,89,188 tonnes (11%) and manganese ore (others) was 4,40,893 tonnes (10%). (Tables- 15 to 20).

Table – 15: Imports of Manganese Ore : Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6500149**	**96424799**	**4641809**	**82621009**
South Africa	2851947	39684590	1843078	30508646
Gabon	1371423	22766318	831403	15971671
Australia	525185	9318282	443527	10544492
Singapore	361419	6085643	427995	8674202
UAE	670246	8982902	582442	8642386
France	169445	2949149	141396	3037668
Hong Kong	56643	764844	169403	2167328
Brazil	116332	1981983	68911	1296699
Cote D' Ivoire	130809	1843644	79232	863790
Switzerland	14061	135832	18425	262072
Other Countries	232639	1911612	35997	652055

Figures rounded off

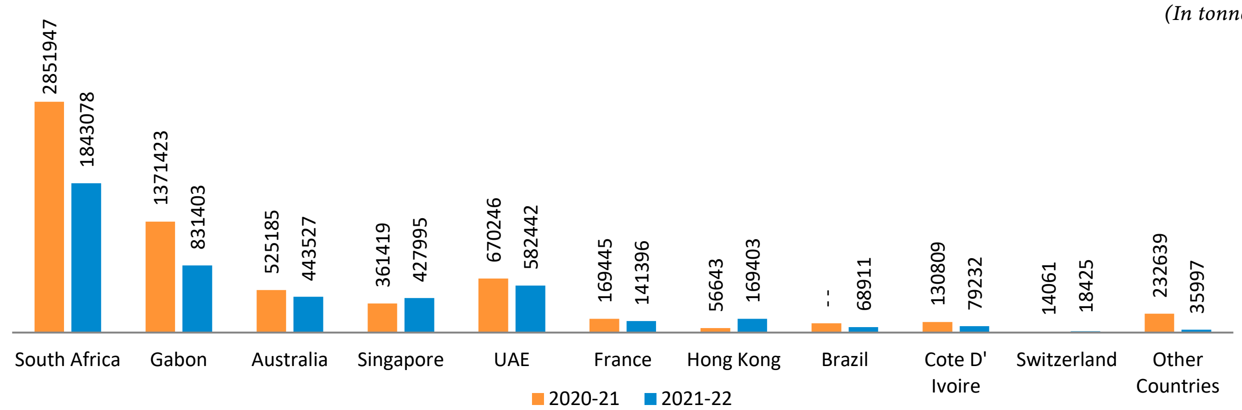


Fig 3: Countrywise Import of Manganese Ore

Table – 16 : Imports of Manganese Ore (46% or more Mn)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**185816**	**3797474**	**47028**	**1042963**
South Africa	79968	1372767	23163	480131
Tanzania	12882	245260	7834	197825
Brazil	11807	215841	8402	184115
Kenya	77	987	3725	86471
Zambia	8838	164417	1421	38655
Cote D' Ivoire	15361	578038	1866	27082
Peru	545	6056	322	13939
China,	3935	154284	162	10758
UAE	18776	299148	83	2249
Morocco	--	--	50	1736
Other Countries	33627	760676	++	2

Figures rounded off

Table – 17 : Imports of Manganese Ore

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**4464163**	**69812534**	**3784313**	**69173601**
South Africa	1586523	23294128	1420850	22905081
Gabon	1066980	18872085	741549	14918735
Australia	525185	9318244	443527	10544492
UAE	347876	5461931	452352	7328598
Singapore	319536	5336575	330272	6743767
France	169445	2949149	141396	3037530
Hong Kong	40055	578472	124168	1649466
Brazil	101505	1739842	60435	1111841
Cote D' Ivoire	115448	1265606	38866	470003
Switzerland	3236	46520	18425	262072
Other Countries	188374	949982	12473	202016

Figures rounded off

Table – 18 : Imports of Manganese Ore (30% or more but below 35% Mn)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**929453**	**9970098**	**189188**	**2136109**
Gabon	244564	3024339	89854	1052936
Hong Kong	15969	175569	38597	447670
Cote D' Ivoire	--	--	38500	366705
South Africa	500060	4878179	20252	250675
Kenya	1905	16654	1911	17380
Brazil	2852	24645	74	743
UAE	151239	1736259	--	--
Switzerland	9511	77333	--	--
Seychelles	1644	17667	--	--
Tanzania	691	8744	--	--
Other Countries	1018	10709	--	--

Figures rounded off

Table – 19 : Imports of Manganese Ore (Others)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**613709**	**9915315**	**440893**	**8601210**
South Africa	504069	8449594	319365	6303464
Singapore	39272	704196	97723	1930435
UAE	27214	248967	19305	320093
Hong Kong	--	--	3358	35360
Kenya	--	--	707	5634
Tanzania	53	645	192	3597
Korea,	--	--	216	1694
Zambia	++	68	27	756
France	--	--	++	138
Germany	++	18	++	39
Other Countries	43101	511827	--	--

Figures rounded off

Table – 20 : Imports of Manganese Ore (Ferruginous, 10% or more but Below 30% Mn)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**307008**	**2929378**	**180387**	**1667126**
UAE	125141	1236597	110702	991446
South Africa	181327	1689922	59448	569295
Seychelles	--	--	6957	71553
Hong Kong	--	--	3280	34832
Kenya	540	2859	--	--

Figures rounded off

FUTURE OUTLOOK

As per World Steel Association, India's per capita steel consumption is about 74.7 kg as against the world's per capita consumption of 230.3 kg. This difference in the per capita consumption of steel in itself reflects opportunities that are bound to occur for Steel Industry which in turn would positively impact the demand for manganese ore. Production of crude steel is the single most important factor that influences the demand for manganese ore. steel Industry accounts for approximately 90% of the world demand for manganese. India's crude steel production grew from 89.79 million tonnes in 2015-16 to 127.19 million tonnes in 2022-23. This indicates strong growth of Steel Industry in the country as steel is the principal market accounting for 65 to 70% manganese consumption.

India has set a production capacity target of 300 million tonnes of steel by 2030-31. The demand for manganese ore is expected to raise commensurately to about 10 million tonnes per year in the coming years. India's largest manganese ore producing company "MOIL Ltd" has targets to increase its production to 3 million tonnes by 2030, the gap in the demand will continue to be filled by imports in years to come.

48. Perlite

Perlite is a hydrated, amorphous, siliceous volcanic glass of rhyolitic composition. It has a perlitic texture and pearly sheen. The perlitic texture is characterised by evident onion peel-like concentric cracking generated by glass expansion during hydration. When heated, it expands to form little spheres. Crude perlite is light grey to glossy black, while expanded perlite ranges from pristine white to greyish white. At temperatures ranging from 850 to 1150 degrees Celsius, it can grow up to 20 times its original volume.The cause of this expansion is the 2–5% total water content in unrefined perlite, which vaporises to generate innumerable small bubbles when heated. A white, lightweight, long-lasting material that deters deterioration is expanded perlite. Not only is expanded perlite incredibly light, but it also possesses remarkable physical qualities. The bulk density of unexpanded (raw) perlite is approximately 1,100 kg/m3 (1.1 g/cm3), whereas the bulk density of expanded perlite is typically between 30 and 150 kg/m3.The two types of perlite utilised in industry are expanded perlite and coarse perlite. By heating, the majority of perlite is expanded to create extremely light perlite. Crushing and screening to separate the different size fractions produces crude perlite.Depending upon the colour, luster and expansionvalues, the grade of perlite is classified as high,medium and low grade. (i) Perlite which is jet black incolour with glassy luster with expansion values morethan 15 to 20 times, is termed as High Grade; (ii) Perlitehaving black colour, dull luster with mixture ofrhyolitic material is termed as Medium Grade; and(iii) Perlite which is black in colour with vitrified,greyish patches and mixture of rhyolitic material istermed as Low Grade

RESERVES/RESOURCES

The total resources of perlite as per NMI database, as on 01-04-2020 hasbeen estimated at 2.41 million tonnes, out of which12% are High-Grade, 12% Medium-Grade, 6% Low-Grade and the remaining 70% fall under Unclassifiedcategory.The only deposit of perlite in India is located in the VillagePatanvav, Rajkot district, Gujarat. It is found to occurin Osam Hill in the form of discontinuous sill. The entire resources of perlite are placedunder Remaining Resources category (Table -1)

Table - 1: Reserves/Resources of Perlite in Inida as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India: Total	**0**	**2406**	**2406**
By Grades			
High	0	283	283
Medium	0	300	300
Low	0	152	152
Unclassified	0	1671	1671
By State			
Gujarat	0	2406	2406

MINING LEASE & PRODUCTION

No production of perlite was reported since2007-08 and also no stocks were reported duringthe year 2022-23. However, as on 31/03/2023, onelease having 144.88 Ha area was granted in Rajkotdistrict, Gujarat.

USES AND CONSUMPTION

There are differentuses of perlite in both crude and expanded form. There are many applications of perlite, such as, producing paint, ceramics, foundry sand, drilling muds, filters, abrasives, matrices for hydroponic plant culturing, for garment washing and loose filling material in insulation and packaging. Usability is mainly controlled by the swelling capacity, which is measured by comparing the bulk density of raw and swelled material. Perlite uses can be grouped under three general categories– construction, horticultural and industrial applications.

Construction Applications

In the construction and manufacturing fields, expanded perlite, on account of its acoustic properties, being light weight, fire resistant and an excellent insulator is used in light weight plasters and mortars, insulation, ceiling tiles and as filter aids.

In addition to providing thermal insulation, perlite enhances fire resistance, reduces noise transmission and is resistant to rot, vermin and termites. Perlite is also ideal for insulation against low temperature. When perlite is used as an aggregate in concrete, a light weight, fire resistant, insulating concrete is produced which is ideal for roof decks and other applications. Perlite is also used as an aggregate in portland cement and gypsum plasters (green plaster) for exterior applications and for fire protection of beams and columns. Other construction applications include: light weight curtain/ partition wall, noise reduction, under-floor insulation, chimney lining, paint texturing, ceiling tiles and roof insulation boards. Perlicon is expanded perlite-based concrete. The expansion is due to presence of two to six per cent combined water in the crude perlite rock. Demand for good quality expanded perlite in India has been showing an upward trend.

Horticultural Applications

In horticulture, expanded perlite is used throughout the world as a component of soil-lessgrowing mixes, where it provides aeration and optimum moisture retention for superior plant growth. Studies have shown that outstanding yields are achieved with perlite hydroponic systems. Other benefits of perlite in horticulture are its neutral pH value and the fact that it is sterile and weed-free. In addition, its light weight makes it ideal for growing plants in small containers. Besides, perlite is a good carrier for fertilizer, herbicides & pesticides and for pelletising seed. Horticultural perlite is used both by home gardeners as well as commercial growers. Green roofing, where perlite is used as the sole growing medium for plants on roofs, has become a popular trend, and offers a unique sustainable way to insulate a roof while adding foliage to the surface. In greenhouse plantations, landscaping and for in- house plants, use of perlite has shown encouraging results with clean & safe handling. Approximately 10% of annual perlite consumption all over the world is reported under horticultural applications. Perlite can be used by mixing with sand in about 1:1 ratio for better results.

Industrial Applications

Industrial applications of perlite are the most diverse, ranging from high performance fillers for plastics to cements, for petroleum, water and geothermal wells. Other applications include its use as a filter media for pharmaceuticals, food products, chemicals and water for municipal systems and swimming pools.

Perlite finds application additionally as an abrasive in soaps, cleaners and polishes. Its high resistance to heat is taken advantage in manufacturing refractory bricks, high temperature insulation, molten metal topping, light weight fillers, mortars and pipe insulation. Crude perlite is used in retention of heat in Foundry and Ferroalloys Industry. Small quantities of perlite are also used in cryogenic insulation and in ceramics as clay.

SUBSTITUTES

There are a number of materials for construction applications, such as, diatomite, expanded clay, shale, pumice & slag and for horticultural use, vermiculite, coco coir, wood pulp & pumice are alternative soil additives and are sometimes used in conjunction with perlite. These materials can be used in place of perlite without losing any of the benefit that perlite provides. Bentonite and zeolite are the alternatives in animal food supplement.

WORLD REVIEW

Insufficient information is available to make reliable estimates of resources in perlite-producing countries. However, the perlite resources in Greece are 120 million tonnes, China 78 million tonnes, Iran 73 million tonnes, Turkey 57 million tonnes, USA contributed 50 million tonnes and Hungary 49 million tonnes (Table-2). Asia Pacific is expected to be the fastest growing market for expanded perlite in the next few years. The major reason for this is the growing demand for expanded perlite in developing Asian countries, such as, India, China, Malaysia, Indonesia and Thailand. The major perlite producing countries in the World during 2022 are China 1,500 thousand tonnes, Turkey 1,319 thousand tonnes, Greece 850 thousand tonnes,Iran 540 thousand tonnes and USA 450 thousand tonnes (Table-3).

As per the Ministry of Commerce under the HS Code: 25301020, the total imports of Perlite during 2021-22 and 2022-23 48.5 thousand tonnes and 55.7 thousand tonnes, respectively. However, small quantity of perlite was exported during the same period

Table – 2 : World Reserves of Perlite

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total	NA
Greece(e)	120,000
China(e)	78,000
Iran(e)	73,000
Tu rk ey(e)	57,000
USA	50,000
Hungary(e)	49,000
Other countries(e)	N A

e-Estimated
NA-Not availabe
Source: USGS Mineral Commodity Summaries, 2023. Note: Sufficient information is not available to make reliable estimates of resources in perlite-producing countries.
Reserve data for China of Iran were revised based on Government report.

Table–3: World Production of Perlite

(By Principal Countries)

(In '000 tonnes)

Country	2020	2021	2022
China	1500	1500	1500
Turkey	1146	1429	1319
Greece	718	975	850
Iran (a)	541	540	540
USA	845	496	458
Armenia	174	168	170
Hungary	42	84	86
Italy	60	60	60
Georgia	32	32	52
Russia	45	45	45
Other contries	57	60	86

Source: BGS World Mineral Production, 2018-2022.
(a) Year ended 20 March following that stated.

FUTURE OUTLOOK

In 2023, the perlite market was estimated to be worth USD 1.83 billion. According to projections, the perlite industry would expand at a compounded annual growth rate (CAGR) of 6.90% from USD 1.95 billion in 2024 to USD 3.34 billion by 2032.Perlite is an amorphous volcanic glass. Due toits low bulk density, high heat resistance, low soundtransmission, high surface area, low thermalconductivity, chemical inertness and light weightmake it more acceptable in industrial applications.Expansion properties from 2 to 20 times of its initialvolume in high temperatures, set perlite as a soughtafter raw material in construction products.The global perlite market is expected to rise in the near future due to rising building activity and increased use in industries such as oil and gas. Asia Pacific is expected to be the fastest expanding market for expanded perlite in the near future due to increased industrialisation and construction activity, increasing urbanisation in emerging Asian nations, and rising demand for gardening in the region.In India, focus on infrastructure development will enhance demand for perlite and expand its domestic market.

49. Potash

Potash, primarily used as a fertilizer, consists mainly of potassium carbonate and potassium salts. It plays a crucial role as one of the three primary agricultural nutrients (nitrogen, phosphorus, and potassium, or N-P-K), with over 90% of its usage in agriculture.

Commercial potash deposits primarily originate from evaporite formations, often located deep underground. The main ore used is sylvinite, which is a combination of sylvite (KCl) and halite (NaCl).

In India, notable potash deposits have been identified in several regions, including:

- Sidhi District, Madhya Pradesh
- Sonbhadra District, Uttar Pradesh
- Kaimur District, Bihar
- Sawai Madhopur and Karauli Districts, Rajasthan

In these areas, potash is found in glauconitic sandstone, which contains potassium-bearing minerals. Despite these deposits, India's potash needs are primarily met through imports, as domestic production is insufficient to satisfy agricultural demand.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total resources of potash as on 01.04.2020 have been estimated at 23,091 million tonnes, all of which are placed under Remaining Resource category. Rajasthan alone contributes 89% to the total resources, followed by Madhya Pradesh (5%) and Uttar Pradesh (4%) (Table- 1).

Table No. 1 Reserves/Resources of Potash as on 1.4.2020

(By Grades/States)

(In million tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	**0**	**23091**	**23091**
By Grades			
Glauconite	0	3149	3149
Polyhalite	0	16164	16164
Sylvite	0	2572	2572
Unclassified	0	1206	1206
By States			
Bihar	0	230	230
Jharkhand	0	152	152
Madhya Pradesh	0	1244	1244
Rajasthan	0	20572	20572
Uttar Pradesh	0	893	893

Figures rounded off

OCCURRENCES

Glauconitic sandstones/greensands deposits can be used as an alternative indigenous resource for potash. Glauconite is essentially a complex hydrous silicate of iron and potassium chiefly with ferric oxide and partly with ferrous oxide. It contains about 4–7% K_2O. Major part of these resources are located in Nagaur district of Rajasthan, followed by Panna district, Madhya Pradesh and the balance in Sonbhadra & Chitrakoot districts, Uttar Pradesh.

Occurrences of potash are also reported from Tirap district of Arunachal Pradesh; Rohtas district of Bihar; Kachchh district of Gujarat; Rohtak & Sirsa districts of Haryana; Leh district of Jammu & Kashmir; Sidhi district of Madhya Pradesh; Bhatinda district of Punjab; Bhilwara & Nagaur districts of Rajasthan; Tanjavur district of Tamil Nadu and Banda, Chitrakoot, Sonbhadra & Etah districts of Uttar Pradesh.

In Rajasthan, glauconitic sandstones/shales occur in Chittorgarh, Kota, Karauli, Jaisalmer and Barmer districts. In Gujarat, glauconite is found in Ukra Formation at Guneri in Kachchh district. In Himachal Pradesh, glauconite of hydrothermal origin is found in Kumla-Kathwar area of Sirmaur district. In Kerala, glauconite occurs in Quilon Limestone and seabed sediments of Thiruvananthapuram coast.

USES

Potash refers to various water-soluble potassium compounds, historically derived from leaching wood ashes, hence the name "pot-ash." It includes key fertilizers like potassium chloride (KCl), which is rich in potassium (60–62% K_2O equivalent) and essential for enhancing nutrient value and disease resistance in crops. Other notable potassium salts used in agriculture are potassium sulphate, potassium magnesium sulphate, and potassium nitrate.

Potassium chloride and potassium nitrate also find applications beyond agriculture, including in glass and ceramics manufacturing, soap production, dye, synthetic rubber and explosives.

In terms of fertilizers, two main forms are common: Muriate of Potash (MOP) and Sulphate of Potash (SOP). SOP is a chloride-free option preferred for high-value crops like fruits and leafy vegetables, while MOP is typically used for carbohydrate-rich crops like wheat. Potash fertilizers enhance plant health and can significantly increase crop yields.

CONSUMPTION

As per FAI, the all India consumption of Potassic fertilizer (in K_2O content) was at 1.71 million tonnes during 2022-23(P), whereas it was 2.53 million tonnes in the previous year.

WORLD REVIEW

The world reserves are estimated at approximately 3,600 million tonnes of K_2O content. Reserves are located mainly in Canada (31%), Belarus (21%), Russia (18%), United State of America (6%), China (5%), Germany (4%) and Chile (3%) (Table-2).

The world production of potash in 2022 was 43 million tonnes in terms of K_2O content as against 46 million tonnes in 2021. Canada is the leading producer of potash with 34% share in total production in 2021, followed by Russia (17%), China (14%), Belarus (9%), Germany (6%), Israel (6%), Jordan (4%) and Laos (4%) (Table-3).

Table – 2: World Reserves of Potash

(By Principal Countries)

(In '000 tonnes of K_2O content)

Country	Reserves
World total	**3600000**
Canada	1100000
Belarus	750000
Russia	650000
USA	220000
China	180000
Germany	150000
Chile	100000
Laos	75000
Spain	68000
Brazil	2300
Other countries	300000

Figures rounded off
Source: USGS Mineral Commodity Summaries, 2023

Table – 3: World Production of Potash

(By Principal Countries)

(In '000 tonnes of K_2O content)

Country	2020	2021	2022
World : total (rounded off)	**44000**	**46000**	**43000**
Canada (Chloride)	13784	14244	14593
Russia (Chloride)	6893	7503	7500
China	5600	6000	6000
Belarus	7562	8000	4000
Germany (Potassic salts)	2874	2793	2709
Israel (Chloride)	2375	2406	2475
Jordan	1598	1563	1637
Laos	714	819	1484
United Kingdom (Polyhalite)	709	789	953
Chile (Chloride)	951	879	672
USA (Potassic salts)	460	430	440
Spain (Chloride)	352	376	398
Brazil (Chloride)	200	200	200

Source: BGS World Mineral Production, 2018-22,

FOREIGN TRADE

Exports

There is no reported production of potash in the country. However, exports of potash fertilizer decreased by 9% to 5,347 tonnes in 2022-23, as compared to 5,877 tonnes during the previous year. Exports were mainly to Malaysia (45%), United Arab Emirates (39%), and Australia (4%). Exports of potassium nitrate increased by 2% to 936 tonnes in 2022-23 from 917 tonnes in the previous year. Exports were done mainly to Thailand (38%), United States of America (33%), Indonesia (6%), South Africa (6%) and Arab Republic of Egypt (6%) (Tables- 4 & 5).

Table – 4: Exports of Potash Fertilizers

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**5877**	**209314**	**5347**	**237161**
UAE	1360	48935	2060	81032
Malaysia	850	21681	2391	68084
Australia	--	--	216	15093
Japan	--	--	50	8661
Vietnam	20	2423	90	7162
Cote D' Ivoire	--	--	80	5350
Pakistan	3	262	28	5088
Mozambique	10	737	69	4675
Gabon	++	25	50	3931
Turkey	--	--	33	3660
Other Countries	3634	135251	280	34425

Figures rounded off

(In tonnes)

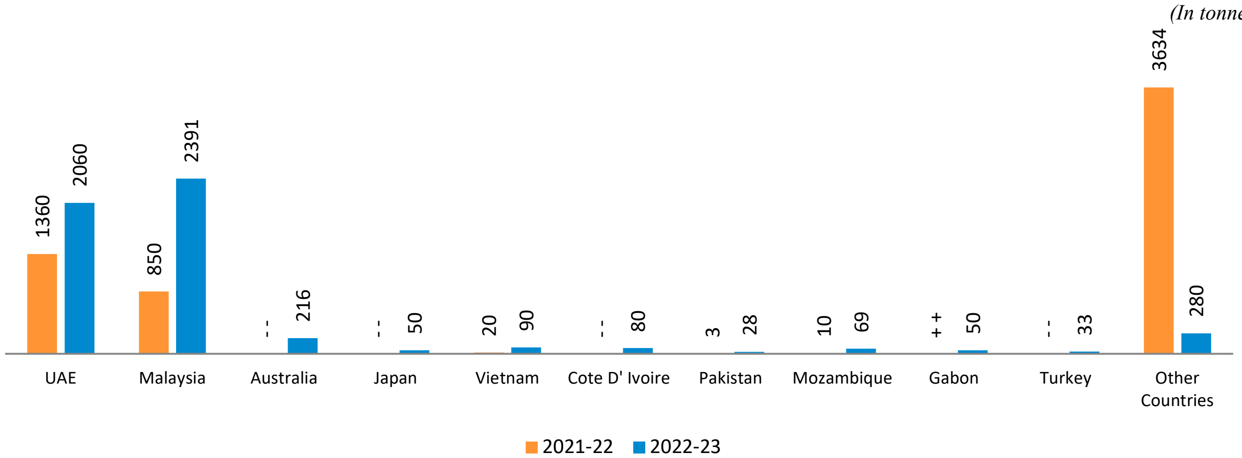


Fig 1: Countrywise Exports of Potash Fertilizers

Table – 5: Exports of Potassium Nitrate

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**917**	**187910**	**936**	**251715**
USA	336	98194	312	132307
Thailand	290	40260	359	59902
Egypt	36	6079	52	13531
South Africa	49	9649	54	12017
Indonesia	51	8508	58	9931
Bangladesh	26	3541	24	5003
UAE	28	3802	21	3826
Korea	25	5608	13	3540
Bahrain	--	--	5	3410
China	29	5176	14	2776
Other Countries	47	7093	24	5472

Figures rounded off

Imports

Like exports, imports of potash fertilizer also decreased by 18% to 2.56 million tonnes in 2022-23 as compared to 3.02 million tonnes during the previous year. Imports were mainly from Canada (45%), Israel (22%), Jordan (16%), Belarus (5%) and Turkmenistan (3%). Imports of potassium nitrate increased exponentially to 524 tonnes in 2022-23 from 153 tonnes in the previous year. People's Republic of China (98%) and Netherlands (2%) were the main suppliers of potassium nitrate in 2022-23 (Tables- 6 & 7).

Table – 6 : Imports of Potash Fertilizers

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3020152**	**77176503**	**2563414**	**120342931**
Canada	615257	13766303	1142719	54381046
Israel	520802	13825336	562389	28755426
Jordan	432153	10826541	416847	19878688
Belarus	1000208	27164459	114922	3854399
Turkmenistan	--	--	69726	2898231
Germany	6629	296578	33035	2151056
United Kingdom	55880	992536	76207	1681402
Russia	54056	976074	42900	1580967
USA	1945	189171	29420	1465082
China	3409	150862	40125	1036788
Other Countries	329813	8988643	35124	2659846

Figures rounded off

(In tonnes)

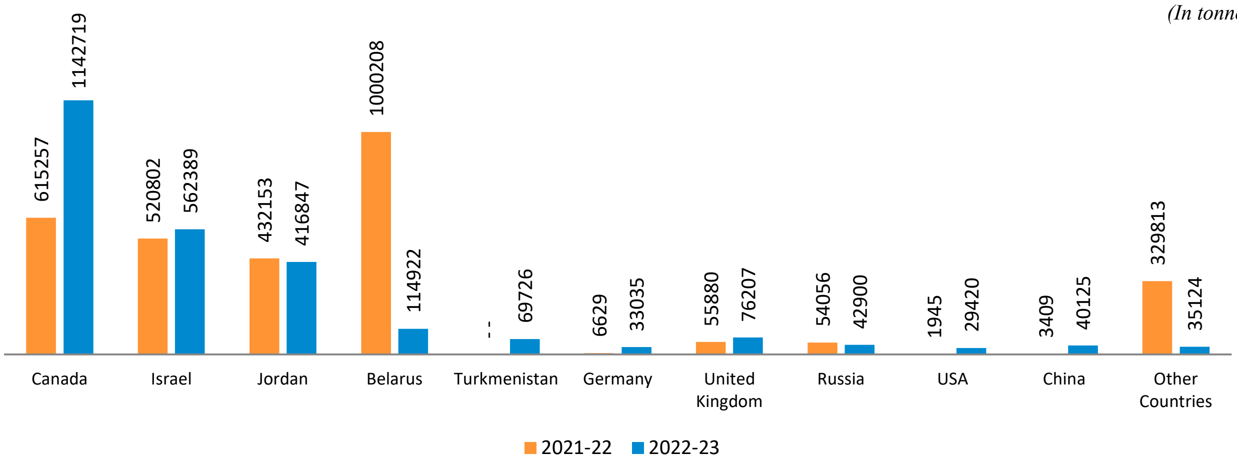


Fig 2: Countrywise Imports of Potash Fertilizers

Table – 7 : Imports of Potassium Nitrate

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**153**	**16481**	**524**	**59500**
China	131	10193	515	56228
Netherlands	--	--	8	1773
Singapore	--	--	++	738
Italy	1	355	1	452
Germany	++	612	++	246
France	++	2	++	39
USA	++	36	++	13
United Kingdom	1	240	++	11
Korea	20	5043	--	--

Figures rounded off

FUTURE OUTLOOK

Agriculture is the backbone of India's Economy. However, declining soil fertility impacts on crop productivity. The appropriate application of fertilizer is a key factor in enhancing soil fertility and productivity for overcoming potassium depletion.

The market of potash is expected to increase year on year globally. The domestic demand of potash is entirely met by imports, which require a turn around and initiatives to promote indigenous mining of potash in India. In this line multiple trenches of auction were done by central and some state government, in which some blocks were of potash mineral. Successful auctioning of these potash blocks will mark the starting of domestic production of potash. India has some good prospects of Potash. These prospects of potash mining in India could mitigate the issue of import of the mineral and consequently will have positive impact in the investment opportunities in the sector which in turn could be utilised for the development of mineral wealth.

Rajasthan has large potash resources in the Nagaur-Ganganagar basin in the northwest of the State. A tripartite agreement was signed between Mineral Exploration Corporation Limited (MECL), Rajasthan State Mines & Minerals Limited (RSMML) and the Department of Mines & Geology (DMG), Govt. of Rajasthan for taking up feasibility studies of Solution Mining of Potash in the state of Rajasthan. The project is expected to be the first solution mining project in the country.

50. Rare Earths

The term "rare earth" arises from the minerals from which they were first isolated, which are common oxide-type minerals (earths) found in Gadolinite extracted from one mine in the village of Ytterby, Sweden. However, with the exception of the highly unstable promethium, rare-earth elements are found in relatively high concentrations in the earth's crust with cerium being 25th most abundant element in the earth's crust at 68 parts per million.

Rare Earths are a group of 17 elements starting with lanthanum in the periodic table of elements and include scandium and yttrium. They are moderately abundant in earth's crust but not concentrated enough to make them economically exploitable. The REEs find key applications in defense, electronics, energy systems etc. For instance, magnets made from rare earths are many times more powerful than conventional ones. Along with energy critical elements (ECE), such as, lithium which has become ubiquitous battery material, REEs have emerged as strategic elements essential for sustainable energy systems.

The Rare-earth Elements (REE) are a collection of 17 elements, namely, scandium, yttrium and lanthanides (15 elements in the periodic table with atomic numbers 57 to 71, namely, lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu).

Although these elements tend to occur together, the lanthanide elements are divided into two groups. The light elements are those with atomic numbers 57 to 63 (La, Ce, Pr, Nd, Pm, Sm and Eu) and the heavy elements are those with atomic numbers 64 to 71 (Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu).

REEs are characterised by high density, high melting point, high conductivity and high thermal conductance. A number of rare-earth minerals contain thorium and uranium in variable amounts, but they do not constitute essential components in the composition of the minerals.

The principal sources of REE are bastnaesite (a fluorocarbonate which occurs in carbonatites and related igneous rocks), xenotime (yttrium phosphate) commonly found in mineral sand deposits, loparite which occurs in alkaline igneous rocks and monazite (a phosphate). The rare earths occur in many other minerals and are recoverable as by-products from phosphate rock and from spent uranium leaching. In India, monazite is the principal source of rare earths and thorium. Monazite is a complex phosphate of thorium and Rare-earth minerals [(Ce, La, Nd, Th, Y) PO_4] and this is radioactive in nature.

RESERVES/RESOURCES

The mineral monazite is a prescribed substance as per the Notification under the Atomic Energy Act, 1962. AMD has been carrying out its resource evaluation for over six decades. It occurs in association with other heavy minerals, such as, ilmenite, rutile, zircon, etc. in concentrations of 0.4 – 4.3% of total heavies in the beach and inland placer deposits of the country.

The resource estimates of monazite in the beach and inland placer deposits are 12.73 million tonnes as on March, 2021. The State-wise breakup of 12.73 million tonnes is furnished in Table -1.

Table – 1: Resources of Monazite

(In million tonnes)

State	No. of Deposits	Resources*
All India	**130**	**12.73**
Andhra Pradesh	24	3.78
Gujarat	2	0.07
Jharkhand	1	0.21
Kerala	35	1.84
Maharashtra	5	0.004
Odisha	12	3.16
Tamil Nadu	50	2.47
West Bengal	1	1.2

**Inclusive of indicated, inferred and speculative categories.*
Source : Reply of Parliament Question No. 2564 in Rajya Sabha, it was answered on 18.03.2021.

Monazite contained in 130 deposits has been established in the coastal beach placer sands in Kerala, Tamil Nadu, Odisha, Andhra Pradesh, Maharashtra & Gujarat and in the inland alluvium in parts of Jharkhand, West Bengal and Tamil Nadu. The major deposits which contain monazite (thorium and REE ore mineral) are:

1. Chavara barrier beach and Eastern Extension, Kollam district, Kerala
2. Manavalakurichi beach sand deposit, Kanyakumari district, Tamil Nadu
3. Sathankulam Teri sand deposit, Tamil Nadu
4. Ovari Manapadu Teri Sand deposit, Tamil Nadu
5. Navaladi-Ovari Teri Sand deposit, Tamil Nadu
6. Kuduraimoli Teri Sand deposit, Tamil Nadu
7. Bhimunipatnam beach sand deposit, Andhra Pradesh
8. Kandivalasa beach sand deposit, Andhra Pradesh
9. Kalingapatanam beach sand deposit, Andhra Pradesh
10. Srikurmam beach sand deposit, Andhra Pradesh
11. Bhavanapadu beach sand deposit, Andhra Pradesh
12. Gopalpur beach sand deposit, Odisha
13. Chhatrapur beach sand deposit, Odisha
14. Brahmagiri beach sand deposit, Odisha.

MINING LEASES & PRODUCTION

Indian Rare Earth Limited (IREL), a Mini Ratna Company, is a Government of India Undertaking under the Department of Atomic Energy (DAE) and KMML, a Kerala State Government Undertaking, are actively engaged in mining and processing of beach sand minerals from placer deposits. IREL is the only entity processing monazite to produce Rare-earth (RE) compounds. Some REE which are available in India such as Lanthanum, Cerium, Neodymium, Praseodymium, Samarium, etc. are in supply surplus while Dysprosium, Terbium, Europium which are classified as HREE are having supply constraint. These HREEs are not available in Indian deposits in extractable quantity. Government is actively engaged in capacity building for consumption of the LREE.

The annual installed mining, production and processing capacities are as under:

(i) Mining: 10 million tonnes

(ii) Processing capacity in terms of rare-earth concentrate: 11,200 tonnes

(iii) Refining capacity in terms of Total Rare-earth Oxide (TREO): 5,000 tonnes

(iv) Rare-earth Concentrate Production: 5,040 tonnes

(v) Refining in terms of TREO: 2,000 tonnes (Both Government and Private sector)

As reported by KMML (The Kerala Minerals & Metals Ltd.) monazite is a strategic mineral and cannot be sold in commercial market. Therefore, the prices are not available.

INDUSTRY

IREL has a plant at Udyogamandal, Aluva, located in Ernakulam district, Kerala, wherein the monazite obtained from Manavalakurichi, is chemically treated to separate rare earths in its composite chloride form and thorium as hydroxide upgrade.

IREL has set up a Rare-Earth Extraction plant (REEP) producing mixed Rare-earth chloride (MRCL) Tri-sodium phosphate etc., at its unit in OSCOM Odisha. MRCL produced from the above plant is processed at IREL's plant at Rare Earth Division (RED) in Aluva, Kerala, for producing separated High Pure Rare Earth (HPRE) Oxides/ Compounds.

IREL implemented flow sheet developed by BARC and has produced 50 kg Nuclear Grade

Gadolinium Oxide (99.99%). Same can be converted into Gadolinium Nitrate which is used by NPCIL. The Company invited research projects pertaining to products in the value chain of Ilmenite, zircon and rare-earth compounds, improvement in recovery energy efficiency, etc.

IREL is actively pursuing setting up of Greenfield operations in Kanyakumari district of Tamil Nadu and Bramhagiri district of Odisha. The proposal for harnessing the beach sand mineral deposits in Tamil Nadu by constituting a Joint Venture Company with the nominated

State Government Agency, TAMIN, is under active consideration by the State Government.

Ambadungar RE Project has been initiated to harness the carbonatite deposit explored by AMD in the state of Gujarat. Initially, about 1.55 Ha of the deposit is proposed to be harnessed, which will be further extended based on the exploratory results of AMD. Action has been initiated to establish the technical feasibility and financial viability of the project.

POLICY

In order to safeguard the strategic interest of the nation it is expedient in larger national interest to prohibit the grant of operating rights in terms of any reconnaissance permit exploration licence or production lease of atomic minerals as defined in Part-B of the first schedule of the MM(DR) Act, 1957.

A Notification No. S.O.2685 (E) dated 27.07.2019, was issued for reserving the prospecting and mining rights of offshore minerals under Offshore Areas Minerals (Development and Regulation) Act, 2002 exclusively to Government or a Government owned company or a corporation owned or controlled by the Government.

As per MMDR Act, 1957, Minerals of the "rare earths" group not containing Uranium and Thorium are mentioned in Part D of First Schedule to the Act for Critical & Strategic minerals. As per PIB Press Release dated 28.11.2023 by Ministry of Mines, Critical minerals are essential for our country's economic development and national security. The lack of availability of these minerals or concentration of their extraction or processing in a few countries may lead to supply chain vulnerabilities.

Other minerals under Code 2617 are freely exportable, except those which have been notified as prescribed substances and controlled under Atomic Energy Act 1962.

As per the Foreign Trade Policy, import policy under ITC(HS), 2022 Schedule 1, the import policy on the import of ores & concentrates of rare-earth metals (under HS Code 25309040) are permitted 'freely' whereas export policy under ITC(HS) 2018 Schedule 2, the export policy on the export of ores and concentrates of rare-earth metals (under HS Code 25309040) are permitted 'freely' .

Export of Beach Sand Minerals have been brought under STE and shall be canalised through Indian Rare Earths Limited (IREL). Beach sand minerals, permitted anywhere in the export policy, will now be regulated in terms of policy under at Sl. No. 98A of Chapter 26 of Schedule 2 of the Export Policy.

As per Gazette Notification No : GSR.134 (E) dated 20.2.2019, the particulars of threshold values for atomic minerals in respect of Beach Sand Minerals (BSM) shall be regulated as Schedule A [Rule 2(1)(m) and Rule 36] (Table-2).

Table - 2 : Particulars of Threshold Value for Atomic Minerals

[See Rule 2(1)(m) and Rule 36]

Uranium-bearing tailings left over from ores after extraction of copper and gold, ilmenite and other titanium ores.	60 ppm U_3O_8 and/or 250 ppm ThO_2.
Zirconium-bearing minerals and ores including zircon.	All cases of zirconium-bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade. In other cases, zircon containing less than 2000 ppm of hafnium.
Beach Sand Minerals, i.e., economic heavy minerals found in the teri or beach sand,which includeilmenite, rutile,leucoxene,garnet,monazite, zircon and sillimanite	All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.

Many projects of IREL have been initiated, such as, capacity expansion of Mineral Separation Plant of OSCOM, Rare Earth Permanent Magnet Plant and Rare Earth Theme Park. Agencies to implement these projects are in place and the projects will be commissioned within the next 2-3 years. New areas of operations, such as, Rare Earths in Ambadungar, Gujarat or Atomic Minerals in Odisha and Tamil Nadu are also in advanced stage of development.

During the year 2020-21, Licence to Operate (LTO) office has been established for centralised monitoring & managing the regulatory compliances, required to achieve and sustain the targeted production plans. Centralised monitoring and control of statutory compliances is enabled through database dashboards. Units are sensitised for complying with the statutory requirements at regular intervals.

Manavalakurichi and OSCOM units are continuing their operations in a sustainable manner. OSCOM has deposited the statutory fees as desired under Stage-I Forest Clearance towards obtaining the Stage-II Forest Clearance. Chavara Unit is in the final stage of receiving the environment clearances for its mining lease areas. LTO office establishes the processes & tools for proactive information gathering and structuring of regulatory requirements.

Rare Earth Permanent Magnet plant will be set up in BARC campus, Achitapuram, Vizag, for production of Samarium-Cobalt permanent magnet for use in Atomic Energy, Defence and Space sectors.

Environment clearance and clearance from Design Safety Review Committee and Safety Committee, BARC for carrying out site activities have been received. Detailed engineering has been completed and appointment of contractor to commence site activities on Engineering Procurement Construction (EPC) model too has been done.

Subsidiary IREL- IDCOL Limited (IIL), the Joint Venture company has been established to harness the beach sand mineral deposit in the State which in turn will widen the footprint of the Company. Ground work towards declaration of the precise area is in the final stages at the State after completion of DGPS survey and preparation of cadastral map. DPR for the project has been prepared.

USES & CONSUMPTION

The Rare Earth Permanent Magnet (REPM) in Vizag and Rare Earth and Titanium Theme Park (RETTP) in Bhopal have kick started with the funding assistance of Government of India, which will enhance the visibility of IREL in the strategic and niche sector.

Environmental clearance for REPM project has been received from MoEF&CC and M/s MECON Limited, Bengaluru, has been appointed as consulting firm for detailed engineering. As regards RETTP project, lease deed execution towards land has been completed. A Letter of Understanding has been inked with BARC towards developing and transferring laboratory-scale technologies in the value chain of Rare Earths which will be suitably upscaled by IREL to pilot-scale and installed in the theme park.

In addition, IREL has been assigned the responsibility of carrying out civil construction works on behalf of BARC for the 5 million liters per day (MLD) hybrid seawater desalination plant at OSCOM. About 60% construction of plant building has been completed.

Execution of Supplimentary Mining Lease deed for OSCOM Mines till a period up to the year 2047 has been completed under the provisions of AMCR 2016. Communication on precise area of the Bramhagiri Mineral Sands Deposit in Puri district under AMCR, 2016 is in the final stages of issuance by the Government of Odisha.

Rare-earth materials are utilised in a wide range of critical products enabling many emerging green energy technologies, high-tech applications and defence systems, such as, hybrid cars, plug-in hybrid electric vehicles (PHEVs), the latest generation of efficient wind power turbines, computer disc drives, missile guidance systems, etc.

The lanthanide elements as a group have magnetic, chemical and spectroscopic properties that have led to their application in a wide range of end-uses. Cerium finds application in polishing of glass items like lenses & display screens of cathode-ray tubes, liquid-crystal displays & plasma-display panels, in petrol & diesel fuels as fuel additive and along with lanthanum for replacement of cadmium in red pigments. Mixed salts of the cerium group of elements, other than fluorides are used in medicine, non-irritating antiseptic dressings, waterproofing agents and fungicides in textile manufacture. The principal uses of commercially pure cerium compounds that are in the form of nitrate are in the manufacture of incandescent gas mantles and cerium compounds as oxide. It also finds usage as a polishing agent of glass. Cerium compounds are also used in ceramic and glass as colouring pigments and also as catalysts in Chemical Industry.

Department of Atomic Energy (DAE), has accorded in principle approval for futuristic proposal of IREL towards setting up of rare earth theme park which inter alia includes setting up of pilot plants in the value chain of rare earths, skill-cum-enterpreneur development center. This will be a first of its kind theme park in the country.

To produce samarium-cobalt (Sm-Co) magnet for meeting national objectives, a Special Purpose Vehicle (SPV) has been formed. Production of Sm-Co metal and magnet is based on technologies developed by BARC, Mumbai & DMRL, Hyderabad. Activities for firming up the investment, plant location etc., are under progress. Supply of Nuclear Grade Ammonium diuranate (NGADU) from new source, i.e, the newly commissioned monazite processing plant at OSCOM, Odisha has commenced. Subsequent to identification and development of conditions for dissolution of Rare Earths (REE) from fly ash generated at lignite coal fired thermal power plant at Neyveli, Tamil Nadu, studies were taken up to understand the overall process efficiency and precipitate dissolved rare earths in purified form. Cerium, lanthanum and neodymium are used as glass additives in optical lenses and display screens, as catalysts in automobiles to reduce sulphur dioxide emission, in multilayer capacitors and along with yttrium in magnesium, aluminium and hydrogen storage alloys. Mischmetal which is an alloy of cerium with small amounts of other rare-earth metals is used in lighter flints, for desulphurisation in steel and foundry, and with lanthanum alloys, in batteries and hydrogen storage systems meant for electronics and hybrid cars. Cerium oxide is used in glass polishing industries.

Lanthanum oxide and neodymium compounds are used in special glass manufacture. Lanthanum finds application in X-ray films as phosphors; yttrium in advanced ceramics like nitrides, Y-stabilised ceramics, etc., and gadolinium in magnet alloys.

Yttrium, europium and terbium are used as phosphors in displays of computers, TV, etc. and with lanthanum, cerium & gadolinium as phosphors in fluorescent and halogen lamps. Neodymium, samarium, dysprosium, praseodymium and terbium have application as high intensity magnets in electronics, electric motors and audio equipment. Lanthanum, erbium and ytterbium have application in fibre optics and lasers.

Lanthanum and yttrium find application in solid oxide fuel cells. Scandium is used mainly in aluminium alloys for sporting goods. Scandium in minor amounts is used in semiconductors and special lighting, including halogen bulbs. Mixed rare-earth products are used as catalysts in petroleum refining and fluid cracking. Neodymium is used in welding in heavy industries and also in MRI scanners. Praseodymium is not a primary element for any specific use, but finds use as a substitute for neodymium in magnets. Samarium is used essentially for the Sm-Co magnets. Europium is a primary component of phosphorus and is responsible for white light in compact fluorescent lamps when used with terbium compounds.

Erbium used as fibre optic has emerged in the nineties as a remarkable tool for communication technology through which high quality rapid data in tight pulses can be transferred in speed unthinkable in the past. The main application for neodymium-iron-boron (Nd-Fe-B) magnets are in automobiles for anti-lock brakes, and in computer hard disk drives, videos, CD-ROMs used in many small-size electronic consumer products, such as, digital cameras, where major advantage is their small sizes. Nickel metal hydride (Ni MH) batteries, containing mischmetal, a mixture of rare-earth compounds, are used mainly in portable electronic equipment, such as, laptops, camcorders and mobile phones. Though, the market for batteries for portable electronic equipment is growing strongly, the Ni MH batteries are increasingly replaced by lithium-ion batteries. Ground monazite is digested with caustic soda lye to produce trisodium phosphate (TSP) and mixed hydroxide slurry. This slurry is used for production of diverse rare-earth compounds. Elaborate solvent extraction and ion exchange facilities were built to produce individual RE oxides, like oxides of Y, Ce, Nd, Pr and La of specific purities. India is the second largest supplier of yttrium in the world and the maximum production is reported from the plant in Kerala. Uranium values presenting monazite which are recovered in the form of nuclear grade ammonium diuranate (ADU) are vital supplement to the indigenous supply of uranium. Thorium is separated in its pure oxalate form. A part of it is taken to OSCOM for further processing by solvent extraction to produce thorium nitrate. A small part of the purified thorium nitrate is converted to nuclear grade thorium oxide powder for supply to Bhabha Atomic Research Centre (BARC) and Nuclear Fuel Complex (NFC) for developing thorium-based fuel for nuclear reactors. IREL has built a large stockpile of impure thorium hydroxide upgrade associated with rare earths and unreacted materials.

Monazite contains about 25.28% P_2O_5 which can be recovered as a by-product for manufacture of fertilizers and production of elemental phosphorus or its salts. Beside, rare earths, thorium is also recovered from monazite. It is a source of atomic energy. An important use of thorium is for addition to tungsten in minute quantity (about 0.75%) to increase the ductility of tungsten wire and thus to facilitate its drawing into filaments used in electric lamps. Metallic thorium is also used in photoelectric cells and X-ray tubes and in certain alloys. Thorium is used as catalytic agent for various processes. Amongst thorium salts, thorium nitrate is used largely in the manufacture of incandescent gas mantles. Mesothorium, the chief radioactive element recovered as a by-product in the chemical treatment of monazite, is marketed usually in the form of its bromide and used in self-luminous paints or enamels. Mesothorium is also used in the treatment of certain types of cancer and skin diseases.

World Review

The total world reserves are estimated at 130 million tonnes of rare-earth oxides equivalent content (REO) of which China alone accounts for 44 million tonnes (34%) followed by Vietnam (17%), Brazil & Russia (16% each) and India (5%) (Table- 3).

China holds the leading position among producers of rare-earth oxides with 210 thousand tonnes. The other major producers are Myanmar, Australia, USA, Russia, India, Vietnam and Malaysia (Table-4)

Table – 3 : World Reserves of Rare Earths

(By Principal Countries)

(In tonnes of REO equivalent content)

Country	Reserves
World: Total (rounded off)	**130000000**
USA	2300000
Australia*	4200000
Brazil	21000000
Burma	NA
Burundi	NA
Canada	830000
China	44000000
Greenland	1500000
India	6900000
Madagascar	NA
Russia	21000000
South Africa	790000
Tanzania	890000
Thailand	NA
Vietnam	22000000
Other countries	280000

Source: USGS, Mineral Commodity Summaries, 2023

** For Australia, Joint Ore Reserves Committee-complaint or equivalent reserves were 3.0 million tons.*

NA - Not available

Table – 4 : World Production of Rare-Earths Oxides

(By Principal Countries)

In tonnes

Country	2020	2021	2022
China	180000[2]	180000[2]	210000[2]
Myanmar	35000[1]	35000[1]	24000[1]
USA	22800	25800[1]	25800
Australia	14562[4]	15761[4]	15970[4]
India	4200[3]	4200[3]	4200[3]
Madagascar	5000[1]	2000[1]	2000[1]
Russia	2663	2276	2038[1]
Vietnam	690[1]	440[1]	440[1]
Malaysia	14	29	52

Source: BGS, World Mineral Production, 2018-22
(1) Estimates
(2) Estimates (Includes production from iron ore extraction, bastnaesite concentrates and ion absorption clays.)
(3) Estimates (Year ending 31st March following that stated.)
(4) Estimates (Year ending 30th June following that stated.)

FOREIGN TRADE

Exports

Exports of Rare earth oxides including rutile sand in 2021-22 were 52.51 tonnes. Uganda (99%) and UAE & Austria (1%) were the main buyers from India (Table-5).

Table-5 : Exports of Rare-Earth Oxides including Rutile Sand

(By Countries)

(In tonnes)

Country	2021-22		2022-23	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**52.51**	**6239**	**–**	**–**
Uganda	52	6223	–	–
UAE	0.5	15	–	–
Austria	0.01	1	–	–

Figures rounded off HS code - 26140031

Imports

The imports of Rare earth oxides including rutile sand in 2022-23 substantially decreased by 22% to 7,906 tonnes as compared to 10,076 tonnes in 2021-22. China (25%), Vietnam (20%), Malaysia (18%) and Australia & Thailand (12% each) were the main suppliers to India (Table-6).

Table-6 : Imports of of Rare-Earth Oxides including Rutile Sand

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
AllCountries	**10076**	**1141015**	**7906**	**1222167**
China	1768	194603	1948	310092
Vietnam	531	57173	1606	220603
Malaysia	256	33845	1391	240834
Australia	1768	191387	936	150000
Thailand	1308	119509	912	115835
Kenya	252	42714	281	51648
South Africa	168	16031	192	30222
Indonesia	–	–	130	18954
Italy	–	–	112	21575
Sri Lanka	586	79329	102	18623
Other countries	3438	406424	296	43781

Figures rounded off HS code - 26140031

FUTURE OUTLOOK

Worldwide explorations for economic deposits of REEs and efforts to bring them into production have increased substantially since 2000. Recovery of REEs can be complex because they occur in minerals as a group of similar elements, and at many deposits the REEs are hosted within more than one mineral. The success and timeliness of rare earth mining projects, and the rare-earth elements industry in general, is difficult to predict and will be continuously monitored and studied by various countries in the world.

As per Roskill report 2021, the global demand of REs is to the tune of 1,31,500 tonnes and the processing capacity is of the order of 1,47,570 tonnes. Hence, as such, there is no supply chain constraint. However, Rare earth comprises of 17 elements and are classified as light RE elements (LREE) and heavy RE elements (HREE). Some REEs which are available in India, such as, Lanthanum, Cerium, Neodymium, Praseodymium, Samarium, etc. are in supply surplus while Dysprosium, Terbium, Europium which are classified as HREE are having supply constraint. These HREE are not available in Indian deposits in extractable quantity. The Government is actively engaged in capacity building for consumption of LREEs. The RE resources in India are fifth largest in the world. Indian resource is significantly lean with reference to grade and it is tied with radioactivity making the extraction long drawn, complex and expensive. In comparison to China, Indian resources are significantly lean.

Production of RE depends on deposits and end-Industry consuming the products. India is one of the pioneers in processing of RE and these capabilities are available in terms of capacity, technology and skill. The Government has targeted increasing REO producing capacity by 3 times by the year 2032. Also, in order to enhance consumption of RE in Indian industries, especially Electric Vehicles, recently Government has announced a PLI scheme vide Item No. 6 page 44 of Notification No. S.O. 4632(E) dated 9th November 2021 of Ministry of Heavy Industries.

IREL has provision for expanding the capacity of processing rare-earth-mineral to 20,000 tonnes per annum in near future. The EV car projects which were expected to boost demand for Rare-earth Magnets are likely to be put on a back burner as the industry will take some time to come back on track. IREL is actively pursuing setting up of Greenfield operations in Kanyakumari district of Tamil Nadu and Bramhagiri district of Odisha. The proposal for harnessing the beach sand mineral deposits in Tamil Nadu by constituting a Joint Venture Company with the nominated State Government Agency, TAMIN, is under active consideration by the State Government. As the country is gearing up towards e-mobility, green energy, e-office and other niche sectors, there is need to secure rare-earth mineral resources in areas beyond the boundaries of the country. in pursuance of IREL has the mandate to explore and acquire rare-earth resources abroad pursunance of which activities for constitution of a separate entity under the aegis of the Department is actively underway.

51. Salt

Salt is the most significant of all the industrial minerals. Occurrence of rock salt in India is scanty. At the time of Independence, there used to be shortfall in production of salt and the same was met through imports. Since then, India has made tremendous progress in production of salt, achieving self-sufficiency in 1953 and even started exporting salt to other countries.

Common salt, when pure, is mineral halite which is an essential item for human consumption. The per-capita consumption of salt in the country is estimated to be about 14 kg, which includes edible and industrial salt. The current annual requirement of salt in the country is estimated to be 63 lakh tonnes for edible use (including requirement for cattles) and 118 lakh tonnes for industrial use.

"Salt is a Central Subject in the Constitution of India and appears as Item No. 58 in the Union List of the 7th Schedule, which reads:

(a) "Manufacture, Supply and Distribution of salt by Union Agencies; and

(b) "Regulation and control of manufacture, supply and distribution of salt by other agencies".

The Central Government is responsible for controlling and regulating all aspects of the Salt Industry. The Salt Commissioner's Organisation (SCO), Jaipur, Rajasthan, an attached office under the Ministry of Commerce & Industry (Department of Industrial Policy & Promotion), Government of India, is the Authority entrusted with the above task. The SCO is responsible for monitoring the production, distribution, quality, prices, supply and administration of Salt Cess Act, 1953 and the Rules, made thereunder

RESERVES/RESOURCES

As per NMI datvabase, based on UNFC system, the total reserves/resources of rock salt as on 1.4.2020 has been estimated at 12.78 million tonnes in Mandi, Himachal Pradesh. The entire resources, fall under Remaining Resources category.

MINING LEASES & PRODUCTION

Production of Rock - Salt at 1,002 tonnes in 2022-23, increased by 250.35 % as compared to the previous year. In the current year, production was reported by single public sector mine from Himachal Pradesh. (Tables-1 to 3). The mine-head closing stocks at the end of 2022-23 was 560 tonnes as against 38 tonnes in 2021-22. (Table-4).

Table – 1 : Producers of Rock Salt, 2022-23

Name and address of the Producer	Location of the mine	
	State	District
Hindustan Salt Ltd, B- 427, Pradhan Marg, Malviya Nagar, Jaipur - 302 017, Rajasthan.	Himachal Pradesh	Mandi

Table – 2 : Production of Rock Salt, 2020-21 to 2022-23

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**486**	**14156**	**286**	**712**	**1002**	**10725**
Himachal Pradesh	486	14156	286	712	1002	10725

(In tonnes)

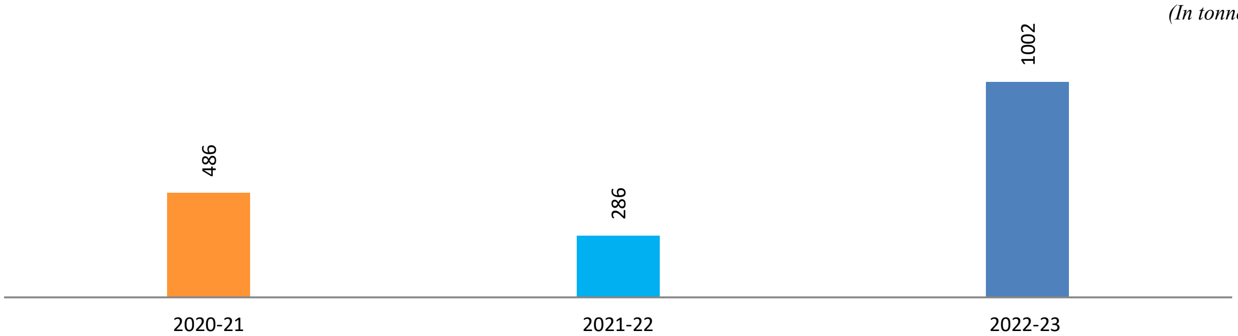


Fig 1: Production of Rock Salt in India

Table – 3 : Production of Rock Salt, 2021-22 to 2022-23

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹000)

State	No. of Mines	2021-22 Production		No. of Mines	2022-23 (P)	
		Qty	Value		Production	Value
India	**1**	**286**	**712**	**1**	**1002**	**10725**
Public Sector	1	286	712	1	1002	10725
Private Sector	-	-	-	-	-	-
Himachal Pradesh	**1**	**286**	**712**	**1**	**1002**	**10725**
Mandi	1	286	712	1	1002	10725

Table – 4: Mine-head Closing Stocks of Rock Salt, 2021-22 to 2022-23

(By States/Grades)

Country/State	2021-22	2022-23 (P)
India	**38**	**560**
Himachal Pradesh	38	560

The average daily labour employed in Rock - Salt mine during 2022-23 was 45 as against 23 in the previous year. India is the 3rd largest salt (common) producing country in the world after China & USA with a production of about 280 lakh tonnes during the year 2022-23. Production of salt involves extensive use of renewable sources of energy. Weather conditions play an important role in production of salt.

Salt (common) is manufactured mainly by solar evaporation of sea water. Sea salt constitutes about 82% of the total salt produced in the country. Salt manufacturing activities are carried out in the coastal states of Gujarat, Tamil Nadu, Andhra Pradesh, Maharashtra, Karnataka, Orissa, West Bengal, Goa and hinterland State of Rajasthan. Gujarat (86%) was the leading State followed by Tamil Nadu (6%) and Rajasthan (6%). Private Sector contributed significantlly in the production of salt and accounted for 97.12% of the production. Co-operative Sector contributed 1.77% and the rest was from the Public/Joint Sector which contributed 1.11% during 2022-23.

The major by-products recovered in the Salt Industry are gypsum, bromine, magnesium chloride, magnesium sulphate, ammonium bicarbonate, soda ash, caustic soda and soda bicarbonate.

MINING

In recent development, Drang Mohal (Bhatog) Rock Salt Mine, Village Mohal Bhatog, District Mandi, Himachal Pradesh, of M/s Hindustan Salts has started production and it produced 1,002 tonnes of rock salt during 2022-23. Mining is carried out by underground semi-mechanised method. The entire mining area is hill (Government waste land) region with no forest land cover.

USES & CONSU MPTION

Salt, in addition to its culinary and domestic uses, is also used in meat packing, fish curing & its preservation, dairying, preservation & processing of hides, manufacturing of soaps, detergent & dyestuff, dyeing & finishing of fabrics, refrigeration, glazing earthenware, explosives, leather industries, bakery products, for soil stabilisation, in manufacturing artificial rubber and as wood preservative. In agriculture, salt is used for treating hay and as a fertilizer for certain crops. In countries with cold weather conditions, salt is used in deicing, i.e., removal of snow and ice, from streets and highways.

Industrial Applications

Salt is an important raw material used in Chemical Industry. It is used in the production of basic chemicals like sodium carbonate (soda ash), caustic soda, hydrochloric acid, chlorine, bleaching powders, chlorates, sodium sulphate (salt cake) and sodium metal. These basic chemicals, in turn, are used in the preparation of various end-products, such as, soaps, detergents, chlorinated hydrocarbons and carbon tetrachloride. Other important applications where salt is widely used are in food processing; as freezing-point depressant in refineries & milk supply schemes; treatment of industrial wastes; purification of drinking water; and manufacture of synthetic indigo, explosives, papers, etc.

The rock salt produced from Mandi mines contains 67.81% NaCl which is not suitable for human consumption as the content of sodium chloride is low from the required 96% NaCl necessary for human consumption. However, this salt finds application as essential suppliment in cattle feeds.

Iodised Salt

The SCO is the nodal agency for monitoring the production and quality of iodised salt at the production level and ensuring its equitable distribution in the country. Production of iodised salt continued its progressive trend and the Universal Salt Iodisation (USI), a programme under National Iodine Deficiency Disorder Control Programme (NIDDCP) reached new heights.

Iodised salt is produced by mixing potassium iodate with salt using spray, drip feed, dry mixing and submersion processes. Iodisation of salt is carried out in plants operated by Sambhar Salts Ltd (a subsidiary of Hindustan Salts Ltd), Kharagoda, Gujarat. SCO has facilitated establishment of 523 salt iodization units including 121 refineries & washeries (capacity 149.5 lakh tonnes) with an annual installed capacity of 218.5 lakh tonnes upto March 2022. The Bureau of Indian Standards (BIS) has revised the specifications of iodised salt and formulated new specifications for refined iodised salt and Vacuum Evaporated iodised salt under IS 7224:2006. BIS has prescribed IS 797:1982 (Reaffirmed 2012) as specification of common salt for chemical industries.

Potassium Iodate Manufacture

Potassium iodate, used for fortifying salt with iodine is produced indigenously, however, iodine, the basic raw material for its production is imported. There are about 13 potassium iodate manufacturing units, registered with the Salt Commissioner. Statewise production of salt (common) during the year 2022-23 is furnished in Table-5.

Table – 5: Statewise Production of Salt (Common), 2020-21

(By States)

(In lakh tonnes)

States	2020-21
India	**265.64**
Andhra Pradesh	2.85
Goa	0.01
Gujarat	216.39
Karnataka	0.12
Maharashtra	0.7
Odisha	0.02
Rajasthan	21.56
Tamil Nadu	23.93
West Bengal	0.06

Source: Salt Commissioner, Govt. of India, Jaipur, Annual Report, 2020-21

CONSUMPTION

Salt is extensively used in various industries like Caustic Soda, Soda Ash, Soaps & Detergents, Chemicals, Water softening plants, dyes etc. The Chlor-Alkali Industries, however, are the major consumer of salt.

TRADE POLICY

Exports of salt have been brought under Open General Licence (OGL) with effect from 25th August, 1987 vide Ministry of Commerce, New Delhi, Export Trade Control Public Notice No. 26-ETC(PN)/87 dated 25th August, 1987. The Ministry of Commerce, Government of India, vide Notification No. 482(E) dated 25th July, 1991 has exempted certain categories of export from compulsory pre-shipment inspection.

As per Foreign Trade Policy (FTP) 2015-2020, exports and imports of rock salt and common salt (including iodised salt) under Heading no. 2501 are allowed as 'Free'.

FOREIGN TRADE

Exports

During 2022-23, the exports of salt (other than common salt) increased by about 54% to about 13.63 million tonnes from about 08.86 million tonnes in the previous year. Exports were mainly to China (48%), Republic of Korea (14%), Japan (9%), Indonesia (6%) and Qatar & Vietnam (5% each). On the other hand, the exports of salt rock increased by about 62 % to 225.6 thousand tonnes in 2022-23 from 139.164 thousand tonnes in 2021-22. The exports were mainly to Bangladesh (91%) and Vietnam (8%). Exports of salt (other) increased by 53% to 13.40 million tonnes during 2022-23 from 8.72 million tonnes in the previous year. Exports were mainly to China (48%), Republic of Korea (14%), Japan (9%), Indonesia(6%) and Qatar & Vietnam (5% each) (Tables-6 to 8).

Table – 6: Exports of Salt (Other Than Common Salt)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**8863780**	**13393717**	**13631830**	**24294751**
China	2607128	4495218	6499944	11746619
Korea, Rep. of	2091035	2502675	1906276	2547562
Japan	1165266	1388618	1270196	1884978
Vietnam	230318	393114	713634	1507818
Bangladesh	410263	743239	593883	1393862
Qatar	652400	1001344	654021	1325350
Indonesia	728745	885075	844606	1322479
Taiwan	377765	450081	529928	788176
UAE	92158	220049	129856	287222
Oman	168527	309456	140752	265789
Other Countries	340175	1004848	348734	1224896

Figures rounded off

Table – 7: Exports of Salt Rock

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**139164**	**277009**	**225595**	**621445**
Bangladesh	53847	94008	206034	500205
Vietnam	170	1384	17121	33666
USA	164	14243	236	17039
Canada	145	11782	140	10061
Nepal	545	5223	644	8610
UAE	182	6503	315	8088
Singapore	140	6180	149	5255
Japan	21	2148	59	3771
Malaysia	71	1376	189	3423
UK	69	4686	51	3339
Other Countries	83810	129476	657	27988

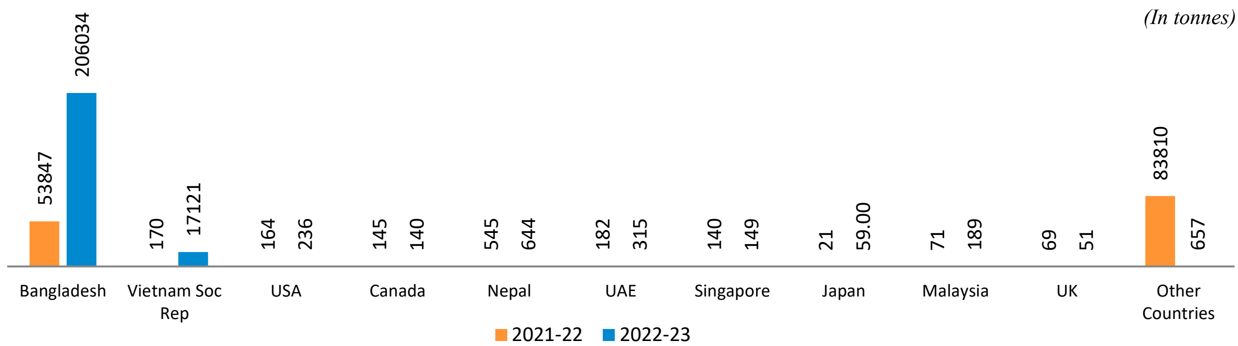


Fig 2: Countrywise Exports of Salt Rock

Table – 8: Exports of Salt (Other)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**8724616**	**13116708**	**13406235**	**23673306**
China	2607128	4495025	6499944	11746555
Korea, Rep. of	2030435	2430925	1906271	2547547
Japan	1165245	1386470	1270137	1881207
Vietnam	230148	391730	696513	1474152
Qatar	651819	997754	653969	1322897
Indonesia	728745	885075	844604	1322100
Bangladesh	356416	649231	387849	893657
Taiwan	377764	450010	529928	788176
UAE	91976	213546	129541	279134
Oman	168491	308412	140690	264546
Other Countries	316449	908530	346789	1153335

Imports

The imports of salts (other than common salt) increased by 42% to 98,986 tonnes in 2022-23 from 69,549 tonnes in the previous year. Imports were mainly from Iran (51%), UAE (42%) and China & Afghanistan (2% each) under Open General Licence (OGL). Similarly, import of salt rock increased marginally by 6 % to 45,106 tonnes in 2022-23 from 42,396 tonnes in 2021-22. The imports were mainly from UAE (69%), Iran (25%) and Afghanistan (4%). Besides, import of salt (other) increased by 98% to 53,880 tonnes during 2022-23 from 27,153 tonnes in the previous year. The imports were mainly from Iran (72%), UAE (19%), and China (3%). (Tables-9 to 11).

Table – 9: Imports of Salt (other than Common salt)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**69549**	**512396**	**98986**	**908453**
UAE	30380	200221	41337	336392
Iran	32983	166575	50086	282924
USA	78	15237	597	120778
Thailand	870	27008	1069	33155
China	1007	14692	1764	30907
Germany	290	15261	423	22197
France	21	14699	30	18295
UK	839	12616	691	17991
Afghanistan	150	346	1812	8205
Malaysia	285	6249	286	6556
Other Countries	2646	39492	891	31053

Table – 10: Imports of Salt Rock

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**42396**	**258506**	**45106**	**363389**
UAE	27334	176544	31213	271046
Iran	12724	70553	11209	73312
Afghanistan	150	346	1812	8205
Malaysia	285	6218	286	6550
USA	--	--	222	1847
Sri Lanka	--	--	53	710

Table- 10 (Concld.)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Pakistan	1632	3287	248	617
Oman	--	--	61	607
China	--	--	++	229
Belgium	++	21	1	42
Other Countries	271	1537	1	224

(In tonnes)

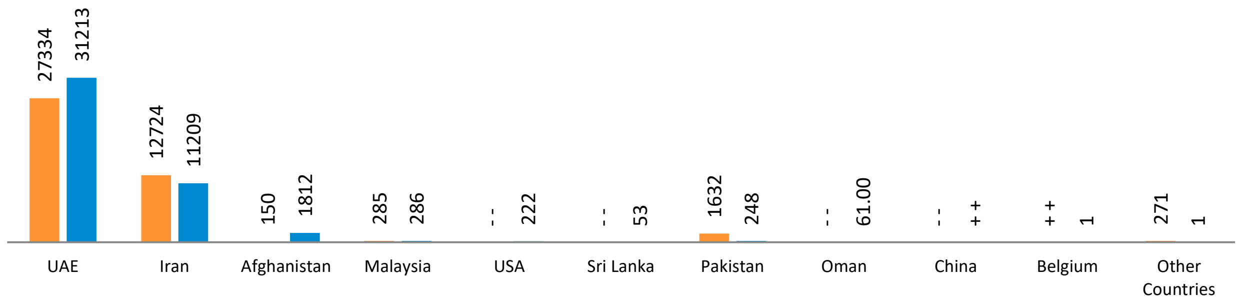


Fig 3: Countrywise Imports of Salt Rock

Table – 11: Imports of Salt (Other)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**27153**	**253890**	**53880**	**545064**
Iran	20259	96022	38877	209612
USA	78	15237	375	118931
UAE	3046	23677	10124	65346
Thailand	870	27008	1069	33155
China	1007	14692	1764	30678
Germany	290	15261	423	22197
France	21	14699	30	18295
UK	839	12614	691	17971
Netherlands	246	5055	304	6459
Czech Republic	++	15	16	5437
Other Countries	497	29610	207	16983

FUTURE OUTLOOK

Sambhar Salts Ltd (SSL) approximately produces 2 lakh tonnes of raw salt every year. In addition, approximately 40,000 tonnes of processed salt are also produced. Schemes are also under preparation to enhance further capacity of raw salt production to 10 lakh tonnes per annum.

Hindustan Salt Limited has been awarded the long term contract through open tender in May-2021 for large scale commercial mining of rock salt at Mandi, Wherein modern Trackless underground mining is proposed to be used to enhance production up to 50,000 MT/annum. This proposal forms a part of Hon'ble PM's vision of Atmanirbhar Bharat wherein it is planned to produce adequate quantity of Himalayan Rock Salt so that complete import of Rock Salt both from Iran and Pakistan gets stopped within 2 years, we also intend to install Salt Refinery for processing of Rock Salt with latest technology as part of contract.

52. Sulphur and Pyrites

Sulphur is an essential raw material for many chemical industries and is essentially used for the production of sulphuric acid which in turn is used for the production of chemical fertilizers, textiles, dyestuffs, pickling and galvanising of steel, storage batteries, refining of petroleum, explosives and other acids.

In India, presently there are no mineable elemental sulphur reserves. Sulphur combines directly with almost all the elements with the exception of gold, platinum and the noble gases. In its native form, sulphur is a yellow crystalline solid. It can be found as a pure element or as sulphate or sulphide minerals. The crystallography of sulphur is complex. Depending on the specific conditions, the sulphur allotropes form several distinct crystal structures, with rhombic and monoclinic S8 best known.

Pyrites is naturally occurring mineral comprised of the elements iron and sulphur (FeS_2). It is used for manufacture of sulphuric acid, and as direct feed for soil conditioning. Pyrite is a fairly ubiquitous mineral and it occurs most commonly in sedimentary rocks. Pyrite has a brass yellow colour, brownish black streak, metallic lusture and occurs as cubic crystals. Pyrites includes a range of sulphide materials, such as, marcasite, pyrite and pyrrhotite. Marcasite usually occurs in low temperature metasediments and sedimentary rocks. Pyrrhotite occurs usually in magmatic or contact metasomatic deposits associated with basic igneous rocks and high temperature sulphide veins and is often nickeliferous. Pyrites was used as a substitute for sulphur in the manufacture of sulphuric acid. However, there was no production of pyrites since 2003.

Native sulphur deposit has been reported in Puga Valley of Leh district in the Union Territory of Jammu & Kashmir. The grade of the deposit ranges from 9% to 24% of sulphur. Small occurrences of native sulphur are also reported from Barren Island of Bay of Bengal. Sulphur along with hot springs were reported from various parts of Chamoli, Rudraprayag, Uttarkashi, etc. districts in Garhwal & Kumaun divisions of Uttarakhand. In Andhra Pradesh, native sulphur occurs in granular form with clay and silt in coastal areas of Krishna and East Godavari districts. Occurrences are also reported from Alappuzha district of Kerala and Kangra district of Himachal Pradesh.

Sulphide occurs naturally in mineral ores, oil and coal deposits. Natural waters containing elevated concentrations of hydrogen sulphide are used for therapeutic baths and have been consumed for medical purposes. Hydrogen sulphide (H2S), which exists as a colourless gas under normal conditions, has a characteristic odour of rotten eggs and occurs naturally in coal, natural gas, oil, volcanic gases and sulphur springs and lakes; H2S is a central participant in the sulphur cycle, the biogeochemical cycle of sulphur on earth. Sulphides form an indispensable link in the sulphur cycle (the reversible interconversion of sulphide and sulphate) in nature.

Petroleum refineries and gas processing plants extract H2S when making "clean fuels" and use it as a feed stock to produce sulphur and water. The domestic production of elemental sulphur is limited to by-product recoveries from petroleum refineries and fuel oil used as feedstock for manufacturing fertilizer. Tar sands-natural sand (Oil sands) formations contain about 10% bitumen and with high hydrogen sulphide content.

The sulphide ores contain sulphur and during the production of metal from sulphide ores, sulphur is released as SO2 which is used to produce sulphuric acid. The sulphuric acid thus produced contains about 32.7% of sulphur and contributes in the industries which otherwise would have used elemental sulphur.

RESERVES/ RESOURCES

The total reserves/ resources of pyrites in the country as per NMI data, based on UNFC system as on 1.4.2020 has been placed at 1,674 million tonnes. There are no reserves and all resources are grouped under 'Remaining Resources' category. Out of these, about 27 million tonnes are under Feasibility (STD211) category.

Out of the total resources, Beneficiable grade resources are 62 million tonnes, Low grade 1,555 million tonnes and Soil Reclamation grade resources are about 6 million tonnes. The balance of about 51 million tonnes resources fall under Unclassified/Not-known grades. Major reserves/ resources are located in Bihar (94%) and Rajasthan (5%) (Table - 1).

Table – 1 : Reserves/Resources of Pyrites as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	–	**1674401**	**1674401**
By Grades			
Soil Reclamation	–	6024	6024
Beneficiable	–	61628	61628
Low	–	1555330	1555330
Unclassified	–	51419	51419
By States			
Andhra Pradesh	–	880	880
Bihar	–	1574561	1574561
Himachal Pradesh	–	2560	2560
Karnataka	–	3000	3000
Rajasthan	–	90876	90876
Tamil Nadu	–	24	24
West Bengal	–	2500	2500

Figures rounded off

Reserves/resources of sulphur (native) have been estimated in the Inferred (STD333) category only. Entire resources are located in Jammu & Kashmir and are placed at 0.21 million tonnes as on 1.4.2020 as per NMI data, based on UNFC System (Table-2).

Table – 2 : Reserves/Resources of Sulphur (Native) as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	–	**210**	**210**
By Grades			
Sulphur (Native)	–	210	210
By States			
Jammu & Kashmir	–	210	210

Figures rounded off

MINING LEASES AND PRODUCTION

Sulphur (By-product)

The production of Sulphur recovered as by product from fertilizer plant and oil refineries were 926 Thousand Tonnes in 2022-23 as against 881 thousand tonnes in the 2021-22.

The oil refineries in public sector reported production of sulphur. During the year 2022-23, Indian Oil Corp. Ltd. contributed about 74.80% of the total production. Among the states, Odisha accounted for 25% of the total sulphur production and it was followed by Kerala 20%, Haryana 17%, Gujarat 16%, West Bengal 9%, Uttar Pradesh 6%, Maharashtra 5%, and remaining production was contributed by Bihar and Assam.

In addition, refineries of Hindustan Petroleum Corp. Ltd, RIL and Essar Oil also reported recovering of by-product sulphur which in turn is used as feedstock in manufacturing fertilizers and pharmaceuticals. The Vadinar refinery of Essar Oil Ltd is also reported to produce by-product sulphur. In Fertilizer Industry, the sulphuric acid is further used for manufacturing phosphoric acid and single super phosphate (SSP) from rock phosphate (Tables - 3 to 5)

Table - 3 : Principal Producers of By-product Sulphur, 2022-23

Name and address of the Producer	Location of plant/refinery	
	State	District (s)
Indian oil Corporation Ltd, (Refineries Division), Scope Complex, Core-II, 7, Institutional Area, Lodhi Road, New Delhi -110 003.	Assam	Kamrup Metro, Tinsukia Chirang
	Bihar	Begusarai
	Gujarat	Vadodara
	Haryana	Panipat
	Odisha	Jagatsinghpur
	Uttar Pradesh	Mathura
	West Bengal	Purba Medinipur
Numaligarh Refinery Limited, 122S, G. S. Road, Christanbasti, Distt- Guwahati, Assam - 781 005.	Assam	Golaghat
Bharat Petroleum Corporation Ltd, Bharat Bhavan, 4 & 6, Currimbhoy Road, Ballard Estate, Mumbai-400 001, Maharashtra	Maharashtra	Mumbai
	Kerala	Ernakulam

Note: Sulphur is recovered as by-product from fertilizer plants and oil refineries (excluding units working under Private Sector)

Table – 4 : Production of Sulphur (By-product) 2020-21 to 2022-23

(By Principal Countries)

(In tonnes)

State	2020-21	2021-22	20222-23
India	**737337**	**880858**	**925663**
Assam	6447	6545	7705
Bihar	7135	8160	14652
Gujarat	82450	117588	146401
Haryana	138025	178740	157228
Kerala	142166	182352	182398
Maharashtra	41375	53165	46283
Odisha	209387	207831	228518
Uttar Pradesh	54234	60607	55411
West Bengal	56118	66170	87067

Figures rounded off

(In tonnes)

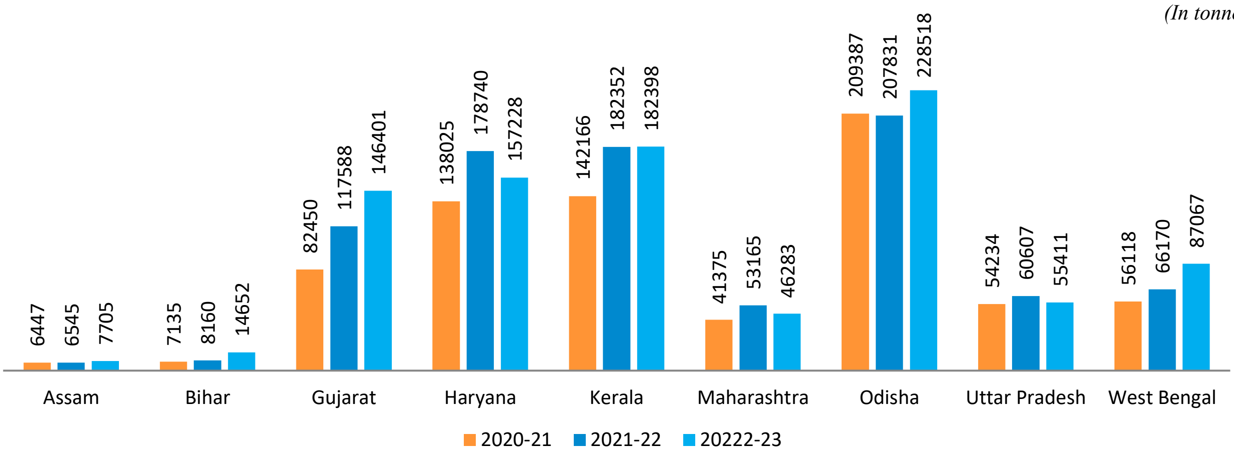


Fig 1: Statewise Production of Sulphur

Table – 5 : Production of Sulphur (By-product) 2021-22 and 2022-23

(By Sectors/States/Districts)

(In tonnes)

State/District	2021-22 (R)		2022-23 (P)	
	No. of units	Quantity	No. of units	Quantity
India	**12**	**880858**	**12**	**925663**
Public Sector	12	880858	12	925663
ASSAM	**4**	**6545**	**4**	**7705**
Chirang	1	1678	1	2114
Tinsukia	1	169	1	335
Kamrup Metro	1	372	1	653
Golaghat	1	4326	1	4603
BIHAR	**1**	**8160**	**1**	**14652**
Begusarai	1	8160	1	14652
GUJARAT	**1**	**117588**	**1**	**146401**
Vadodara	1	117588	1	146401
HARYANA	**1**	**178740**	**1**	**157228**
Panipat	1	178740	1	157228
KERALA	**1**	**182352**	**1**	**182398**
Ernakulam	1	182352	1	182398
MAHARASHTRA	**1**	**53165**	**1**	**46283**
Mumbai	1	53165	1	46283
ODISHA	**1**	**207831**	**1**	**228518**
Jagatsinghpur	1	207831	1	228518
UTTAR PRADESH	**1**	**60307**	**1**	**55411**
Mathura	1	60307	1	55411
WEST BENGAL	**1**	**66170**	**1**	**87067**
Purba Medinipur	1	66170	1	87067

Figures rounded off

Pyrites

Pyrites Phosphates and Chemicals Ltd (PPCL) had two pyrites production units located at Amjhore (Bihar) and Saladipura (Rajasthan) besides phosphorite division in Dehradun. The Government approved closure and hiving off of these two units in July 2002 and Amjhore unit in June 2003 and since then no activity has been reported.

Petroleum Refining

In fossil fuels, sulphur is naturally present as an impurity when fuel is burnt, the sulphur is released as sulphur dioxide, an air pollutant. Hydrodesulfurisation (HDS) is a catalytic chemical process widely used to remove sulphur from natural gas and from refined petroleum products, such as, gasoline or petrol, jet, fuel, kerosene, diesel and fuel oils. Sulphur is a by-product produced in various refineries processing high sulphur crude oil. Sulphur is produced from the sulphur-rich fuel gas as a process to reduce the emission level of sulphur in the atmosphere along with flue gases from the furnaces. Mathura refinery started production of sulphur from beginning itself and sulphur recovery units have been provided in Haldia, Koyali, Panipat, Mathura and Guwahati refineries.Refinery-wise Sulphur (by-product) production capacity of Indian Oil Corporation Ltd is as under:

Unit	Production Capacity ('000 MTPA)
Mathura	48.0
Haldia	24.0
Koyali	18.0
Panipat	144.0
Barauni	12.0
Guwahati	0.6

Specification of sulphur at Mathura, Panipat, Koyali, Haldia, Barauni & Guwahati refineries is as under:

Property	
Purity	**99.9**
Colour	Yellow
Shape	Lump

USES & CONSUMPTION

Flowers of Sulphur (sublimed sulphur)

Powdered form of sulphur produced by sublimation process that may contain up to 30% of the amorphous allotrope are generally used in rubber vulcanisation, agricultural dusts, pharmaceutical products and stock feeds.

Sulphur dioxide (SO_2)

Sulphur dioxide is a by-product gas generated during processing of sulphide ores as well from other industries. It is used in many industrial processes such as, chemical preparation, refining, pulp-making and solvent extraction and also is the feed stock to manufacture sulphuric acid. Sulphur dioxide is also used in the preparation and preservation of food because it prevents bacterial growth and browning of fruit.

Sulphuric Acid

Sulphuric acid is a strong mineral acid with the formula H_2SO_4. It is soluble in water at all concentrations. Sulphuric acid has many applications and is produced in greater amounts than any other chemical besides water. Principal uses include ore processing, fertilizer manufacturing, oil refining, waste water processing and chemical synthesis.

Miscellaneous

One of the direct uses of sulphur is in vulcanisation of rubber. Sulphur is a component of gunpowder. It reacts directly with methane to give carbon disulphide, which is used in the manufacturing of cellophane and rayon.

Elemental sulphur is mainly used as a precursor to other chemicals. Most of the sulphur is converted to sulphuric acid (H_2SO_4), which is of prime importance to the world economy.

The production and consumption of sulphuric acid are an indicator of a nation's industrial development. The principal use of sulphuric acid is in the manufacture of phosphatic fertilizer.

Other applications of sulphuric acid include oil refining, waste water processing and mineral extraction. Sulphur compounds are also used in detergents, fungicides, dyestuffs and agrichemicals. In silver based photography, sodium and ammonium thio-sulphate are used as "fixing agents". Sulphites, derived from burning sulphur, are used to bleach paper. They are also used as preservatives in dried fruit and processed fruit products.

Sulphur is used as a light-generating medium in the rare lighting fixtures known as "sulphur lamps". The sulphur lamp is a highly efficient full-spectrum electrodeless lighting system whose light is generated by sulphur plasma that has been excited by microwave radiation.

Nitrogen (N), phosphorus (P) and potassium (K) are critical components of a well-fertilized crop. But to achieve yields and more nutritious foods, crops need sulphur (S). It improves protein and oil percentage in seeds, cereal quality for milling and baking, marketability of dry coconut kernel (copra), quality of tobacco, nutritive value of forages, etc. It is associated with special metabolisms in plant and the structural characteristics of protoplasm. Judicious application in sulphur-deficient soils is a cost-effective way to produce more food and feed.

Concrete binder made with sulphur is an eco-efficient alternative to conventional Portland cement for paving stones, sidewalks and building foundations. In road construction, sulphur technology can replace up to 30 per cent of asphalt binder, a high energy-intensive input in blacktop roads. Sulphur-enhanced roads and parking lots offer a longer life cycle.

INDUSTRY

Coromandel International Ltd, formerly Coromandel Fertilizers Limited (CFL), is a leading manufacturer of a wide range of fertilizers & pesticides. The fertilizer manufacturing units in Visakhapatnam, Kakinada, and Ennore operate with multiple rock and acid combinations, allowing them to produce over 10 products. Additionally, there is a water-soluble fertilizer plant at Kakinada. Through its 8 SSP plants across the country, the company offers a low-cost source of phosphate-based nutrition products.

Coromandel holds the top position as the largest producer of Single Super Phosphate (SSP) in the country, with an annual production capacity of approximately 4.5 million tons of complex fertilizer and SSP. According to Coromandel International Ltd's Annual Report for 2022-23, the commissioning of its new 1,650 MT per day sulphuric acid plant is on track and is likely to be completed during the year 2023. With this addition, the company plans to increase its sulphuric acid production by 5,00,000 MT per annum from the current level of 6,00,000 MT, resulting in a combined capacity of 1.1 million MT.

The Fertilisers And Chemicals Travancore Limited (FACT) was incorporated in 1943 as India's first large-scale fertilizer plant in Udyogamandal, Kochi, Kerala. The Udyogamandal plant has an installed capacity of 76,050 tonnes of N and 29,700 tonnes of P2O5. It produces fertilizers like Ammonium Sulphate and Ammonium Phosphate Sulphate (FACTAMFOS 20:20:0:13) as well as intermediate chemicals such as Sulphuric Acid, Anhydrous Ammonia, Phosphoric Acid, Sulphur Dioxide, and Oleum. The FACT Cochin facility produces 4,85,000 TPA of Complex Fertilizer (FACTAMFOS 20:20:0:13), 3,30,000 TPA of Sulphuric Acid, and 1,15,200 TPA of Phosphoric Acid.

According to the 2022-23 Annual Report, the Udyogamandal Complex produced 2,08,146 MT of Factamfos (NP 20:20:0:13), which is 140% of its installed capacity, and 2,44,732 MT of Ammonium Sulphate, which is 109% of its installed capacity. The Cochin Division produced 6,20,050 MT of Factamfos (128% of installed capacity), 1,24,010 MT each of nutrient nitrogen and nutrient P_2O_5 (127.85% of installed capacity), 234,330 MT of Sulphuric Acid, and 63,050 MT of Phosphoric Acid.

At present Company has a tie-up with BPCL-Kochi Refinery for sourcing about 60% of its annual requirement minimising import. Company also import Sulphuric Acid to meet its requirement for fertilizer production, mainly from metallurgical industry, where it is a waste / by-product during processing.

According to the Annual Report of Gujarat State Fertilizers & Chemical Limited, (GSFC), the company is planning to set up a 600 tonnes per day Sulphuric Acid Plant at its Vadodara unit. Additionally, it is considering installing a 600 tonnes per day Phosphoric Acid Plant and an 1,800 tonnes per day Sulphuric Acid Plant at its Sikka unit. To expand GSFC's Agro-product portfolio, company is considering to enter into organic fertilizers by setting up 2x200 tonnes per day Phosphate Rich Organic Manure (PROM) plant at Polymer unit by using available existing infrastructure.

HZL produce 98 % concentrated Sulphuric Acid at Chanderia, Debari and Dariba plants in the state of Rajasthan. Hindustan Zinc, the second largest zinc miner, is also the largest producer of sulphuric acid, which is sold in the domestic market, mainly to fertiliser and sulphonation industries. Rock phosphate, sulphuric acid, ammonia and potash are the major ingredients for production of DAP/ NPK. Currently, HZL is operating total 8 sulphuric acid plants in Rajasthan and is planning to Commission the fertiliser plant in Chanderiya, enabling better utilisation of sulphuric acid generated in operations through production of fertilisers, catering to the demand in the Indian market and delivering international quality products, while commanding a premium in the domestic market. Sulphuric Acid is used in production of Single Super Phosphate Fertilizers/ Zinc Sulphate/ Phosphoric Acid/LABSA for detergent/Chemical Gypsum for Cement Industries/ Metal Industry/Speciality Chemicals/ Dyes etc. For all spectrum of Industries.

TRADE POLICY

Imports of sulphur of all kinds other than sublimed sulphur, precipitated sulphur and colloidal sulphur under Heading No. 2503 are allowed free under the Foreign Trade Policy (FTP), 2015-20. Similarly, the imports of unroasted iron pyrites under Heading No. 2502 are allowed free.

WORLD REVIEW

The world sulphur industry was composed of two sectors—discretionary and nondiscretionary. In the discretionary sector, the mining of sulphur or pyrites is the sole objective; this voluntary production of either sulphur or pyrites (mostly naturally occurring iron sulphide) is based on the mining of discrete deposits, with the objective of obtainng as nearly a complete recovery of the resource as economic conditions permit. In the non-discretionary sector, sulphur or sulphuric acid is recovered as an involuntary byproduct; the quantity of output is subject to demand for the primary product and environmental regulations that limit atmospheric emissions of sulphur compounds irrespective of sulphur demand. Discretionary sources (Frasch, native, and pyrites), once the primary sources of sulphur in all forms, represented only 8% of the sulphur produced worldwide in 2018.

The Frasch process is the term for hot-water mining of native sulphur associated with the caprock of salt domes and in sedimentary deposits; in this mining method, the native sulphur is melted underground with superheated water and brought to the surface by compressed air. The United States, where the Frasch process was developed early in the 20th century, was the leading producer of Frasch sulphur until 2000. Poland, with 6,60,000 tonnes, was the only country that produced more than 3,00,000 tonnes of native sulphur by using either the Frasch process or conventional mining methods. Small quantities of native sulphur were produced in Asia, Europe, and South America. The importance of pyrites to the world's sulphur supply has significantly decreased; China and Finland were the top producers of sulphur from pyrites with China accounting for 86% of the world pyrite production.

Native sulphur production, including production of Frasch sulphur at Poland's last operating mine, was estimated to be about the same as that in 2017. Recovered elemental sulphur production and byproduct from metallurgy was slightly higher than that in 2017. Globally, production of sulphur from pyrites was estimated to have been the same as that in 2017. Pyrites is a less attractive alternative to elemental sulphur for sulphuric acid production, primarily because the environmental remediation cost of mining pyrites is high (Table – 6 : World Production of Sulphur & Pyrite).

Table – 6 : World Production of Sulphur & Pyrites

(By Principal Countries)

In tonnes (sulphur content)

Country	2020	2021	2022
World:- Total Pyrites	**5600000**	**5500000**	**5500000**
World:- Total Frasch	**400000**	**400000**	**500000**
World:- Total Recovered	**74200000**	**73500000**	**75700000**
World:- Total Sulfur	**50000**	**50000**	**50000**
Austria			
Recovered [(a)]	* 44000	* 44000	* 44000
Belarus			
Recovered [(a)]	64336	* 64000	* 64000
Belgium			
Recovered [(a)(b)]	* 400000	* 400000	* 400000
Bosnia & Herzegovina			
Recovered	* 3700	* 3700	* 3700
Bulgaria Recovered (b)	486381	425188	400000
Recovered [(a)]	* 60000	* 60000	* 60000
Croatia Recovered [(a)]	8618	8659	7274
Czech Republic			
Recovered [(a)]	* 25000	* 23000	* 21000
Denmark			
Recovered [(a)]	4140	4090	3727
Finland			
Pyrites	194000	182000	143000
Recovered [(b)]	358700	338400	341100
Recovered (a)	* 120000	* 120000	* 120000
France			
Recovered [(a)]	* 370000	* 370000	* 370000
Recovered [(c)]	* 55000	* 55000	* 55000
Germany			
Recovered [(a)]	353293	382049	370664
Recovered [(c)]	213398	235769	227281
Greece			
Recovered [(a)]	627800	500000	390000
Hungary			
Recovered [(a)]	* 54000	* 54000	* 54000
Italy			
Recovered [(d)]	* 550000	* 550000	235628
Lithuania			
Recovered [(a)]	71247	72988	64498
Netherlands			
Recovered [(b)]	* 90000	* 90000	* 90000
Recovered [(a)]	* 510000	* 500000	* 500000
Norway Recovered [(b)]	73187	70948	69013
Recovered [(a)]	* 22000	* 22000	* 22000
Poland Frasch	422380	449100	476900
Recovered [(b)]	* 280000	* 280000	* 280000
Recovered [(a)]	24740	24240	22670
Portugal			
Recovered	* 21000	* 21000	* 21000
Romania			
Recovered	* 42000	* 42000	* 42000

Table- 6 (Contd.)

In tonnes (sulphur content)

Country	2020	2021	2022
Russia			
Pyrites	* 71000	* 71000	* 71000
Recovered [(a)]	* 6100000	* 6400000	* 6582000
Recovered (c)	* 954000	* 954000	* 954000
Sulfur ore	* 28000	* 28000	* 28000
Serbia			
Recovered [(b)]	* 29400	* 29400	* 29400
Slovakia			
Recovered [(b)]	* 4900	* 4900	* 4900
Recovered [(a)]	* 15000	* 25000	* 15000
Sweden Recovered [(b)]	165500	172700	179900
Recovered [(a)]	39085	38248	28170
Turkey Pyrites	46408	39681	41788
Recovered [(a)(c)]	* 92000	* 98000	* 102000
Sulfur ore	—	—	—
United Kingdom			
Recovered [(a)]	106000	107000	121000
Algeria			
Recovered [(a)]	* 10000	* 10000	* 10000
Egypt			
Recovered [(a)]	* 68000	* 65000	* 65000
Libya			
Recovered [(a)]	133300	139000	139500
Morocco			
Recovered	* 60000	* 60000	* 60000
Namibia			
Recovered	81500	65500	* 74500
South Africa			
Recovered [(b)(a)]	575491	32044	70640
Zambia			
Recovered [(b)]	917300	691900	* 700000
Canada			
Recovered [(b)]	554746	* 555000	* 555000
Recovered [(a)]	4349262	4193003	4348607
Cuba			
Recovered	3176	2846	2951
Recovered [(a)]	* 20000	* 20000	* 20000
Mexico			
Recovered [(b)]	* 556000	* 556000	* 556000
Recovered [(a)]	315935	182871	290121
Trinidad & Tobago			
Recovered [(a)]	* 10000	* 10000	* 10000
"USA Recovered [(b)]"	581000	* 600000	* 600000
Recovered [(a)]	7310000	* 7500000	* 8000000
Argentina			
Recovered [(b)]	* 20000	* 20000	* 20000
Brazil			
Pyrites	* 20000	* 20000	* 20000
Recovered [(b)]	* 292000	* 292000	* 292000

Table- 6 (Contd.)

In tonnes (sulphur content)

Country	2020	2021	2022
Recovered [a]	* 239000	* 239000	* 239000
Chile			
Recovered [b]	1476154	1400388	1334713
Colombia			
Recovered [a]	* 5900	* 5600	* 5700
Ecuador			
Recovered [a](e)	* 5000	* 5000	* 5000
Peru			
Recovered [d]	* 556000	* 556000	* 556000
Venezuela			
Recovered [a]	* 100000	* 100000	* 100000
Bahrain			
Recovered [a]	* 120000	* 110000	* 110000
China			
Pyrites	5240000	* 5200000	* 5200000
Recovered	13610000	* 13600000	* 13600000
India			
Recovered [b]	* 1200000	* 1200000	* 1200000
Recovered [a](f)	737337	723400	926270
Indonesia			
Recovered [b]	* 160000	* 160000	* 160000
Recovered [a]	* 120000	* 120000	* 120000
Iran			
Recovered [d]	* 1600000	* 1900000	* 2000000
Iraq			
Recovered [a]	* 5858000	* 5823000	* 6417700
Israel			
Recovered [a]	45184	43664	* 40 000
Japan			
Recovered [b]	1728654	1575032	1655704
Recovered [a]	1411860	1420094	1542244
Jordan			
Recovered [a]	* 490000	* 490000	* 490000
Kazakhstan Recovered [b]	* 604000	* 604000	* 604000
Recovered [a]	* 2484000	* 2490000	* 2438900
Korea (Rep. of)			
Recovered [b]	* 1078000	* 1078000	* 1078000
Recovered [a]	2000000	2000000	2000000
Kuwait			
Recovered [a]	* 780000	* 785000	* 874200
Oman			
Recovered [a]	* 48000	* 48000	* 51400
Pakistan			
Sulfur ore [g]	19948	19398	16288
Philippines			
Recovered [b]	* 169000	* 169000	* 169000
Recovered [a]	* 26400	* 22600	* 20700
Qatar			
Recovered [a]	* 1512900	* 1539700	* 1556100

Table- 6 (Concld.)

In tonnes (sulphur content)

Country	2020	2021	2022
Saudi Arabia			
Recovered [(a)]	* 3500000	* 3400000	* 3820667
Singapore			
Recovered [(a)]	* 300000	* 300000	* 300000
Syria			
Recovered [(a)]	* 5000	* 12000	* 12000
Taiwan			
Recovered	167336	192227	162571
Thailand			
Recovered [(a)]	* 37300	* 49200	* 41000
Turkmenistan			
Recovered [(a)]	* 299000	* 348000	* 336000
United Arab Emirates			
Recovered [(a)]	* 2318000	* 2300000	* 2500000
Uzbekistan			
Recovered [(b)]	* 131000	* 131000	* 131000
Recovered [(a)]	* 81000	* 78000	* 81200
Australia			
Recovered [(b)]	* 810000	* 810000	* 810000
Recovered	[(a)])* 90000	[(a)]* 90000	[(b)]* 90000
New Zealand			
Recovered [(a)]	* 16000	* 14000	* 12000

Source: BGS, World Mineral Production, 2020-2023
Note (s)
"(1) In addition to the countries listed Dem. P.R. of Korea may also produce pyrites and may recover sulfur from metal processing; Ukraine may also produce sulphur."
(a) From petroleum refining and/or natural gas
(b) From metal sulphide processing (c) Other
(d) Sulfur; all forms
(e) Including Frasch
(f) Years ended 31 March following that stated
(g) Years ended 30 June of that stated

FOREIGN TRADE

Exports

Exports of sulphur (excluding sublimed, precipitated, and colloidal) increased to 15,54,999 tonnes in 2022–23 as compared to 12,90,620 tonnes in the preceding year. Exports were mainly to China (78.7%), South Africa (11.03%), and Morocco (8.1%). On the other hand, exports of sulphur (sublimed, precipitated, and colloidal) decreased by 17% to 14,515 tonnes in 2022–23 as compared to 17,607 tonnes in the preceding year. Exports were mainly to the USA (17.16%), Netherlands (11.11%), Brazil (11.42%), Indonesia, Russia, and Thailand (8% each), South Africa and Spain (approximately 6% each), Portugal(4.46%) , and Italy (4.65%) (Tables 7–11). Exports of sulphur (sublimed) were at 14,515 tonnes for the years 2022-23. Exports of sulphur (colloidal and precipitated) were negligible for the both years 2021-22 and 2022–23.

Table – 7 : Exports of Sulphur (Excl. Sublimed, Precipitated & Colloidal) :Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1290620**	**21010532**	**1554999**	**33267617**
China	1233483	19687695	1224865	26488190
South Africa	20	1879	171543	3714608
Morocco	21000	351372	126000	1904754
Jordan	28500	696561	21024	489880
Tanzania	1067	33377	5673	285410
Turkey	829	59435	1741	206739
Sri Lanka	1361	39319	1278	54667

Table- 7 (Concld.)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Nepal	764	24554	1042	25631
Brazil	68	4770	145	15059
Nigeria	120	3667	270	13274
Other Countries	3408	107903	1418	69405

Figures rounded off

(In tonnes)

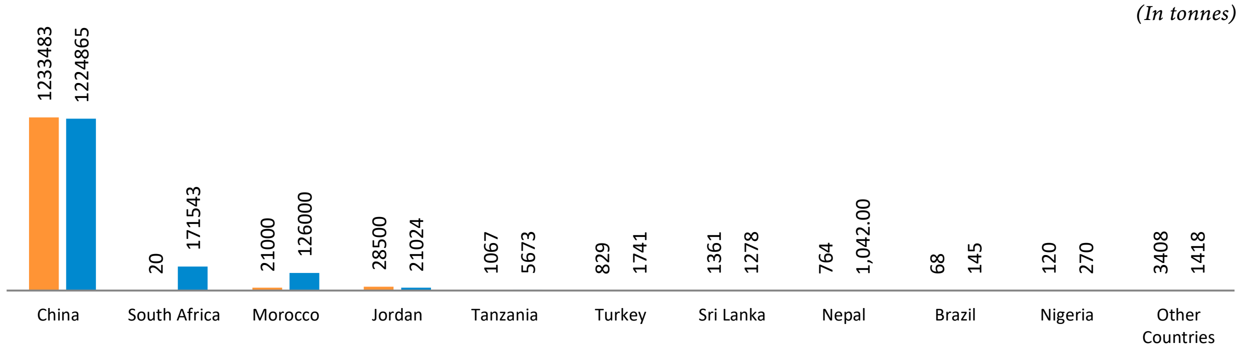


Fig 2: Countrywise Export of Sulphur

Table –8 : Exports of Sulphur (Sublimed, Precipitated & Colloidal) : Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**17607**	**1941916**	**14515**	**2059103**
USA	2667	282792	2491	349843
Netherlands	1699	212919	1613	262811
Brazil	1338	146605	1657	243930
Indonesia	1728	183822	1180	154906
Thailand	1336	146119	1130	147880
Russia	1230	124625	1217	144710
South Africa	1112	134059	852	128511
Spain	904	88319	820	111752
Portugal	840	99572	648	102326
Italy	940	107934	675	95092
Other Countries	3813	415150	2232	317342

Figures rounded off

Table – 9: Exports of Sulphur (Colloidal)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**9**	**312**	**9**
Sri Lanka	--	--	312	4
Korea Rp	++	4	-- --	3
Singapore	++	4	-- --	1
Brunei	++	1	-- --	1

Figures rounded off

Table – 10 : Exports of Sulphur (Sublimed)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**17607**	**1941891**	**14515**	**2052830**
USA	2667	282792	2491	349841
Netherlands	1699	212919	1613	262811
Brazil	1338	146605	1657	243930
Indonesia	1728	183822	1180	154906
Thailand	1336	146119	1130	147880
Russia	1230	124625	1217	144710
South Africa	1112	134059	852	128511
Spain	904	88319	820	111752
Portugal	840	99572	648	102326
Italy	940	107934	675	95092
Other Countries	3813	415125	2232	311071

Figures rounded off

Table-11 : Exports of Sulphur (Precipitated)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**16**	**++**	**5961**
Malaysia	-	-	++	5827
Sri Lanka	-	-	++	102
Maldives	-	-	++	27
Qatar	++	3	++	2
USA	-	-	++	2
Nepal	-	-	++	1
UAE	++	++	++	++
Guinea	-	-	++	++
Indonesia	-	-	++	++
Russia	-	-	++	++
Other Countries	++	13	++	++

Figures rounded off

Imports

Imports of sulphur (excluding sublimed, precipitated, and colloidal) decreased by 29% to 13,37,789 tonnes in 2022-23 from 18,95,211 tonnes in the previous year. Imports were mainly from UAE (33.13%), Qatar (32.27%), Oman (14%), Kuwait (6.83%), Saudi Arabia, and Russia (nearly 4% each). Imports of sulphur (sublimed, precipitated, and colloidal) increased marginally by 8% to 1,036 tonnes in 2022-23 from 959 tonnes in the previous year. Imports were mainly from Taiwan (52.70%), Malaysia (24.71%), China (15%) and Germany (3.57%) (Tables 12-16). Imports of sulphur (sublimed) and (precipitated) were at 757 and 252 tonnes respectively during the year 2022-23.

Table – 12-: Imports of Sulphur (Excl. Sublimed, Precipitated & Colloidal): Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1895211**	**35362092**	**1337789**	**26766634**
Qatar	613000	12587182	431741	8485668
UAE	477998	7701252	443186	7686919
Oman	287017	5282758	186816	4781107
Kuwait	169333	3400845	91398	1828376
Saudi Arabia	210168	3792684	47976	1108595

Table- 12 (Concld.)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Japan	47997	947759	37999	1107462
Russia	260	4260	51819	870827
Iraq	39087	659967	12943	306763
Korea Rp	176	8651	20078	302439
Singapore	19499	424202	8144	107387
Other Countries	30676	552532	5689	181091

Figures rounded off

(In tonnes)

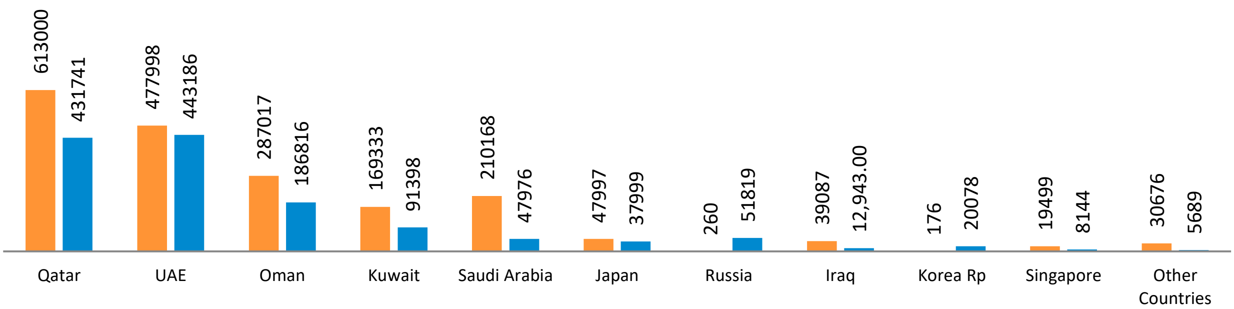


Fig 3: Countrywise Imports of Sulphur

Table – 13: Imports of Sulphur (Sublimed, Precipitated & Colloidal): Total

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**959**	**335922**	**1036**	**290426**
Taiwan	779	297938	546	203812
Malaysia	48	6832	256	40209
China	44	4779	159	21130
Germany	36	5710	37	8957
Vietnam	2	1641	15	6170
Belgium	18	7450	7	3899
Korea Rp	15	5867	8	3147
Netherland	6	2833	4	1812
Japan	5	1837	4	1071
USA	++	248	++	183
Other Countries	6	787	++	36

Figures rounded off

Table – 14: Imports of Sulphur (Precipitated)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3**	**6196**	**252**	**40331**
Malaysia	-	-	220	35109
Germany	36	5273	28	4141
Japan	3	854	4	1018
USA	++	61	++	63
UK	++	8	-	-

Figures rounded off

Table – 15: Imports of Sulphur (Colloidal)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**27**	**10666**	**27**	**10921**
Germany	-	-	9	4732
Belgium	18	7450	7	3899
Netherlands	6	2833	4	1812
Malaysia	3	147	7	395
Japan	++	43	++	53
UK	++	192	++	15
Baharain	-	-	++	15
USA	++	1	-	-

Figures rounded off

Table – 16: Imports of Sulphur (Sublimed)

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**893**	**319060**	**757**	**239174**
Taiwan	779	297938	546	203812
China	44	4779	159	21130
Vietnam	2	1641	15	6170
Malaysia	45	6685	29	4705
Korea Rp	15	5867	8	3147
U S A	++	186	++	120
Germany	++	437	++	84
France	--	--	++	6
Japan	2	940	--	--
Indonesia	6	587	--	--

Figures rounded off

FUTURE OUTLOOK

Country is deficient in sulphur and pyrites which are essential for Fertilizer Industry. Recovered sulphur output was expected to increase significantly worldwide. Refineries in developing countries are expected to improve environmental protection measures and eventually compare with the environmental standards of plants in Japan, North America and Western Europe in future. Higher sulphur recovery is likely to result from several factors, viz, higher refining rates, higher sulphur content in crude oil, lower allowable sulphur content in finished fuels and reduced sulphur emissions mandated by regulations.

World consumption of natural gas is expected to maintain strong growth, and sulphur recovery from that sector is likely to maintain an increasing trend. Some of the future gas production is expected to come from unconventional natural gas resources, such as, shale gas and coal-bed methane.

In the near term, increased global production and continued demand will keep the sulphur market balanced, which is expected to be followed in the long term by a surplus worldwide. International sulphur trade is expected to increase significantly, driven by demand for sulphuric acid in industrial sectors (particularly new ore-leaching operations) and a modest increase in demand for fertilizers.

53. Vermiculite

Vermiculite is a term applied commercially to micaceous minerals (essentially hydrated silicates of Al, Mg and Fe), usually alteration products of biotite or phlogopite micas, formed by the removal of much alkalies and addition of water. Vermiculite differs from mica in its characteristic property, i.e., exfoliation. Crude vermiculite is always exfoliated before use.

RESERVES/RESOURCES

The total reserves/resources of vermiculite as on 1.4.2020 as per NMI data, based on UNFC system has been placed at 2.36 million tonnes of which about 1.60 million tonnes (68%) are placed under Reserves category and balance 0.77 million tonnes (32%) are placed under Remaining Resources category. Reserves/resources are mainly located in Tamil Nadu that reported 1.86 million tonnes (79%) followed by Andhra Pradesh with 0.20 million tonnes (8%), Karnataka 0.16 million tonnes (7%), Rajasthan 0.01 million tonnes (4%) and Jharkhand 0.03 million tonnes (1%). Nominal resources are located in Gujarat, Madhya Pradesh and West Bengal (Table-1).

Table - 1: Reserves/Resources of Vermiculite as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India: Total	1590996	**765227**	**2356223**
By Grades			
Refractory	38752	807	39559
Unclassified	1552244	764420	2316664
By States			
Andhra Pradesh	74193	117908	192101
Gujarat	-	1960	1960
Jharkhand	-	30048	30048
Karnataka	-	162240	162240
Madhya Pradesh	-	329	329
Rajasthan	-	104125	104125
Tamil Nadu	1516803	343051	1859854
West Bengal	-	5566	5566

Figures rounded off

MINING LEASES & PRODUCTION

As on 31.03.2023, a total of 52 vermiculite mines, covering an area of 914.65 hectares, have been reported. Production of vermiculite was at 2,303 tonnes in 2022-23 which decreased by 25% as compared to 3,060 tonnes in the year 2021-22. There were 6 reporting mines including three associated mines in 2022-23 as compared to 6 reporting mines including one associate mine in previous year.

Andhra Pradesh is the leading producer of vermiculite in 2022-23, which accounted for 100% of the total production (Tables-2 to 4).

Mine- head closing stocks of vermiculite at the end of the year 2022-23 were 8,285 tonnes as against 16,476 tonnes in the previous year (Table-5).

The average daily employment of labour during this year was 21 and 43 in the previous year.

Table – 2: Principal Producers of Vermiculite, 2022-23

Name & address of producer	Location of mine	
	State	District
T. Meenatchi Sundaram, Plot No. 2, Industrial Estate, Gudur P.O., (Mandal), SPSR Nellore - 524 101, Andhra Pradesh.	Andhra Pradesh	Nellore
Sadhana Minerals 1-116, Masthanvali Complex, Anil Nagar, Bye Pass Road Gudur, Chillakur, Post- Gudur Dist. Nellore-524412, Andhra Pradesh	Andhra Pradesh	Nellore
Modi Minerals 13/128,Gangammagudi Street, Gudur Mandal SPSR NELLORE 524101 Andhra Pradesh	Andhra Pradesh	Nellore
Eswara Enterprises 13/128,Gangammagudi Street,, GUDUR-(P.O), SPSR Nellore Dt,(A.P) SPSR Nellore 524101 Andhra Pradesh	Andhra Pradesh	Nellore

Table – 3 : Production of Vermiculite, 2020-21 to 2022-23

(By States)

(Qty in tonnes; Value in ₹'000)

State	2020-21		2021-22		2022-23(p)	
	Qty	Value	Qty	Value	Qty.	Value
India	**1260**	**2157**	**3060**	**3765**	**2303**	**1484**
Andhra Pradesh	750	469	2370	1481	2303	1484
Karnataka	-	-	-	-	-	-
Tamil Nadu	510	1688	690	2284		

(P) : Provisional

Table – 4 : Production of Vermiculite, 2021-22 and 2022-23

By Sectors/States/Districts)

(Qty. in tonnes; Value in ₹ '000)

State/District	No. of Mines	2021-22		No. of Mines	2022-23 (P)	
		Qty	Value		Qty	Value
India	6(1)	3060	3765	6(3)	2303	1484
Public Sector	1	690	2284	1	-	-
Private Sector	5(1)	2370	1481	5(3)	2303	1484
Andhra Pradesh	**4(1)**	**2370**	**1481**	**4(3)**	**2303**	**1484**
Nellore	4(1)	2370	1481	4(3)	2303	1484
Karnataka	**1**	**-**	**-**	**1**	**-**	**-**
Mysuru	1	-	-	1	-	-
Tamil Nadu	**1**	**690**	**2284**	**1**	**-**	**-**
Vellore	1	690	2284	1	-	-

Table – 5 : Mine-head Closing Stocks of Vermiculite 2021-22 and 2022-23
(By States)

(In tonnes)

State	2021-22	2022-23(p)
India	**16476**	**8285**
Andhra Pradesh	11267	3113
Karnataka	-	-
Tamil Nadu	5209	5172

MINING AND INDUSTRY

In Andhra Pradesh, vermiculite is available in the district of Nellore, where three (03) working mines have been reported during 2022–23. Vermiculite is mined and refined using a variety of techniques and supplied commercially in a range of particle-size grades of vermiculite concentrate. In Tamil Nadu, good-quality deposits of vermiculite are mostly found in the North Arcot regions, where mines remain non-working during the year. In Karnataka, vermiculite is found in the districts of Hassan, Mandya, and Mysuru.

Vermiculite, when heated to a high degree of temperature, exfoliates and expands 8–14 times in volume, yielding exfoliated vermiculite by the loss of water molecules. The chemical composition shows average moisture of 7.89%, loss on ignition of 11.05%, SiO_2 of 30.52%, Fe_2O_3 of 16.32%, and TiO_2 of 2.63%. The strong basal cleavage exhibits exfoliation at right angles. This property is the basis for its commercial use. A change in colour is observed during the heating process, and this depends upon the composition of the vermiculite and the furnace temperature.

USES & CONSUMPTION

Vermiculite is known for its horticultural applications. It is a common component in potting soils. Unfoliated (unexpanded) vermiculite has only minor uses, such as, for circulation in drilling muds and in the annealing of steel. In order to convert raw vermiculite into a product suitable for industrial use, it must be exfoliated or expanded by heating, a process termed 'exfoliation'. Vermiculite is chemically inert, fireproof, non-conductor of electricity and a good insulator against heat (both radiant and conducted), cold and sound. Unlike cork and other organic lightweight insulating material, it neither rots nor is attacked by vermin and has a fair mechanical strength.

Vermiculite is added to soil for conditioning and lightening either alone or in conjunction with peat or compost which facilitates the growth by enabling the plant to absorb the NPK nutrients and promote anchorage for tender young root systems. It is also used as a carrier in fertilizers, herbicides and insecticides. Cementing mixtures of exfoliated vermiculite and binding agents, such as, gypsum and plaster, have been important products and are applied to structural steel members in commercial buildings.

The mineral is used in various types of building boards and in pollution control applications. Fine-sized, untreated vermiculite concentrates are included in the preparation of fireproof plaster boards. The exfoliated product forms the basis of some lightweight plasterboard, whilst ground, exfoliated vermiculite is used in various refractory board products.

The principal uses of expanded vermiculite are based on its thermal insulating quality (due to presence of innumerable air cells), low-density, fire-proof nature and granular form. Larger vermiculite granules are used as a loose fill for thermal insulation for homes, industrial structures, cold storage, and refrigeration and high temperature & low temperature industrial equipment.

Vermiculite is also used for refractory and high temperature insulation as it can withstand hot face temperature of 1,000 °C, i.e., it can act as a thermal insulator.

The high absorbency and chemical inertness of exfoliated vermiculite have made it suitable for a wide range of absorbent packing materials as well as for packaged units for the containment of oil and similar liquids. Like perlite, vermiculite is a mined mineral that is heated to yield a soilless ingredient of potting mixes. Unlike perlite, vermiculite absorbs and retains water and nutrients. This quality is desirable especially in container gardens because of their quicker evaporation rates compared to in-ground plantings. On heating, vermiculite swells up and exfoliates into thin sheets the swellings may be twenty times or more. The swelled-up vermiculite is very light and thus may be used as an ingredient for the making of light cement or plaster. Vermiculite is also used in the Packing Industry and the making of insulator against heat and sound. Its colour may be yellow, brown or blue. It is very soft and slippery like soap. Pure vermiculite is also used for plaster aggregates as fireproof insulating material in steel/concrete structures. It is widely used in lightweight insulating material for roof/floor deck system, insulation fill for homes and commercial building, packaging material, bitumen-coated vermiculite screens, acoustic insulation, etc.

The apparent consumption of vermiculite slightly increased for the year 2022-23 to 3,606 tonnes, as against 2,894 tonnes in 2021-22.

SUBSTITUTES

Expanded perlite is a substitute for exfoliated vermiculite in lightweight concrete and plaster. Other denser but less costly substitutes in these applications are expanded clay, shale, slag and slate. Alternate materials for loose-fill fire-proofing insulation include fibreglass, perlite and slag wool. In agriculture, substitutes include bark and other plant materials, peat, perlite, sawdust and synthetic soil conditioners. Finely-ground pine bark also called "pine fines" is a principal ingredient of most potting mixes. As an alternative to vermiculite, pine fines also has water retentive qualities, especially with smaller particle sizes. Cotton gin waste includes gin leavings, such as, stems, leaves and hulls. Cotton gin compost renders these waste products into a viable alternative to vermiculite, also because of its ability to increase water-holding qualities in mixes. Resembling sphagnum peat moss, coir is the finish product of ground coconut husks. The University of Arkansas Co-operative Extension Service reports that coir can retain up to nine times its weight in water.

POLICY

As per foreign trade policy 2015-20, the imports and exports of vermiculite (unexpanded) [ITC (HS) Code 25301010] and vermiculite insulation bricks [ITC (HS) Code 69029030] are allowed 'free'.

WORLD REVIEW

Significant deposits have been reported in Australia, China, Russia, Uganda and some other countries, but reserves and resources information are reported from many sources and in most cases, it is not clear whether the numbers refer to vermiculite alone or vermiculite plus other minerals and host rock and overburden and production data. The details of world reserves of vermiculite are reflected in Tables -6 & 7.

Table – 6: World Reserves of Vermiculite

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (Rounded off)	NA
USA	25000
South Africa	14000
Turkey	11000
Brazil	6600
China	2900
India	1600

Source: USGS, Mineral Commodity Summaries, 2023

Table – 7: World Production of Vermiculite

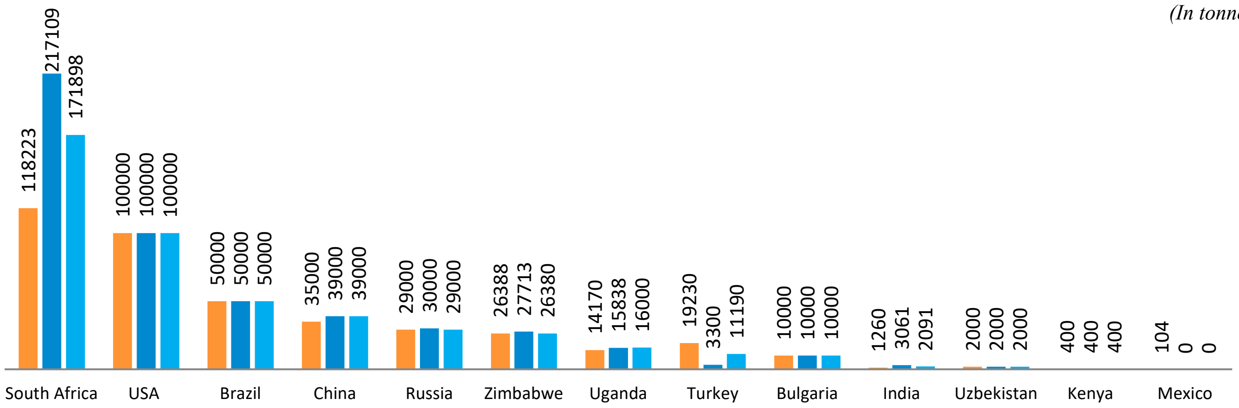
(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
South Africa	118223	217109	171898
USA [(a)]	100000 *	100000	100000
Brazil	50000 *	50000	50000
China	35000 *	39000	39000
Russia	29000 *	30000 *	29000
Zimbabwe	26388	27713	26380
Uganda	14170	15838	16000
Turkey	19230	3300	11190
Bulgaria	10000 *	10000 *	10000
India	1260 (b)	3061 (b)	2091
Uzbekistan	2000 *	2000 *	2000
Kenya	400 *	400 *	400
Mexico	104	-	-

Source: BGS, World Mineral Production, 2018-22
** Estimated*
(a):Sold or used by producers
(b): Years ended 31 March following that stated

(In tonnes)



World Production of Vermiculit

FOREIGN TRADE

Exports

Exports of vermiculite decreased by 22% to 989 tonnes in 2022-23 as compared to 1,263 tonnes in 2021-22. Exports were mainly to Nepal (42%), Japan (34%), UAE (18%) and Norway (5%) for the years 2022-23. (Table-8)

Table – 8: Exports of Vermiculite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1263**	**21780**	**989**	**12888**
Japan	616	9435	338	5634
UAE	252	4900	175	3601
Nepal	39	217	418	2250
Norway	242	4467	48	1083
Bangladesh	++	4	10	258
Kenya	--	--	++	40
Bhutan	--	--	++	22
Angola	59	1357	--	--
Taiwan	28	720	--	--
Other countries	27	680	++	++

Figures rounded off

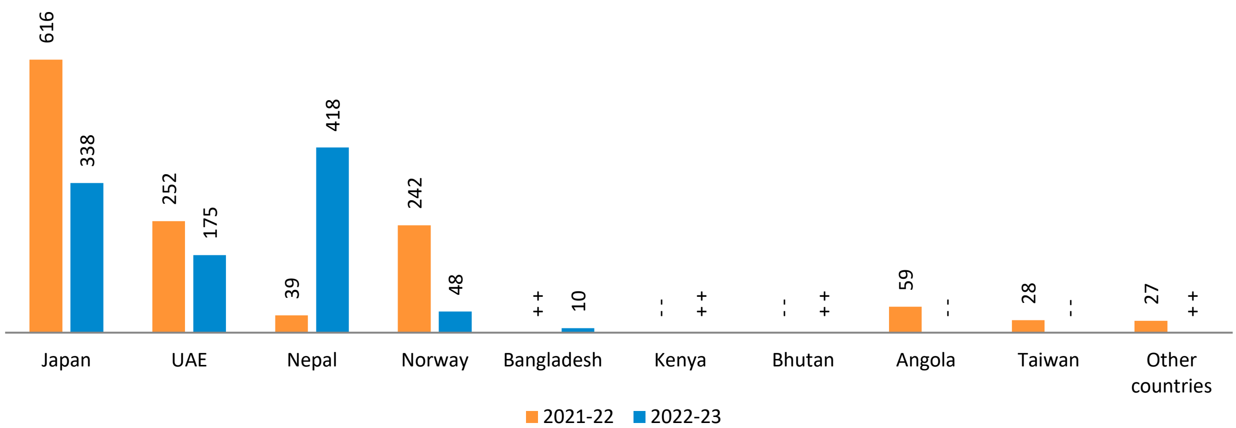


Fig 2: Countrywise Export of Vermiculite

Imports

Imports of vermiculite increased significantly by 109% to 2292 tonnes in 2022-23 from 1096 tonnes in 2021-22. Imports were mainly from Kenya (44%), Mozambique (32%), Brazil (14%) and South Africa (10%) for the years 2022-23. (Table-9)

Table – 9: Imports of Vermiculite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1096**	**25520**	**2292**	**73873**
Kenya	902	20626	1012	26931
Mozambique	80	2604	740	26237
Brazil	--	--	315	12856
South Africa	60	2093	224	7767
Iran	--	--	1	79
Turkey	--	--	++	3
Saudi Arabia	54	197	--	--

Figures rounded off

(In tonnes)

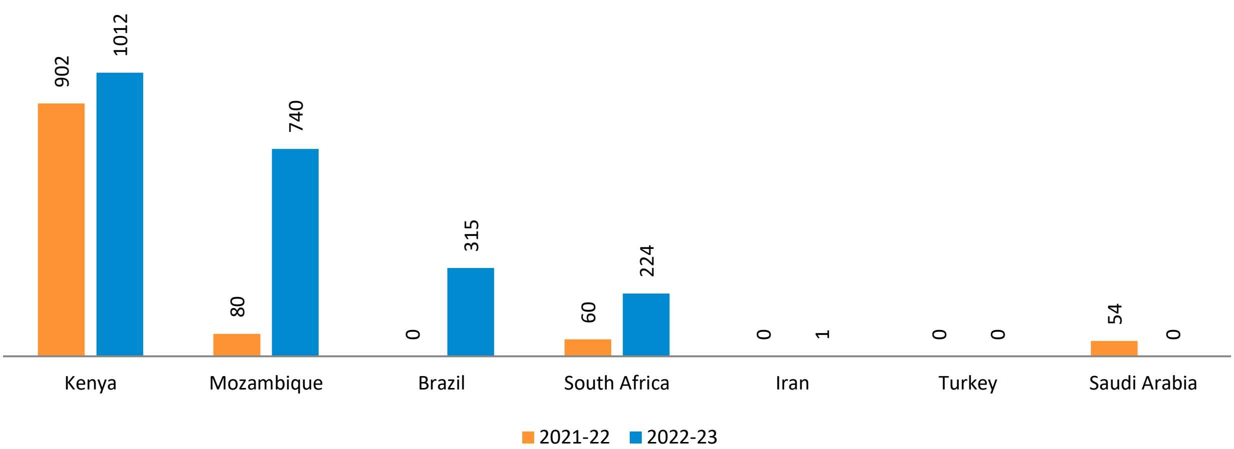


Fig 2: Countrywise Import of Vermiculite

FUTURE OUTLOOK

Global vermiculite (fine, medium and coarser grade) demand has increased over time due to a number of factors, such as industrial applications, building activity, economic situations, and movements in agriculture. The increased demand for these larger grades is projected to drive exploration and development of vermiculite resources with medium, large, and premium (coarser) grades, primarily in China and South Africa. It is anticipated that operations in Brazil and the United States are expected to help maintain regional and global supplies of fine, superfine, and micron grades. Innovative applications have continued to emerge including the use of fine-sized to micronsized grades of vermiculite to combat air pollution and absorb water in mines, replacing zeolites in ion-exchange columns, purifying waste water and for containing or removing nuclear waste.

54. Wollastonite

Wollastonite is a chemically simple mineral named in honour of English Mineralogist and Chemist Sir W.H.Wollaston. Wollastonite is composed of calcium and silica with a chemical formula CaSiO3. Wollastonite may contain impurities like iron, potassium, manganese, etc. Though normally wollastonite is bright white in colour, the impurities can produce grey, cream, brown or red colour in wollastonite. Wollastonite is formed when limestone/dolomite is subjected to high temperature and pressure in the presence of silica-bearing fluid as in skarn deposits or metamorphic rocks. It occurs as aggregates of bladed or needle-like crystals with hardness of 4.5 to 5 on Mohs scale. The uses of wollastonite in applications other than as filler include marine wallboard, paint, plastic, in refractory liners in steel mills and as a partial replacement for short-fibre asbestos in certain applications.

RESERVES/RESOURCES

Major deposits of wollastonite have been found in Ajmer, Dungarpur, Pali, Sirohi and Udaipur districts in Rajasthan. Besides, in Ghoda area, Banaskantha district in Gujarat and in Dharmapuri and Tirunelveli districts in Tamil Nadu, occurrences of a few deposits have been reported. As on 1.4.2020, the reserves/resources of wollastonite, as per NMI database, based on UNFC system are placed at 25.11 million tonnes of which Reserves under Proved and Probable categories together constitute 2.68 million tonnes (11%) and Remaining Resources constitute for the balance 22.43 million tonnes (89%). Out of the total resources, about 92% (23.11 million tonnes) including 2.68 million tonnes reserves are located in Rajasthan and the remaining about 8% resources (1.99 million tonnes) in Gujarat. Meagre resources are also located in Tamil Nadu (3,533 tonnes) (Table-1).

Table 1: Reserves/Resources of Wollastonite as on 1.4.2020

(By Grades/States)

(In tonnes)

Grade/State	Reserves Total (A)	Remaining Resources Total (B)	Total Resources (A+B)
All India : Total	2680978	**22427488**	**25108466**
By Grades			
Marketable	1790818	9161800	10952618
Unclassified		10662900	11302845
Not-known	250215	2602788	2853003
By States			
Gujarat	0	1990000	1990000
Rajasthan	2680978	20433955	23114933
Tamil Nadu	0	3533	3533

Figures rounded off

MINING LEASES & PRODUCTION

Production of Wollastonite at 1,10,793 tonnes in 2022-23 increased by 2.27% as compared to 1,08,335 tonnes in the preceding year. The major producers of Wollastonite are located in the Ajmer and Udaipur districts of Rajasthan. Provisionally, there are five reporting mines in the year 2022-23 which is same as reported in the previous year. The entire production was reported only from Private Sector mines located in the State of Rajasthan (Table-2 to 4).

The mine-head closing stocks at the end of 2022-23 was 157223 tonnes as against 137695 in 2021-22. (Table- 5).

The average daily labour employed in Wollastonite mines during 2022-23 was 224 against 191 in the previous year.

As per information available from Mining Lease Directory as on 31.03.2023, the total number of Mining Leases granted for mining of mineral Wollastonite is 13 covering an overall mining lease area of 258.69 Hectares

Table – 2: Principal Producers of Wollastonite, 2022-23

Name and address of the Producer	Location of Mine	
	State	District (s)
Wolkem Industries Ltd, P.B.21, E-101, Mewar Industrial Area, Madri, Distt Udaipur- 313 003, Rajasthan.	Rajasthan	Udaipur
Renu Atre, C- 378, Pradhan Marg, Malviya Nagar, Jaipur – 302 017, Rajasthan.	Rajasthan	Ajmer
Mr. SURESH YADAV Yadav Trailer transport co. 26 Mile chourah, Vijaynager, Vijaynagar, Ajmer, Rajasthan-305624	Rajasthan	Ajmer

Table (3): Production of Wollastonite, 2020-21 to 2022-23

(By State)

(Qty. in tonnes; Value in ₹ '000)

State	2020-21		2021-22		2022-23(p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	**103902**	**122210**	**108335**	**149156**	**110793**	**147258**
Rajasthan	103902	122210	108335	149156	110793	147258

(p): Provisional

(In tonnes)

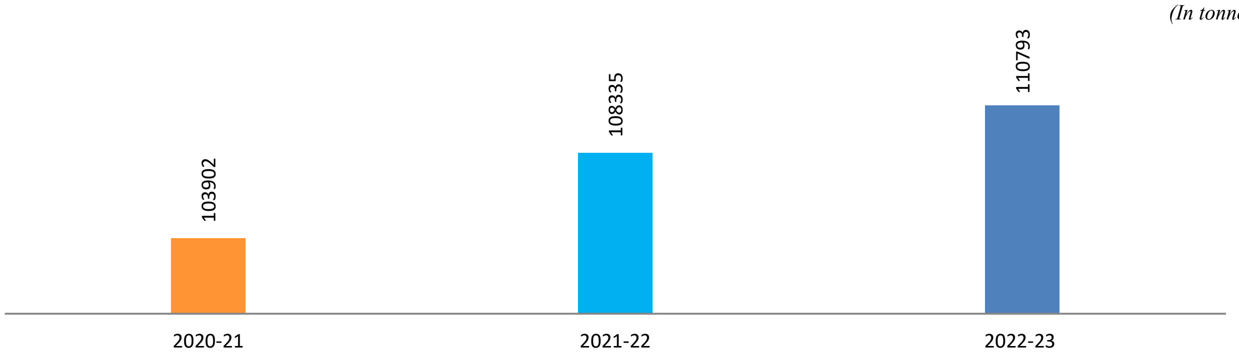


Fig 1: Production of Wollastonite in India

Table (4): Production of Wollastonite, 2021-22 and 2022-23

(By Sector/State/Districts)

(Qty.in tonnes; Value in ₹ '000)

State/District	2021-22			2022-23(p)		
	No. of mines	Quantity	Value$	No. of mines	Quantity	Value$
India	**5**	**108335**	**149156**	**5**	**110793**	**147258**
Private Sector	5	108335	149156	5	110793	147258
Rajasthan	5	108335	149156	5	110793	147258
Ajmer	3	550	305	3	8326	5318
Pali	1	-	-	1	-	-
Udaipur	1	107785	148851	1	102467	141940

(p) : Provisional

Table (5): Mine-head closing stocks of Wollastonite 2021-22 and 2022-23

(By State)

(In tonnes)

State	2021-22	2022-23(p)
India	137695	157223
Rajasthan	137695	157223

(p) : Provisional

USES & CONSUMPTION

The use of wollastonite depends on the acicularity or the aspect ratio, i.e., ratio between length and width of a crystal, chemical composition, brightness and fibre length. Wollastonite having aspect ratio in the range from 3:1 to 5:1 has little potential for reinforcing applications. Hence, market is primarily confined to ceramic, metallurgical fluxes and simple filler and coating applications. Wollastonite reduces the volume of the expensive plastic or resin medium and contributes to physical and chemical properties of the finished products. It improves tear strength, dielectric properties and retains mechanical properties at elevated temperatures.

Wollastonite is used primarily in automobile brakes, ceramics, metallurgical processing, paper, paint, plastic, cosmetics, adhesives and as a replacement of asbestos in asbestos-cement boards and sheets. Some of the properties that make it so useful are high brightness & whiteness, low moisture & oil absorption, low volatile content and the acicular nature of some wollastonite. A better compatibility between the polymer and the filler is achieved by chemical surface treatment of the mineral filler. Wollastonite results improved flexural modules in polypropylene and improved reinforcement in nylon. It is also used as performance additive in a wide range of construction material (concrete, stucco and adhesives).

Bulk of the demand for wollastonite in the country is in the Ceramic Industry for the manufacture of floor and wall tiles. In ceramics, wollastonite decreases shrinkage and gas evolution during firing. Small quantities are used in asbestos-cement products as a partial replacement for short fibre asbestos, paint, insecticide, marine wallboard and welding rod industries. In metallurgical applications, wollastonite serves as a flux for welding, a source for calcium oxide, as slag conditioners and to protect the source of molten metal during the continuous casting of steel. The addition of wollastonite to metallurgical fluxes provides ready fusibility, good insulating qualities and low viscosity.

A new development with very large potential is the use of wollastonite as a sequestration mineral for carbon dioxide, a major factor in global warming. Unlike other methods, sequestration by wollastonite is permanent and results in a mixture of precipitated calcium carbonate and silica that may have filler applications in paper, plastics & rubber.

The apparent consumption of wollastonite at 1,39,382 tonnes in 2022-23 increased by 9% as compared to 1,27,255 tonnes in 2021-22. The Ceramic Industry is the sole consuming Industry in the entire quantity of wollastonite (Table-6).

Table-6 : Estimated Consumption of Wollastonite 2020-21 to 2022-23

(By Industries)

(In tonnes)

Industry	2020-21	2021-22	2022-23 (P)
All Industries	**98943**	**127255**	**139382**
Ceramic	98943	127255	139382

Figures rounded off
P: Provisional

SUBSTITUTE

The acicular nature of many wollastonite products allow it to compete with other acicular materials, such as, ceramic fibre, glass fibre, steel fibre and several organic fibres, such as, aramid, polyethylene, polypropylene, and polytetrafluoroethylene in products where improvements in dimensional stability, flexural modulus and heat deflection are sought. Wollastonite also competes with several non-fibrous minerals or rocks, such as, kaolin, mica and talc, which are added to plastics to increase flexural strength and such minerals as baryte, calcium carbonate, gypsum and talc, which impart dimensional stability to plastics. In ceramics, wollastonite competes with carbonates, feldspar, lime and silica as a source of calcium and silica. Its use in ceramics depends on the formulation of the ceramic body and the fixing method.

WORLD REVIEW

World reserves of wollastonite are estimated to exceed 100 million tonnes. Many deposits, however, have not been surveyed, precluding accurate estimates of reserves. The large deposits of wollastonite have been identified in China, Finland, India, Mexico and the United States. Smaller but significant deposits were in Canada, Chile, Kenya, Namibia, South Africa, Spain, Sudan, Tajikistan, Turkey and Uzbekistan.

In 2022, Global sales of wollastonite were estimated to be in the range of 900,000 to 1,000,000 tonnes, higher than those in 2021. In 2022, China was the largest producer of Wollastonite with a production of 900 thousand tonnes. India with 104 thousand tonnes, Mexico with 162 thousand tonnes and USA with 50 thousand tonnes were the other major producers. In addition, small quantities of wollastonite were also produced in Spain, Australia and Thailand. India stands at 3rd position globally in production of Wollastonite in 2022-23.

The Ceramic Industry probably accounts for the major consumption of wollastonite worldwide, followed by polymers (plastic and rubber) and paint. The remaining were used in construction, friction products and metallurgical applications.

The countrywise production of wollastonite by principal countries from 2020-2022 is furnished in (Table-7).

Table –7 : World Production of Wollastonite

(By Principal Countries)

(In metric tonnes)

Country	2020	2021	2022
Finland	* 11 000	* 11 000	* 11 000
Spain	17 412	17 246	18 741
Mexico	131 518	200 588	162 410
USA	* 40 000	* 50 000	* 50 000
China	* 890 000	* 890 000	* 900 000
India	(a) 103 902	(a) 108 383	104 294
Australia (b)	2426	4 495	* 4500

Source: *BGS, World Mineral Production, 2018-2022*
Note(s)
(1) In addition to the countries listed, Canada also produces wollastonite (since 2014).
(a) Years ended 31 March following that stated
(b) Years ended 30 June of that stated
** estimated*

FOREIGN TRADE

Exports

In 2022-23, exports of wollastonite increased marginally by 8.88% to 12,847 tonnes from 11,705 tonnes in the previous year. Exports were mainly to Belgium (63%), Germany (10%), Hungary (11%), Japan (6%), U K (2%), France & Bangladesh (1% each) (Table-8).

Table – 8 : Exports of Wollastonite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**11705**	**282266**	**12847**	**365656**
Belgium	6723	167779	8093	246137
Hungary	1334	27088	1452	32927
Germany	1240	29991	1250	29674
Japan	1078	23675	812	19376
UK	383	10399	240	7661
France	168	4890	180	5866
Bangladesh	52	1441	163	5218
Mexico	82	3431	82	4468
Turkey	115	1650	127	3544
Russia			55	1879
Other Countries	530	11922	393	8906

Figures rounded off

(In tonnes)

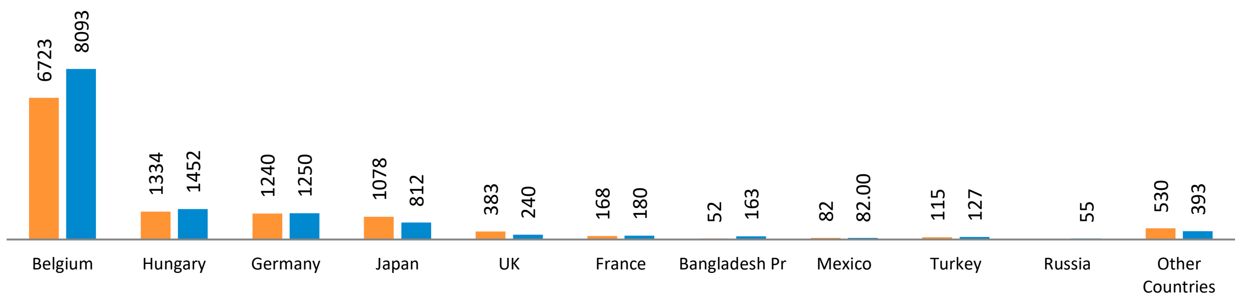


Fig 2: Countrywise Exports of Wollastonite

Imports

Like exports, imports of wollastonite in 2022-23 also increased substantially by 26.09% to 41,436 tonnes as compared to 30,625 tonnes in the previous year. Imports were almost entirely from China (99%) and the remaining 1% were from Mexico,USA and other countries (Table-9).

Table – 9 : Imports of Wollastonite

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**30625**	**675667**	**41436**	**877192**
China	30294	644660	41091	837980
Mexico	133	10604	112	10396
USA	41	3160	94	9130
Belgium	50	7589	37	6516
Canada	80	5099	60	4851
Germany	2	620	20	3423
Netherlands	19	2175	19	3023
Denmark	1	448	1	1005
Hong Kong	--	--	1	456
Japan	4	1228	1	406
Other Countries	1	84	++	6

Figures rounded off

(In tonnes)

Fig 3: Countrywise Imports of Wollastonite

FUTURE OUTLOOK

Presently, India is world's third largest producer of wollastonite after China and Mexico. The existing mines in the country are in a position to meet the domestic requirements of the Ceramic Industry as well as export demand. There is an increasing demand for wollastonite in the international markets, especially in ceramic, metallurgy, paint, construction and as asbestos substitute. In India, the present apparent consumption of wollastonite is around 1,39,382 tonnes.

The exports of processed wollastonite with high- aspect-ratio and powdered wollastonite may have to be encouraged for the betterment of export of value-added products. As a result of augmentation of resources of wollastonite in the States of Tamil Nadu and Gujarat, India would end up being in a formidable position and would be in a position to cope with any futuristic demand.

55. Zircon

Zirconium is the twentieth most abundant element in the Earth's crust and occurs in a variety of rock types and geological environment but most often, in the form of zircon ($ZrSiO_4$) found usually as a constituent in heavy mineral sand assemblages, which include ilmenite, rutile, leucoxene, monazite and garnet in varying proportions. Zircon sand and baddeleyite (an oxide- ZrO_2) are used via their salts to extract zirconium and hafnium. Normally, all zirconium compounds contain between 1.4 % and 3 % hafnium. Zircon is very stable at high temperature and has excellent thermal shock resistance, low thermal conductivity and chemical inertness. It finds use chiefly in industries like ceramic, refractory, abrasive, foundry, chemical and specialty alloys. Gem variety of zircon is used in jewellery. Ministry of Mines vide its Notification No. S.O.2356 (E) dated 11.07.2016 inserted Zircon (covered under beach sand minerals) as entry 12 of Part B of the First Schedule to the MMDR Act, 1957. However, later on, As per (1) Mines and Minerals (Development and Regulation) Amendment Act, 2023 (vide notification no. 16 of 2023 dated 09.08.2023) and (2) Atomic Minerals Concession (Amendment) Rules, 2024 (vide notification no. 97 dated 14.02.2024), six minerals, namely, (i) Beryl and other beryllium-bearing minerals (ii) Lithium-bearing minerals, (iii) Niobium-bearing minerals, (iv) Titanium bearing minerals and ores, (v) Tantalum-bearing minerals and (vi) Zirconium-bearing minerals and ores have been delisted from the list of atomic minerals specified in Part-B of the First Schedule to the Act.

RESERVES/RESOURCES

Zircon occurs in close association with other heavy minerals, such as, ilmenite, rutile and monazite in beach sands, along the coastal tracts of the country. Its concentration in the deposits is about 0.6–18.7% of the total heavy minerals. Indian zircons analyse 63–66% ZrO_2. AMD has carried out reconnaissance investigation in parts of Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Odisha and West Bengal during 2008-14. The resource estimation in these areas has been carried out up to March 2020. The resources of zircon in India are placed at 36.56 million tonnes as per Department of Atomic Energy (DAE). However, the State-wise break-up as on March 2020 is not available so far. The breakup of 33.71 million tonnes resources up to 2016 is furnished in Table-1

Table – 1: Resources of Zircon

(In million tonnes)

State	Resources#
Total	**33.71**
Andhra Pradesh	11.94
Bihar/Jharkhand	0.08
Gujarat	0.01
Kerala	7.83
Maharashtra	0.01
Odisha	3.25
Tamil Nadu	10.2
West Bengal	0.39

Source:Department of Atomic Energy, Mumbai
 # :Inclusive of indicated, inferred and speculative categories.
As per letter received from Department of Atomic Energy dated 26.07.2018.

MINING LEASES AND PRODUCTION

Production of zircon increased to 15,600 tonnes in 2019-20 from 11,906 tonnes in the preceding year. The production of zircon is provided in Table-2. Prices of zircon as furnished by Indian Rare Earths Limited (IREL) and Kerala Minerals and Metals Limited (KMML) are detailed in Table- 3.

Due to strategic reasons, the mining leases for zircon in the country were hitherto granted only to the government company namely IREL and the state government undertaking namely KMML. IREL has mining lease areas in the Neendakara-Kayamkulam (NK) belt of Kerala whereas KMML has mining lease areas in the Neendakara-Kayamkulam (NK) belt of Kerala.

Table – 2: Production of Zircon 2017-18 to 2019-20

(In tonnes)

Year	Production of Zircon*
2017-18	9107
2018-19	11906
2019-20	15600

**As reported by Indian Rare Earths Ltd.*

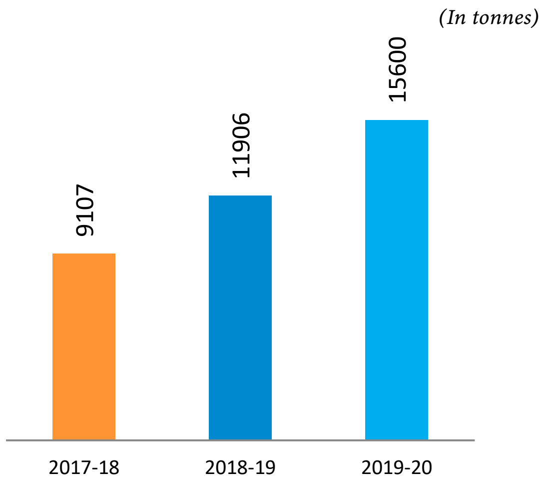


Fig 1: Production of Zircon in India

Table –3: Prices of Zircon, 2017-18 to 2019-20

(₹ per tonne)

Period	Grade	Price	Remarks
IREL			
2017-18	Q	70215	-
	MK	-	-
	OR	61638	-
2018-19	Q	105245	-
	MK	103099	-
	OR	90149	-
2019-20	Q	106790	-
	MK	107032	-
	OR	95297	-
KMML			
2017-18	Zircon Gr.I	85167	Average
	Zircon Gr.II	80167	Average
	Zircon Gr.III	76167	Average
	Zircon Gr.IV	Nil	
2018-19	Zircon Gr.I	109750	Average
	Zircon Gr.II	104750	Average
	Zircon Gr.III	100750	Average
	Zircon Gr.IV	98500	Average
2019-20	Zircon Gr.I	115000	Average
	Zircon Gr.II	110000	Average
	Zircon Gr.III	106000	Average
	Zircon Gr.1V	102000	Average

Source: Department of Atomic Energy, Mumbai.

INDUSTRY

IREL has set up a dry grinding mill at Chavara, Kerala to produce Zirflour for its application in the Ceramic Industry. A wet grinding mill was also set up at Chavara to produce micro-zir for its specialised application as opacifier. Besides, IREL established a small chemical plant at Manavalakurichi, Tamil Nadu to produce zircon frit, zirconium chloride, etc., primarily for supply of zircon frit to Department of Atomic Energy's Nuclear Fuel Complex (NFC), Hyderabad. A pilot plant (3.5 tpy capacity) was set up at Orissa Sand Complex (OSCOM) to produce a whole range of zirconia stabilised with CaO, MgO and rare earths.

The NFC manufactures and supplies fuel bundles for Pressurised Heavy Water Reactors (PHWRs) and Boiling Water Reactors (BWRs) of NPCIL. Highest ever production of PHWR fuel bundles, Zirconium Oxide, Zirconium sponge and Niobium metal was achieved during the period. The NFC, Hyderabad, has different types of production facilities which include the zirconium oxide plant for processing of zircon to pure zirconium oxide and zirconium sponge plant for conversion of zirconium oxide to pure sponge metal and Zirconium Complex (ZC) at Pazhayakayal, near Thoothukudi, Tamil Nadu. NFC Hyderabad produced 585 tonnes, 470 tonnes and 605 tonnes of zirconium oxide during 2019-20, 2020 - 21 and 2021-22,respectively. ZC, Pazhayakayal, produced 454 tonnes, 408 tonnes and 535 tonnes of ZrO_2 in 2019-20, 2020-21 and 2021-22, respectively. Besides, the Zircaloy Fabrication Plant produces various zirconium alloy tubings and sheet, rod and wire products. The plant also has facilities for reclamation of zircaloy mill-scrap. Zircon sand is processed through caustic fusion, dissolution, solvent extraction (to remove hafnium), precipitation and calcination to obtain zirconium oxide. The pure oxide is then subjected to high temperature chlorination, reactive metal reduction and vacuum distillation to obtain homogeneous zirconium sponge. The sponge is briquetted with alloying ingredients and melted in vacuum to produce zircaloy ingots. The alloy ingots are extruded to convert into seamless tubes, sheets and bars. The total installed capacity and production of zirconium oxide and zirconium sponge plants at NFC and ZC are furnished in Table-4 & 5.

Besides, Bhalla Chemical Works Pvt. Ltd operates three plants—two of which are located in Gurgaon, Haryana to manufacture zirconium derivatives (ZrO_2), based on imported zircon ore (capacity 10,000 tpy) and zirconium silicate opacifiers (capacity 5,000 tpy). The third plant of the Company in Rajasthan manufactures zirconium oxychloride crystals and special zirconias (capacity 10,000 tpy).

Table –4 : Plantwise Capacity and Production of Zircon Ore, 2017-18 to 2019-20

(By States)

(In tonnes)

Company	Location	Specification	Installed capacity** (tpy)	Production		
				2017-18	2018-19	2019-20
Total			**39000**	**13951**	**-**	
Indian Rare Earths Ltd	Manavalakurichi, Kanniyakumari distt., Tamil Nadu	65% ZrO_2+HfO_2 (min)	10000	*	2190	
	Chavara, Kollam distt., Kerala	65% ZrO_2+HfO_2 (min.)	17500	2649	3072	11490
	Orissa Sand Complex, Ganjam distt., Odisha	64.25% ZrO_2 (min)	5000	6458	6694	
Kerala Minerals & Metals Ltd	Chavara, Kollam distt., Kerala	Zircon Gr.I 64.0% (min.) Zircon Gr.II 62% (min.)	6500	4844	4762	4110

Source: Respective Producers and Department of Atomic Energy, Mumbai.
** During 2017-18 plant was not operating from Jan. 17 because of non-availablity of environment clearance.*
*** Excluding the V.V.Mineral's installed capacity of 18,000 tpy vide their letter and e-mail dated 09.09.2019 regarding non-operation of mining.*

Table –5 : Production of Zirconium Oxide and Sponge Plants of DAE at NFC and ZC, 2018-19 to 2020-21

(In tonnes)

Company	Installed capacity** (tpy)	Production		
		2019-20	2020-21	2021-22
Zirconium Oxide Plant, NFC, Hyderabad	600	585	470	605
Zirconium Sponge Plant, NFC, Hyderabad	400	-	-	-
Zirconium Oxide Plant, ZC, Pazhayakayal	500	454	408	535
Zirconium Sponge Plant, ZC, Pazhayakayal	250	-	-	-

Source: Department of Atomic Energy, Mumbai.

USES & CONSUMPTION

Zircon's exceptional qualities of hardness and durability makes it a must-use for the manufacture of ceramics and refractory tiles and also for a range of other high-tech applications, such as, armour plating on military aircraft, heat shield in space shuttles, potentially as solid oxide fuel cells in hydrogen- powered vehicles and in many industrial & chemical applications. Owing to its chemical inertness, very low heat conductivity, high specific gravity, low expansion, good resistance to abrasion, high melting point and no shrinkage on being heated up to 1,7500 °C, zircon is found to be an outstanding refractory material. Zircon finds its application in ceramics, zirconia, chemicals, refractory and foundry & castings which accounts for zircon's total world estimated consumption. Zirconia and Zirconium chemicals can be used for a variety of uses. Yttria-stablised zirconia (YSZ) is used in the manufacture of oxygen sensors that control combustion in automobile engines and furnaces. In Foundry Industry, zircon is used as facing for foundry moulds as it increases the resistance to metal penetration and accords a uniform finish to castings. Zircon sand is preferred to silica sand because of its uniform size, higher melting point, low thermal expansion and resistance to molten metal, acidic chemicals, slag, etc. Zircon containing 64% ZrO_2 is used generally for foundry applications. In Ceramic Industry, finely ground high-grade zircon and zirconium dioxide are used as opacifier in melts for vitreous enamelling and as pigment in ceramic glazes. Zirconium oxide is considered as a potential ceramic material for high temperature applications like engine components. Usually, zircon containing 65% ZrO2 is preferred in ceramics. The toughened zirconia finds its use in ceramic coatings in jet aircraft engines and in other applications where strength and high temperature oxidation resistance are important. Zirconia ceramics are also used in automobile sensors for the microprocessor control of engines. In Chemical Industry, its property of high resistance to corrosion is used where dry chlorine, hydrochloric acid and caustic alkalis are involved. Abrasive and grinding wheels made from zircon sands are used for polishing optical glasses. Zircon powder is used as a medium in waterjet cutting machines.

Zirconium and zirconium powders are used in ammunition, primers, detonation caps, flashlight mixtures, radio tubes and in various heating elements. Hafnium-free zirconium metal is used as cladding material in atomic reactors due to its low absorbing cross section for thermal neutron. Green, blue, indigo, red, orange coloured zircon is used as a natural gemstone and also processed to produce cubic zirconia - a synthetic gemstone resembling diamond. Zircon compounds have a very low toxicity and are not perceived as a potential environmental hazard. They are even said to have some medicinal properties and are now increasingly preferred in the manufacture of food products and pharmaceuticals too. It is also widely used in television and computer screens, resistance to corrosion and erosion makes zircon products ideal for use in the Chemical Industry and in desalination plants. Zircon flour is manufactured by milling zircon sand. It is used in ceramic frits, foundry mould coatings, ceramic shells for investment casting, refractories, friction products, insulating fibres and glass. Zircon opacifier is used in refractories and friction products. Zirconium metal or sponge is used mainly in the Nuclear Industry with a requirement for minimum content of hafnium.

Consumption of zircon/zirflour decreased considerably by 17% to 13,829 tonnes in 2019-20 from 16,600 tonnes in 2018-19. The consumption of zircon during the year 2019-20 was reported only by IREL. Consumption of zircon/zirflour during the year 2017-18 to 2019-20 is furnished in Table- 6.

Table –6: Estimated Consumption * of Zircon 2017-18 to 2019-20

(By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	**17500**	**16600**	**13829#**
Ceramic	7200	6300	3963
Refractory	9700	9400	1153
Others (Alloy Steel,Iron & Steel, Chemical, foundry, paint and cement)	600	900	8751

Figures rounded off.
** Includes actual reported consumtion and/or estimates made wherever required. Due to paucity of data, coverage may not be complete.*
 # only reported by IREL.

RESEARCH & DEVELOPMENT

Various R&D studies have been conducted by R&D Laboratory, OSCOM and Department of Atomic Energy to improve the metallurgical performance of mining and mineral separation plants. As a result throughput of the plants has increased and the grade and recovery of heavy minerals in concentrate has been enhanced. The two most outstanding contributions of this laboratory in the areas of value addition are development of new process flow sheets for the preparation of synthetic rutile from OSCOM ilmenite and zirconia from zircon.

IREL Technology Development Council (IRELTDC) has been formed with an objective of promoting industrial scale R & D that would be beneficial to the overall programme of DAE in both strategic and non-strategic fields utilizing mineral & value added products of IREL.

POLICY

Zircon was earlier classified as a 'prescribed substance', as per notifications issued under Atomic Energy Act, 1962. From the revised list notified vide S. O. No. 61(E), dated 20.1.2006, zircon was deleted, subject to the condition that the mineral shall remain a prescribed substance till the policy on exploration of beach sand minerals notified on 6.10.1998, is adopted/revised/modified by Ministry of Mines or till 1.1.2007, whichever occurs earlier and shall cease to be so thereafter. Ministry of Mines, vide Notification No.S.O.2356 (E) dated 11.07.2016, zircon covered under beach sand minerals was inserted as entry 12 after entry 11 of Part B of the First Schedule to the MMDR Act, 1957. As per the Foreign Trade Policy, 2015-20, the export and import of zirconium ores and concentrates under ITC (HS) Code 26151000 are freely allowed. The notification reads:

S.O. 1592(E)—In pursuance of Clauses (f) and (g) of Sub-section (1) of Section 2 and Section 3 of the Atomic Energy Act, 1962 (No. 33 of 1962) and in supersession of the notifications of the Government of India in the Department of Atomic Energy vide Number S.O. 61(E) dated 20th January 2006, the Central Government hereby notifies the substances, equipment and technology specified in the Schedule appended hereto as 'Prescribed Substances, Prescribed Equipment and Technology'.

Under Category 0A303 and under Heading Nuclear materials, nuclear-related other materials, equipment and technology - "Zirconium with hafnium content of less than 1 part to 500 parts of zirconium by weight (i.e. less than 2,000 ppm) in the form of metal, alloys containing more than 50% zirconium by weight, compounds, manufactures thereof, waste or scrap of any of the foregoing".

G.S.R. 134(E) dated 20.02.2019 — In exercise of the powers conferred under Section 11B of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) and Rule 36 of the Atomic Minerals Concession Rules, 2016, the Central Government hereby makes the following amendments further to amend the Atomic Minerals Concession Rules, 2016, namely—

(1) These rules may be called the Atomic Minerals Concession (Second Amendment) Rules, 2019.

(2) They shall come into force on the date of their publication in the Official Gazette.

In the Atomic Minerals Concession Rules, 2016, for Schedule A, the following Schedule has been substituted, namely –

PARTICULARS OF THRESHOLD VALUE FOR ATOMIC MINERALS

[See Rule 2 (1) (m) and Rule 36]

1.	Beryl and other beryllium - bearing minerals	0.1% BeO (1000 ppm BeO) of the rock or 10 kg/tonne Beryl in excavated material.
2.	Lithium bearing minerals	0.5% (5000 ppm) Li_2O in ore, except brine (200 ppm Li, i.e. 200 g/tonne Li).
3.	Minerals of the 'rare earths' group containing uranium and thorium	60 ppm U_3O_8 and/or 250 ppm ThO_2 in ore
4.	Niobium-bearing minerals	100 ppm $(Nb+Ta)_2\ O_5$ (100 g/tonne) in ore.
5.	Phosphorites and other phosphatic ores containing uranium	60 ppm U_3O_8 in ore.
6.	Pitchblende and other uranium ores	60 ppm U_3O_8 in ore, except in Singhbhum Shear zone in Jharkhand where the threshold value will be 150 ppm U_3O_8 in ore.
7.	Titanium bearing minerals and ores (ilmenite, rutile and leucoxene)	In case of titanium-bearing minerals occurring in hard rock, 60 ppm U_3O_8 and/or 250 ppm ThO_2 in the rock. All cases of titanium-bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.
8.	Tantalum-bearing minerals	100 ppm $(Ta+Nb)_2O_5$ (100 g/tonne) in ore.
9.	Uraniferous allanite, monazite and other thorium minerals	60 ppm U_3O_8 and/or 250 ppm ThO_2 All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.
10	Uranium bearing tailings left over from ores after extraction of copper and gold, ilmenite and other titanium ores.	60 ppm U_3O_8 and/or 250 ppm ThO_2.
11.	Zirconium bearing minerals and ores including zircon.	All cases of zirconium -bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade. In other cases, zircon containing less than 2000 ppm of Hafnium.
12.	Beach Sand Minerals i.e. economic heavy minerals found in the teri or beach sand, which include ilmenite, rutile, leucoxene, garnet, monazite, zircon and sillimanite	All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.

As per (1) Mines and Minerals (Development and Regulation) Amendment Act, 2023 (vide notification no. 16 of 2023 dated 09.08.2023) and (2) Atomic Minerals Concession (Amendment) Rules, 2024 (vide notification no. 97 dated 14.02.2024), six minerals, namely, (i) Beryl and other beryllium-bearing minerals (ii) Lithium-bearing minerals, (iii) Niobium-bearing minerals, (iv) Titanium bearing minerals and ores, (v) Tantalum-bearing minerals and (vi) Zirconium-bearing minerals and ores have been delisted from the list of atomic minerals specified in Part-B of the First Schedule to the Act. These minerals have various applications in space industry, electronics, communications, energy sector, electric batteries and are critical in net-zero emission commitment of India. Due to their inclusion in the list of atomic minerals, their mining and exploration is reserved for government entities. Due to removal of these minerals from the said list, exploration and mining of these minerals has been opened up for the private sector as well. As a result, exploration and mining of these minerals is expected to increase significantly in the country.

WORLD REVIEW

World reserves of zirconium are placed at 68 million tonnes in terms of ZrO_2. The world's largest reserves are with Australia (71%), South Africa (9%) and Senegal (4%). The world production of zirconium minerals was estimated at 1.44 million tonnes in 2022 which has been increased by 26% as against 1.14 million tonnes in the previous year. Australia (37%), South Africa (22%), Mozambique (7%) are the principal producers of zirconium minerals (Tables-7 & 8).

Table – 7: World Reserves of Zirconium

(By Principal Countries)

(In thousand metric tons, ZrO_2 content)1

Country	Reserves
World total (rounded)	68,000
USA	500
Australia	48,000
China	500
Indonesia	NA
Mozambique	1,800
Senegal	2,600
South Africa	5,900
Other countries	8,500

Source: USGS, Mineral Commodity Summaries, 2023
1Calculated ZrO_2 content as 65% of gross production.
#For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 24 million tonnes, gross weight.

Table – 8 : World Production of Zirconium Minerals

(By Principal Countries)

(In tonnes)

Country	2020	2021	2022
World: Total	**1101000**	**1144000**	**1445000**
Australia (f)	434339	427565	529067
South Africa	280000	320000	320000
Mozambique	78138	100158	103553
USA	*20000	*20000	*100000
Indonesia (e)	*64000	*54000	*97000
Kenya	32224	25928	90698
Senegal	59000	64000	57000
China	*40000	*35000	*50000
Vietnam	*11000	*30000	*30000
Other countries	82299	67349	67682

Source: BGS, World Mineral Production, 2018-22.
*Note: *) Estimate*
(f) Years ended 30 June of that stated
(e) Conservative BGS estimates, based on exports

(In tonnes)

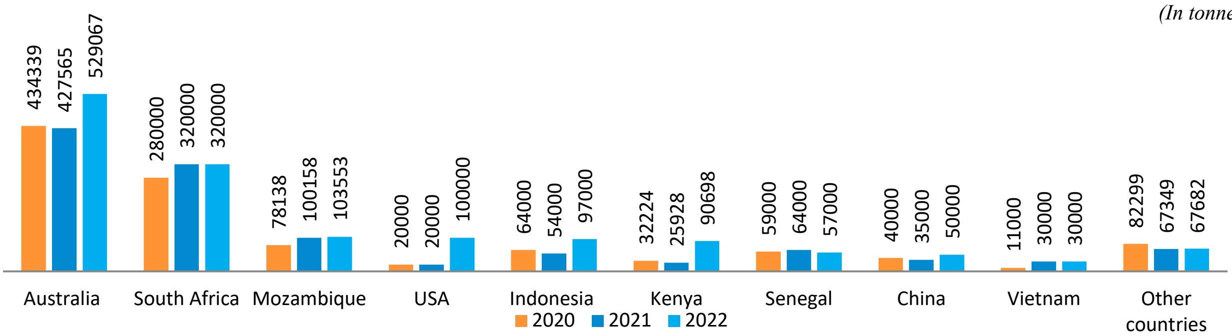


Fig 3: Countrywise Production of Zirconium Mineral

FOREIGN TRADE

Exports

Exports of zirconium ores and concentrates increased drastically to 43 tonnes in 2022-23 as compared to negligible quantity in the previous year. The export of the same was significantly confined to UAE with meager quantity to Germany and Iran. In 2022-23, there was no export of zirconium and scrap. The export of Ferro-Zirconium increased drastically by 100% to 32 tonnes in 2022-23 as compared to 16 tonnes in the previous year (Tables-9 to 11).

Table – 9: Export of Zirconium Ores and Conc.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**180**	**43**	**15779**
UAE	--	--	43	15649
Germany	--	--	++	130
Iran	--	--	++	++
Tanzania	++	180	--	--

Figures rounded off
++ Negligible

Table – 10 : Export of Zirconium

(By Product)

Product	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Total	**3**	**25189**	**--**	**--**
Zirconium Waste And Scrap	2	13258	--	--
Zirconium Unwrought : Powders	1	11931	--	--

Figures rounded off

Table – 11 : Export of Ferro-Zirconium

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**16**	**7127**	**32**	**10215**
Germany	7	1761	26	6128
Malaysia	2	1600	3	2763
UAE	--	--	3	857
Brazil	6	3347	++	304
Egypt	--	--	++	153
Israel	1	419	++	10

Figures rounded off
++ Negligible

Imports

Imports of zirconium ores and concentrates decreased by 13% to 82,831 tonnes in 2022-23 from 94,839 tonnes in the previous year. The main suppliers were Indonesia (27%), Australia (27%), Malaysia (20%) and South Africa (13%). In 2022-23, there was no import of zirconium and scrap. Further, the Import of Ferro -Zirconium increased by 26% to 658 tonnes in 2022-23 as compared to 522 tonnes in the previous year. The import was mainly from China (97%) (Tables-12 to 14).

Table – 12 : Import of Zirconium Ores And Cons.

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**94839**	**11260337**	**82831**	**15163201**
Indonesia	3293	544617	22741	4367177
Australia	48157	5605301	22330	3951295
Malaysia	16177	2029298	16338	2970528
South Africa	16885	1797571	11089	1891198
USA	2853	331378	3591	704551
China	208	23441	2372	422312
Senegal	979	132217	1971	385678
Thailand	3477	424799	1764	320304
Vietnam	1172	174328	404	87778
UK	2	1171	61	19392
Other Countries	1636	196216	170	42988

Figures rounded off

(In tonnes)

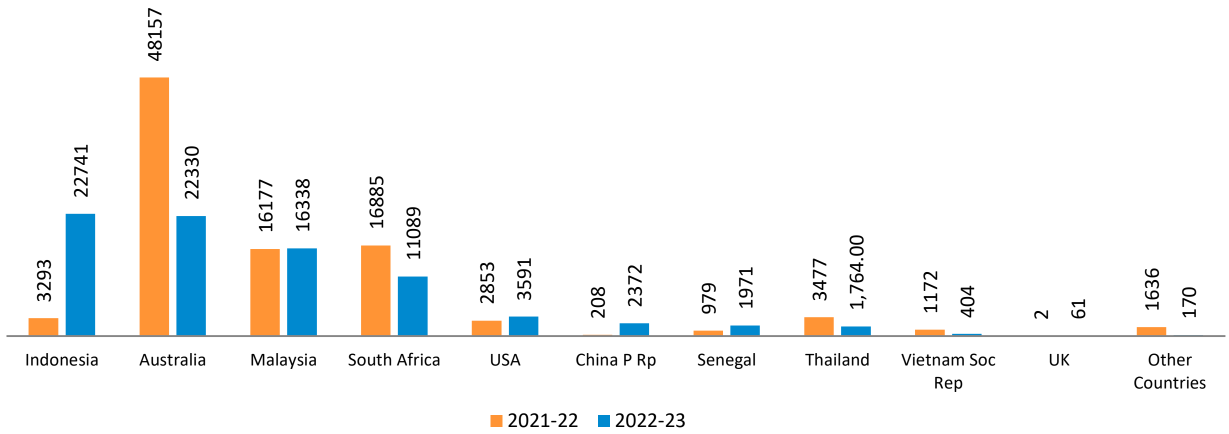


Fig 3: Countrywise Imports of Zircon Ores & Conc.

Table – 13 : Import of Zirconium

(By Product)

Product	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Total	**45**	**170561**	**--**	**--**
Zirconium Waste And Scrap	42	141637	--	--
Zirconium Unwrought : Powders	3	28924	--	--

Figures rounded off

Table – 14 : Import of Ferrozirconium

(By Countries)

Country	2021-22 (R)		2022-23 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**522**	**96181**	**658**	**162218**
China	512	92825	637	157656
Hong Kong	--	--	10	4106
UK	--	--	11	456
Netherlands	8	3022	--	--
UAE	2	334	--	--

Figures rounded off

FUTURE OUTLOOK

During 2024, the demand for zircon sand has been soft, mainly affected by the decline in the Chinese construction industry that accounts for 50% of the global zircon demand. As per report namely "Zirconium Market Size, Share, Industry, Forecast and Outlook (2024-2031)", the global zirconium market reached USD 1.4 billion in 2022 and is expected to reach 2.5 billion by 2030, growing with a CAGR of 6.9% during the forecast period 2024-2031.

Zircon flour is essential for various industries due to its exceptional thermal and chemical resistance. In the ceramics industry, zirconium-based ceramics, which incorporate zircon flour/sand, are crucial for applications like refractories, foundry coatings, and ceramic glazes. This growing use in construction and industrial applications is a significant driver for the zirconium market in the future. Further, zirconium's role in the nuclear industry is pivotal, as it is used for cladding fuel rods in reactors. Its excellent resistance to corrosion by water and its transparency to neutrons make it an ideal material for nuclear power stations. The demand for zirconium in this sector supports substantial market growth. Zirconium alloys, formed by alloying with metals such as nickel, titanium, or iron, find applications in aerospace, automotive, and chemical processing industries. The versatility and demand for these alloys across multiple sectors further drive market expansion. Rapid urbanization and infrastructure development in emerging economies are boosting the demand for zirconium-based materials, especially in tiles, sanitaryware, and architectural applications.

Zircon and Zirflor are the key ingredients in ceramics, foundry and refraction and are likely to see growth path on account of Government of India's thrust for 'Housing for all'.

INDIAN BUREAU OF MINES