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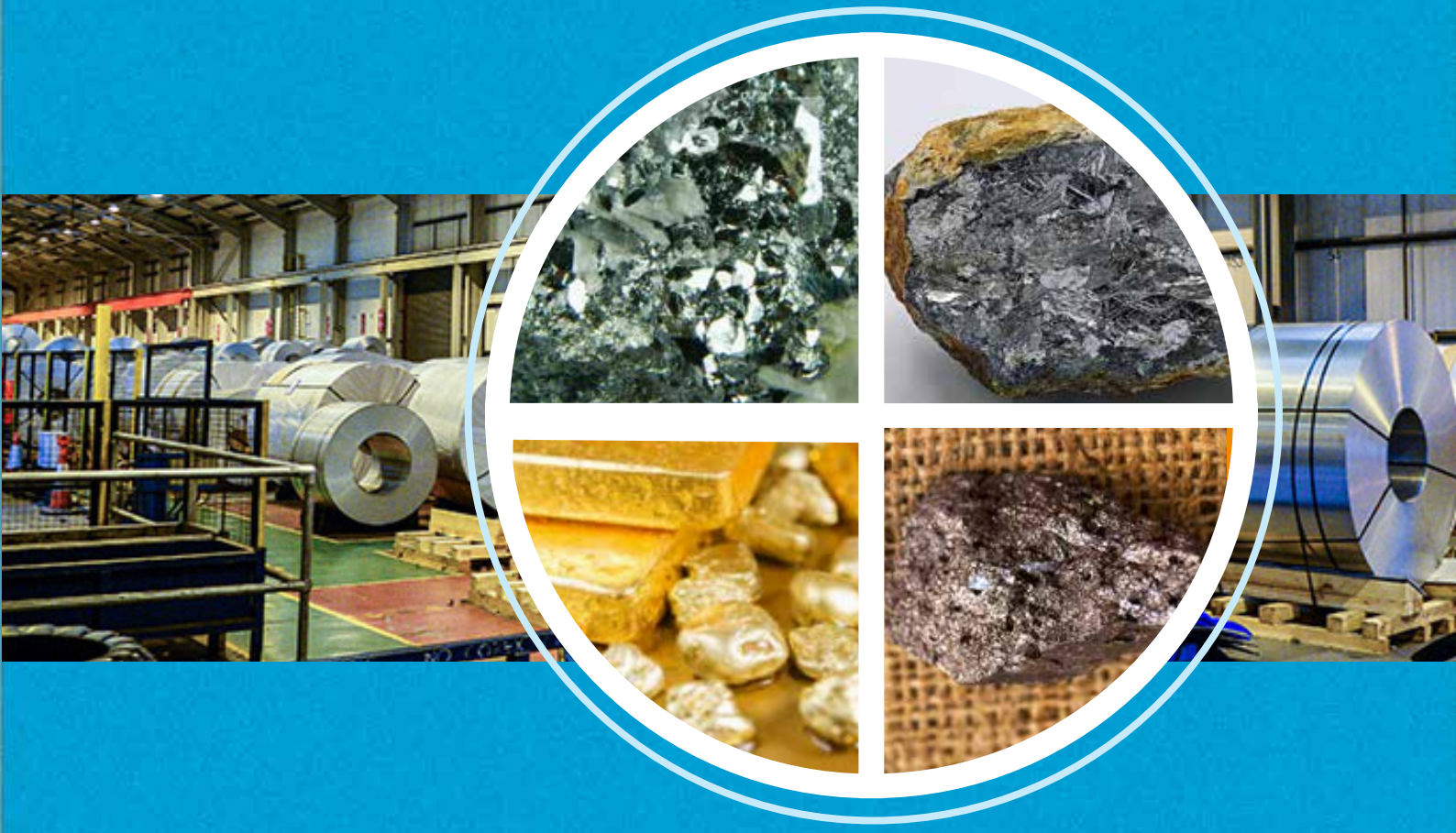
INDIAN MINERALS YEARBOOK 2022

METALS & ALLOYS

VOLUME II



INDIAN BUREAU OF MINES

Government of India
Ministry of Mines
Indian Bureau of Mines

INDIAN MINERALS YEARBOOK 2022

VOLUME - II
METALS & ALLOYS

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PREFACE

Indian Minerals Yearbook–2022 (IMYB–2022) is the 61st Edition in its series and comprises three Volumes. This book titled 'Metals & Alloys' is the second Volume and it contains 19 Reviews of important metalliferous minerals, metals and alloys produced in the country and comprehensively covers 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 data coverage of this Edition, i.e., IMYB–2022 pertains to the year 2021-22.

Attempts have been made to comprehensively cover the Metal Industry in India at the micro-level with inclusion of all recent updates. It has been our continuous endeavour to improve upon the coverage of the Yearbook and to present a complete perspective of all domains that have relevance to minerals and metals to the fullest extent possible.

This year there has been a transformational change in the aesthetics especially in the get-up and layout of the book. Refreshing changes in terms of colour- scheme and presentation of content have been effectuated with a belief that these would engage the attention of the readers. Additional features by way of presentation of tables, illustration (both pictorial & graphical) along with highlight-jottings are expected to add value to the book.

This Yearbook is the outcome of the joint efforts of the Bureau's Mineral Economics Division and Mining & Mineral Statistics Division. While preparing this Volume, inputs have been drawn 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 resourced and incorporated wherever necessary, during the compilation & formulation of this Volume.

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 this Edition of Indian Minerals Yearbook, i.e., IMYB–2022 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
November, 2024

(Sanjay Lohiya)
IAS
Additional Secretary &
Controller General (In-charge)
Indian Bureau of Mines

Volume- II

METALS & ALLOYS

Contents

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

UNITS UNITS

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

Conversion Table

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

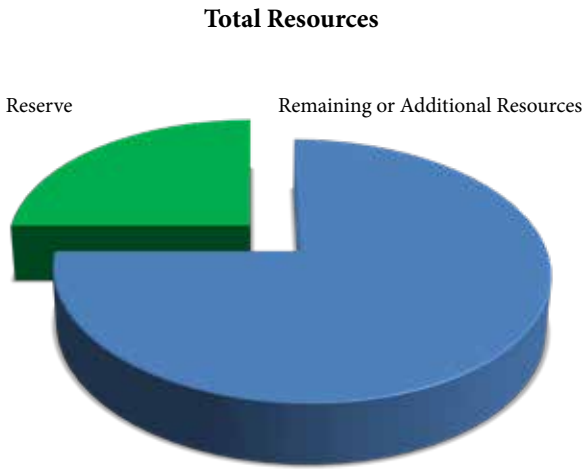
The UNFC consists of a three-dimensional system with the following three axes : Geological Assessment, Feasibility Assessment and Economic Viability. The process of geological assessment is generally conducted in stages of increasing details. The typical successive stages of geological investigation, 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.



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

1. Aluminium and Alumina

41.45
(lakh tonnes) Total annual installed capacity of aluminium plants in the country in 2021-22

74.75
(lakh tonnes) Installed capacity of alumina plants in the country in 2021-22

4,016
(thousand tonnes) Production of aluminium in 2021-22

7,229
(thousand tonnes) Production of alumina in 2021-22

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 2021-22

(By Producers)

(In '000 tonnes)

Producer	Plant	Annual capacity
Total Public Sector		**4145**
National Aluminium Co. Ltd	Angul (Odisha)	460
Private Sector Bharat Aluminium Co. Ltd	Korba (CG) - I	590
	Korba (CG)- II	
Hindalco Industries Ltd	Aditya (Odisha)- 360	1345
	Hirakud(Odisha)- 216	
	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)

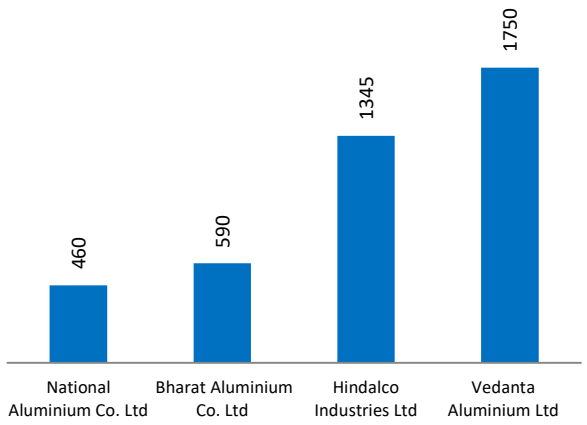


Fig 1.Company wise Installed Capacity of Aluminium 2021-22

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 (Karnataka)-	350	
	Muri (Jharkhand)-	450	
	Utkal Alumina (Odisha) -	1500	
Vedanta Aluminium Co. Ltd	Lanjigarh (Odisha)		2000

Source: Information received from the companies/Annual Reports.
 # Plants remained non-operational during the year.

(In '000 tonnes)

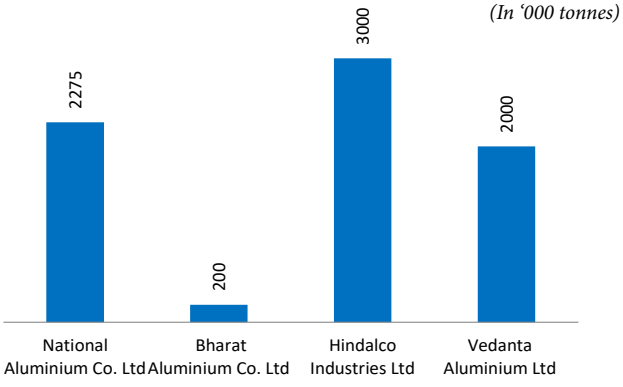


Fig 2.Companywise Installed Capacity of Alumina

PRODUCTION

Aluminium

The production of aluminium at 4016 thousand tonnes in 2021-22 registered an increase of 11% as compared to that in the previous year. Seven plants reported production of aluminium during the year. (Tables - 3 & 4).

Table – 3: Production of Aluminium 2019-20 to 2021-22

(Quantity in tonnes; Value in ₹'000)

Year	Production	
	Qty	Value
2019-20	3635089	455960160
2020-21	3619237	415967702
2021-22 (P)	4016621	714320466

Table – 4: Production of Aluminium 2020-21 and 2021-22

(By Plants)

(In tonnes)

Producer	Plant	Production	
		2020-21	2021-22 (P)
National Aluminium Co. Ltd	Angul	418522	460020
Hindalco Industries Ltd	Aditya	355881	365466
	Hirakud	154126	172071
	Mahan	356354	367168
	Renukoot	362587	389470
Bharat Aluminium Co. Ltd	Korba	565112	580426
Vedanta Aluminium Ltd	Jharsuguda	1403271	1682000

(In tonnes)

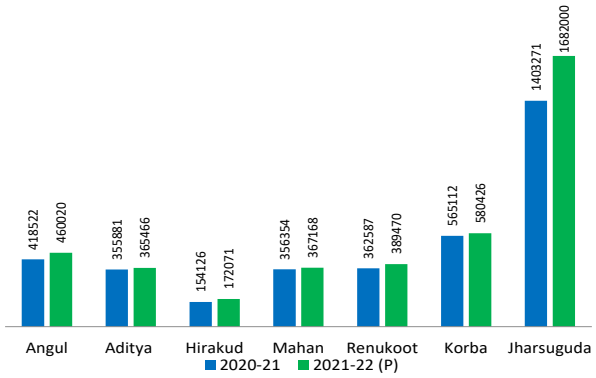


Fig 3: Plantwise Production of Aluminium

Alumina

The production of alumina at 7,229 thousand tonnes in 2021-22 increased by 11% as compared to that in the previous year. NALCO continued to be the leading producer of alumina accounting for 38% of the total production during the year under review. (Tables-5 & 6).

Table – 5: Production of Alumina (including Calcined alumina) 2019-20 to 2021-22

(Quantity; Value in ₹'000)

Year	Production	
	Quantity	Value
2019-20	6670576	130410346
2020-21	6520842	118069838
2021-22(P)	7229508	159576853

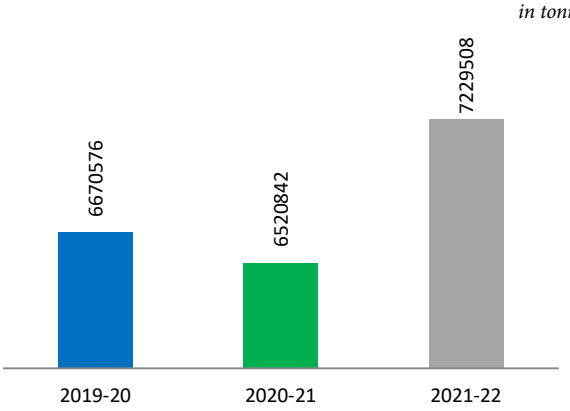


Fig 4: Production of Alumina (including Calcined alumina) 2019-20 to 2021-22

Table – 6: Production of Alumina 2020-21 and 2021-22

(By Plants)

(In tonnes)

Producer	Plant	2020-21	2021-22 (P)
National Aluminium Co. Ltd	Damanjodi	2202220	2110000
Hindalco Industries Ltd	Belagavi	253000	307600
	Muri	222126	262373
	Renukoot	511831	559717
	Utkal Alumina	1643000	2021908
Vedanta Aluminium Ltd	Lanjigarh	1688665	1967910

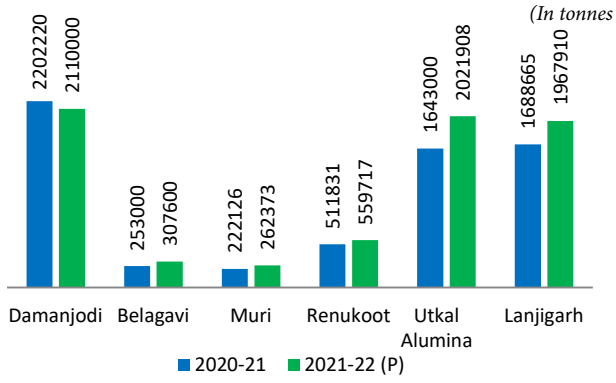


Fig 5. Plantwise Production of Alumina 2020-21 and 2021-22

INDUSTRY

Aluminium is the fastest growing non-ferrous metal in India an d 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 which 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. The information on installed capacity of Aluminium semis by different plants is furnished in (Table-7).

Table – 7: Capacity for Aluminium Semis

(In tonnes)

Producer/product	Annual installed capacity
HINDALCO INDUSTRIES LTD	
Rolled product	205000
Extruded products	31000
Conductor redraw rods	56400
Aluminium foils	40000
Aluminium wheels (No. of pieces)	-
NALCO	
Aluminium wire rods	100000
Aluminium billets	30000
Aluminium strips (smelter)	26000
Aluminium strips (RPU)	52000
Rolled products	45000
MALCO	
Rolled products	12000
Properzi rods	36000
Bus bars-Aluminium wire rods	32850
BALCO	
Extruded products	8000
Rolled products	72500
Properzi rods	111500
Foil product	600
Conductors	1200
Aluminium wire rods	43200
JINDAL ALUMINIUM LTD	
Aluminium Extruded products	128000
Foil product	40000

Source: Information received from individual plants/Annual Reports.

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 01.28 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) na med 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 byfinancial 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 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. The compamy plans 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 goods sector. 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 0.57 million 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

Aluminium 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.

CONSUMPTION

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.

RESEARCH & DEVELOPMENT

The Hindalco's Research & Development (R&D) activities are focused on providing innovative, cost- effective and sustainable solutions to support consistent growth of business. The R&D activities include process, product and application development, to develop short-term as well as long-term solutions to the issues faced by Non-ferrous sector, such as, raw material quality, new product development, cost-effective management of waste generated during processing, recovery of values from by-products as well as any waste products, developing better understanding of the science of processes, reducing the specific energy consumption & carbon footprint etc.

Hindalco operates three Hindalco Innovation Centres (HIC) (i) HIC–Alumina at Belagavi, Karnataka, undertakes specialised works on R&D of bauxite ore, alumina refining and specialty alumina, hydrate products as well as waste management; (ii) HIC–SemiFab located at Taloja, near Mumbai, Maharashtra, handles projects in the areas of tribology, metallurgy related to aluminium fabricated products and new applications and modelling;

(iii) Innovation Centre at HIC–Copper at Birla Copper, Dahej, has its focus on maximisation of copper recovery as well as recovery of various metal values, such as, selenium, tellurium, nickel, bismuth etc. from the effluent generated in the plant.

The R&D acitivities undertaken at Hindalco during the year include (i) Developing a superior Aluminium – Jute packaging material by combing aluminium foil with jute. Aluminium foils are impervious to moisture, bacteria and gases while jute is an environment-friendly natural material with elastic properties. (ii) Aluminium foil for Li-ion batteries–Hindalco developed aluminium foils which can be used for the packaging of Lithium-ion (Li- ion) batteries. These foils are approved by the Indian Space Research Organisation (ISRO) and the Automobile Research Association of India (ARAI). These foils are expected to reduce the use of plastic in the manufacturing of Li-ion batteries and increase battery life.

NALCO is exploring to set up world class, state-of-the-Art research and development centre in the field of bauxite, alumina, aluminium, downstream products, power, waste utilisation and in other allied areas. Some of the in-house R&D activities carried out by NALCO include R & D trial for Development of APz×No technology in smelter plant for DC energy reduction in electrolysis process successfully completed in 30.01.2021 against MoU 2020-21.

The five ongoing Research & Development projects sponsored by Ministry of Mines (SSAG) at JNARDDC, Nagpur, are as follows (i) Nano Processing of Industrial Rejects for use as additives in Mixdesigns for improved pozzolanic reaction efficiency with VNIT (ii) Fabrication of Advanced Ceramic Nano-coatings for Automotive Applications with Christ University (iii) Techno-economic Survey of Aluminium Scrap Recycling in India with MRAI (Metal Recycling Association of India) (iv)To study the fire retardancy of nano-ATH in polymers with CIPET (Central Institute of Plastics & Engineering Technology) (v) Bench-scale study on extraction of pure Silica and smelter grade Aluminium Fluoride from Coal Fly Ash (CFA)– S&T (Mines).

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, there by 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 140 million tonnes in 2021. China continued to be the leading producer with a share of about 55% which is followed by Australia (14%), Brazil (7%), India (5%) and Russia (2%) & UAE (2% each). World production of aluminium was at 67 million tonnes in 2021. China continued to be the leading producer with a share of about 57% which is followed by Russia, (5%), India (5%) & Canada (5%). (Tables-8 & 9).

Table – 8: World Production of Alumina

(By Principal Countries)

(In '000 tonnes of Al_2O_3 content)

Country	2019	2020	2021
World: Total (rounded off)	**131200000**	**134600000**	**140700000**
China	71474166	73131946	77480000
Australia	20239198	120836304	20624088
Brazil	9170800	10185000	11171300
India*[(d)]	6706500	6624500	7325000
Russia	27550000	2873000	3054000
UAE	1100000	1920000	2300000
Saudi Arabia	1798340	1782041	1879000
Ireland	1860970	1822368	1878000
Ukraine	1690000	1725000	1800000
Spain	1595000	1553000	1536000
Other countries	12799824	12167385	11180265

Source: BGS World Mineral Production, 2016-2020.

(d) Years ended 31st March following that stated

** During 2018-19, 2019-20 and 2020-21 India's production of alumina was 6,446, 6,670 and 6,520 thousand tonnes, respectively.*

Table – 9: World Production of Aluminium (Primary)

(By Principal Countries)

(In '000 tonnes)

Country	2019	2020	2021
World: Total (rounded off)	**62900000**	**65200000**	**67000000**
China	35043604	37080401	38502600
Russia	3635089	3638000	3640000
India*[(d)]	3635089	3154493	3583800
Canada	2853771	2520000	3157762
UAE	2600000	1548000	1561222
Bahrain	1365005	1585017	1558529
Australia	1569591	1330000	1431000
Norway	1312000	1010563	1431000
Saudi Arabia	967000	1010563	998000
USA	1126032	1026217	907846
Other countries	880615	8703598	9095927

Source: BGS World Mineral Production, 2016-2020

(e) Years ended 31 March following that stated. # estimated

** During 2018-19, 2019-20 and 2020-21 India's production of aluminium was 3,696, 3,635 and 3,619 tousand tonnes, respectively.*

To provide a generalised view of the development in various countries, the countrywise description source from latest available publication of Minerals Yearbook 'USGS-2018' is furnished below:

Australia

Production of aluminium showed a marginal increase in Australia in 2019 compared with that in 2017. The increase was attributed to the restart of capacity in 2017 at the Portland, Victoria, smelter; production increased by 46% compared with that in 2017. On January 19, 2017, capacity that was shut down after a power failure on 1st, December 2016, was restarted at the 3,85,000-t/yr smelter. By mid-October 2017, the smelter was producing at 85% of its capacity, the same rate as before the shutdown. The smelter was a joint venture of Alcoa of Australia Ltd (55%), CITIC Nominees Pty. Ltd (22.5%), and Marubeni Aluminium Australia Pty. Ltd (22.5%). Alcoa of Australia was owned by Alcoa (60%) and Alumina Ltd (40%).

Bahrain

Aluminium Bahrain B.S.C. (Alba) continued construction on a sixth potline that would have a capacity of 5,40,000 t/yr when completed in 2019. The project also included an expansion of Alba's captive powerplant. Production from some pots started in December, and full ramp-up of the new capacity was scheduled for 2020. The project would increase the smelter's capacity to 1.5 million metric tons per year from 9,60,000 t/yr.

Brazil

Primary aluminium production decreased by 18% as compared with that in 2017. In April, Norsk Hydro temporarily shut down 2,30,000 t/yr of capac-ity at the 4,60,000-t/yr Albras aluminium smelter in Barcarena, citing a shortage of alumina. In March, Norsk Hydro temporarily shut down one half of the capacity at the adjacent 6.3-Mt/yr Alunorte alumina refinery, citing high water levels in the red mud im-poundment after heavy rainfall. The Albras smelter, a joint venture between Norsk Hydro (51%) and Nippon Amazon Aluminium Co. Ltd (49%), would re-turn to full production once the Alunorte refinery resumed full production.

In July, the Government extended the elimination of a 6% tariff on unwrought primary aluminium imports through the end of June 2019. A quota of 2,82,500 t of unwrought primary aluminium would be permitted to be imported without payment of the tariff. Since 2014, the Government has eliminated the 6 % tariff on imported aluminium for a limited amount of metal during a specific time, citing the shutdown of smelting capacity caused by high power prices. The most recent quota was for 1,73,000 t of primary aluminium imports from July 1, 2017, through 30th June 2018. The elimination of the tariff caused prices in Brazil to decrease even though the capacity at the Albras smelter was shut down in April.

Novelis was planning to expand the secondary smelting and rolling capacity in Pindamonhangaba. Smelting capacity would increase to 4,50,000 t/yr from 3,90,000 t/yr, and rolling capacity would increase to 6,80,000 t/yr from 580,000 t/yr. The mill produced beverage can sheet and other aluminium packaging products from UBCs and other scrap. The project was scheduled to start in February 2019 and was scheduled for completion in 2021.

China

Primary aluminium production in 2018 was 35.8 Mt, 11% more than the 32.3 Mt in 2017. Aluminium production increased from an average rate of 98,200 metric tons per day (t/d) in the first quarter of the year to 1,02,000 t/d for the remainder of the year. Smelters in 31 cities, mainly in the Eastern and Central Provinces, shut down 30% of their capacity from 15th November, 2017, until 15th March, 2018. The Government cited winter pollution control efforts for ordering the shutdown of capacity at primary aluminium smelters, alumina refineries and power-plants. When the restrictions on production expired, some of the capacity affected by the policy was restarted. At the end of the year, the Government instituted a similar production cut from 5th October, 2018, to 31st March, 2019, to reduce pollution during the winter. The policy required aluminium smelters and alumina refineries to close 30% of their capacity and carbon anode plants to close 50% of their capacity. The policy applied to facilities in 26 cities.

In order to contain smelter capacity, the Government had implemented a capacity replacement quota system in recent years. To expand capacity, companies were required to purchase capacity replacement quotas from companies that had shut down older, inefficient capacity. In the last quarter of the year, decreasing aluminium prices and increasing production costs were cited for capacity shutdown at several smelters throughout China. An estimated 3.2 Mt/yr of capacity was shutdown during the year for economic reasons.

Import restriction were cited for aluminum scrap imports declining by 28% as compared with those of the prior year. Scrap availability from domestic sources enough that secondary smelters did not need to import scrap, and imports were expected to decline in future years. China was considering a complete ban on imports of solid waste, including aluminium scrap, by 2021. Environmental concerns and goals to advance the domestic recycling industry were cited for the proposed ban on scrap imports.

Oman

Production increased by 50% compared with that in 2017 because capacity at the 3,75,000-t/yr Sohar smelter was restarted after a power failure on 4th August, 2017, resulted in a shutdown. Production was restarted in mid-September 2017, and the ramp-up was completed by April 2018. The Sohar smelter was a joint venture among Oman Oil Co. S.a.O.C. (40%), Abu Dhabi National Energy Co. PJSC (40%) and Rio Tinto (20%).

United Arab Emirates

Aluminum production increased slightly compared with that in 2017 because new capacity completed in 2016 was ramped-up. Emirates Global Aluminium PJSC completed a modernisation and expansion project at the Jebel Ali smelter in October 2017. The project replaced 520 smelting pots in two potlines with pots that were more energy efficient and produced fewer emissionsofperfluorocarbons. Capacity of the smelter increased by 58,000 tpy.

FOREIGN TRADE

Exports

Exports of alumina increased by 18% to 1,487 thousand tonnes in 2021-22 from 1,265 thousand tonnes in the previous year. Exports were mainly to UAE (50%), Oman (16%), China (9%) and Malaysia (6%).

Exports of aluminium and alloys increased drastically by 46% to 3,454 thousand tonnes from 2,735 thousand tonnes. Exports in 2021-22 were mainly to Korea (15%), China (14%), Turkey (9%), USA (8%) and Greece. (Tables-10 to 12).

Table – 10: Exports of Alumina

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1265941**	**28280781**	**1487035**	**47334417**
UAE	706087	15048867	745938	22936746
Oman	183711	3891344	244982	8394532
China	69353	1658847	133323	4018156
Qatar	61208	1284659	30714	909852
Malaysia	61330	1203104	95678	2864082
Egypt	61683	1182271	92027	2953898
Taiwan	23266	921583	22700	941879
UK	30935	734852	31312	730576
Korea	14037	564754	18490	797254
Other countries	53496	1758538	39682	1891347

Figures rounded off

Table – 11: Exports of Aluminium and Alloys Incl. Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2735588**	**427759670**	**3454121**	**791688112**
Korea	603730	79903721	544473	113328421
USA	160795	37510442	270434	82666048
China	219829	29862598	487586	94661686
Turkey	25514	4442749	320151	66426511
Mexico	77356	12689868	146144	30200871
Italy	28592	5005313	158098	36801783
Greece	66598	596608	159919	36386353
Japan	62609	8470779	118441	23606891
Netherlands	21300	4652293	127039	32504416
Croatia	2	1934	94334	21766254
Other countries	1469263	235623365	1027502	253338878

Figures rounded off

Table – 12: Exports of Aluminium

(By Items)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All items	**2735588**	**427759670**	**3454121**	**791688112**
Aluminium & Alloys : Unwrought	2324305	317093138	2932260	622444035
Aluminium Alloys Unwrought	240867	36269198	466857	107772630
Aluminium Ingots	2081831	280582856	2462842	514076586
Aluminium Unwrought Nes	1607	241084	2561	594819
Aluminium & Alloys : Worked	231811	45462208	308958	80005080
Aluminium & Alloys :Worked (Bars, Rods, Plates)	164374	28138974	221750	52848855
Aluminium & Alloys :Worked (Bars, Rods, Profiles)	47824	13330801	65170	21514780
Aluminium Worked (Bars, Rods, Profiles etc.)	19613	3992433	22038	5641445
Aluminium & Alloys, Worked, Nes	170757	63784997	199044	86361195
Aluminium & Scrap	5428	598217	9529	1604369
Aluminium Powders & Flakes	3287	821110	4330	1273433

Figures rounded off

Imports

Import of alumina increased by 9% to 2,549 thousand tonnes in 2021-22 from 2,334 thousand tonnes in the previous year. Imports were mainly from Australia (38%), Vietnam (27%), Indonesia (26%), China (3.6%) and Netherlands (1%).

Imports of aluminium & alloys including scrap also increased 13% to 2,334 thousand tonnes in 2021-22 from 2,060 thousand tonnes in the previous year. The imports were mainly from USA(21%), China (11%), Malaysia (4%), UAE (8%), UK (8%), Saudi Arabia (7%) and Republic of Korea (2.4%) (Tables- 13 to 15).

Table – 13: Imports of Alumina

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2334786**	**57491719**	**2549567**	**82447635**
Australia	1323262	30057614	957664	27069771
Indonesia	490792	10803369	654730	19029897
Vietnam	378634	8817322	682631	22554543
China	62128	3706946	92555	6313320
Netherlands	19710	972577	25074	1428683
Germany	5686	752942	7122	949584
USA	3418	531390	4302	823975
Canada	3630	441073	3102	416853
Bahrain	28092	302334	50774	672294
Other countries	18499	1098489	28362	1699986

Figures rounded off

Table – 14: Imports of Aluminium Alloys Incl. Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2060227**	**299126164**	**2334438**	**452887747**
China	228165	54307692	250509	76342593
USA	332610	36918693	479644	72677925
UAE	181587	25032890	188607	36663829
Malaysia	127515	19415186	79672	15939942
UK	147742	16647921	179648	27522218
Saudi Arabia	128621	16357314	157267	29347969
Korea	51085	11663612	58355	16508772
Thailand	40730	8824410	53597	16521970
Bahrain Is	53510	8042213	54589	12034735
Netherlands	76260	8196043	78386	11589611
Other countries	692402	93720190	754164	137738183

Figures rounded off

Table – 15: Imports of Aluminium

(By Items)

Item	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All items	**2060227**	**299126164**	**2334438**	**452887747**
Aluminium & Alloys:Unwrought	265121	39500561	213611	45666154
Aluminium Alloys Unwrought	36521	5567424	50835	10244963
Aluminium Ingots	224566	33335909	161124	35041224
Aluminium Unwrought Nes	4034	597228	1652	379967
Aluminium & Alloys:Worked	369440	83394272	390525	116853619
Aluminium & Alloys:Worked (Bars,Rods,Plates)	134777	29387734	126761	37013014
Aluminium & Alloys:Worked (Bars,Rods,Profiles)	191905	45018990	191905	71007555
Aluminium Worked(Bars,Rods,Profiles Etc)	42758	8987548	42758	8833050
Aluminium &Alloys,Worked,Nes	52537	27206116	52537	32363370
Aluminium & Scrap	1369546	148399920	1369546	257308920
Aluminium Powders & Flakes	3583	625295	3583	695684

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 machinability. 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.

2. Antimony

18,683
(thousand tonnes) Total reserves/ resources of antimony as on 1st April 2020

Nil
Exports of antimony ores & concentrates in 2020-21

4,555
(tonnes) Imports of antimony ores and concentrates in 2021-22

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 has been estimated at 18,683 thousand tonnes. The ore with metal content is placed at 255 thousand tonnes, Inferred category located in Lahaul & Spiti district, Himachal Pradesh (68%) and Madhya Pradesh (32%)(Table-1).

Table – 1 : Reserves/Resources of Antimony as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total													
Ore	-	-	7503	7503	-	-	592	-	-	10588	-	11180	18683
Metal	-	-	75	75	-	-	5.92	-	-	174	-	179.92	254.92
By State													
Himachal Pradesh													
Ore	-	-	-	-	-	-	-	-	-	10588	-	10588	10588
Metal	-	-	-	-	-	-	-	-	-	174	-	174	174
Madhya Pradesh													
Ore	-	-	7503	7503	-	-	592	-	-	-	-	592	8095
Metals	-	-	75	75	-	-	5.92	-	-	-	-	5.92	80.92

Figures rounded off

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.

USES

Antimony and it's 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.

SUBSTITU TES

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 stabilisers in 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)	**1800000**
China	350000
Russia (recoverable)	350000
Bolivia	310000
Kyrgyzstan	260000
Myanmar	140000
Australia	120000[b]
Turkey	100000
Canada	78000
Tajikistan	50000
USA	60000[a]
Pakistan	26000
Mexico	18000

Source: USGS, Mineral Commodity Summaries, 2023

NA - Not available

(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 decreased by 23% to 91,000 tonnes in 2021 as against 1,19,000 tonnes in the previous year. China with (47%) production was the main producer of antimony in the world followed by Tajikistan (22%), Russia (10%) and Iran (5%) (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	2019	2020	2021
World: Total (rounded off)	**132000**	**119000**	**91000**
China	60229	60995	42622
Tajikistan	29898	22500	20000
Russia	21671	17532	9000
Iran(j)	5264	5006	5000
Turkey	3810	2570	4210
Australia(c)	2170	3903	3380
Mexico	290	136	413
Bolivia	2747	2629	3084
Myanmar(e)	5000	3800	2300
Vietnam	395	312	305
Laos	70	-	242
Other countries	196	49	205

Source: BGS, World Mineral Production, 2017-21

(c) Years ended 30 June of that stated.

(j) Years ended 31 March following that stated

(In tonnes of metal content)

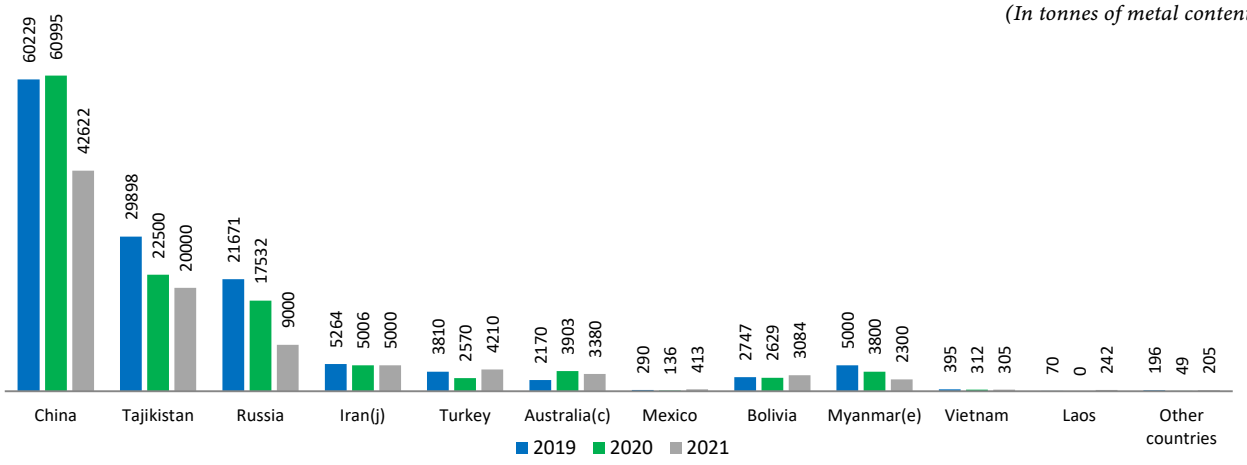


Fig 1 Countrywise Production of Antimony

FOREIGN TRADE

Exports

Exports of antimony ores & concentrates was nil for the years 2021-22 and 2020-21.

Exports of antimony alloys and scrap decreased slightly by 11% to 1,918 tonnes in 2021-22 as against 2,134 tonnes in the previous year. Exports were mainly to USA (84%), Brazil (5%) and UAE. Exports of antimony (Unwrought) powders also decreased to 1,916 tonnes in 2021-22 as against 2,130 tonnes in 2020-21. Exports of antimonial lead were at 22,633 tonnes in 2021-22 as compared to 15,839 tonnes in 2020-21 (Tables- 4 to 7).

Table – 4 : Exports of Antimony (Unwrought) Powders

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2130**	**930744**	**1916**	**1507015**
USA	1679	716907	1627	1271920
Brazil	84	46566	111	98654
UAE	73	34572	75	56118
Bangladesh	17	7530	38	33305
South Africa	-	-	35	27188
Vietnam	-	-	20	9077
Sri Lanka	7	3727	6	6132
Nepal	++	15	2	2123
Netherlands	69	32042	1	1115
Nigeria	3	1527	1	1033
Other countries	198	87858	++	350

Figures rounded off

Table – 5 : Exports of Antimony & Articles, NES

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4**	**2178**	**2**	**973**
Nepal	3	1267	1	662
Australia	-	-	1	259
Rwanda	-	-	++	22
Bahrain	-	-	++	21
Bangladesh	-	-	++	9
Maldives	-	-	++	++
Uganda	1	657	-	-
Sudan	++	225	-	-
UAE	++	15	-	-
Bhutan	++	8	-	-
Other countries	++	6	-	-

Figures rounded off

Table – 6: Exports of Antimony Alloys & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2134**	**932922**	**1918**	**1507988**
USA	1679	716907	1627	1271920
Brazil	84	46566	111	98654
UAE	73	34587	75	56118
Bangladesh	17	7530	38	33314
South Africa	-	-	35	27188
Vietnam	-	-	20	9077
Sri Lanka	7	3727	6	6132
Nepal	3	1282	3	2785
Netherlands	69	32042	1	1115
Nigeria	3	1527	1	1033
Other countries	199	88754	1	652

Figures rounded off

Table – 7 : Exports of Antimonial Lead

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	**Value** (₹'000)	**Qty** (t)	**Value** (₹'000)
All Countries	**15839**	**2395362**	**22633**	**4087251**
Korea, Rep. of	1120	176475	8769	1602541
UAE	4102	619059	4410	777971
Vietnam	1421	213221	3032	538127
Bangladesh	6084	905373	2280	400045
Japan	842	126448	983	177169
Singapore	100	15582	727	126085
Oman	852	126136	647	110721
Thailand	-	-	409	90888
Nepal	383	60365	465	85049
USA	548	90144	268	51966
Other countries	387	62559	643	126689

Figures rounded off

Imports

Imports of antimony ores and concentrates decreased by 24% to 4,555 tonnes in 2021-22 as compared to 5,977 tonnes in the previous year. Imports were mainly from Tajikistan (53%), Russia (22%), Canada (17%).

Imports of antimony alloys and scrap decreased sustantially by 11% to 1,173 tonnes in 2021-22 from 1,319 tonnes in the previous year. Imports of alloys and scrap were mainly from Oman (36%), China (34%) and Vietnam (14%). Imports of antimony (Unwrought) powders decreased by 11% to 1,162 tonnes in 2021-22 as compared to 1,298 tonnes in the preceding year. Imports were mainly from Oman (36%), China (34%), Vietnam (13%) and Thailand (10%) (Tables-7 to 12).

Table – 8 : Imports of Antimony Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	**Value** (₹'000)	**Qty** (t)	**Value** (₹'000)
All Countries	**5977**	**1072406**	**4555**	**1499919**
Tajikistan	249	51502	2430	781446
Canada	1133	207763	777	322490
Russia	3355	583767	996	257428
Chile	-	-	131	58262
Italy	25	10941	79	38211
USA	-	-	61	24669
Kazakhstan	-	-	81	17413
China	1155	207247	-	-
Myanmar	60	11181	-	-
Thailand	++	5	-	-

Figures rounded off

(In ₹'000)

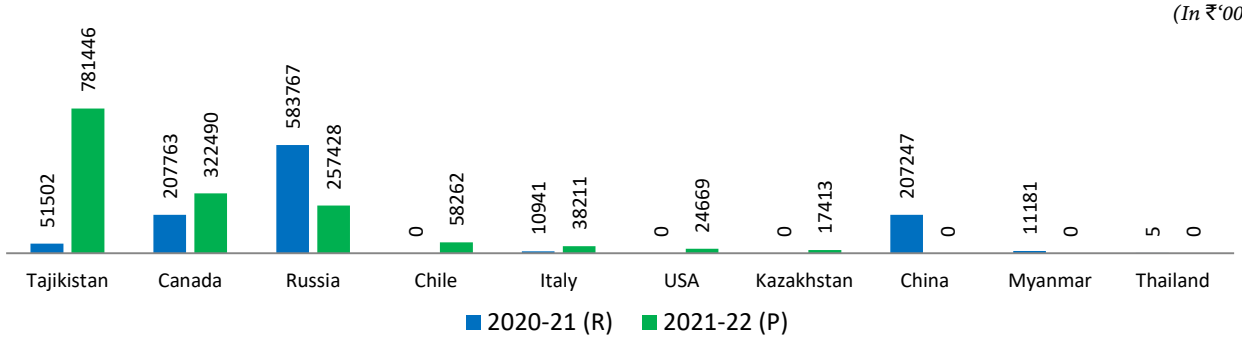


Fig: 2 Countrywise Value of Import of Antimony

Table – 9 : Imports of Antimonial Lead

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**30477**	**4523873**	**32305**	**5657916**
Malaysia	11878	1703491	13304	2289306
Korea, Rep. of	5553	848224	8086	1472811
Singapore	5194	770024	6217	1087677
UAE	2459	368954	1188	218727
Saudi Arabia	2002	306045	1096	171853
Vietnam	-	-	600	106264
Germany	98	13950	404	66736
Thailand	499	78370	353	61923
Luxembourg	224	32847	319	58129
UK	-	-	197	33824
Other countries	2570	401968	541	90666

Figures rounded off

Table – 10 : Imports of Antimony & Articles, NES

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**21**	**10067**	**11**	**9341**
Vietnam	21	9368	10	7739
Japan	-	-	1	1188
UK	++	224	++	379
USA	++	414	++	35
Germany	++	61	-	-

Figures rounded off

Table – 11 : Imports of Antimony (Unwrought), Powders

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1298**	**581296**	**1162**	**988906**
Oman	58	23937	420	377739
China	693	320171	402	328961
Vietnam	134	62034	155	118749
Thailand	77	33425	123	107106
Netherlands	124	55557	23	22984
Sweden	-	-	24	18904
UK	25	9953	15	14460
USA	++	40	++	3
Singapore	93	39818	-	-
Myanmar	24	10307	-	-
Other countries	70	26054	-	-

Figures rounded off

Table – 12 : Imports of Antimony Alloys & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1319**	**591363**	**1173**	**998247**
Oman	58	23937	420	377739
China	693	320171	402	328961
Vietnam	155	71402	165	126488
Thailand	77	33425	123	107106
Netherlands	124	55557	23	22984
Sweden	-	-	24	18904
UK	25	10177	15	14839
Japan	25	10303	1	1188
USA	++	454	++	38
Singapore	93	39818	-	-
Other countries	69	26119	-	-

Figures rounded off

FUTURE OUTLOOK

Antimony is in the list of 30 critical minerals 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, all though its use has become more regulated due to concern about its environmental and health impacts.

3. Cadmium

913
(tonnes per year) Total annual installed capacity of cadmium ore in 2020-21

Nil
Production of cadmium in 2021-22

169
(tonnes) Exports of Cadmium in 2021-22

6, 374
(tonnes) Imports of cadmium in 2021-22

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 D ebari; 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 & PRICES

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".

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 recoveryof cadmium fromcadmium 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 maunfacture 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 200:1 to 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 25600 tonnes in 2021. 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 2019 to 2021 by principal countries is furnished in Table-2. To provide a generalised view of the development in various countries, the country-wise description sourced from latest available publication of Minerals Yearbook 'USGS' 2018 is furnished as below.

Table – 2 : World Production of Cadmium

(By Principal Countries)

(In tonnes)

Country	2019	2020	2021
World: Total (rounded)	**26800**	**24200**	**25600**
China	*10300	*10300	10349
Korea, Rep. of	*4500	*4500	*4500
Japan	2000	1880	1900
Canada[(a)]	1803	140	*1800
Kazakhstan[(e)]	*1400	*1500	*1500
Russia[(e)]	*1400	*1300	*1400
Mexico	952	978	1051
Netherlands[(e)]	*1100	*880	*900
USA	*550	*550	*550
Other countries	2806	2143	1650

Source: BGS World Mineral Production, 2017-21,
(a): including cadmium sponge and/or secondary metal.
(e): Estimated

(In tonnes)

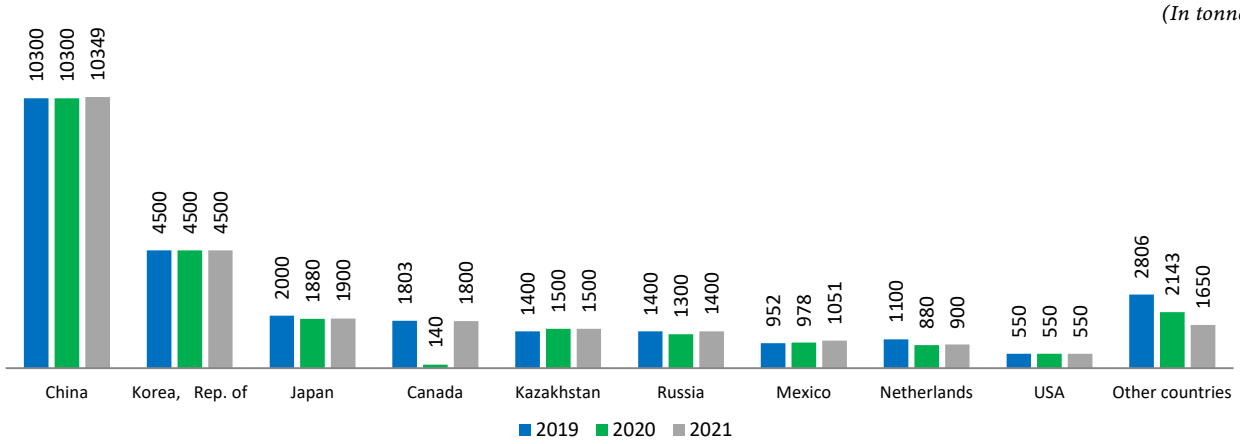


Fig 1: Countrywise Value of Export of Cadmium

China

Supply from large cadmium-producing smelters was stable, but cadmium from smaller smelters decreased because of ongoing environmental inspections.

Republic of Korea

Most of the cadmium produced in the Republic of Korea, the second-ranked producer after China, was exported to China and India. Korea Zinc Co. Ltd. Onsan zinc-lead refinery had the capacity to produce 5,100 metric tonnes per year (tonnes/year) of refined cadmium, and Young Poong Corp.'s Seokpo zinc refinery had the capacity to produce 1,750 tonnes/year of cadmium.

Russia

Ural Mining and Metallurgical Co.'s Vladikavkaz zinc plant, one of two zinc smelters in Russia that produced cadmium, was closed in October because of significant damage from a fire. The cadmium capacity of the plant was about 300 tonnes/year. Repairs would take at least 6 to 8 months according to preliminary estimates from the company.

FOREIGN TRADE

Exports

Exports of Cadmium decreased by 10% to 169 tonnes during 2021-22 from 187 tonnes in the previous year. Exports were mainly to Bangladesh (99%), and UAE (1%). Similarly, exports of cadmium (including waste & scrap) also decreased by 19% to 169 tonnes during 2021-22 from that of 208 tonnes in the previous year.

Exports of cadmium & alloys decreased substantially by 27% to123 tonnes during 2021-22 as against 170 tonnes in the previous year, while exports of cadmium & scrap decreased marginal tonnes in 2021- 22 against 21 tonnes in 2020-21. Exports of cadmium unwrought and powders increased 46 tonnes during 2021-22 as compared to 156 tonnes in the previous year. Exports were mainly to Bangladesh (82%),Turkey (18%)(Tables- 3 to 7).

Table – 3: Exports of Cadmium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value(₹'000)
All Countries	**187**	**24202**	**169**	**23129**
Bangladesh	180	22289	168	22814
UAE	4	1008	1	258
Saudi Arabia	-	-	++	30
Myanmar	-	-	++	16
Egypt	-	-	++	5
Kenya	++	204	++	4
Sri Lanka	-	-	++	2
Turkey	3	603	-	-
Iraq	++	38	-	-
Qatar	++	31	-	-
Other countries	++	29	-	-

Figures rounded off

Table – 4: Exports of Cadmium

(Including Waste & Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**208**	**24971**	**169**	**23278**
Bangladesh	201	22756	168	22863
UAE	4	1139	1	294
Sudan	-	-	++	64
Saudi Arabia	++	87	++	30
Myanmar	-	-	++	16
Egypt	++	24	++	5
Kenya	++	204	++	4
Sri Lanka	-	-	++	2
Turkey	3	603	-	-
Iraq	++	38	-	-
Other countries	++	120	-	-

Figures rounded off

Table –5: Exports of Cadmium & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**170**	**21746**	**123**	**16061**
Bangladesh	166	20475	122	15886
UAE	4	1008	1	166
Kenya	++	204	++	4
Egypt	-	-	++	3
Sri Lanka	-	-	++	2
Iraq	++	38	-	-
USA	++	13	-	-
Nepal	++	6	-	-
Fiji Is	++	2	-	-

Figures rounded off

Table – 6: Exports of Cadmium & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**21**	**769**	**++**	**149**
Sudan	-	-	++	64
Bangladesh	21	467	++	49
UAE	++	131	++	36
Saudi Arabia	++	87	-	-
Oman	++	31	-	-
Yemen	++	29	-	-
Egypt	++	24	-	-

Figures rounded off

Table – 7: Exports of Cadmium:

Unwrought, Powders

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**17**	**2456**	**46**	**7068**
Bangladesh	14	1814	46	6928
U A E	-	-	++	92
Saubi Arabia	-	-	++	30
Myanmar	-	-	++	16
Egypt	-	-	++	2
Turkey	3	603	-	-
Qatar	++	31	-	-
J ordan	++	8	-	-

Figures rounded off

Imports

The imports of cadmium also decreased by 16% to 6374 tonnes in 2021-22 from 7570 tonnes in the previous year. Imports of cadmium was mainly from Korea Rep of (22%), Japan (17%), Russia (10%), Uzbekistan (5%), Hong Kong, Peru & UAE (4% each). Imports of cadmium (including waste & scrap) decreased by 18% to 6787 tonnes in 2021-22 from 8249 tonnes in the year 2020-21. The imports also comprised 6373 tonnes of unwrought & powders and 413 tonnes of cadmium & scrap besides one tonne of cadmium & alloys in 2021-22 (Tables- 8 to 12).

Table – 8: Imports of Cadmium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**7570**	**1224090**	**6374**	**1142118**
Korea, Rep.of	890	137018	1423	254599
Japan	1271	202576	1201	213381
Russia	152	22463	675	125033
China	2025	348870	363	75739
Belgium	473	66157	435	71961
UAE	284	42027	406	66511
Peru	320	52128	240	40674
France	98	12507	247	36807
Australia	40	6170	180	31778
Bulgaria	264	43187	152	29982
Other countries	1753	290987	1052	195653

Figures rounded off

Table – 9: Imports of Cadmium

(Including Waste & Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**8249**	**1338734**	**6787**	**1218010**
Korea, Rep.of	1190	183652	1683	306004
Japan	1408	226999	1201	213381
Russia	254	39613	675	125033
Belgium	473	66157	476	75876
China	2107	365126	363	75739
UAE	284	42027	406	66511
Peru	320	52128	280	47756
Australia	60	9181	233	38453
France	98	12507	247	36807
Bulgaria	264	43187	152	29982
Other countries	1791	298157	1071	202468

Figures rounded off

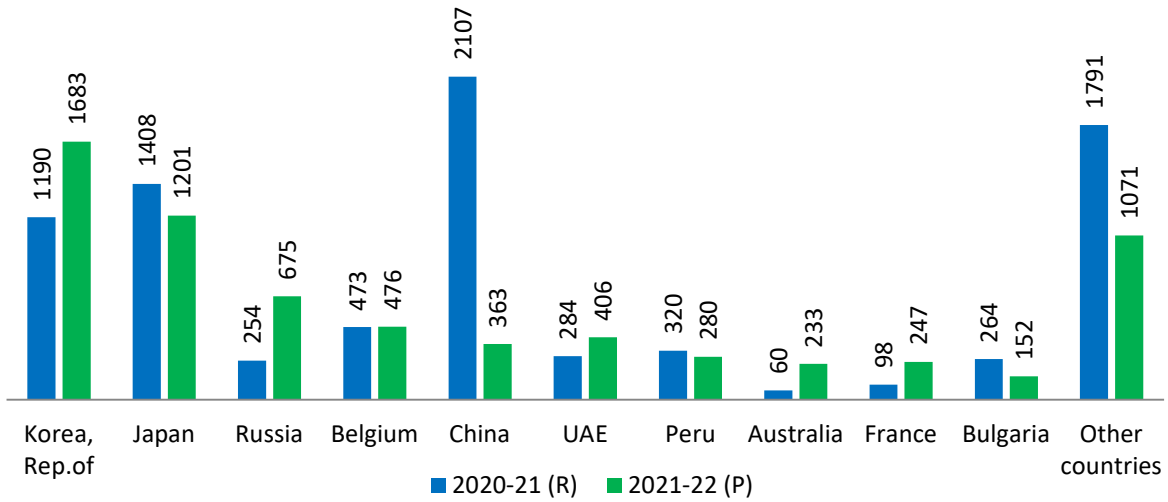


Fig 2: Countrywise Value of Import of Cadmium

Table – 10: Imports of Cadmium & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**17**	**1**	**5570**
China	-	-	1	5524
UK	-	-	++	26
USA	-	-	++	13
Germany	++	17	++	7

Figures rounded off

Table – 11: Imports of Cadmium: Unwrought, Powders

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**7570**	**1224073**	**6373**	**1136548**
Korea, Rep. of	890	137018	1423	254599
Japan	1271	202576	1201	213381
Russia	152	22463	675	125033
Belgium	473	66157	435	71961
China	2025	348870	362	70215
UAE	284	42027	406	66511
Peru	320	52128	240	40674
France	98	12507	247	36807
Australia	40	6170	180	31778
Bulgaria	264	43187	152	29982
Other countries	1753	290970	1052	196507

Figures rounded off

Table – 12: Imports of Cadmium & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**679**	**114644**	**413**	**75892**
Korea, Rep. of	300	46634	260	51405
Peru	-	-	40	7082
Australia	20	3011	53	6675
Belgium	-	-	41	3915
USA	38	5524	19	3487
Canada	++	1646	++	3328
Japan	137	24423	-	-
Russia	102	17150	-	-
China	82	16256	-	-

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.

4. Cobalt

44.91
(million tonnes) Total reserves/ resources of cobalt in terms of ore as on 1st April 2020

1,340
(tonnes) Exports of cobalt and alloys including waste and scrap in 2021-22

1,130
(tonnes) Import of cobalt and alloys including waste and scrap in 2021-22

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.

RESERVES/RESOURCES

Occurrences of cobalt are reported from Singhbhum district, Jharkhand; Kendujhar and Jajpur districts, Odisha; Jhunjhunu district, Rajasthan; Tuensang district, Nagaland; and Jhabua & Hoshangabad districts , Madhya Pradesh. Cobalt occurring with nickeliferous limonite/ laterite in Sukinda area, Jajpur district, Odisha and copper slags produced by HCL are two possible sources of cobalt. The seabed multimetal nodules which contain 0.3% Co (Av) along with other minerals are the other sources of cobalt.

As per NMI data based on 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 (P)

(By Grades/States)

(In million tonnes)

State	Reserves	Remaining Resources					Total
	Total	Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	A	STD331	STD332	STD333	STD334	(B)	(A+B)
All India	**0**	**30.63**	**2**	**0.28**	**12**	**44.91**	**44.91**
By States							
Jharkhand	0	0	2	0	7	9	9
Nagaland	0	0	0	0	5	5	5
Odisha	0	30.63	0	0.28	0	30.91	30.91

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under Volume- I " General Reviews".

USES

Major use of cobalt is in metallurgical applications, in Special alloy/Superalloy Industry, in magnets and cutting tools industries. 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). Cobalt-based superalloys normally contain 45% or more cobalt, while nickel and iron-based superalloys contain 8 to 20% cobalt. 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).

Superalloys made of cobalt have improved strength and wear & corrosion resistance characteristics at elevated temperatures. Another use of cobalt-based superalloys is in turbines for pipeline compressors and jet aircraft engines. Hard-facing or cutting tools with cobalt alloys provide greater resistance to wear, heat, impact and corrosion. 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. Cobalt-molybdenum-alumina compound is used as catalyst in hydrogenation and for petroleum desulphurisation. Elemental Cobalt-60 (radioactive isotope, a production of atomic pile) is used in industrial radiography and therapeutics. 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. Other significant uses of cobalt are in battery electrodes, airbags in automobiles, etc. Further, as per Avicenne (CRU), 2015 , different types of lithium-ion batteries with composition of cobalt are available in the market, i.e., Lithium–Cobalt Oxide (LCO) which contains 60% of cobalt oxide is used in high capacity storage cellphone, iPad cameras and wearables; NMC-Lithium-Nickel-Manganese-Cobalt oxide that contains 10–20% of cobalt sulphate is used in the manufacturing of low capacity but high specific power batteries which have longer lifecycle have found applications in laptops and electronic vehicle (EVs); and NCA Lithium-Nickel-Cobalt Aluminium-oxide that contains 9% cobalt sulphate is used in EVs, elctric grid storage (Tesla,s EVs and Smart Grid/ home storage and laptops).

INDUSTRY & PRODUCTION

Presently, there is no production of cobalt in the country from primary cobalt resources. The demand for cobalt is usually met through imports.

Refining capacity of cobalt in India is estimated at about 2,060 tonnes per year. Of these, Nicomet Industries Ltd, Cuncolim, Goa and Rubamin Ltd, 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 manufactures cobalt cathodes of LME-approved specifications under NICO Brand along with nickel cathodes & sodium sulphate in Mumbai, Maharashtra. 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. Cobalt metal powder

is reportedly recovered from cemented carbide scrap by Sandvik Asia Ltd 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 specialised applications and is difficult to be substituted. Potential substitutes 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. Presently, 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. Potential substitutes include barium or strontium ferrites, neodymium-iron-boron, or nickel-iron alloys in magnets; 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-phosphorous, 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 hydro for mylation 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 criti- cal 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 8.3 million tonnes of cobalt metal content. Cobalt reserves are mainly in the Congo (Kinshasa) which contributes (48%) to the total reserves followed by Australia (18%). Besides, major reserves are also located in Indonesia (7%), Cuba (6%) and Philippines, Russia & Canada (3% 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)	**8300000**
Australia [a]	1500000
Canada	220000
China	140000
Congo (Kinshasa)	4000000
Cuba	500000
Indonesia	600000
Madagascar	100000
Morocco	13000
Papua New Guinea	47000
Philippines	260000
Russia	250000
Turkey	36000
USA	69000
Other countries	610000

Source: USGS Mineral Commodity Summaries, 2023

a: For Australia, Joint Ore Reserves Committee-compliant reserves were 6,70,000 tonnes.

The world mine production of cobalt in terms of metal content increased by 3% to 131 thousand tonnes in 2021 as compared to 127 thousand tonnes in the preceding year. The Democratic People's Republic of Congo (DRC) was the principal producer contributing about (71%) which is followed by Russia (6%), Australia (4%) and Cuba, Canada & Philippines (3% each) (Table-3).

Table – 3 : World Mine Production of Cobalt

(By Principal Countries)

(In tonnes of metal Content)

Country	2019	2020	2021
World:Total (rounded off)	**119000**	**127000**	**131000**
Congo, Dem. P.R.	77964	86591	93011
Finland	1454	1559	1084
Russsia	5500	5700	8000
Turkey	115	250	*200
Australia [b]	5693	5796	5426
Cuba	5200	5500	*4400
Canada	5132	4279	3834
Philippines	3750	3600	3200
Papua New Guinea	2911	2941	2955
Madagascar	2930	833	2111
Morocco[a]	2397	2416	1796
South Africa [a]	1027	960	355
Zambia	379	316	247
Zimbabwe	400	956	230
USA	500	600	700
Brazil	30	20	20
China	2000	1750	1750
Indonesia	350	350	350
Other countries	8705	9489	6436

Source: BGS, World Mineral Production, 2017-21
a:Metal and/refined
b:Years ended 30 June of that stated

(In tonnes of metal Content)

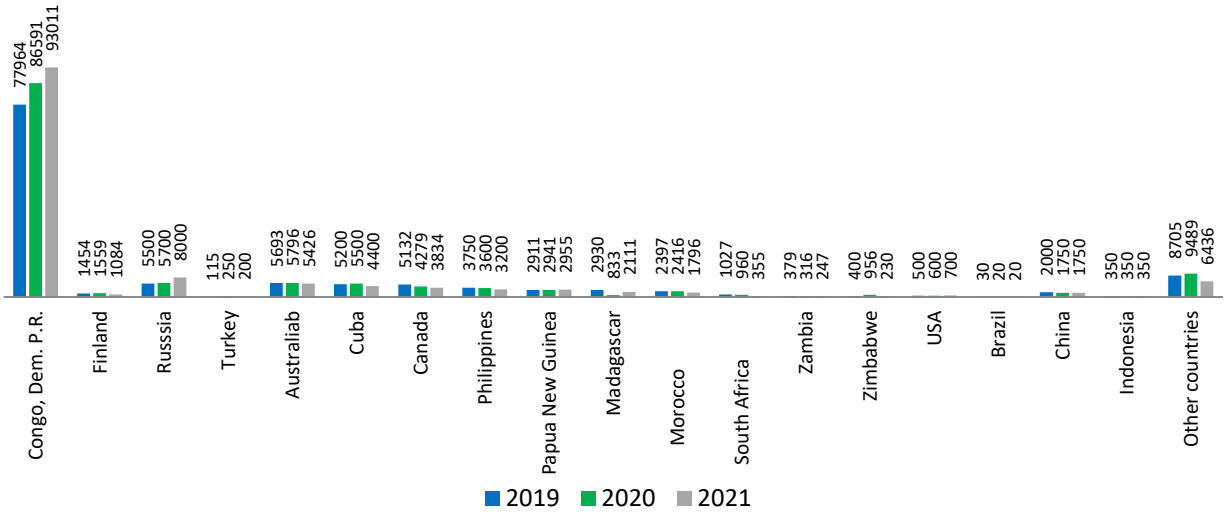


Fig 1: Countrywise production of Cobalt

In India, cobalt consumption is showing rising trend. It is very important to recover cobalt from various secondary sources. At Hindustan Zinc Ltd, process for recovery of cobalt from purification cake has been explored at lab-scale and cobalt sulphate crystal of about 60% purity with 50% recovery has been generated.

To provide a generalised view of the development in various countries in respect of cobalt, the countrywise description, as sourced from the latest available publication of 'USGS 2018' Minerals Yearbook, Release is furnished below:

Australia

In 2018, cobalt mine production as a byproduct of nickel mining in Western Australia decreased by 3% and Australian production of refined cobalt increased by 7%. BHP Group Ltd.'s Nickel West operations in Western Australia consisted of open pit and underground nickel sulfide mines; concentrators, which processed ores mined by BHP and other companies; the Kalgoorlie smelter, where nickel matte was produced from concentrates; and the Kwinana nickel refinery, which produced cobalt in intermediate cobalt- nickel sulfide. In 2018, BHP produced 920 tonnes of salable cobalt (full-year data for 2017 were not available). During the year, BHP began preparatory work on a 100,000-tonnes/year nickel sulfate plant at its Kwinana refinery and continued with solvent extraction test work for a potential cobalt sulfate circuit at the plant.

Independence Group NL owned the Nova underground nickel-copper-cobalt sulfide mine east of Norseman, Western Australia. During the calendar year, the company ramped up production to 969 tonnes of cobalt in nickel concentrate, an increase from 400 tonnes in 2017. Production from the first 3 years of operation was committed for sale to BHP's Nickel West operation and to Glencore plc. During the year, Independence Group studied the potential to refine its nickel concentrate using a hydrometallurgical process to produce nickel and cobalt sulphates. Production guidance for the fiscal year beginning July 1, 2018, was 850 to 950 tonnes of cobalt in concentrate.

Minara Resources Ltd. (Glencore plc) produced 3,200 tonnes of cobalt metal at its Murrin Murrin nickel- cobalt laterite mining and pressure-acid-leaching operation in Western Australia, 7% more than the 3,000 tonnes produced in 2017. Production in 2017 was less because of a scheduled maintenance shutdown during that year. In 2017 and 2018, approximately 300 tonnes of Murrin Murrin's production was from third-party feed.

First Quantum Minerals Ltd. (Canada) kept its Ravensthorpe nickel-cobalt laterite mine and hydrometallurgical processing plant in Western Australia on care-and-maintenance status throughout the year. The company planned to monitor nickel market conditions to determine when it might restart production. In 2017, the plant produced intermediate nickel-cobalt hydroxide containing 17,837 tonnes of nickel and an estimated 620 tonnes of cobalt.

Canada

Vale's global cobalt production was 5,093 tonnes in 2018, 12% less than the 5,811 tonnes produced in 2017. Vale produced 1,288 tonnes (1,675 tonnes onnes in 2017) of refined cobalt metal at its Port Colborne, Ontario, refinery; 1,630 tonnes (1,231 tonnes in 2017) of refined cobalt metal at its Long Harbour, Newfoundland and Labrador, refinery; 2,105 tonnes (2,780 tonnes in 2017) of cobalt in a cobalt intermediate product at its nickel operation in New Caledonia; and 70 tonnes (125 tonnes in 2017) of cobalt contained in other, intermediate products such as nickel concentrates. Vale's cobalt supply was produced from company-owned nickel-sulfide mines at Sudbury in Ontario, Thompson in Manitoba, and Voisey's Bay in northeastern Labrador; from company-owned nickel laterite mines in Indonesia and New Caledonia; and from purchased feedstock materials. Vale reported that 520 tonnes (840 tonnes in 2017) of cobalt came from Sudbury, 198 tonnes (138 tonnes in 2017) came from Thompson, 1,902 tonnes (1,829 tonnes in 2017) came from Voisey's Bay, 2,104 tonnes (2,780 tonnes in 2017) came from New Caledonia, and 371 tonnes (224 tonnes in 2017) came from external sources, including 173 tonnes of cobalt in ore from PT Vale Indonesia Tbk (6 tonnes in 2017).

In 2018, all of Vale's Voisey's Bay nickel concentrate was shipped to its hydrometallurgical refinery in Long Harbour, where cobalt was produced in the form of electrolytic metal rounds. In June, Vale established a cobalt streaming transaction with Wheaton Precious Metals Corp. and Cobalt 27. Vale agreed to sell 75% of future cobalt production from Voisey's Bay ore to Wheaton and Cobalt 27, starting January 1, 2021, for $690 million and payments averaging 20% of cobalt prices upon delivery. Vale planned to use the funds to complete the Voisey's Bay underground mine extension project, which would extend the operation's mine life and increase average annual production to an estimated 45,000 tonnes of nickel, 20,000 tonnes of copper, and 2,600 tonnes of cobalt.

Glencore reported that 900 tonnes of the cobalt produced at its Nikkelverk refinery in Norway originated from concentrates produced from its mines at Sudbury, Ontario, and Raglan, Quebec (800 tonnes in 2017).

The Fort Saskatchewan refinery, a joint venture of Sherritt and General Nickel Co. S.A., produced 3,234 tonnes of cobalt as metal powder and briquettes in 2018 (3,601 tonnes in 2017). The decrease was attributed to a disruption in the supply of hydrogen sulfide needed for refining, reduced availability of intermediate nickel- cobalt sulfide because of high rainfall in Cuba, and delays in rail transportation to the refinery. Approximately 89% of the cobalt originated from Moa, Cuba, and the remainder was from purchased materials. As a result of a United States embargo on imports of products originating from Cuba,

cobalt and nickel produced by Sherritt could not be sold to customers in the United States.

China

China was the world's leading producer and consumer of refined cobalt. In 2018, China's total production, including an estimate for Umicore's Ganzhou Yi Hao plant, increased by 11% from that in 2017 and was estimated to constitute about two-thirds of world refined cobalt production. Most production was in the form of cobalt salts (84%); the remainder was metal (10%) and metal powder (6%). China's consumption of refined cobalt increased to 64,000 tonnes, 11% more than that in 2017; 81% of 2018 consumption was used to make cathode materials for rechargeable batteries.

Congo (Kinshasa)

Congo (Kinshasa) was the world's leading producer of mined cobalt and was estimated to represent 70% of global production, Most of the country's cobalt mine production was from copper-cobalt ores mined by industrial or mechanised methods. A lesser amount was gathered by tens of thousands of artisanal miners by handpicking cobalt-rich ores. Artisanal mining filled the role of a swing producer, increasing during periods of supply deficits and higher prices. Although analysts agreed that artisanal mining increased in 2018 compared with that in 2017, their estimates of the amount of cobalt produced by artisanal methods in 2018 varied widely, from 15,000 tonnes to 17,000 tonnes of contained cobalt to one forecast of nearly 30 , 000 tonnes of contained cobalt.

The state-owned mining company La Générale des Carrières et des Mines SA (Gécamines) held a minority share in most of the copper-cobalt operations in Congo (Kinshasa) and had been the sole producer of refined cobalt in the country since late 2015, when Kamoto Copper Company SA (KCC) halted metal production at its Luilu cobalt refinery. In 2018, Gécamines was estimated to have produced 60 t of refined cobalt at its Shituru refinery in Likasi (based on reported exports), down from 120 tonnes in 2017.

Mutanda Mining SPRL (Glencore, 100%) mined copper-cobalt oxide ore from open pits near Kolwezi and produced a record-high 27,300 tonnes of cobalt in concentrate and crude cobalt hydroxide, 14% more than the 23,900 tonnes produced in 2017.

Tenke Fungurume Mining S.A.R.L. [China Molybdenum Co., Ltd. (CMOC), BHR Equity Investment Fund Management Co. (BHR Partners), and Gécamines] mined copper-cobalt ore, which it processed onsite to produce 18,747 tonnes of cobalt in crude cobalt hydroxide, 14% more than the 16,419 tonnes produced in 2017.

The increased production was attributed to investments to optimize production. Most of the hydroxide was sold to Freeport Cobalt Oy's Kokkola refinery in Finland under a long-term agreement; the remainder was sold to refiners in China. CMOC forecast a cobalt production volume of 16,500 to 19,000 tonnes of cobalt in hydroxide in 2019.

KCC [Katanga Mining Ltd. (a subsidiary of Glencore plc), Gécamines, and La Société Immobilière du Congo] restarted cobalt processing as part of commissioning the whole ore leach project at its copper-cobalt mining and refining operation in Lualaba Province and produced 11,112 tonnes of cobalt in hydroxide. The company also worked on a cobalt debottlenecking project, which included adding a magnesium oxide reagent plant within the cobalt circuit, new filter presses, and new cobalt hydroxide dryers. The project was intended to align cobalt-processing capacity with the life-of-mine plan to produce an average of 30,000 tonnes/year of cobalt in hydroxide and a maximum processing capacity of 40,000 tonnes /year of cobalt in hydroxide.

The remainder was exported to Zambia to be refined at ERG's Chambishi Metals plc plant. In 2018, Boss Mining exported 5,970 tonnes gross weight of cobalt carbonate, 34,600 tonnes gross weight of cobalt concentrate, and 2,320 tonnes gross weight of copper- cobalt concentrate.

By yearend, ERG had commissioned phase 1 of its Metalkol Roan Tailings Reclamation project and began producing copper cathode and cobalt hydroxide. The project entailed recovering copper and cobalt from tailings deposited in the Kingamyambo Tailings Dam and Musonoi River Valley in Haut Katanga Province during past mining operations. In 2018, Metalkol produced 300 tonnes of contained cobalt in salable cobalt hydroxide. At full operation, Metalkol's phase 1 was expected to produce 14,000 tonnes/year of cobalt in hydroxide, which would increase to 20,000 tonnes/ year during a phase 2 expansion.

Metal Mines SARL (Nanjing Hanrui Cobalt Co., Ltd.) reportedly expanded the cobalt hydroxide production capacity of its processing plant in Likasi, Haut Katanga Province, to 5,000 tonnes/ year of cobalt in hydroxide. The plant processed copper-cobalt ore from mines leased by Metal Mines as well as some ore from other companies. In 2018, Metal Mines exported 19,600 tonnes gross weight of cobalt hydroxide and 14 ,800 tonnes gross weight of cobalt concentrate.

Somika SPRL (Société Minière de Katanga, Vinmart Group, India) produced cobalt hydroxide at it's plant in Lubumbashi, Haut- Katanga Province, from copper-cobalt ores sourced from small- and large-scale mining operations. In 2018, the company exported 10,400 tonnes gross weight of cobalt hydroxide, exported 5,430 tonnes gross weight of cobalt concentrate, and sold 6, 960 tonnes gross weight of cobalt mineral to the local market.

China Railway Group Ltd. had shares in three copper-cobalt mining and refining operations in Congo (Kinshasa) La Sino-Congolaise des Mines S.A. (Sicomines) (a joint venture with Gécamines, Sinohydro Corp., and Zhejiang Huayou Cobalt Co., Ltd.), Compagnie Minière de Luisha S. A.S., and La Minière de Kalumbwe Myunga sprl (MKM).

In 2018, Sicomines exported 1,630 tonnes gross weight of cobalt hydroxide and 34 tonnes gross weight of cobalt concentrate and MKM exported 3,110 tonnes gross weight of cobalt hydroxide.

Congo Dongfang International Mining SPRL (CDM) was responsible for procuring cobalt feed materials for Huayou's refineries in China and produced crude cobalt hydroxide at its La Minière de Kasombo SPRL (MIKAS) hydrometallurgical plant in Lubumbashi. In 2018, CDM and MIKAS exported about 35,400 tonnes gross weight of cobalt hydroxide. The ores and concentrates reportedly were sourced from CDM's mines and other Congolese mining operations, including artisanal miners.

Compagnie Minière de Kambove (COMIKA) (Wanbao Mining Ltd. and Gécamines) mined copper-cobalt ore from the open pit Kamoya copper-cobalt mine near Kambove, Haut-Katanga Province. In 2018, COMIKA exported 46,200 tonnes gross weight of copper-cobalt concentrate and 1,460 tonnes gross weight of cobalt hydroxide. Wanbao Mining planned to expand the operation in 2019.

The Lualaba Copper Smelter SAS joint venture (LCS) [composed of subsidiaries of China Nonferrous Mining Corp. Ltd. (CNMC) and Yunnan Copper Industry Group Co., Ltd.] began construction of a blister copper smelter. As part of the project, LCS was constructing a "cobalt recycling system" to produce 10,000 tonnes/year of crude copper-cobalt alloy.

Cuba

Moa Nickel S.A. (part of the 50–50 joint venture between Sherritt and General Nickel) mined nickel- cobalt laterites at Moa, Holguin Province, and produced intermediate nickel-cobalt sulfide, which was sent to the joint venture's Fort Saskatchewan refinery in Canada. In 2018, the sulfide contained 35,125 tonnes of nickel and cobalt (34,595 tonnes in 2017).

The Government-owned Empresa Niquelífera Ernesto Che Guevara operation (also known as Punta Gorda) in Moa, Holguin Province, mined and processed nickel-cobalt laterites. The operation was expected to undergo repair and maintenance work, including the purchase of mining equipment, beginning in mid-2018 (Redacción ¡ahora!, 2018). Nickel and cobalt originating in Cuba could not be imported into the United States because of a United States embargo on imports from Cuba.

Finland

According to the Cobalt Institute (2019), in 2018, Freeport Cobalt Oy (Freeport-McMoRan Inc., Lundin, and Gécamines) produced 5% more cobalt at its Kokkola refinery than it produced in 2017. The company produced a wide range of cobalt chemicals and metal powders. In 2018, the main feed for the refinery was crude cobalt hydroxide supplied under a long-term agreement by the Tenke Fungurume operation in Congo (Kinshasa); the refinery also processed cobalt-bearing scrap from the cemented carbide, battery, and catalyst industries. Since 2016, when it sold its share of Tenke Fungurume to China Molybdenum, Freeport-McMoRan has wanted to sell its share in Freeport Cobalt.

Boliden's Kevitsa open pit nickel-copper-PGM sulfide mine and beneficiation plant produced nickel concentrate containing 13,948 tonnes of nickel and 591 tonnes of cobalt in 2018 (compared with 13,777 tonnes of nickel and an estimated 587 tonnes of cobalt in 2017). In 2018, Boliden began producing nickel-cobal tconcentrate at its underground Kylylahti copper-zinc mine and produced concentrate containing 518 tonnes of nickel and 278 tonnes of cobalt. During the year, Boliden worked to expand production at Kevitsa by 27 % by yearend 2020 and evaluated the potential of extending Kylylahti's lifespan. The company's Harjavalta smelter processed nickel concentrates from Kevitsa and elsewhere and sold the resulting nickel matte.

Terrafame Ltd. [Finnish Minerals Group Ltd. (formerly Terrafame Group Ltd., Government of Finland), Trafigura Ventures V B.V., Galena Private Equity Resources Investment 2 L.P., Galena Private Equity Resources Investment 3 L.P. funds, and Sampo plc] stabilized operations at its polymetallic sulfide mining and bioheap-leaching operation in Sotkamo, central Finland. In 2018, the company produced intermediate nickel-cobalt sulfide containing 27,377 tonnes of nickel and, based on reported nickel and cobalt contents of the sulfide in 2016, an estimated 550 tonnes of cobalt (20,864 tonnes nickel and an estimated 420 tonnes cobalt in 2017).

New Caledonia

In 2018, estimated recoverable mine production decreased by 24% compared with that in 2017 because of a decrease in production from sole producer Vale Nouvelle-Calédonie S.A.S. (VNC) (Vale and Société de Participation Minière du Sud Caledonien S.A.S.). VNC continued to ramp up production at its operation in the southern tip of New Caledonia's main island, which consisted of a nickel-cobalt laterite mine, an HPAL processing plant, and a refinery. During the year, VNC added new trucks to its mining fleet, worked to update its mine plan, and evaluated ways to increase efficiency at the plant. Following rampup over the next 5 to 6 years, the operation was expected to have a nominal production capacity of 50,000 tonnes/yr of nickel contained in nickel oxide and an estimated 4,000 tonnes/year of cobalt contained in an intermediate cobalt carbonate.

Russia

Production by Nornickel, the sole producer of refined cobalt in Russia, decreased for the second consecutive year. The company mined and beneficiated nickel-copper sulphide ores and smelted the concentrates at its Polar

Division on the Taymyr Peninsula and at Kola MMC on the Kola Peninsula. The resulting matte from the Polar Division was refined at Kola MMC's Severonickel refinery at Monchegorsk on the Kola Peninsula, where high- grade electrolytic cobalt (cobalt cathode) was produced. Matte from Kola MMC was refined at Severonickel and by Norilsk Nickel Harjavalta Oy in Finland. In addition to producing refined cobalt, Nornickel reportedly also produced about 1,100 tonnes of cobalt in a cobalt intermediate in 2018, which was sent to be refined at Harjavalta and Glencore's Nikkelverk operation in Norway.

Turkey

Nikel Kobalt Madencilik Sanayi ve Ticaret A.S. (Vestel Elektronik Sanayi ve Ticaret A.S. and Zorlu Holding A.S.) produced intermediate nickel-cobalt hydroxide containing 5,001 tonnes of nickel and 259 tonnes of cobalt from its HPAL processing plant at Gordes, Manisa Province.

FOREIGN TRADE

Exports

Cobalt ores & concentrates exports were nil during the last two years. Exports of cobalt and alloys including waste and scrap increased exponentially by 294% to 1,340 tonnes in 2021-22 from 340 tonnes in the previous year. Exports were mainly to Korea (88%), Turkey (3%) and UK & Belgium (2% each). Out of the total exports in 2020-21, exports of cobalt and alloys were at 1,309 tonnes and those of cobalt & scrap were at negligible levels. Similarly, during 2021-22 exports of cobalt powder were at 1,232 tonnes and that of cobalt (other articles) were at 76 tonnes (Tables-4 to 9).

Table –4: Exports of Cobalt & Alloys (Including Waste and Scrap)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**340**	**364327**	**1340**	**895452**
Korea, Rep. of	252	55551	1179	550695
Belgium	1	2580	32	105686
UAE	3	21129	12	65548
USA	59	202658	19	56922
U K	2	8905	33	36648
Turkey	++	129	41	23427
France	1	4006	1	10010
Finland	2	8883	1	8537
Germany	1	2495	2	7482
China	15	38392	2	6783
Other countries	4	19599	18	23714

Figures rounded off

Table – 5: Exports of Cobalt & Alloys

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**340**	**364006**	**1309**	**812402**
Korea, Rep. of	252	55551	1179	550695
UAE	3	21129	10	63861
USA	59	202658	16	53145
Belgium	1	2580	11	35141
UK	2	8840	29	31114
Turkey	++	129	41	23427
France	1	4006	1	10010
Finland	2	8883	1	8537
Germany	1	2495	2	7482
China	15	38392	2	6783
Other countries	4	19343	17	22207

Figures rounded off

Table – 6: Exports of Cobalt & Scrap

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**321**	**31**	**83050**
Belgium	-	-	21	70545
U K	++	65	4	5534
USA	-	-	3	3777
UAE	-	-	2	1687
Netherlands	-	-	1	1481
Nepal	-	-	++	26
Vietnam	++	256	-	-

Figures rounded off

Table –7: Exports of Cobalt Powder

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**137**	**59805**	**1232**	**629350**
Korea, Rep. of	134	41019	1179	550039
UAE	3	18340	10	50544
Turkey	++	77	41	23427
Brazil	-	-	1	3619
Belgium	-	-	++	1243
China	-	-	1	272
Austria	-	-	++	99
U K	++	190	++	97
USA	-	-	++	10
Saudi Arabia	++	179	-	-
Other Countries	-	-	-	-

Figures rounded off

Table –8: Exports of Cobalt (Other Articles)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**149**	**127944**	**76**	**180381**
USA	19	63709	16	53118
Belgium	1	2580	10	32002
UK	2	8650	29	31017
UAE	++	2789	++	13317
France	1	4006	1	10010
Finland	2	8883	1	8537
Germany	1	2495	2	7482
China	1	1087	1	6511
Switzerland	2	12084	++	4581
Netherlands	++	2082	1	3473
Other Countries	120	19579	15	10333

Figures rounded off

Table – 9: Exports of Cobalt Unwrought

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**54**	**176257**	**1**	**2671**
Belgium	-	-	1	1896
Korea, Rep. of	-	-	++	650
Switzerland	-	-	++	108
USA	40	138949	++	17
China	14	37305	-	-
Morocco	++	3	-	-

Figures rounded off

Imports

During the period 2021-22, one tonne of cobalt ores and concentrate were imported, while it was negligible in the previous year.

Imports of cobalt & alloys including waste and scrap increased by 41% to 1,130 tonnes in 2021-22 from 802 tonnes in the previous year. Imports in 2021-22 were mainly from USA & Netherlands (16% each), Japan & Belgium (12% each), and Norway (11%). Out of the total imports in 2021-22, imports of cobalt & alloys were at 1,128 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 353 tonnes, 438 tonnes and 337 tonnes, respectively (Tables-10 to 16).

Table – 10: Imports of Cobalt & Alloys (Including Waste & Scrap)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**802**	**2898721**	**1130**	**5852552**
USA	106	563955	181	982003
U K	69	396203	80	938461
Netherlands	171	421470	176	668410
Belgium	100	277313	134	552752
Norway	26	67271	125	547533
China	85	241056	102	422343
UAE	13	42497	86	422061
Japan	96	281460	131	409178
France	8	100585	24	330325
Germany	9	178290	12	207270
Other countries	119	328621	79	372216

Figures rounded off

Table – 11: Imports of Cobalt Powder

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**237**	**722141**	**353**	**1490170**
Belgium	67	203912	120	490617
Netherlands	14	34252	58	272167
Japan	33	111860	56	214086
China	29	83490	29	109629
South Africa	10	31128	17	80086
Finland	10	28304	16	76963
USA	16	41581	18	75947
France	7	25226	13	59330
Turkey	12	33692	15	54039
UK	15	53737	8	32526
Other countries	24	74959	3	24780

Figures rounded off

Table – 12: Imports of Cobalt (Other Articles)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**343**	**1612473**	**438**	**2933766**
USA	81	495573	161	891777
U K	54	341609	68	887078
China	27	75267	70	303765
France	1	70393	11	269757
Germany	8	170462	11	193151
Netherlands	85	221054	53	175571
Singapore	4	13786	11	73241
Belgium	12	30399	14	62135
Japan	22	65295	37	57586
Hong Kong	++	1948	2	15180
Other countries	49	126687	++	4525

Figures rounded off

Table – 13: Imports of Cobalt (Unwrought)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**222**	**564100**	**337**	**1426119**
Norway	-	-	125	547533
UAE	13	41548	86	421288
Netherlands	72	166164	65	220672
Japan	41	104305	38	137506
Singapore	10	28276	10	36893
U K	++	857	4	18857
Bahamas	25	60736	4	15840
USA	9	26794	2	14279
China	29	82299	3	8949
France	++	4966	++	2561
Other countries	23	53121	++	1741

Figures rounded off

Table – 14: Imports of Cobalt & Alloys

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**802**	**2898714**	**1128**	**5850055**
USA	106	563948	181	982003
U K	69	396203	80	938461
Netherlands	171	421470	176	668410
Belgium	100	277313	134	552752
Norway	26	67271	125	547533
China	85	241056	102	422343
UAE	13	42497	86	422061
Japan	96	281460	131	409178
France	8	100585	24	330325
Germany	9	178290	12	207270
Other countries	119	328621	77	369719

Figures rounded off

Table – 15 : Imports of Cobalt & Scrap

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**7**	**2**	**2497**
Bangladesh	-	-	2	2497
USA	++	7	-	-

Figures rounded off

Table – 16 : Imports of Cobalt Ore & Conc.

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**325**	**1**	**6917**
UK	++	325	1	6917

Figures rounded off

FUTURE OUTLOOK

India does not have any primary cobalt resources. Two possible secondary sources 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.

Due to specialised nature of applications and difficulty in substitution, the future demand for cobalt is likely to follow an increasing trend.

The bulk demand for cobalt in the world would be in cemented carbides used in cutting tools, catalysts in Petrochemical Industry, drying agent in Paint Industry and in superalloys used mainly in jet engine parts. The demand for cobalt is estimated to go up manifolds with use of superalloys in civil aviation, catalysts for gas- to-liquid production of synthetic liquid fuels, rechargeable batteries for hybrid electric vehicles, cellular telephones, aerospace and energy generation industries. The global demand for lithium-ion batteries has grown rapidly as a result of the increase in demand for mobile phones, portable PCs & electronic devices. The demand projection for refined electronic devices has been staggering. As per CRU, cobalt consumption was forecasted to grow by an incredible rate of 68% in the period between 2015 and 2025.

In India, cobalt will find major applications in metallurgy due to greater demand in special alloys/ superalloys and in cutting tools and as an alloy in permanent magnets. Cobalt powder demand will continue to grow as it is extensively used in the manufacture of bonded tools that are used in the Diamond Industry.

As far as cobalt is concerned the Indian Industry is very small, but it is growing at a steady pace in various sectors, especially in aerospace. The Aerospace Industry is mainly dependent on import of cobalt. Other industries are growing at a consistent level but cannot be compared to China. The total consumption could be 70 tonnes to 80 tonnes minimum and it could be 100 tonnes maximum per month in terms of cobalt content. Cobalt sulphate is mostly used in Chemical Industries.

Battery manufacturing is considered as a major segment with huge potential in India which could trigger development of new technology and product upgrading. Increase in cobalt consumption by the Battery Industry, mainly for personal electronics, have resulted in global annual growth rates in cobalt consumption exceeding growth rates for the global gross domestic product. This rate was forecast to increase to 9.5% between 2018 and 2025, driven mainly by cobalt's use in rechargeable lithium-ion batteries for electric vehicles.

5. Copper

1.66
(billion tonnes) Total reserves/ resources of copper ore as on 1st April 2020

3.56
(million tonnes) Production of copper ore in 2021-22

34,827
(tonnes) Exports of copper ores & concentrates in 2021-22

10,18,934
(tonnes) Imports of copper ores & concentrates in 2021-22

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 (P)

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconna - issance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India: Total													
Ore	128267	20045	15580	163891	83102	111376	41368	135884	340902	778987	5360	1496979	1660870
Metal	1664.12	313.64	183.81	2161.57	873.59	428.09	246.48	1655.35	2748.95	4051.37	31.69	10035.52	12197.09
By Grades													
Ore with 1.85% & Above Cu	-	-	-	-	-	62	-	2520	2645	2186	870	8283	8283
Ore With 1.00 % to below 1.85 % Cu	128267	20045	15580	163891	69113	7372	14977	86623	112772	132046	-	422903	586795
Ore with (+) 0.50% to below 1.00% Cu	-	-	-	-	3070	103942	11596	46741	94495	534442	3620	797906	797906
Ore with (-) 0.50% Cu	-	-	-	-	10919	-	14795	-	130990	110312	870	267886	267886
Metal	1664.12	313.64	183.81	2161.57	873.59	428.09	246.48	1655.35	2748.95	4051.37	31.69	10035.52	12197.09
By States													
Andhra Pradesh													
Ore	-	-	-	-	686	-	105	-	5791	1000	-	7582	7582
Metal	-	-	-	-	6.88	-	1.05	-	97.45	8.32	-	113.7	113.7
Arunachal Pradesh													
Ore	-	-	-	-	-	-	-	-	-	-	10	10	10
Metal	-	-	-	-	-	-	-	-	-	-	0.02	0.02	0.02
Gujarat													
Ore	-	-	-	-	2013	2371	969	129	-	7131	-	12613	12613
Metal	-	-	-	-	31.2	35.8	19.67	0.69	-	113.38	-	200.74	200.74

Table -1: (Countd.)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconna - issance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Haryana													
Ore	-	-	-	-	-	2230	-	-	20900	30686	-	53816	53816
Metal	-	-	-	-	-	11.82	-	-	73.19	94	-	179.01	179.01
Jharkhand													
Ore	6150	-	3000	9150	10445	2804	3988	87330	99890	37855	-	242313	251463
Metal	72.08	-	35.37	107.45	115.59	29.98	45.9	1002.92	1023.12	454.7	-	2672.21	2779.66
Karnataka													
Ore	-	-	-	-	867	1301	3114	1750	6833	27634	-	41499	41499
Metal	-	-	-		-	-	15.28	22	65.77	142.81	-	245.86	245.86
Madhya Pradesh													
Ore	107773	-	12580	120353	55777	100411	8824	23062	300	77938	-	266312	386665
Metal	1422.6	-	148.44	1571.04	686.05	321.31	27.35	207.45	9.78	843.88	-	2095.82	3666.86
Maharashtra													
Ore	-	-	-	-	-	-	-	-	5831	11774	150	17755	17755
Metal	-	-	-	-	-	-	-	-	58.36	99.18	0.54	158.08	158.08
Meghalaya													
Ore	-	-	-	-	-	-	-	-	880	-	-	880	880
Metal	-	-	-	-	-	-	-	-	9	-	-	9	9
Nagaland													
Ore	-	-	-	-	-	-	-	-	-	2000	-	2000	2000
Metal	-	-	-	-	-	-	-	-	-	15	-	15	15
Odisha													
Ore	-	-	-	-	-	-	-	1340	2306	8345	-	11991	11991
Metal	-	-	-	-	-	-	-	20.63	20.14	56.26	-	97.03	97.03

Table -1: (Countd.)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconna - issance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Rajasthan													
Ore	14344	20045	-	34388	13314	1148	24304	18603	197078	573814	5200	833461	867849
Metal	169.44	313.64	-	483.08	33.87	12.2	136.32	338.66	1385.88	2214.46	31.13	4152.52	4635.6
Sikkim													
Ore	-	-	-	-	-	445	63	300	-	150	-	958	958
Metal	-	-	-	-	-	7.86	0.91	8.47	-	4.23	-	21.47	21.47
Tamil Nadu													
Ore	-	-	-	-	-	-	-	200	590	-	-	790	790
Metal	-	-	-	-	-	-	-	1.08	2.73	-	-	3.81	3.81
Telangana													
Ore	-	-	-	-	-	666	-	-	-	-	-	666	666
Metal	-	-	-	-	-	9.12	-	-	-	-	-	9.12	9.12
Uttarakhand													
Ore	-	-	-	-	-	-	-	3170	390	660	-	4220	4220
Metal	-	-	-	-	-	-	-	53.45	1.44	5.15	-	60.04	60.04
West Bengal													
Ore	-	-	-	-	-	-	-	-	113	-	-	113	113
Metal	-	-	-	-	-	-	-	-	2.09	-	-	2.09	2.09

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION & PRICES

Copper Ore and Concentrates

The production of copper ore at 3.56 million tonnes in 2021-22 increased by 9% as compared to that in the previous year. The metal content in the ore produced in 2021-22 works out to 27,622 tonnes as against 25,623 tonnes in previous year. During the year under review, 3.60 million tonnes of ore was treated for obtaining copper concentrates as against 3.44 million tonnes in previous year.

Production of copper concentrates at 1,14,421 tonnes in 2021-22 increased by about 5% 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 2021-22, followed by Rajasthan (43%). The number of reporting mines was 5 in both the years, i.e., 2020-21 and 2021-22 (Tables-2 to 6).

Table – 2: Principal Producer of Copper Concentrates, 2021-22

Name and address of the producer	Location of mine	
	State	District
Hindustan Copper Ltd, Tamra Bhavan, 1,Ashutosh Choudhury Avenue, Kolkata – 700 019.	Madhya Pradesh	Balaghat
	Rajasthan	Jhunjhunu

Table – 3: Production of Copper Ore, 2020-21 and 2021-22

(By States)

(In tonnes)

State	2020-21			2021-22 (P)		
	Ore produced	Cu%	Metal content	Ore produced	Cu%	Metal content
India	**3272915**	**0.78**	**25623**	**3569632**	**0.77**	**27622**
Jharkhand	41772	0.65	272	25834	0.81	209
Madhya Pradesh	2239152	0.76	17114	2442459	0.74	18105
Rajasthan	991991	0.83	8238	1101339	0.85	9308

(P): Provisional

Table – 4: Copper Ore Treated, 2020-21 and 2021-22

(By States)

(In tonnes)

State	2020-21			2021-22 (P)		
	Ore treated	Cu%	Metal content	Ore treated	Cu%	Metal content
India	**3439102**	**0.77**	**26552**	**3604690**	**0.77**	**27709**
Jharkhand	47277	0.65	307	-	-	-
Madhya Pradesh	2384025	0.75	17880	2486190	0.73	18261
Rajasthan	1007800	0.83	8365	1118500	0.84	9448

(P): Provisional

Table – 5: Production of Copper Concentrates, 2019-20 to 2021-22

(By States)

(Quantity in tonnes; Value in ₹ 000)

State	2019-20		2020-21		2021-22 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**124586**	**8448405**	**108718**	**8533354**	**114421**	**10951112**
Jharkhand	7660	604135	1208	23707	-	-
Madhya Pradesh	65094	4750125	64920	5137695	65022	5487137
Rajasthan	51832	3094145	42590	3371952	49399	5463975

(P): Provisional

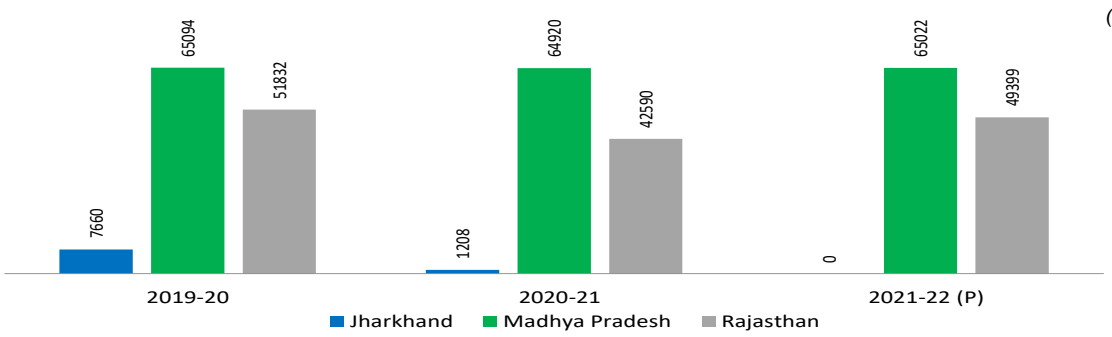


Fig. 1: Production of Copper Concentrates

Table – 6: Production of Copper Concentrates, 2020-21 and 2021-22

(By Sector/States/Districts)

(Quantity in tonnes; Value in ₹ '000)

State/District	2020-21			2021-22 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**5**	**108718**	**8533354**	**5**	**114421**	**10951112**
Public Sector	5	108718	8533354	5	114421	10951112
Jharkhand	**2**	**1208**	**23707**	**2**	**-**	**-**
Singhbhum (East)	2	1208	23707	2	-	-
Madhya Pradesh	**1**	**64920**	**5137695**	**1**	**65022**	**5487137**
Balaghat	1	64920	5137695	1	65022	5487137
Rajasthan	**2**	**42590**	**3371952**	**2**	**49399**	**5463975**
Jhunjhunu	2	42590	3371952	2	49399	5463975

(P): Provisional

Grade Analysis

During the year 2021-22, the average copper content in the ore produced was 0.77% Cu as against 0.78% in the previous year. All India average metal content of ore treated during the year 2021-22 works out to 0.77% Cu which is same as previous year. The copper content in the ore treated varies from State to State. The average metal content in the concentrate produced works out to 23.13% Cu in 2021-22 as against 23.12% Cu in the previous year.

The average daily employment of labour in copper mines in 2021-22 was 2,931 as against 2,829 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).

The production of copper blister was reported as nil in 2021-22 while copper continuous cast wire rods registered an increase of 3% in 2021-22 as compared to the previous year. The production of copper cathodes increased by 33%. Production of copper electrolytic wire bars was not reported for more than eight years (Tables-8 to 11). Prices of copper are furnished in the General Review on 'Prices'.

Table – 7: Producers of Copper Metal, 2021-22

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-700 019, West Bengal.	Jharkhand Maharashtra	Singhbhum (East) Raigad
Hindalco Industries Ltd., Century Bhawan, Dr. Annie Besant Road, Mumbai –400 030, Maharashtra.	Gujarat	Bharuch

Name and address of the producer	Location of the plant	
	State	District
Vedanta Ltd., Sesa Ghor, 20 EDC Complex, Patto, Panaji - 403 001, Goa.	Tamil Nadu Dadra & Nagar Haveli	Thoothukudi Chinchpada (Silvassa)

Table – 8: Production of Copper Metal, 2019-20 to 2021-22

(In tonnes)

Year	Copper blister	Copper cathodes Wirebars	Copper Electrolytic	Copper CCWR
2019-20	3997	408003	-	349475
2020-21	-	363609	-	341563
2021-22 (P)	-	483994	-	351464

(P): Provisional

Table – 9: Production of Copper (Blister), 2020-21 and 2021-22

(By State/Plant)

(Quantity in tonnes; Value in ` '000)

State	Plant	2020-21		2021-22 (P)	
		Quantity	Value	Quantity	Value
India		**-**	**N.A.**	**-**	**N.A.**
Jharkhand	Surda ICC	-	N.A.	-	N.A.

(P): Provisional

Table – 10: Production of Copper (CCWR), 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		**341563**	**188445400**	**351464**	**261303186**
Gujarat	Hindalco	219171	122004100	225017	168737600
Maharashtra	HCL Taloja	-	-	-	-
Tamil Nadu	Vedanta Ltd	-	-	-	-
Dadra & Nagar Haveli	Vedanta Ltd	122392	66441300	126447	92565586

(P): Provisional

Table – 11: Production of Copper (Cathodes), 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		**363609**	**190616200**	**483994**	**363507671**
Gujarat	Hindalco	262174	136047000	358889	27263400
Jharkhand	Surda ICC	-	-	-	-
Tamil Nadu	Vedanta Ltd	-	-	-	-
Dadra & Nagar Haveli	Vedanta Ltd	101435	54569200	125105	90875271

(P): Provisional

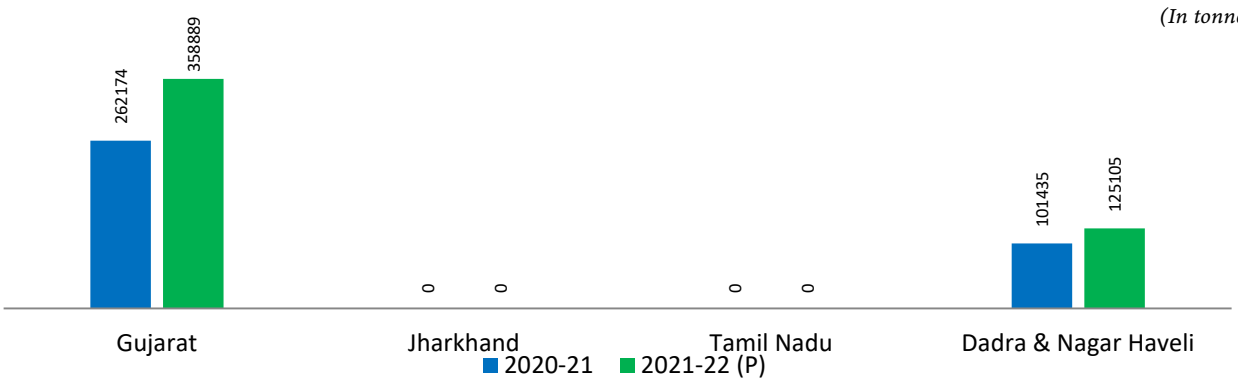


Fig. 2: Production of Copper (Cathodes)

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 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 during FY 2020-21 had envisaged to enhance the ore production capacity from the current level of 4.24 million tonnes per annum (MTPA) to 12.20 MTPA by FY 2028-29. Status of different 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 the existing open cast mine. The earlier awarded 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 undertaken to augment the production capacity to 1.5 MTPA for which 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 mine, another contract has been awarded 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. 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 fo r 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 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 about 10.28 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	Type of Copper Producer	Annual Capacity
TOTAL		**1028.5**
1. Hindustan Copper Ltd, Ghatsila, Jharkhand & Jhagadia, Gujarat	CPSE (integrated producer)	68.5
2. Hindalco Industries Ltd, Dahej, Distt. Bharuch, Gujarat.	Private (Port based custom smelter)	500
3. Sterlite Industries Tuticorin, Tamil Nadu, & Silvasa, Daman and Diu.	Private (Port based custom smelter)	460

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 Organised Sector in the country.

USES

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.

In Transportation Industry, copper is used in various components. According to ICSG the world Copper Factbook 2023 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.

CONSUMPTION

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 2021-22, the imports of refined copper were more than the exports. The apparent availability of refined copper increased from 4,30,288 tonnes in 2020-21 to 5,14,545 tonnes in 2021-22 (Table-13).

Table – 13: Apparent Availability of Copper for Domestic Consumption

(Based on Production of Refined Copper, Imports and Exports)

(Quantity in tonnes)

Item	2020-21	2021-22 (P)
I) Total Production* (Cathodes)	363609	483994
II) Total Imports (copper refined)	155038	138531
III) Total Exports (copper refined)	88359	107980
IV) Apparent Availability	430288	514545

** 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 890 million tonnes of copper content. Chile has the largest share, accounting for about 21% of world reserves, followed by Australia (11%), Peru (9%), Russia (7%), Mexico (6%), USA (5%), Congo (Kinshasa), Poland, China & Indonesia

(3% each), Kazakhstan & Zambia (2% each) and Canada (1%). Remaining about 24% 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 off)	**890000**
Australia[a]	97000
Canada	7600
China	27000
Chile	190000
Congo (Kinshasa)	31000
Germany	–
Indonesia	24000
Japan	–
Kazakhstan	20,000
Korea	–
Mexico	53000
Peru	81000
Poland	30000
Russia	62000
USA	44000
Zambia	19000
Other countries	200000

Source: USGS, Mineral Commodity Summaries, 2023,
(a): For Australia, Joint Ore Reserves Committee Compliant reserves were about 23 million tonnes.

The world mine production of copper remains almost same at 21.4 million tonnes of metal content in 2021 as compared to previous year. Chile continued to be the largest single producer of copper in 2021 with 26% share followed by Peru (11%), China & Dem. Rep. of Congo (8% each) and USA (6%) (Table-15).

Table – 15: World Mine Production of Copper

(By Principal Countries)

(In tonnes of metal content)

Country	2019	2020	2021
World Total	**20700000**	**21000000**	**21400000**
(rounded off)			
Chile	5787400	5733100	5624900
Peru	2455440	2150126	2299277
Congo, Dem. Rep. of	1420386	1601208	1797836
China	1683700	1723100	1750000
USA	1260000	1200000	1230000
Russia	812400	924100	900000
Zambia	789942	868671	800696
Australia	925157	879522	813145
Indonesia	351000	507000	775000
Mexico	713704	800316	734100
Other countries	4500871	4612857	4675046

Source: BGS, World Mineral Production, 2017-21.

(In tonnes of metal content)

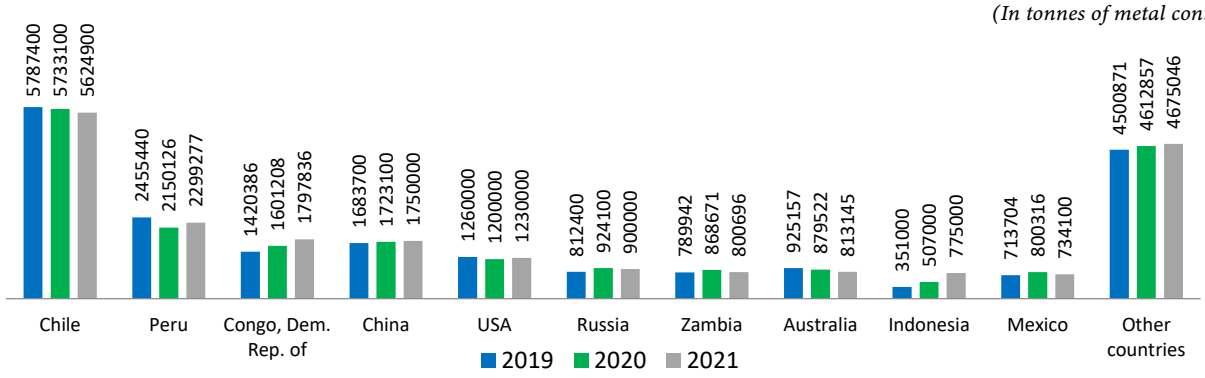


Fig. 3 : World Mine Production of Copper

As per BGS world refined copper production was 24.80 million tonnes in the year 2021 which showed a slight decrease of 0.40% from 24.90 million tonnes in the previous year. China was the largest producer of refined copper with 10.49 million tonnes in the year 2021 (42% of world production) followed by Chile 2.27 million tonnes (9%), Japan 1.52 million tonnes (6%), Dem. Rep. of Congo 1.30 million tonnes (5%) and Russia & USA (4% each), etc.

In 2022, China accounted for almost 50% of world copper smelter production, followed by Japan (7.4%), Chile (5.2%) and Russia (4.6%). China was also the largest consumer of refined copper in 2022 with apparent usage of around 14.7 million tonnes as per International copper Study Group (ICSG).

Australia

Mineral copper production in Australia increased by 7% to 9,20,000 tonnes in 2018 from 8,56,000 tonnes in 2017. Newerest Mining Ltd increased copper production at the Cadia Valley Mine by 19,100 tonnes (34%) from that in 2017, when an earthquake disrupted operations for several mnths. The Capricorn copper project (owned by EMR Capital Pty Ltd) commenced production in late 2017 and was ramping up to an annual capacity of 30,000 tonnes (Department of Industry, Innovation, and Science, 2018).

Production statistics at the mine level were not available for two of the leading copper operations in Australia- the Mount Isa and Olympic Dam complexes. Glencore plc

produced 1,52,000 tonnes of refined metal at Mount Isa, a decrease of 8% from 1,65,000 tonnes in 2017. At Olympic Dam, BHP Group produced 1,47,000 tonnes of electrolytic and electrowon copper cathode in 2018, an increase of 4% from 1,42,000 tonnes.

Canada

In 2018, production decreased at nearly all copper mines in Canada, and total mine output fell by 9% to 5,43,000 tonnes of copper from 5,95,000 tonnes in 2017. The largest decline in production took place at the Sudbury complex (owned by Vale S.A.), where output decreased by 26,000 tonnes; at the Voisey's Bay Mine (Vale), by 7,800 tonnes; and at the Gibraltar Mine, by 7,260 tonnes. Vale attributed the decrease at the Sudbury complex and the Voisey's Bay Mine to a strategic decision to deprioritise its nickel operations, resulting in lower production of copper by-product.

Chile

In 2018, 7 of the leading 20 copper mines in the world were located in Chile, the first-ranked global producer of mined copper since 1982. Mined copper production in Chile increased by 6% to 5.83 million tonnes from 5.50 million tonnes in 2017. At the Escondida Mine production rose by 34% to 1.21 million tonnes from 9,03,000 tonnes in 2017. At the Collahuasi Mine production was 5,59,000 tonnes in 2018, up by 7% from 5,24,000 tonnes because of higher ore grades and improved copper recovery rates following planned maintenance and the installation of 24 new flotation cells in the first half of the year. Owing to higher ore grades, output rose by 20% at the Los Bronces Mine.

In 2018, the state-owned Corporation Nacional del Cobre de Chile (Codelco) operated 7 mines in the country, 3 of which were ranked among the 20 leading global copper mines. An overall decrease of 3% in mined copper production at Codelco's operations, to 1.68 million tonnes compared with 1.73 million tonnes in 2017, partially offset the increases at other major copper mines in Chile. The company attributed the decline to lower copper ore grades.

China

Beijing Antaike Information Co., Ltd estimated that refined copper capacity in China increased by about 1.2 million tonnes in 2018 to 12.2 million tonnes. New capacity came online at a minimum of seven refineries in the country, either through the opening of new facilities or upgrades at existing facilities. Most notably, Chinalco Southeast Copper Co., Ltd. finished construction of a new refinery with an annual cathode production capacity of 4,00,000 tonnes, and Guangxi Nanguo Copper Co. completed a 3,00,000 tonnes per year expansion.

Congo (Kinshasa)

Owing primarily to the restart of ore processing operations at the Kamoto complex, output of mined copper in Congo (Kinshasa) increased by 13% to 1.23 million tonnes in 2018 from 1.09 million tonnes in 2017, and refined copper production rose by 15% to 9,53,000 tonnes from 830,000 tonnes. From September 2015 until November 2017, ore processing at Kamoto was suspended while Katanga Mining completed the first phase of capacity expansion project. Cathode production resumed in December 2017, and the final components of the second phase of expansion were completed and began ramping up in the fourth quarter of 2018. Output of SX–EW cathode increased by 1,50,000 tonnes in 2018 and was expected to increase by roughly 1,35,000 tonnes in 2019.

Indonesia

In December 2018, Freeport reached an agreement with the Government of Indonesia for an extension of the mining licence at the Grasberg Mine (third-ranked) through 2031, which had been set to expire in 2021. The licence would be valid through 2041 once the Company constructed a new smelter in Indonesia and fulfilled other fiscal obligations. As part of the agreement, Freeport divested a portion of its 90.64% ownership in the mine to PT Inalum, an Indonesian state-owned firm, and held a 48.76% stake following the transaction. The Company's license to export copper concentrates would require approval by the Government of Indonesia every 6 months, depending on smelter construction progress. Production of mined copper at Grasberg increased by 18% to 5,26,000 tonnes in 2018 from 4,46,000 tonnes in 2017, when operations were affected by multiple disruptions related to restrictions on copper concentrate exports. Freeport expected production from the underground portion of the mine to commence in the first half of 2019 and anticipated that mine output would be lower than that in 2018 during the transition from open pit to underground operations in 2019 and 2020.

Panama

A partial strike at the Cobre Panama project began on March 9 and ended on March 26. First Quantum had previously anticipated that the mine (the only copper operation in Panama and the only major worldwide copper project expected to initiate production in 2018) would begin ramping up in the fourth quarter of the year. The project was nearing completion at year-end 2018, with first production expected in early 2019. First Quantum projected that Cobre Panama would produce 3,00,000 tonnes per year of copper in concentrates by 2021.

Peru

In 2018, 4 of the leading 20 copper mines in the world were located in Peru, and mine production of copper was essentially unchanged at 2.44 million tonnes. At the Antamina Mine, copper output rose by 6% (23,600 tonnes) to 4,46,000 tonnes because of increased copper ore grades compared with those in 2017. Higher production at Antamina was offset by reduced output from other leading copper mines in Peru. Owing to lower copper recovery rates, production at the Cerro Verde Mine.

Russia

Refined copper production rose by 8% in 2018 to an estimated 1.03 million tonnes from 9,56,000 tonnes in 2017. PJSCMMC Norilsk Nickel, which owned multiple refineries that accounted for roughly 40% of the refined copper capacity in Russia, reported refined output of 4,26,000 tonnes from its Russian operations, an increase of 47,300 tonnes (13%) from that in 2017.

Zambia

In 2018, output of mined copper increased by 60,000 tonnes (8%) to 8,54,000 tonnes from 7,94,000 tonnes in 2017. Production at some of the leading copper mines in Zambia was as follows: the Kansanshi Mine, Sentnel Mine and Lumwana Mine.The combined output of these three operations was equivalent to 68% of the country's total mined copper in 2018 and rose by 19,200 tonnes compared with production in 2017.

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.

Exports of copper ores & concentrates decreased considerably by 58% to 34,827 tonnes during 2021-22 from 82,463 tonnes in 2020-21. The export were mainly to Philippines (64%) followed by China (28%) and Malaysia (8%). Exports of refined copper increased substantially by 22% to 1,07,980 tonnes in 2021-22 from 88,359 tonnes in 2020-21. Exports of refined copper were mainly to China (89%), Singapore (6%) and Republic of Korea (3%). The total exports of copper & alloys (including brass & bronze) were at 2,46,963 tonnes in 2021-22 as against 2,09,332 tonnes in 2020-21. Export of copper (scrap) were at 18,244 tonnes in 2021-22 as against 7,290 tonnes in 2020-21 (Tables-16 to 32).

Table – 16: Exports of Copper Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**82463**	**7689376**	**34827**	**3964549**
Philippines	--	--	22202	2521496
China	81060	7590259	9815	995831
Malaysia	--	--	2810	447213
Canada	++	++	++	9
Korea, Rep. of	1403	99117	--	--

Figures rounded off

Table – 17: Exports of Refined Copper

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**88359**	**43312924**	**107980**	**75635022**
China	87429	42824386	96377	67360076
Singapore	-	-	6987	5070168
Korea, Rep. of	-	-	2993	2087244
Thailand	45	21291	499	382736
Bangladesh	509	281143	499	355267
UAE	++	66	482	351579
Saudi Arabia	++	542	125	8363
Sri Lanka	++	84	8	6677
UK	++	734	++	2790
Belgium	++	59	4	2120
Other countries	376	184619	6	8002

Figures rounded off

Table – 18: Exports of Copper & Alloys (Including Brass & Bronze) : Total

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**209332**	**102064524**	**246963**	**171342596**
China	138740	57637004	145530	90126841
USA	14536	12160651	20238	21452759
Qatar	2690	1459572	9037	6661402
Singapore	200	147977	7238	5338856
UAE	4664	2680903	6225	4607590
Korea, Rep. of	9679	2185298	12819	4362692
Germany	1885	1608456	3094	3195374
Saudi Arabia	3301	2232114	4170	3185402
UK	2081	1887684	2052	2541122
Canada	1185	988420	1852	1799101
Other countries	30371	19076445	34708	28071457

Figures rounded off

Table – 19: Exports of Copper (Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**7290**	**2977834**	**18244**	**8312550**
China	2252	1172553	13286	5444991
Japan	634	246012	1019	621948
UAE	88	34568	868	569862
Korea, Rep. of	2953	938544	1349	565890
Malaysia	432	223770	643	453625
Spain	555	217431	254	156168
Germany	95	40957	245	142864
Nepal	1	680	152	100944
Australia	--	--	114	71676
Belgium	29	8500	99	56190
Other countries	251	94819	215	128392

Figures rounded off

Table – 20: Exports of Copper & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**139540**	**67619065**	**169736**	**120781592**
China	100047	44731757	105534	72301396
USA	7848	6306411	9127	10082665
Qatar	2501	1309383	8967	6571359
Singapore	89	64000	7101	5196242
Korea, Rep. of	6401	1128242	10933	3527307
UAE	2787	1546711	3367	2592036
Saudi Arabia	1221	817185	2192	1644492
Germany	780	632438	1479	1555948

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Thailand	1445	791623	2219	1555179
UK	945	820074	1081	1216120
Other countries	15476	9471241	17736	14538848

Figures rounded off

Table – 21: Exports of Brass & Bronze

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**61018**	**30956169**	**56963**	**41245793**
China	36171	11652944	26188	12141377
USA	6685	5853235	11110	11369460
Saudi Arabia	2080	1414865	1978	1540880
UAE	1739	1087478	1962	1435409
Germany	933	904192	1219	1432080
Indonesia	1316	914448	1894	1349824
UK	1136	1067610	970	1324518
Canada	516	473011	824	855645
Mexcio	467	354316	996	772973
Italy	528	417890	536	581198
Other countries	9447	6816180	9286	8442429

Figures rounded off

Table – 22: Exports of Brass & Bronze (Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1484**	**511456**	**2020**	**1002659**
Korea, Rep. of	294	98250	507	239937
China	270	79750	522	239077
Spain	189	69627	245	142419
Belgium	-	-	222	142216
Malaysia	504	180003	150	73708
Germany	77	30869	151	64482
Hong Kong	83	32957	95	37709
Turkey	-	-	48	24276
Nepal	1	380	27	11999
Japan	6	2921	20	11431
Other countries	60	16699	33	15405

Figures rounded off

Table – 23: Exports of Copper & Alloys: Worked (Bar, Rod, Plates, etc)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**8547**	**5638560**	**13132**	**11454522**
USA	1541	1286505	2780	2722357
UAE	1549	859494	1792	1373748
Canada	445	314201	753	670805

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Saudi Arabia	213	131814	821	653580
Germany	71	58619	500	493042
Egypt	116	71374	596	490385
Korea, Rep. of	685	385456	703	469447
Thailand	373	216899	552	388171
Oman	353	213009	426	381872
Nepal	211	120316	329	275196
Other countries	2990	1980873	3880	3535919

Figures rounded off

Table – 24: Exports of Copper Mattes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**16307**	**1572663**	**9961**	**1230271**
Korea, Rep. of	5341	574265	7099	873651
China	10721	986780	2680	347980
Thailand	244	11281	182	8523
Nepal	++	14	++	68
Bangladesh	--	--	++	41
Vietnam	--	--	++	4
Germany	++	8	++	2
USA	--	-	++	1
Canada	--	-	++	1
Reunion	--	-	++	++
Other countries	1	315	++	++

Figures rounded off

Table – 25: Exports of Copper & Alloys: Worked, Nes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**14934**	**11103826**	**15749**	**15962044**
USA	6176	4943763	6145	7164224
Germany	461	455155	741	909735
UK	659	623998	719	903957
Saudi Arabia	938	637328	1071	817682
Thailand	771	534777	977	767655
UAE	712	432449	725	576050
Colombia	328	185839	525	330759
Australia	314	223086	232	262655
Italy	195	147233	274	258704
Slovenia	25	24508	267	238785
Other countries	4355	2895690	4073	3731838

Figures rounded off

Table – 26: Exports of Copper Powder & Flakes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**353**	**211413**	**244**	**227005**
Brazil	290	195963	205	192680

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Indonesia	--	--	23	18430
Thailand	10	6154	8	6747
USA	++	444	4	3902
Malaysia	++	298	2	1464
China	++	50	2	1455
Japan	++	427	++	623
Mexico	--	--	++	405
Netherlands	++	83	++	235
Kenya	++	7	++	149
Other countries	53	7987	++	915

Figures rounded off

Table – 27: Exports of Blister & Other Unrefined Copper (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value(₹ '000)
All Countries	**1027**	**491605**	**5169**	**3608670**
China	1027	491605	5169	3608670

Figures rounded off

Table – 28 : Exports of Brass & Bronze : Bronze Powder (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1**	**351**	**81**	**13361**
USA	-	-	80	12788
Nepal	-	-	1	321
Korea, Rep. of	-	-	++	111
Bangladesh	1	220	++	73
Australia	-	-	++	68
Brazil	-	-	++	++
Austria	++	131	-	-

Figures rounded off

Table – 29: Exports of Copper Alloys: Unwrought Excl. Brass & Bronze (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**937**	**391076**	**1798**	**1184227**
China	608	239809	796	552615
Germany	1	988	222	134400
Spain	24	10458	223	122469
Belgium	--	--	155	100291
Sri Lanka	114	58548	141	97732
Korea, Rep. of	--	--	100	58963
Taiwan	75	31144	75	44944

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Italy	26	10797	28	23125
Netherlands	1	852	27	22230
Malaysia	42	18095	19	12795
Other countries	46	20385	12	14663

Figures rounded off

Table – 30 : Exports of Brass & Bronze Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**36524**	**11593935**	**26635**	**12263801**
China	35669	11237540	25581	11605007
Taiwan	275	93528	293	137991
Belgium	25	11797	156	125204
USA	82	38153	134	92143
Netherlands	21	7874	99	65760
Thailand	177	64265	104	57949
Malaysia	9	3804	63	35988
Germany	++	429	37	33314
Nepal	87	32014	60	32655
UAE	24	13864	42	23648
Other countries	155	90667	66	54142

Figures rounded off

Table – 31: Exports of Copper (Cement Copper Precipitated)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**4**	**1066**	**501**	**25047**
China	-	-	501	24882
Nigeria	++	50	++	159
Senegal	--	--	++	6
UAE	--	--	++	++
Korea, Rep. of	4	948	--	--
South Africa	++	39	--	--
Kazakhstan	h	17	--	--
Australia	++	12	--	--

Figures rounded off

Table – 32 : Exports of Copper & Alloys (Excluding Brass & Bronze and Scrap)

(By Items)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All items	**139540**	**67619065**	**169736**	**120781592**
Blister & Other Unrefined Copper	1027	491605	5169	3608670
Copper & Alloys :Workerd				
(Bars, Rods, Plates, etc.)	8547	5638560	13132	11454522
Copper & Alloys :Worked, Nes	14934	11103826	15749	15962044
Copper Alloys: Unwrought Excl. Brass & Bronze	937	391076	1798	1184227
Copper Mattes	16307	1572663	9961	1230271
Copper Powder & Flakes	353	211413	244	227005
Copper Refined Copper Worked	8687	4705513	14936	10928585
Electroplated Anode of Nickel	64	31638	14	13359
Master Alloys of Copper	325	159847	753	537887
Refined Copper	88359	43312924	107980	75635022

Figures rounded off

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 2021-22, imports of copper ores & concentrates increased drastically by 145% to 10,18,934 tonnes as compared to 4,15,136 tonnes in 2020-21. Chile with a share of 37% was the leading supplier followed by Indonesia (20%), Peru (12%), Australia (11%), Panama Republic (9%), Saudi Arabia (4%) and Canada & Brazil (3% each). While imports of refined copper decreased by 11% to 1,38,531 tonnes in 2021-22 from 1,55,038 tonnes in 2020-21. Japan was the leading supplier of refined copper with share of 86% followed by Tanzania (7%) and UAE (3%). Out of the total imports in 2021-22, copper & alloys comprised 5,53,443 tonnes and copper (scrap) 1,16,755 tonnes (Tables - 33 to 42).

Table – 33: Imports of Copper Ores & Concentrates

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**415136**	**59071579**	**1018934**	**223814328**
Chile	245238	29065049	375188	67704766
Indonesia	119609	21391418	205140	46083939
Australia	-	-	111474	41880647
Peru	-	-	120062	25675980
Panama Republic	-	-	91636	17694145
Canada	20386	2969661	30902	9029113
Saudi Arabia	10046	1667131	44551	7472539
Brazil	-	-	30532	6698492
Thailand	-	-	9424	1570009
Congo	--	-	25	2771
Other countries	19857	3978320	++	1927

Figures rounded off

Table – 34: Imports of Refined Copper

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**155038**	**78258449**	**138531**	**89656181**
Japan	127811	64345604	119775	77685170
Tanzania	4736	2451911	9437	6941877
UAE	15051	7771508	4443	1653538
Thailand	1471	700847	1401	976238
South Africa	1147	603482	937	680877
Malaysia	968	439346	831	531060
Austria	174	90478	585	433076
China	41	23676	325	161515
Germany	381	198253	218	159094
Italy	51	23111	177	138006
Other countries	3207	1610233	402	295730

Figures rounded off

Table – 35: Imports of Copper & Alloys (Including Brass & Bronze) : Total

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**744819**	**341717156**	**823597**	**526294673**
Japan	143670	73323543	143168	88832936
Tanzania	58541	30001251	109468	80444953
South Africa	71269	37370877	70512	49947173
UAE	66135	32035807	54511	34262391
Vietnam	36163	20580074	38875	30027109
Germany	34242	11519130	36275	28844276
Thailand	31124	16491527	37109	27775840
Malaysia	26219	13755862	36709	27251204
China	25903	12376742	37603	26674647
Mozambique	13788	6363551	24385	16590163
Other countries	237765	87898792	234982	115643981

Figures rounded off

Table – 36: Imports of Copper & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**496358**	**261483027**	**553443**	**392177470**
Japan	140585	71641305	138963	85728235
Tanzania	58289	29931494	109085	80225352
South Africa	70647	37179074	70354	49889614
Vietnam	36077	20525043	38536	29766283
Thailand	29056	15512568	35385	26663619
Malaysia	20433	11444563	34236	26032953
UAE	51803	26747022	34640	23656691
China	22019	10023048	33266	23339229

Mozambique	13646	6308248	24233	16508584
Korea, Rep. of	6017	3086070	8994	6141032
Other countries	47786	29084592	25751	24225878

Figures rounded off

Table – 37 : Imports of Copper (Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**90604**	**28462247**	**116755**	**53221910**
USA	12540	3452407	24463	9237981
UAE	7388	3194766	11665	7066839
Saudi Arabia	12315	5966405	10874	6972837
Kuwait	6191	2755410	12047	6872186
UK	12402	2329223	12195	4138951
Netherlands	4306	1001698	5770	2052799
Australia	5706	1498850	5287	1862221
Canada	1976	715362	3262	1680028
Germany	8419	1476016	3864	1206824
Kenya	1061	490351	1592	1009048
Other countries	18300	5581759	25736	11122196

Figures rounded off

Table – 38 : Imports of Brass & Bronze

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**19468**	**11486251**	**20218**	**15778525**
China	3847	2339606	4066	3217927
Japan	1650	1232034	3508	2791802
Korea, Rep. of	3693	1828557	3228	2094690
Germany	1290	1083767	1828	1867477
Thailand	1547	759946	1288	890524
Malaysia	3173	1265470	1782	843599
USA	520	432978	613	721401
Indonesia	242	130029	758	524131
Belgium	266	211971	361	397215
Taiwan	442	243415	507	340775
Other countries	2798	1958478	2279	2088984

Figures rounded off

Table – 39 : Imports of Brass & Bronze (Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**138389**	**40285631**	**133181**	**65116768**
Germany	21183	6114950	27531	21806908
UK	12427	3667903	18673	7683915
Saudi Arabia	12329	3670926	10657	4499365
USA	20949	6210740	10411	4151725
UAE	6920	2080389	8148	3479722
Netherlands	8779	2540524	5991	2503463
Belgium	4889	1382706	5664	2309572
Sweden	4866	1296978	3639	1478787
Switzerland	2265	681336	3378	1425476
Denmark	3516	985599	3459	1415889
Other countries	40266	11653580	35630	14361946

Figures rounded off

Table – 40 : Imports of Copper (Cement Copper Precipitated)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**39**	**5489**	**281**	**8758**
Australia	39	5471	39	6734
Beligum	-	-	242	2008
China	++	18	++	16
Germany	++	++	-	-

Figures rounded off

Table – 41 : Imports of Copper & Alloys (Excluding Brass & Bronze and Scrap)

(By Items)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All items	**496358**	**261483027**	**553443**	**392177470**
Blister & Other Unrefined Copper	77702	39937454	103456	75547984
Copper & Alloys :Workered				
(Bars, Rods, Plates, etc.)	83438	44695904	95258	70745986
Copper & Alloys :Worked, Nes	6334	6448830	8175	10441584
Copper Alloys: Unwrought Excl.				
Brass & Bronze	993	587326	748	735160
Copper Mattes	3	1159	0	2090
Copper Powder & Flakes	702	563996	928	961700
Copper Refined Copper Worked	93319	50376605	109628	75271271
Electroplated Anode of Nickel	78724	40534144	96488	68600951
Master Alloys of Copper	105	79160	231	214563
Refined Copper	155038	78258449	138531	89656181

Figures rounded off

Table – 42 : Imports of Copper & Alloys : Worked (Bars, Rods, Plates, etc.)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**83438**	**44695904**	**95258**	**70745986**
Vietnam	35758	20342324	38466	29624570
China	19324	7628556	29732	19109926
Malaysia	11231	6363215	10017	7610444
Thailand	4773	2485366	5839	4519092
Germany	2142	1541451	2010	2092922
Korea, Rep. of	2743	1307888	2528	1574130
Taiwan	2035	751076	2004	1216893
Japan	702	688367	1017	1195602
Hong Kong	1616	921410	1403	1049708
USA	379	642923	359	790683
Other countries	2735	2023328	1883	1962016

Figures rounded off

FUTURE OUTLOOK

HCL during FY 2020-21 had envisaged to enhance the ore production capacity from the current level of 4.24 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.

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. 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 press release, 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 evolving market will have a substantial impact on copper demand. The increase in the electric vehicles in the market will significantly impact the demand for copper. 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.

6. Ferroalloys

5.10
(million tonnes) Total installed capacity of bulk ferroalloys per annum

50,000
(tonnes) Total installed capacity of noble ferroalloys per annum

6,08,617
(tonnes) Imports of ferroalloys in 2021-22

25,37,463
(tonnes) Exports of ferroalloys in 2021-22

Ferroalloys are one of the important inputs in the manufacture of alloys and special steel. They are used as deoxidisers and alloy additives in the steel manufacturing process. They impart special properties to steel. The alloys provide increased resistance to corrosion, improve hardness & tensile strength at high temperature, impart wear and abrasion resistance and increases creep strength etc. The growth of Ferroalloys Industry is, thus, linked with the development of the Iron and Steel Industry, Foundry Industry and to some extent Electrode Industry. The principal ferroalloys have distinctively high additions of one or more other elements, such as chromium, manganese and silicon to that of iron The product series consists mainly of ferromanganese, silicomanganese, ferrosilicon and ferrochrome.

Ferroalloys are classified into two main categories,viz, bulk ferroalloys and noble ferro- alloys. Bulk ferroalloys are majorly used in stainless steel & carbon steel. Most of the noble ferroalloys are made from rare-earth minerals and are expensive to produce as compared to bulk ferroalloys. Owing to high cost of power, Ferroalloys Industry has not been operating to its full capacity in India. Ferroalloys Industry spends 40 to 70% production cost on power consumption. The power consumption per tonne of ferroalloys production in the country varied from 3,000 to 12,000 kWh.

At present, major portion of the ferroalloys prod uced is exported . Ferromanganese, silicomanganese, ferrosilicon, high carbon ferrochrome and charge chrome are exported after meeting the domestic requirements.

INDUSTRY, PRODUCTION, DEVELOPMENT AND CONSUMPTION

As per Indian Ferroalloys Producers' Association (IFAPA), the total installed capacity of bulk Ferroalloys Industry in India is estimated at 5.10 million tonnes per annum and for noble ferroalloys it is 50,000 tonnes per annum. The products covered are Manganese alloys (HC, MC & LC ferrochrome, silicochrome and charge chrome) and Noble ferroalloys (ferromolybdenum, ferrovanadium, ferrotungsten, ferrosilicon magnesium, ferroboron, ferrotitanium etc.). The details are furnished in Table- 1.

Table – 1 : Capacity of Ferroalloys Industry in India

(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 Producers' Association (IFAPA), Mumbai.

The Ferroalloys Industry was established as an ancillary industry to cater to the growing needs of the domestic Steel Industry and is spread all over the country. Most of the ferroalloys units have been set up in Andhra Pradesh, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha and West Bengal because of availability of the raw material as well as uninterrupted electricity supply. Recently, the Industry has further spread to the North-Eastern Region of India. In Meghalaya, a number of small units producing ferrosilicon and ferrosilico- manganese have come up.

The ferroalloy units have incorporated the latest technology in order to use non-metallurgical grade ores, both lumps and fines, after necessary beneficiation and agglomeration. The units have also incorporated an effective pollution control measures in the form of gas cleaning, deoxidising and waste heat recovery.

BULK FERROALLOYS

Bulk ferroalloys consist of principal alloys, viz, ferromanganese, silicomanganese, ferrochrome, charge chrome and ferrosilicon. The production of different kinds of ferroalloys was not received from IFAPA as well as from other sources. However, the data received from JPC for some of the ferroalloys and partial coverages on ferroalloys that have been published in IBM's Monthly Statistics of Mineral Production (MSMP) in its March, 2022 Issue have been reproduced in Table-2. It may be noted that the data coverage in Table-2 is partial and does not reflect the actual production of ferroalloys.

Table – 2 : Production of Ferroalloys, 2019-20 to 2021-22 (P)

(In tonnes)

Ferroalloys	2019-20	2020-21	2021-22
A) Bulk Ferroalloys			
Ferromanganese	NA	NA	NA
Silicomanganese	320593	329295	349414
Ferrosilicon	NA	NA	NA
Ferrochrome	921000	868000	1113000
Chargechrome	NA	NA	NA
B) Noble Ferroalloys			
Ferromolybdenum	527	428	436
Ferrovanadium	665	634	850
Ferrotungsten	NA	NA	NA
Magnesium-ferro-silicon	13930	10220	15081
Ferroaluminium	1461	1119	1139
Ferro-silicon-zirconium	NA	NA	NA
Ferrotitanium	121	249	416
Ferroboron	NA	NA	NA
Ferroniobium	NA	NA	NA

Source: Monthly Statistics of Mineral Production (MSMP), IBM, March, 2022 Issues.

(In tonnes)

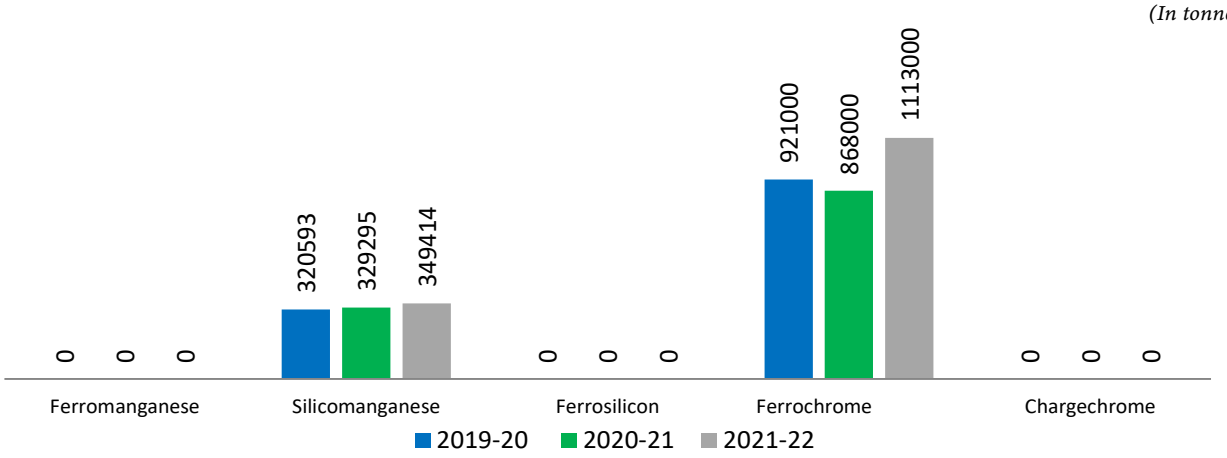


Fig 1: Production of Ferro alloys

Ferromanganese/Silicomanganese

Ferromanganese is produced as high carbon ferromanganese with 72–82% Mn, 6–8% C and 1.5% Si; medium-carbon ferromanganese with 74–82% Mn, 1–3% C and 1.5% Si; and low-carbon ferromanganese with 80–85% Mn, 0.1 to 0.7% C and 1–2% Si. Silicomanganese on the other hand is a combination of 60–70% Mn, 10–20% silica and about 20% carbon. Manganese in the form of ferromanganese is added for hardening and desulphurisation of steel. Nav Bharat Ferro Alloys Ltd, Paloncha, Andhra Pradesh; Chhattisgarh Electricity Co. Ltd, Raipur, Chhattisgarh; Indsil Energy & Electro Chemicals Ltd , Raipur, Chhattisgarh; Ispat Godawari Power & Ispat Ltd (GPIL), Chhattisgarh; Monet Ispat Ltd, Raipur, Chhattisgarh; Union Ferro, Raigarh, Chhattisgarh; Prakash Industries, Raigarh, Chhattisgarh; Tirumala Balaji Alloys Pvt. Ltd, Raigarh, Chhattisgarh; Vandana Global Ltd, Raipur, Chhattisgarh; SAL Steels Ltd, Gandhidham, Gujarat; Anjaneya Ferro Alloys Ltd, Mihijam, Jharkhand; Gautam Ferro Alloys Ltd, Ramgarh, Jharkhand; Shivam Iron & Steel Co. Pvt. Ltd, Giridih, Jharkhand; Sandur Manganese & Iron Ores Ltd, Sandur, Karnataka; Indsil Electrosmelt Ltd, Palakkad, Kerala; Chandrapur Ferro Alloys Plant (formerly Maharashtra Electrosmelt Ltd), Chandrapur, Maharashtra; Nagpur Power Ind. Ltd, Kanhan, Maharashtra; Natural Sugar & Allied Ind. Ltd, Osmanabad, Maharashtra; Adhunik Meghalaya Steels Pvt. Ltd, Bymihat, Meghalaya; Meghalaya Sova Ispat Ltd, Meghalaya; Shyam Century Ltd, Meghalaya; Tata Steel Ltd, Joda, Odisha; Bhaskar Shrachi Alloys Ltd, Durgapur, West Bengal; Cosmic Ferro Alloys Pvt. Ltd, Bankura, West Bengal; Dayal Ferro Alloys Ltd, Ramgarh, West Bengal; Haldia Steels Ltd, Burdwan, West Bengal; Impex Ferro Tech Ltd, Burdwan, West Bengal; Maithan Alloys Ltd, Burdwan, West Bengal; Modern India Con-Cast Ltd, Birhampur, West Bengal; Sharp Ferro Alloys Ltd, Durgapur, West Bengal; Shri Gayatri Minerals Ltd, Bishnupur, West Bengal; Shyam Ferro Alloys Ltd, Burdwan, West Bengal; and Sova Ispat Ltd, Durgapur, West Bengal are the major producers of ferromanganese/silicomanganese.

Silicomanganese, is an alloy that contains 60– 70% manganese, 16–28% silicon and 1.5 to 2.5% carbon. It is more preferred as an effective deoxidising agent than high-carbon ferromanganese in the production of various types of steels. It is also used as feedstock to produce refined alloys like medium and low- carbon ferromanganese. Around 4,750 to 5,250 kWh power is consumed to produce one tonne of silicomanganese. Silicomanganese has emerged as a more important alloy than ferromanganese. The country, over the years, has emerged as a leading producer of silicomanganese. Silicomanganese was also produced by a number of small-scale ferroalloy producers. The estimated consumption of ferromanganese was 50 , 800 tonnes in 2017 - 18 . The production of silicomanganese (including medium-carbon & low- carb on silicomanganese) whic h was a bo ut 3,29,295 tonnes in 2020-21 increased to 3,49,414 tonnes in 2021 - 22 . In 2017 - 18 , the total consumption of silicomanganese by all industries has been estimated at 1,22,600 tonnes.

Ferrochrome/Charge chrome

Ferrochrome when added to steel imparts hardness, strength and augments its stainless characteristics. For every tonnes of stainless steel (depending on the grade), 17–23% of chrome content is required. Hence, if the stainless-steel Industry grows, the Ferrochrome Industry also grows. Carbon content classifies the ferrochrome alloy into high-carbon (6–8%), medium-carbon (3– 4 %) and low- carbon (1 . 5 to 3 %), although chromium content in all the three grades is around 60–70%. Around 2.5 tonnes chrome ore with an estimated power consumption of 4,500 kWh is required to produce one tonne of ferrochrome. Ferrochrome is produced by electric carbothermic reduction of chromite.

FACOR Alloys Ltd, Garividi, Andhra Pradesh; Jindal Steel & Power Ltd, Raigarh, Chhattisgarh; Standard Chrome Ltd, Raigarh, Chhattisgarh; SAL Steel, Kachchh-Bhuj, Gujarat; Balasore Alloys Ltd, Balasore, Odisha; IDCOL Ferro Chrome Plant, Jajpur Road, Odisha; Indian Metals

& Ferro Alloys Ltd, Therubali, Odisha; Jindal Stainless Ltd, Duburi, Odisha; Nava Bharat Ferro Alloys Ltd, Dhenkanal, Odisha; Utkal Manufacturing Services Ltd, Choudhwar, Odisha; Rawat Ferro Alloys, Cuttack, Odisha; Rohit Ferro Tech. Pvt. Ltd, Bishnupur, West Bengal; and Sri Vasavi Ind. Ltd, Bishnupur, West Bengal are the major ferrochrome producers. A sizeable quantity is also produced by units in the small-scale sector.

The total production of ferrochrome/charge chrome in 2020-21 was about 8,68,000 tonnes which increased to 11,13,000 tonnes in 2021-22.

Ferrosilicon

Ferrosilicon contains about 75–90% silicon and minor amounts of iron, carbon, etc. It is produced by using quartzite, iron ore, coke and electrode paste. Around 1.75 to 2 tonnes quartzite are required to produce one tonne of ferrosilicon. A very high consumption of power, i.e., 9,000 to 10,000 kWh is required to produce one tonne of ferrosilicon. It is a powerful deoxidising agent and its major applications are in electrical steel used for transformers and dynamos, alloy steel for tools & automobile valves and in iron casting and mineral dressing. Ferrosilicon is used by the military to quickly produce hydrogen for balloons For this, chemical reaction of sodium hydroxide, ferrosilicon and water is utilised.

Bharat Alloys & Energy Ltd, Kurnool, Andhra Pradesh; VBC Ferro Alloys, Medak, Andhra Pradesh; SMS Smelters Ltd, Lekhi, Arunachal Pradesh; Visvesvaraya Iron & Steel Plant, Bhadravati, Karnataka; Silical Metallurgic Pvt. Ltd, Palakkad, Kerala; Jayantia Alloys, Meghalaya and Indian Metals & Ferro Alloys Ltd, Therubali, Odisha, are the major producers of ferrosilicon. Small-scale producers of ferrosilicon are also in operation in Kerala and Tamil Nadu. In Meghalaya, three units have sprung up that produce ferrosilicon.

The production of ferrosilicon during 2020-21 and 2021-22 is not available.

NOBLE FERROALLOYS

Noble ferroalloys are one of the vital additive inputs required especially in production of alloy and special steel. Noble ferroalloys also refer to alloys used in small quantities and are relatively expensive compared to bulk ferroalloys. These are used in the production of steel as deoxidant and alloying agents.

The high temperature alloysmpart strength, resistance and stability within a temperature range from 260 to 1,200°C. These alloys are used generally in turbine engines, power plants, furnaces and all pollution control equipment .Noble ferroalloys includefer rovanadium, ferrot it anium, ferronickel, ferromolyb denum, ferrotungsten and ferroniobium. In India, noble ferroalloys are mostly manufactured through alumino-thermic process.

Ferronickel

The consumption and production of ferronickel were not reported in the Organised Sector.

Ferromolybdenum

There were five important Units, namely, Mehra Ferroalloys, Electro Ferroalloys Pvt. Ltd, India Thermit Corporation, Bharat Pulverising Mills Ltd and Sunbel Alloys Co. of India Ltd that produced ferromolybdenum. The all India production increased to 436 tonnes in 2021-22 as compared to 428 tonnes in 2020-21.

Ferrotungsten

The consumption and production of ferrotungsten in 2021-22 were not reported in the Organised Sector.

Ferrovanadium

Production of ferrovanadium in 2020-21 was 634 tonnes which increased to 850 tonnes in 2021-22.

Others

Mishra Dhatu Nigam Ltd (MIDHANI) (A Govt. of India Enterprise), Hyderabad, produced chiefly cobalt, molybdenum, titanium and tungsten-based super-alloys.

The production details of various types of Bulk ferroalloys and Noble ferroalloys during the year 2019-20 to 2021-22 are furnished in Table- 2. Information on plantwise capacity of principal ferroalloys in India together with general specifications of products is elucidated in Table-3. Consumption of principal alloys by different industries is furnished in Table- 4.l

Table – 3 : Statewise, Plantwise Capacity and Specifications of Principal Ferroalloys Produced in India

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Andhra Pradesh			
Andhra Ferro-alloys Ltd,	HC ferrochrome	Cr: 60-65% max. Si: 2-4% max.	
Srinivasanagar,		C: 6-8% max. P: 0.040% max.	
Distt Vizianagaram		S: 0.040% max.	
	Silicomanganese	Mn: 60% min.	20,000
		C: 2.5% max. Si: 14% min.	
		P: 0.3 % max. S: 0.035% max.	
FACOR Alloys Ltd,	HC ferromanganese	Mn: 70-80%, C:6-8%,	72,500

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Shreeramnagar, Garividi,		Si: 1-5 % max.	(For all
Distt Vizianagaram		P: 0.35% max.	ferroalloys)
		S: 0.05% max.	
		Size: 25-150 mm +/- 10%,	
		Corresponding ISI specification:	
		IS 1171-2011.	
	HC Ferrochrome	Cr: 60-63%,	90,345
		Si: 3-4%, C: 6-8%,	
		P: 0.03-0.05% (max.),	
		S: 0.03-0.05% (max.)	
	Silicomanganese	Mn: 60-70%, Si: 16-20%,	
		C: 2.0% max.	
		S: 0.03%,	
		P: 0.3 %,	
		Size: 10 - 150 mm +/- 10%,	
		Corresponding ISI specification:	
		IS 1470-1990.	
	Ferrosilicon	Si: 60-80%,	
		C: 0.15% max.	
		P: 0.05%,	
		S: 0.05% max.	
		Al : 1-15% max.	
		Size: 25-150 mm +/- 10%,	
		Corresponding ISI specification:	
		IS 1110-2011.	
	Ferrosilicon-magnesium	Mg: 4-30%,	
		Si: 44-55 %,	
		Al: 1.00%,	
		Ca: 1.0-4.0%,	
	Silico-chrome	NA	
Deccan Ferro Alloys (P) Ltd,	Silicomanganese	NA	30,000
Chintalapalem (PO),			
Pendurthi (SO),			
Vizianagaram			
Jindal Stainless Ltd,	HC ferrochrome	Cr: 62%, Si: 2.5%,	40,000
(Ferro Alloys Division)		C: 7-8%, P: 0.040%,	
Jindal Nagar, Kothavalasa,			
Distt Vizianagaram.			
Sree Sarda Alloys Ltd,	Ferrochrome	NA	6,000
Ravivalsa, Tekkali Mandal,			
Distt Srikakulam.			
Metkore Alloys and Industries Ltd,	H C ferrochrome	NA	25000
Srikakulam.			
Siri Smetters & Energy	Silicomanganese	NA	8,500
Pvt. Ltd, Distt Vizianagaram.			
Maithan Alloys Ltd,	Ferroalloy	NA	1,20,000 (Total)
Visakhapatnam.			
MDA Mineral Dhatu AP Pvt.	Ferro Mn	NA	9,000
Ltd, Distt Vizianagaram.	Silico Mn	NA	11,000
Rhodium Ferro-alloys Pvt. Ltd,	Ferrosilicon	NA	8,000
Gollapuram, Distt Anantapur			

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Ushodaya Electrodes Pvt. Ltd,	Ferromanganese	NA	4
Visakhapatnam			
Srinivasa Ferro Alloys Ltd,	Silicomanganese	NA	26000
Visakhapatnam			
Sri Raghvendra Ferro Alloys	Silicomanganese	NA	18000
Pvt. Ltd, Nalgonda			
Sri Balaji Electro Smelters	Silicomanganese	NA	4650
Ltd, Hyderabad			
Sri Mahalakshmi Smelters	Ferrosilicon	NA	7,200
Pvt. Ltd, Vizianagaram			
Nav Bharat Ventures Ltd,	Silico Mn	NA	125,000
Distt Khammam			
Anjaney Alloys Ltd,	Ferroalloys	NA	120,000
Atchutapuram, Distt			
Visakhapatnam			
M.B. SMELTERS Pvt. Ltd,	MC ferromanganese	NA	7,500
Hindupur, Distt Anantapur	HC ferromanganese	NA	
Chhattisgarh			
(i) Hira Ferro Alloys Ltd,	HC ferromanganese	Mn: 70-75%, Si: 1.50% max.	
Urla, Distt Raipur.		C: 6-8 %, P: 0.30% max.	
		S: 0.05% max.	61,500
	Silicomanganese	Mn: 60-65%, Si: 14-17%,	
		C: 2.0% max. P: 0.35% max.	
		S: 0.05% max.	
ii) Alok Ferro-Alloys Ltd,	Ferroalloys	NA	18,000
Raipur.			
INDSIL Energy &	Silicomanganese	NA	19,200
Electrochemical Ltd,			
Raipur, Chhattisgarh			
Sarda Energy & Minerals Ltd	Ferromanganese	Mn: 70% (min.), Si: 1.5% (max.),	45 MVA (Total)
		C: 6-8%, P: 0.35% (max.), S: 0.050% (max.)	
	Silicomanganese	Mn: 60% (min.), Si: 15-20%,	
		C: 2.50% (max.), P: 0.35% (max.),	
		S: 0.050% (max.)	
Chhattisgarh Electricity Co. Ltd,	HC ferromanganese	Mn: 70-75%,	36,000
Siltara, Raipur.		Si: 1.5-2.0%,	
		C: 6.0-8.0%,	
		P: 0.35-0.40%,	
		S: 0.05% (max.)	
	Silicomanganese	Mn: 60-65% ,	NA
		Si: 15-20%, C: 2.0-2.5%,	
		P : 0.3-0.35 %, S: 0.05% (max.)	
Nav-chrome Ltd,	HC ferromanganese	NA	21,560
Urla Industrial Area,	Silicomanganese	NA	
Distt Raipur.	HC ferrochrome	NA	14,700
Deepak Ferro Alloys Ltd	Ferromanganese		5,000
VA Power & Steel	Ferrosilicon	NA	8,100
Pvt. Ltd, Distt Raigarh	Silicomanganese	NA	14,400
Orion Ferro alloys, Gharghoda,	Silicomanganese	NA	8,000
Raigarh	Silico-slag (as by-product)	NA	12,000

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Vandana Global Ltd, Raipur	Silicomanganese	NA	36,000
Jindal Steel & Power Ltd,	HC Ferrochrome	Cr: 60-66%,	36,000
Kharsia, Distt Raigarh.		C: 6 to 8%,	
		Si: 4% (max.),	
		P: 0.050% (max.),	
		S: 0.050% (max.),	
	Silicomanganese	Mn: 60%, Si: 15%, P: 0.3% max.	
Sai Chemical Pvt. Ltd,	Silicomanganese	NA	10,200
Tadesara, Distt Rajnandgaon			
MSP Sponge Iron Ltd,	Silicomanganese	NA	42057
Manuapali, Jamgaon,			
Raigarh (Chhattisgarh)			
Goa			
Karthik Alloys Ltd,	HC Silicomanganese	Mn: 60-65%	25,500
Cuncolim, Distt South Goa.		SiO_2:14-15% (min.)	
		C:2.5-0.20% (max.)	
		P:0.03-0.2% (max.)	
		S:0.05% (max.)	
Gujarat			
Essel Mining & Industries Ltd,	Ferrovanadium	V: 50%, C: 0.1% (max.),	400
Vapi, Distt Valsad.		S and P: 0.05% each,	
		Al: 1.5%	
	Ferromolybdenum	Mo: 60%, C: 0.1%,	1,200
		S: 0.08%, P: 0.06%,	
		Al: 0.5%	
	Ferrotitanium	NA	600
Electro Ferro-Alloys (Pvt.) Ltd,	Ferromolybdenum	NA	300
Ahmedabad, Gujarat.	Ferro-silico-zirconium		
Baroda Ferro-Alloys,	HC ferrochrome	NA	3500
Distt Panchmahals.			
Sal Steel Ltd,	Silicomangenese	NA	61890
Gandhidham, Distt Kachchh			
Sahjanand Ferro Alloys,	NA	NA	3,000
Distt Vadodara.			
Haryana			
Haryana Ferro-Alloys Ltd,	–	–	2,500
Gohana Road, Distt Rohtak.			
Jammu and Kashmir			
Shree Sitaram Industries Pvt. Ltd,	Ferrochrome	NA	3,325
Phase II, SIDCO Complex,			
Bari Brahmana.			
Jharkhand			
Anjaneya Ferro Alloys Ltd,	Ferroalloys	NA	41,850
Mihijam,			
Distt Jamtara			
Bihar Foundry & Casting Ltd	Silicomanganese	Si: 14%, Mn : 60%	34,000
(Unit Gautam Ferro Alloys)			
Bihar Foundry & Casting Ltd	Silicomanganese	Si: 14%, Mn : 60%	34,000
(Unit Gautam Ferro Alloys)			
Castron Technologies Ltd,	Ferromanganese	NA	14,400
Bokaro Industrial Area,	Silicomanganese	NA	

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Shivam Iron & Steel Co. Ltd,	Ferromanganese	NA	37,400
Ferro Alloys Division, Jambad,	Silicomanganese		
Udnabad, Giridih			
Dayal Ferro Alloys,	Silicomanganese	NA	10,000
Ramgarh Cantt., Hazaribagh			
Jamshedpur Mineral & Chemicals,	Ferromanganese	NA	4,800
Distt Saraikela-Kharaswan.			
Karnataka			
Sandur Manganese & Iron ores Ltd,	HC ferromanganese	NA	29,100
Vyasanakere, Distt Ballari	Silicomanganese		36,000
	Ferrosilicon		24,000
Dandeli Steel & Ferro Alloys Ltd,	Ferromanganese	Mn: 70-75%, C: 0.1%,	6,000
Dandeli, Distt Uttara Kannada.		Si: 2.4%, P : 0.15%,	
		S: 0.05%, Size: 37 mm	
	MC ferromanganese	Mn: 70-75%, C: 1.5%, P: 0.25%,	
		Si: 2%, S: 0.05%	
S.R. Chemicals & Ferro-Alloys,	LC Ferromanganese	Mn: 70%,	25
KIADB Honaga,		C: 0.1%,	
Distt Belagavi.		P: 0.12%	
Thermit Alloys (Pvt.) Ltd,	Ferromanganese	NA	
N-7, Industrial Estate,	Silicomanganese	NA	
Distt Shivamogga	Ferrochrome	NA	1,200
	Ferrosilicon	NA	
	Silicochrome	NA	
Padmavati Ferrous Ltd,	Ferromanganese	Mn: 24 to 48%	5,000
Distt Ballari	Silicomanganese	Fe:4 to 30%	5,000
	Ferrosilicon		2,000
Kerala			
The Silical Metallurgic Ltd,	Silicomanganese	Mn: 70-75%	3,600
Wayalur, Distt Palakkad.			
INDSIL Electrosmelts Ltd,	Silicomanganese	NA	NA
Pallatheri, Distt Palakkad.	Ferrosilicon	NA	NA
INDSIL Hydro Power &	Silicomanganese	Mn: 55% (min.),	14,400
Manganese Ltd,		Si: 23-27%,	
Distt Palakkad, Kerala		C: 0.1 % (max.)/0.2%	
		(max.)/0.5% (max.),	
		S: 0.02% (max.),	
		P: 0.15% (max.)	
Shri Laxmi Electro	Ferrosilicon	NA	NA
Smelters (Pvt.) Ltd,			
Industrial Development Area			
Erumathala, P.O. Aluva- 683 105.			
Madhya Pradesh			
MOIL Ltd,	HC ferromanganese	Mn:78±1%,	10,000
(formerly Manganese Ore India Ltd)		P: 0.35% (max.),	
Ferro-manganese Plant,		C: 6.8%	
Bharweli (Manjhara), Distt Balaghat.			
Jalan Ispat Castings Ltd,	Silicomanganese	Mn: 60-65%, Si: 15-20%,	12,000
Industrial Area,		C: 2% (max.), P: 0.35%	
Meghnagar, Distt Jhabua.			
Crescent Alloys Pvt. Ltd,	Ferrosilicon	N.A.	4,500

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Seoni.	Ferromanganese	N.A.	(Total)
S.R Ferro Alloys, Jhabua	Silicomanganese	NA	8,639
Maharashtra			
Chandrapur Ferro Alloy	HC ferromanganese	Mn: 70-74 % and 74-78% ,	1,90,000
Plant (Erstwhile Maharashtra		Si: 1.5% (max.),	
Electrosmelt Ltd),		C: 6.8%, P: 0.43%. (max.)	
Distt Chandrapur- 442 401.			
	MC ferromanganese	Mn : 70-74% and 74-78% ,	1,800
		Si: 2% max.,	
		C: 1 - 3% , P: 0.4% max.	
	LC ferromanganese	Mn: 70-74% and 74-78% ,	NA
		Si: 2% (max.), C: 1.5% max.,	
		P: 0.4% max.	
	Silicomanganese	Mn: 60-65% and 65% min.,	1,30,000
		Si: 15-20%, C: 2 % max.,	
		P: 0.35% max.	
Nagpur Power & Industries Ltd,	Silicomanganese	Mn: 60-65%, P: 0.35%	NA
P.O. Khandelwal Nagar,	HC ferromanganese	Mn: 70-75%, P: 0.4%	NA
Distt Nagpur.			
Bharat Pulverising Mills Ltd,	Ferromolybdenum	NA	200
Andheri, Mumbai.	Ferrotungsten	NA	(Total)
	Ferrovanadium	NA	
Sunbel Alloys Co. of India Ltd,	Ferromolybdenum	NA	300
Thane-Belapur, Mumbai.	Ferrosilicon	NA	(Total)
	Ferrotungsten	NA	
	Ferrovanadium	NA	
Natural Sugar and Allied	HC Ferromanganese	Mn: 70-75%,	16,500
Ind. Ltd,		Si: 2-2.5%,	
Sainagar, Ranjani,		P: 0.4%,	
Distt Osmanabad.		C: 6-8%	
	Silicomanganese	Mn: 60-65%,	16,500
		Si: 13-15%,	
		P: 0.3%, C: 2-2.5%	
Mahavir Ferro Alloys,	Ferroalloys	NA	100
Paonakhari, Distt Bhandara			
Minex Metallurgical	Ferrotitanium	NA	250
Co. Ltd, Distt Nagpur			
Meghalaya			
Maithan Alloys Ltd,	Ferromanganese	NA	28,000
Distt Rio Bhoi.			
Odisha			
Ferro Alloys Corporation Ltd,	HC ferrochrome/	Cr: 60-64%, Si: 3-4%,	75,000
(Ferro Chrome Plant Randia),	Chargechrome	C: 6-8%, P: 0.03-0.05% (max.),	
D.P. Nagar, Randia, Distt Bhadrak.		S: 0.03-0.05% (max.)	
Tata Steel Ltd, Ferro Manganese	HC ferromanganese	Mn: + 70%, C: 6-8 %,	50,400
Plant, Joda,		Si :0.3-2%, P: 0.2-0.4%,	-
Distt Keonjhar	Silicomanganese	Mn: 46-48%,	65,000
Tata Steel Ltd,	Ferrochrome	NA	65,000
(Charge-chrome Plant),	Chargechrome	Cr: 60% (min.), Si: 4% (max.) ,	55,000
Bamnipal, Distt Keonjhar.		C: 8% (max.), P: 0.03% (max.),	
		S: 0.03% (max.)	

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
	Ferromanganese	Mn: 46 to 49%	50,400
Balasore Alloys Ltd,	HC ferrochrome	Cr: 60-63%, Si: 3.5% (max.) Grade I	1,50,000
Balgopalpur, Distt Balasore.		C: 8.0% (max.), Cr: 57-60%	
(Formerly Ispat Alloys Ltd)		S: 4.0% (max.) Grade II, C: 8.0% (max.)	
Jeypore Sugar Co. Ltd,	HC ferrochrome	Cr: 60-65%,	22,000
(Ferro-manganese Plant)		P: 0.055%,	
Distt Rayagada.		C: 2%,	
		S: 0.05%,	
		Si: 4%,	
		Fe: Balance	
	Silicomanganese	Mn: 60-65%,	22,000
		Si: 15-18%,	
		C: 2% max.	
J.B. Ferro Alloys, At Tanto,	LC ferromanganese	NA	200
P.O. Bhadrashahi, Keonjhar.			
IDCOL Ferro Chrome & Alloys Ltd,	HC ferrochrome	Cr: 62-65%,	18,000
Jajpur Road, Distt Jajpur.		Si: 1.5 to 8%,	
		C: 8% (max.)	
Indian Metals & Ferro Alloys Ltd,	HC ferrochrome/	Cr: 60%	62,500
(IMFA)	Chargechrome		
Indian Metals & Ferro Alloys Ltd,	Ferrosilicon	Si: 70-75%,	61,000
(IMFA), Therubali, Distt Rayagada.	HC ferrochrome	Cr: 60%	1,16,400
Superb-Metal Alloys (Pvt.) Ltd,	Ferrocolumbium	NA	300
Rairangpur, Distt Sundergarh.	Ferromolybdenum		(Total)
	Ferrotungsten		
	Ferrovanadium		
Jabamayee Ferro Alloys Ltd,	HC Ferrochrome	NA	15,660
Sukinda, Distt Jajpur			
M M Minerals & Alloys Pvt. Ltd,	HC Ferrochrome	NA	25,000
Jamirdiha, Distt Mayurbhanj.			
T S Alloys Ltd, Anantapur, Cuttack.	Ferrochrome	NA	59,400
Stork Ferro and Mineral	Silicomanganese	NA	25,000
Industries Pvt. Ltd,	Ferromanganese	NA	29,700
Somnathpur, Distt Balasore	Ferrochrome	NA	25,000
Aarti Steel Ltd,	Ferrochrome	NA	25,000
Ghantikhal, Distt Cuttack.			
Kalinga Ferro Ispat Pvt. Ltd,	HC Ferrochrome	NA	8052
Mandia, Distt Jajpur			
Puducherry			
The Silical Metallurgic Ltd	Ferrosilicon	–	10,560
	Ferro-silicon-magnesium	–	1,800
VSK Ferro Alloys Ltd,	Ferrosilicon	Si: 72.3%, C: 0.15%,	3,000
Thuthipet.		S: 0.051%, Mn: 0.55%,	
		P: 0.042%, Fe: 26.13%	
Snam Alloys (Pvt.) Ltd,	Ferrosilicon	NA	12,000
Kariamanikam,	Ferro-silicon-magnesium		
Distt, Puducherry.	Ferrochrome	Si: 14.56%, P: 0.197%	
Tata Steel Alloys Ltd,	Ferrochrome		50,000

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Ferro Alloy Plant,			
Cuttack.			
Punjab			
Mehra Ferro-Alloys,	Ferromolybdenum	NA	300
Verka, Amritsar.	Ferrovanadium		(Total)
	Ferrotitanium		
	Ferrotungsten		
	Ferroboron		
Sikkim			
Akshay Ispat & Ferro Alloys Ltd,	Ferrosilicon	NA	6,000
Mamring, Namchi,			
Distt South Sikkim.			
Telangana			
VBC Ferro Alloys Ltd,	Ferrosilicon	–	10,000
Village Rudraram,	Ferrochrome		27,000
Patancheru Mandal	Silicomanganese/	–	31,500
Distt Medak.	Ferromanganese		
Shree Raghvendra Ferro Alloys	Silicomanganese	NA	15000
Pvt. Ltd, Nalgonda			
Nava Bharat Ventures Limited,	HC Silicomanganese	NA	1,25,000
Paloncha, Distt Khammam,	HC ferromanganese		
Uttar Pradesh			
The India Thermit Corp. Ltd,	Ferromolybdenum	NA	300
Fazalganj, Distt Kanpur.	Ferrotitanium		(Total)
	Ferrochrome		
	Ferroboron		
	Chromium metal		
	LC ferromanganese		
	Ferrovanadium		
Hindustan Ferro-Alloys,	Ferrosilicon	NA	3,200
Hamirpur.			
West Bengal			
Bhaskar Shrachi Alloys Ltd,	Silicomanganese	Si: 15%	24,000
Durgapur			
Cosmic Ferro Tech. Ltd,	HC ferromanganese	Mn: 66-71%, Si: 1.4%	45,375
Bishnupur,		C: 6.5-7%, P: 0.3%	
Distt Bankura.			
	Silicomanganese	Mn: 61-65%, Si: 15.5%	
		C: 1.9%, P: 0.28%	
Sri Gayatri Minerals Pvt. Ltd,	HC silicomanganese	Mn: 60-65% & 65% min.,	24,000
WBIIDC Growth Centre,		Si: 15% min. & 16% min.,	
Bishnupur, Bankura.		C: 2% max.,	
		P: 0.3% max., S: 0.03% max.	
Industrial Metals & Ferro Alloys,	LC ferrotitanium	NA	20
Jamuria, Burdwan.	LC ferrochrome	NA	20

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Hira Concast Ltd, Salanpur,	Silicomanganese	NA	11,455
Burdwan.	Ferromanganese	NA	15,225
Karthik Alloys Ltd (I & II),	MC silicomanganese	Mn: 54-56%, C: 0.2-0.5% Si: 22-25%	19,000
Durgapur.		P: 0.15-0.2%, S: 0.05%	
	LC silicomanganese	Mn: 53-55%, C: 0.15-0.2% Si: 25-28%	NA
		P: 0.15-0.2%, S: 0.05%	
Maithan Alloys Ltd,	Ferromanganese	NA	94,600
Burdwan.	Silicomanganese		(Total)
	Ferrochrome		
Monnet Ferro Alloys Ltd,	Silicomanganese	NA	12,500
Burdwan.			
Shyam Ferro Alloys Ltd,	HC silicomanganese	NA	1,04,957
Palitpur Road, Burdwan,	HC ferromanganese		(Total)
Dewandighi (Katwa Road)	HC ferrochrome		
Srinivasa Ferro Alloys Ltd,	HC ferromanganese	Mn: 70-74%, 74-76%	10,800
Durgapur, Burdwan.		Si: 1.5% max., C: 6-8%,, P: 0.25%,	
		0.30% and 0.40% max., S: 0.03% max.	
	HC silicomanganese	Mn: 60-65% & 65% min.	23,400
		Si: 15% min. & 16% min.	
		C: 2% max., P: 0.3% max., S: 0.03% max.	
	LC silicomanganese	NA	5,400
Shri Vasavi Industries Ltd,	HC ferrochrome	Cr: 58-60%, Si: 2-4%,	45,000
WBIIDC Industrial Growth Centre,		C: 8% max., P: 0.05% max.	(16MVA 1No. &
Bishnupur, Distt Bankura.		S: 0.05% max.	12MVA 1 No.)
Modern India Con-Cast Ltd,	Bulk ferroalloys	–	22,000
WBIIDC Industrial Growth Centre,			
Bishnupur, Distt Bankura.			
Rohit Ferro Tech. Ltd,	HC ferrochrome	Cr: 60% (min.), C: 8% (max.)	45,375
Bishnupur, Distt Bankura		Si: 3.5% (max.), P: 0.03% (max.)	
		S: 0.04% (max.)	
Sharp Ferro Alloys, Durgapur	HC silicomanganese	NA	42,500
Nilkantha Ferro Ltd, Bankura	HC silicomanganese	NA	39,960
	Silicomanganese Slag	NA	40,200
Lalwani Ferro Alloysa Ltd,	Silicomanganese	NA	48,780
Kolkata	HC ferromangenese	NA	69,285
Ispat Damodar Pvt. Ltd,	Ferroalloys	NA	40,000
(Sponge Iron Plant),			
Nabagram, PS-Neturia,			
Digha, Purulia.			
Sonic Thermal Pvt. Ltd,	Silicomanganese	NA	39,500
(Ferro Alloys Plant),			
Namobandh, Sitarampur,			
Bankura.			
Shree Ambry Ispat	Ferromanganese	NA	22,600
Pvt. Ltd, Basdebpur,	Silicomanganese	NA	17,400
Distt Bankura.	Ferrosilicon	NA	7,600

Note: HC : High carbon. MC: Medium carbon. LC: Low carbon

Source: Information collected by IBM

Table – 4 : Consumption* of Principal Ferroalloys, 2017-18 (P)

(In tonnes)

	Consumption
Ferrochrome	14600
Ferromanganese	50800
Ferrosilicon	23400
Silicomanganese	122600

*Note: 1) *Includes actual reported consumption and/or estimates made wherever required; Due to paucity of data, hence consumption figures may not be complete*

(In tonnes)

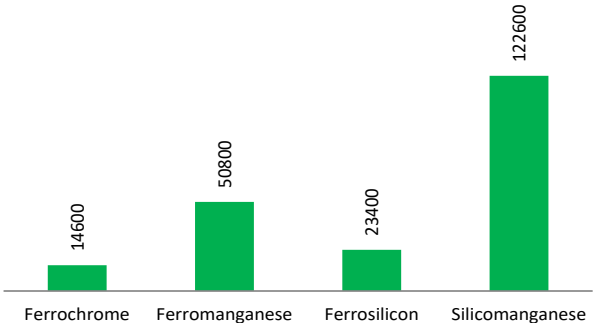


Fig 2: Consumption of Principal Ferro Alloys 2017-18

ENVIRONMENT

Studies reveal that depending on the ferroalloy manufactured, waste generation per day in 35 tpd and 50 tpd ferrosilicon and ferrochrome plants may be in the following range:
Silica fines: 7 to 8 tonnes/day
Fe-Cr slag (fined boulder): 40 tonnes/day
Charcoal & coke fines: 7 to 8 tonnes/day

Waste from ferroalloys industries could be effectively utilised— a typical Fe-Si or Fe-Cr manufacturing unit can provide material for 10 small- scale units for manufacturing bricks and each unit can produce 2,400 bricks per day. Other units which can be set up are board-and-briquette-making units. The utilisation of waste materials for converting them into building materials will result in bringing down the building material cost, and therefore, lead to conservation of natural resources like clay and sand Domestic vanadium sludge is used for producing ferrovanadium by Essel Mining & Industries Ltd, Gujarat.

The implementation of the Kyoto Protocol by the European Union provides significant opportunities for Ferroalloys Industry in India to implement CO_2 reduction technologies, which could be traded in terms of carbon credits. Installation of an electricity generation facility driven by CO-rich furnace gas is an obvious means by which CO_2 saving could be achieved.

WORLD REVIEW

The major ferroalloys producing countries were China, South Africa, India, Russia and Kazakhstan. The production of ferroalloys in China during 2021 was 36,000 thousand tonnes, while production of ferroalloys in South Africa during 2021 was 3,478 thousand tonnes. Kazakhstan reported production of 1,704 thousand tonnes of ferrochrome during 2021. The markets for the bulk alloys like high- carbon ferromanganese, silicomanganese, ferrosilicon and high-carbon ferrochrome showed varied responses to the fluctuations in steel and stainless steel production which seem to have influence as per the different circumstances that prevailed in different markets.

World production of various ferroalloys in principal producing countries is furnished in Table- 5.

Table – 5 : World Production of Ferroalloys, 2019 to 2021

(By Principal Countries)

(In tonnes)

Country	Ferroalloys	2019	2020	2021
Albania	Ferrochrome	66402	53543	103700
Armenia	Ferromolybdenum	7712	6718	8335
Austria	Ferromolybdenum	4000	3000	3000
	Ferronickel	2500	2500	2500
	Ferrovanadium	7000	7000	7000
Bosnia & Herzegovina	Ferroalloys	31911	14641	35920
Czech Republic	Ferrovanadium	6700	5600	6900
Finland	Ferrochrome	505000	498000	515000
France	Ferromanganese	115000	68000	68000
	Ferro-ilico-manganese	68000	62000	62000
	Ferrosilicon	48000	41000	41000
	Silicon metal	105000	87000	87000
Georgia	Ferromanganese	4500	4500	4500

Country	Ferroalloys	2019	2020	2021
	Ferro-silicon-manganese	291608	217463	322877
Germany	Ferrochrome	26000	11000	12000
	Silicon metal	29606	30234	31318
	Other ferroalloys	8200	8000	8000
Greece	Ferronickel	62251	30518	19394
Iceland	Ferrosilicon	120255	128187	123800
Italy	Ferro-silico-manganese	90000	90000	90000
Kosovo	Ferronickel	7200	7000	5000
North Macedonia	Ferronickel	15202	17747	17714
	Ferro-silicon	117	-	-
Norway	Ferromanganese	330000	330000	330000
	Ferro-silico-manganese	290000	260000	310000
	Ferrosilicon	200000	260000	240000
	Silicon metal	200000	210000	200000
Poland				
	Ferromanganese	-	-	-
	Ferrosilicon	65523	61709	73370
	Other ferroalloys	16815	38104	31170
Russia	Spiegeleisen	7000	7000	7000
	Ferrochrome	384089	390000	390000
	Ferro-silicon-chrome	4200	4200	4200
	Ferromanganese	273000	240000	240000
	Ferro-silico-manganese	51774	50000	50000
	Ferromolybdenum	4700	4700	4700
	Ferronickel	20000	20000	20000
	Ferrosilicon	846579	830000	830000
	Ferrovanadium	10894	12000	12000
	Silicon metal	48000	48000	48000
	Other ferroalloys	34000	34000	34000
Slovakia				
	Ferromanganese	26200	24000	30900
	Ferro-silico-manganese	49900	33800	48600
	Ferrosilicon	29400	29600	34700
	Other ferroalloys	2100	1200	1500
Spain				
	Ferromanganese	55500	28000	25000
	Ferro-silico-manganese	98400	83000	83000
	Ferrosilicon	90000	77000	83000
	Silicon metal	7500	5000	5800
Sweden				
	Ferrochrome	120000	120000	120000
Turkey				
	Ferrochrome	81743	94200	100750
	Ferrosilicon	7500	5000	5800
Ukraine				
	Ferromanganese	172508	117215	117000
	Ferro-silico-manganese	858708	850000	850000
	Ferronickel	79334	73700	74000
	Ferrosilicon	97000	97000	97000
	Other ferroalloys	100000	100000	100000

Country	Ferroalloys	2019	2020	2021
Egypt [b]				
	Ferrosilicon	60500	60000	60000
	Other ferroalloys	20000	20000	20000
Gabon				
	Ferro-silico-manganese	43000	37000	22000
South Africa				
	Ferroalloys	3806766	2984105	3478867
Zimbabwe				
	Ferrochrome	308593	134000	306847
Canada				
	Ferroniobium	6600	6200	7400
	Ferrosilicon	37000	34000	30000
	Ferrovanadium	1200	1300	1100
	Silicon metal	34000	25000	30000
Dominican Republic				
	Ferronickel	78662	59211	75887
Mexico				
	Ferromanganese	72937	57127	71637
	Ferro-silico-manganese	154209	147784	170929
USA				
	Ferrosilicon & Silicon metal	310000	277000	411000
Argentina				
	Ferro-silico-manganese	-	-	-
	Ferrosilicon	13000	11200	13000
Brazil				
	Ferrochrome [c]	136780	254346	300000
	Ferro-silico-manganese	20000	20000	20000
	Ferromanganese	151000	73000	71000
	Ferronickel [d]	45543	46000	41700
	Ferroniobium	60000	60000	60000
	Ferrosilicon	100000	100000	100000
	Silicon metal	214051	203940	200000
	Other ferroalloys	40000	40000	40000
Chile				
	Ferromolybdenum	14500	14500	14500
Colombia				
	Ferronickel	116000	103000	109000
Venezuela				
	Ferromanganese	6000	6000	6000
	Ferro-silico-manganese	7000	7000	7000
	Ferronickel	25000	25000	25000
	Ferrosilicon	40000	40000	40000
Bhutan				
	Ferrosilicon	138900	103500	130400
China				
	Ferroalloys	36577000	36000000	36000000
	Silicon metal	2400000	2400000	2400000
India [e]				
	Aluminium	1461	1119	1100
	Ferrochrome	921000	868000	855300

Country	Ferroalloys	2019	2020	2021
	Ferromagnesium	14173	9700	9700
	Ferromanganese	-	-	-
	Ferro-silico-manganese	320594	329295	328000
	Ferromolybdenum	527	428	430
	Ferrosilicon	-	-	-
	Ferrotitanium	121	249	210
	Ferrovanadium	665	634	610
Indonesia				
	Ferro-silico-manganese	4000	4000	13000
	Ferronickel	128565	129850	129090
Iran [f]				
	Ferrochrome	8000	8000	8000
	Ferrosilicon	70000	60000	60000
Japan				
	Ferromanganese	462740	400331	440173
	Ferronickel	337790	234505	243275
	Other ferroalloys	74015	49544	54275
Kazakhstan				
	Ferrochrome	1858130	1841309	1704561
	Ferro-silico-chrome	110500	110500	110500
	Ferro-silico-manganese	123528	122743	132119
	Ferrosilicon	79930	180645	180000
Korea, Rep. of				
	Ferro-magnesium	355000	355000	355000
	Ferro-silico-manganese	196000	196000	196000
	Other ferroalloys	4200	4200	4200
Korea, Dem. P.R. of				
	Ferroalloys	46000	15300	37000
Myanmar				
	Ferronickel [e]	54247	76347	52970
Australia				
	Ferromanganese & Ferro-silico-manganese [b]	257000	270000	270000
	Silicon metal	52000	45000	45000
New Caledonia				
	Ferronickel	247746	236421	205108

Source: BGS, World Mineral Production, 2017-2021 BGS

Note: FeAl : Ferroaluminium; FeCr : Ferrochrome; FeSiCr : Ferro-silico-chrome; FeSiMg : Ferro-silico-magnesium; FeMn : Ferromanganese; FeSiMn : Ferro-silico-manganese; FeMo : Ferromolybdenum; FeNi : Ferronickel; FeNb : Ferroniobium; FeSi : Ferrosilicon; FeTi : Ferrotitanium; FeV : Ferrovanadium

(e) Estimate
(b) Years ended 31st March following that stated
(d) Including ferro-silico-chrome
(f) Including ferro-silico-manganese
(g) Years ended 30th June of that stated
(x) Sales
(y) Nickel Content

FOREIGN TRADE

Exports

In 2021-22, exports of ferroalloys (total) increased by 38% to 25,37,463 tonnes in 2021-22 from 18,43,322 tonnes in the previous year. In terms of value, ferroalloys exports also increased to ₹ 27,124 crore in 2021-22 from ₹ 12,773 crore in 2020-21.

Out of total export, in terms of quantity, majority were exports of followed by ferrosilico manganese (44%), ferro chrome (29%) ferromanganese (25%) and ferrosilicon (1%). The other ferroalloys together accounted for the remaining 1% of exports in 2021-22. Exports were mainly to China (12%), UAE, Japan & Italy (9% each) and Republic of Korea & Taiwan (7%) (Tables-6 to 25).

Table – 6 : Exports of Ferroalloys : Total

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1843322**	**127735114**	**2537463**	**271246477**
China	365306	25279096	316403	33180156
UAE	210748z	15800630	231856	30019225
Japan	144689	10340378	215738	23037081
Italy	119785	7649075	225401	21888415
Korea, Rep. of	175560	12094753	186591	19338068
Taiwan	133816	8647484	185523	18016330
Egypt	65616	4396277	122188	13134786
Indonesia	59316	4451852	123611	12587112
Turkey	48615	3311803	87978	9884723
Netherlands	37523	2479126	82551	8900787
Other countries	482348	33284640	759623	81259794

Figures rounded off

Table – 7 : Exports of Ferroboron

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**39**	**9728**	**33**	**11024**
South Africa	31	7527	27	8917
Turkey	2	573	3	977
U A E	-	-	2	470
Brazil	1	303	1	362
Malaysia	++	73	++	188
Thailand	-	-	++	88
Nepal	-	-	++	21
Colombia	-	-	++	1
Ukraine	2	524	-	-
Oman	2	381	-	-
Other countries	1	347	-	-

Figures rounded off

Table – 8 : Exports of Ferrochrome

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**720539**	**49939983**	**753389**	**76899138**
China	362570	24871853	299949	31187711
Korea, Rep. of	160428	11043385	148501	15076551
Indonesia	45272	3456230	104161	10205766
Taiwan	49667	3334406	77539	7302786
Japan	35780	2639979	67382	7237905
Thailand	13532	1049023	11880	1285703
Netherlands	7601	364171	12594	808110
Italy	11882	814645	6978	762353
Mexico	6533	434927	5124	563457
U A E	970	101434	1886	371871
Other countries	26304	1829930	17395	2096925

Figures rounded off

Table – 9 : Exports of Ferromanganese

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**335229**	**23997006**	**638850**	**74044066**
UAE	105006	8680752	122816	19104032
Italy	25342	1691665	73251	7647223
USA	16110	1183401	56152	5708010
Netherlands	16932	1185968	44150	5288306
Egypt	13001	823569	41460	4738817
Brazil	16958	1165667	39313	4143453
Turkey	12826	822519	36375	4093503
Taiwan	19999	1207025	36525	3491361
Korea, Rep . of	7242	443380	28843	3072007
Vietnam	12639	768150	23395	2599718
Other countries	89174	6024910	136570	14157636

Figures rounded off

Table – 10 : Exports of Ferromolybdenum

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**279**	**324540**	**324**	**529440**
Oman	220	240963	242	369881
UAE	4	5669	41	56260
Peru	1	2063	14	44320
Thailand	6	6459	10	18748
Indonesia	3	5515	6	14080
Brazil	++	833	4	12037
Saudi Arabia	4	4029	1	2939

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
South Africa	25	34174	2	2629
Chile	-	-	1	1975
Malaysia	++	605	1	1513
Other countries	16	24230	2	5058

Figures rounded off

Table – 11 : Exports of Ferronickel

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**77**	**65052**	**1**	**2822**
China	76	63882	1	1222
Kyrgyzstan	1	1170	++	854
Bahrain Is	-	-	++	737
Malaysia	-	-	++	8
U A E	-	-	++	1

Figures rounded off

Table – 12 : Exports of Ferroniobium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**14**	**25114**	**25**	**69528**
Malaysia	++	640	9	22061
Peru	-	-	7	20981
South Africa	-	-	4	10739
China	-	-	3	8614
UAE	14	23884	2	3863
Indonesia	-	-	++	1351
Thailand	-	-	++	895
Saudi Arabia	-	-	++	492
France	++	36	++	268
U K	-	-	++	138
Other Countries	++	554	++	126

Figures rounded off

Table – 13 : Exports of Ferro-phosphorus

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**77**	**11038**	**156**	**16804**
Sweden	76	10909	74	11205
Canada	-	-	55	3609
Oman	-	-	24	1760
Saudi Arabia	1	129	3	223
Italy	-	-	++	7

Figures rounded off

Table – 14: Exports of Ferro-silico-chrome

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**32**	**12095**	**20**	**8932**
Netherlands	-	-	20	8417
U A E	-	-	++	285
U S A	-	-	++	115
Canada	-	-	++	115
Turkey	12	10152	-	-
Nepal	16	1287	-	-
Jordan	2	436	-	-
Saudi Arabia	2	216	-	-
Japan	++	4	-	-

Figures rounded off

Table – 15 : Exports of Ferro-silico-magnesium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4192**	**483234**	**6407**	**1098652**
USA	540	60061	1763	305710
Mexico	1051	112845	1220	214004
Turkey	488	54045	1002	178353
South Africa	178	18309	432	70216
Italy	273	31379	327	59367
UAE	489	60077	300	48544
Saudi Arabia	148	17520	303	46743
Sri Lanka	157	24779	208	38336
Oman	140	17898	122	20581
Slovenia	112	12411	97	17500
Other countries	616	73910	633	99298

Figures rounded off

Table – 16 : Exports of Ferro-silico-Manganese

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**764747**	**50326047**	**1112950**	**113600728**
Japan	99815	7081430	131321	14007615
Italy	80714	4977728	142948	13104422
UAE	100922	6409352	101904	9718850
Egypt	52366	3552108	80183	8311903
Taiwan	63878	4068495	71150	7162030
Bangladesh	36256	2208861	55244	5445075
Turkey	33880	2296815	47543	5006237
Malaysia	42338	2868163	46348	4910829
Saudi Arabia	20194	1304853	37367	4142661
Thailand	30156	1956520	40230	4086765
Other countries	204228	13601722	358712	37704341

Figures rounded off

Table – 17 : Exports of Ferrosilicon

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**11236**	**1194260**	**19567**	**3246485**
UAE	2012	196679	3833	541141
Italy	379	48893	1349	262881
USA	512	77741	1106	201740
Slovenia	687	82827	1020	187896
Turkey	302	36897	762	151243
Brazil	766	87456	974	148940
Oman	616	61957	970	145164
Bangladesh	872	72541	1105	145124
Libya	-	-	550	132637
Nigeria	418	37332	603	122915
Other countries	4672	491937	7295	1206804

Figures rounded off

Table – 18 : Exports of Ferrotitanium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2553**	**567131**	**1860**	**689076**
Japan	220	57155	320	116547
Spain	120	31706	288	108481
Korea, Rep. of	279	73593	316	108049
UK	99	26611	191	69989
UAE	240	67047	174	62063
Netherlands	100	24288	173	60833
South Africa	32	9288	106	58498
Oman	52	11616	90	33650

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
Saudi Arabia	25	6012	53	19412
Taiwan	24	4445	49	17406
Other countries	1362	255370	100	34148

Figures rounded off

Table – 19 : Exports of Ferrotungsten

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**1150**	**1**	**4368**
Brazil	++	234	1	2926
U A E			++	1442
South Africa	++	740	-	-
Qatar	++	148	-	-
Venezuela	++	13	-	-
Kenya	++	12	-	-
Spain	++	3	-	-

Figures rounded off

Table – 20 : Exports of Ferrovanadium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**240**	**346840**	**168**	**353217**
Oman	32	49299	66	126260
Thailand	42	64449	58	118040
Netherlands	40	55916	20	53247
UAE	102	141985	18	38004
France	1	2162	2	6043
Turkey	1	1508	1	3017
Brazil	2	3803	1	2679
Fiji Is	-	-	1	1649
Bangladesh	++	141	1	1067
Indonesia	++	507	++	1057
Other countries	20	27070	++	2154

Figures rounded off

Table – 21 : Exports of Ferrocolumbium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**1522**	**1**	**1787**
Malaysia	-	-	1	1662
U A E	++	849	++	125
U K	++	648	-	-
Qatar	++	25	-	-

Figures rounded off

Table – 22 : Exports of Ferrozirconium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3**	**1644**	**16**	**7127**
Brazil	3	1644	6	3347
Germany	-	-	7	1761
Malaysia	-	-	2	1600
Israel	-	-	1	419

Figures rounded off

Table – 23 : Exports of Ferroselenium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**979**	**5**	**3653**
China	-	-	5	2172
Malaysia	++	979	++	1481

Figures rounded off

Table – 24 : Exports of Ferroalloys (Others)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4065**	**427722**	**3690**	**659380**
Turkey	143	26042	760	240479
South Africa	260	41345	570	119325
Bangladesh	228	27861	305	80324
U A E	989	112902	880	72274
Italy	1195	84723	548	52039
Germany	1	129	75	22686
Spain	-	-	132	17639
Japan	264	11048	184	10152
Nigeria	3	368	48	9239
Egypt	10	1451	13	8472
Other countries	972	121853	175	26751

Figures rounded off

Table – 25 : Exports of Ferrocobalt

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**29**	**++**	**250**
Korea, Rep. of	-	-	++	250
Germany	++	15	-	-
U S A	++	14	-	-

Figures rounded off

Imports

Imports of ferroalloys (total) increased by 44% to 6,08,617 tonnes in 2021-22 from 4,21,980 tonnes in the previous year. In terms of value, the ferroalloys imports also increased to ₹ 12,334 crore in 2021-22 from ₹ 5,531 crore in 2020-21. Out of total imports in terms of quantity, imports of ferronickel accounted for about (41%) followed by Ferrosilicon (35%), ferrochrome and ferromanganese (7% each) and ferro- silico-manganese (4%). Other ferroalloys together accounted for the remaining 6% of the imports in 2021-22. Imports were mainly from Indonesia (36%), followed by Bhutan 25%), China (8%) Korea, Rep.of (6%) and Russia (4%), (Tables-26 to 44).

Table – 26 : Imports of Ferroalloys : Total

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**421980**	**55319083**	**608617**	**123345004**
Indonesia	62209	12174907	218002	45543784
Bhutan	105907	8388867	149221	18859215
Korea, Rep. of	16970	4414616	34633	12993108
China	48375	5045760	48848	8066104
Singapore	10508	5161202	8637	7659089
Brazil	7416	2660712	7879	3257969
Russia	20599	1965356	23982	3223748
Japan	5505	1258262	7582	2806088
Switzerland	4240	605166	11649	2364363
Netherlands	10560	1215357	11689	2311941
Other countries	129691	12428878	86495	16259595

Figures rounded off

Table – 27 : Imports of Ferroboron

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1238**	**197093**	**1046**	**215732**
China	1224	196384	1046	215606
USA	++	84	++	126
UK	14	625	-	-

Figures rounded off

Table – 28 : Imports of Ferrochrome

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**39002**	**4897369**	**44631**	**8360932**
Russia	6249	819171	11418	2001821
Turkey	2770	322344	8753	1774750
Albania	562	68139	5468	995163
China	19525	2513774	5727	933418
Netherlands	800	119875	3118	831706
Brazil	2528	366851	1735	415281
U S A	600	86659	2472	413534
Sweden	825	75307	1730	310857
U A E	537	51384	1572	266626
Switzerland	844	112104	1625	260250
Other Countries	3762	361761	1013	157526

Figures rounded off

Table – 29 : Imports of Charge-chrome

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**14004**	**741433**	**8832**	**769273**
South Africa	12018	636251	5359	481167
Switzerland	987	54623	3322	268222
Turkey	-	-	151	19884
Mozambique	999	50559	-	-

Figures rounded off

Table – 30 : Imports of Ferromanganese

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**66089**	**4785976**	**40881**	**7059207**
Korea, Rep. of	13807	1305274	24684	4825454
Japan	1170	132227	4008	788532
Vietnam	540	65473	2749	516534
South Africa	16662	1118462	3287	353533
Malaysia	29550	1808754	3893	279929
China	115	18140	572	110756
UAE	794	45248	628	56070
Norway	2489	219991	342	51597
Netherlands	500	44368	405	47799
Hong Kong	-	-	149	14199
Other countries	462	28039	164	14804

Figures rounded off

Table – 31 : Imports of Ferromolybdenum

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2883**	**3115738**	**2558**	**6140376**
Korea, Rep. of	2697	2928669	2214	5535468
Switzerland	100	100055	180	299988
China	-	-	131	268565
UAE	80	78222	31	33673
Germany	3	4439	2	2059
Sweden	-	-	++	623
Canada	3	4320	-	-
USA	++	33	-	-

Figures rounded off

Table – 32 : Imports of Ferronickel

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**79737**	**16875880**	**249315**	**55890205**
Indonesia	62174	12168876	218002	45543784
Korea	30	26523	7378	1858644
Singapore	7757	1630801	3979	1497280
Japan	3331	704757	3016	1463786
Switzerland	302	101890	5021	1326578
Albania	1903	467983	3991	1015887
Dominican Rep.	765	616318	2048	1011358
Colombia	-	-	661	627103
New Caledonia	-	-	1876	580399
France	-	-	1181	387353
Other countries	3475	1158732	2162	578033

Figures rounded off

Table – 33 : Imports of Ferroniobium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3026**	**5857814**	**3982**	**8642844**
Singapore	1681	3397956	2456	5713088
Brazil	879	1480909	1065	1866600
Canada	275	653843	265	595637
UAE	40	94965	59	127723
Netherands	27	62304	38	119934
Korea, Rep. of	-	-	33	110276
Netherlands	-	-	20	42834
Hong Kong	68	70128	32	31120
Swizerland	30	47403	6	21546
South Africa	-	-	8	14067
Other countries	26	50306	++	19

Figures rounded off

Table – 34 : Imports of Ferrophosphorus

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2006**	**55172**	**3746**	**148545**
Vietnam	989	24022	2540	89299
Russia	27	618	862	37811
China	619	22162	308	17333
Sweden	3	1250	8	2857
Kazakhstan	216	4895	27	920
Germany	125	1429	1	325
Thailand	-	-	++	++

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
Hong Kong	27	603	-	-
Italy	++	173	-	-
USA	-++	20	-	-
Other Countries	-	-	-	-

Figures rounded off

Table – 35 : Imports of Ferro-silico-Chrome

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**-**	**-**	**100**	**12778**
China	-	-	100	12778

Figures rounded off

Table – 36 : Imports of Ferro-silico-manganese

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**10497**	**546336**	**26676**	**2741398**
Bhutan	2964	236017	23557	2496565
Malaysia	5673	234668	1996	150949
Netherlands	10	1122	270	40894
Australia	1620	63433	520	24923
Tanzania	-	-	221	14847
France	10	1222	30	5821
U A E	-	-	54	5105
Sudan	-	-	27	1830
U S A	-	-	1	266
Switzerland	-	-	++	115
Other countries	220	9874	++	83

Figures rounded off

Table – 37 : Imports of Ferro-silico-magnesium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2765**	**289625**	**4299**	**631424**
Bhutan	1720	186911	2203	355816
China	946	93015	1623	241440
U A E			375	17363
Marshall Islands	38	3420	68	11437
South Africa	-	-	25	4293
Belgium	7	1069	5	1075
Taiwan	54	5210	-	-

Figures rounded off

Table – 38 : Imports of Ferrosilicon

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**194439**	**16370102**	**212256**	**28265119**
Bhutan	101183	7963507	123461	16006834
China	23053	1869232	33602	5017812
Netherlands	9149	958416	7741	1171057
Russia	14265	1133643	11667	1163832
Malaysia	15976	1234247	7930	957197
Norway	4332	645226	4912	883461
Brazil	2952	288143	4657	689434
UAE	8287	596568	5525	638357
France	3190	508442	3769	619134
South Africa	3256	499144	2886	420211
Other countries	8796	673534	6106	697790

Figures rounded off

Table – 39 : Imports of Ferrotitanium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**462**	**109565**	**731**	**300529**
UK	255	59672	378	158587
Canada	70	15641	197	75945
Netherlands	69	20561	64	30540
Russia	58	11924	35	20284
Estonia	-	-	18	7625
China	-	-	20	3822
Korea, Rep. of	-	-	19	3573
USA	++	42	++	153
Taiwan	10	1725	-	-

Figures rounded off

Table – 40 : Imports of Ferrovanadium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**480**	**613762**	**900**	**1806932**
Korea, Rep. of	76	131424	280	658607
Germany	188	260094	287	555669
Japan	113	124205	81	192180
Czech Republic	30	29993	90	122774
UAE	48	26724	56	72657
South Africa	-	-	20	51635
Slovenia	-	-	16	42155
China	-	-	20	25003
Switzerland	20	32604	10	23724
Austria	-	-	10	23282
Other countries	5	8718	30	39246

Figures rounded off

Table – 41 : Imports of Ferrotungsten

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**13**	**23282**	**2**	**4892**
China	9	15511	2	4892
Belgium	4	7448	-	-
USA	++	171	-	-
Turkey	++	152	-	-

Figures rounded off

Table – 42 : Imports of Ferrozirconium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**374**	**51237**	**522**	**96181**
China	346	46248	512	92825
Netherlands	-	-	8	3022
UAE	8	1371	2	334
Hong Kong	15	3395	-	-
UK	5	223	-	-

Figures rounded off

Table – 43 : Imports of Ferroalloys (Others)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4965**	**787297**	**8140**	**2258637**
China	2528	269832	5185	1121771
Singapore	713	103277	1951	407483
Japan	890	296556	423	350834
UAE	45	22985	326	221171
Netherlands	-	-	40	55651
USA	40	15746	59	50813
Brazil	-	-	20	32948
Canada	395	44132	97	14123
Turkey	54	4922	27	3400
U K	++	17	++	102
Other countries	300	29830	12	341

Figures rounded off

Table – 44 : Imports of Ferrocobalt

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**1402**	**-**	**-**
Germany	++	*1402*	-	-

Figures rounded off

FUTURE OUTLOOK

Depending on the process of steel making and the type of steel being manufactured, the requirement of different ferroalloys varies widely.

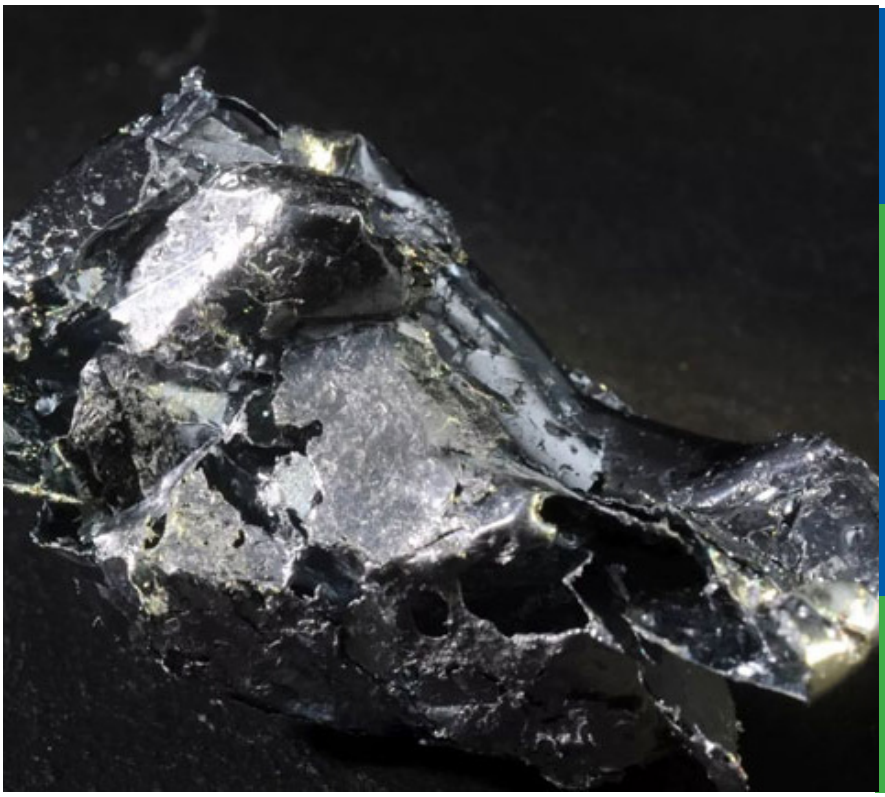
Indian Ferroalloys Industry has immense potential and capability to compete in the international market. On the positive side, India produces some of the finest ferroalloys in the world. Indian ferroalloys are extensively preferred in Europe. India exports potential is indeed bright with very high growth prospects.

As per the steelworld report, Ferroalloys Industry is estimated to grow at a CAGR of 5.9% between 2017 and 2025 and is expected to reach a valuation of US$ 188.7 billion by 2025.

India is expected to show strong growth in usage of steel in the coming years because of its robust economy, massive infrastructure needs and expansion of industrial production. India is expected to become one of the leading steel consuming nations in the next decade. In this scenario, the Ferro- alloys Industry estimates that the consumption of ferroalloys will increase domestically and internationally in the coming years. Some of the Ferroalloy Producers have already gone for expansion and some new units are coming up.

As per the National Steel Policy, 2017, Ferro-alloy Industry is a power intensive industry. Hence, captive power generation in the ferroalloys plants will be extensively supported. Since the demand for ferroalloys is likely to grow along with steel production in the country, the Industry would have to be encouraged to set up larger units to achieve adequate economies of scale. Efforts in the direction of providing necessary raw materials linkages and stable supply of power to the Ferroalloy units must be rendered priority.

7. Gallium



Gallium is a soft, silvery-white strategic metal predominantly used in electronics

Gallium is recovered as a by-product while producing alumina

The demand for gallium is likely to increase with the growth of Electronic Industry in the country

370
(tonnes) Worldwide gallium consumption in 2021

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.

USES

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-shap 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.

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 Damanjodial uminare finery, 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.

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 suitablity 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 defence 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

Reported gallium production figures for China and Japan, and 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 increased its production of low-purity primary gallium in 2018 by approximately 32% and was estimated to account for 96% of worldwide low-purity primary gallium production. Estimated worldwide low-purity primary gallium production was 413 tonnes in 2018, an increase of about 30% from that of 2017. Principal world producers were China, Japan, the Republic of Korea, Russia, and Ukraine. Gallium also may have been recovered in Hungary. Production of high-purity primary refined gallium (sourced from current and stockpiled low-purity primary gallium) in 2018 was estimated to be 205 tonnes, 50% less than low-purity primary production. China, Japan, the United States, and possibly Slovakia refined high-purity gallium from low-purity primary material. The United Kingdom ceased production of high-purity refined gallium in 2018. 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. Gallium was recycled from new scrap in Canada, China, Germany, Japan, Slovakia, and the United States. The United Kingdom ceased recycling of gallium in 2018. Roskill Information Services Ltd. (2014) expected that, by 2020, worldwide gallium consumption would increase to approximately 420 tonnes.

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 defence applications. The cellular telephone market was principally responsible for growth in gallium consumption in the past few years.

China is the largest producer of Gallium (primary) in the World during 2021, followed by Russia (13 tonnes), Ukraine (4 tonnes), Japan (3 tonnes) and Korea (2 tonnes) (Table-1).

Table – 1 : World Production of Gallium (Primary)

(By Principal Countries)

(In tonnes)

Country	2019	2020	2021
China	357	350	350
Russia[(e)]	13	13	13
Ukraine[(e)]	8	4	4
Japan	3	3	3
Korea, Rep. of [(ae)]	3	2	2

(e)-estimated
(a)-Primary production only

To provide a generalised view of the development in various countries, the country-wise discription as sourced from the latest available publication of Minerals Yearbook 'USGS' 2018 is furnished below.

Japan

Japan Oil, Gas and Metals National Corp. (JOGMEC) reported that Japan's gallium supply in 2018 totaled 174 tonnes, a 6% increase from 165 tonnes in 2017, with 57% of the gallium supply sourced from imports, 41% from recovered scrap, and 2% from low-purity primary gallium produced in Japan as a byproduct of zinc refining. Of Japan's 99.4 tonnes of imported gallium, 75% came from China; Japan remained the leading gallium- consuming country and consumed 156 tonnes of gallium in 2018, approximately 42% of worldwide consumption. Production of GaN wafers was concentrated in Japan with more than 85% of sales held by three Japan-based companies: Mitsubishi Chemical Corp., Sciocs Co. Ltd., and Sumitomo Electric Industries Ltd.

China

China produced a reported 397 tonnes of low-purity primary gallium in 2018 and consumed an estimated 115 tonnes of gallium, approximately 31% of worldwide consumption. China's share of worldwide consumption was forecast to increase to 35% in 2020 owing to the rapid growth of the country's LED industry. Approximately 95% of China's gallium was sourced as a byproduct from bauxite during alumina production. The remaining 5% was sourced from the refining of lead and zinc ores. China's major low-purity primary gallium producers included Aluminum Corp. of China Ltd. (Beijing); Beijing JiYa Semiconductor Material Co., Ltd. (Beijing Municipality); East Hope Mianchi Gallium Industry Co., Ltd. (Shanghai); Shanxi Jiahua Tianhe Electronic Materials (Shanxi Province); Shanxi Zhaofeng Gallium Industry Co. (Shanxi Province); Xiaoyi Xingan Gallium Co., Ltd. (Guangxi Province); and Zhuhai Fangyuan Inc. (Guangdong Province). China's high-purity primary refined gallium producers included Beijing JiYa Semiconductor Material Co., Ltd. (Beijing Municipality); 5N Plus Inc. (Shenzhen, Guangdong Province); Nanjing Jingmei Gallium Co., Ltd. (Nanjing, Jiangsu Province); and Zhuzhou Keneng New Material Co. Ltd.

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 establishing 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 2022. Installation of 3G and 4G mobile networks in India and the Republic of Korea 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.

Yole Developpement forecast that RF GaN device sales would increase by a compound annual growth rate (CAGR) of 23% between 2017 and 2023 owing to increased adoption of GaN technology in wireless infrastructure and defence applications, as well as implementation of new fifth-generation (5G) networks beginning around 2019. High-frequency RF applications over 3.5 gigahertz, including military radar and electronic warfare systems,commercial wireless telecommunications and CATV applications require high-voltage and high-power capabilities of significant expansion of LED manufacturing capacity, Government incentives and reduced prices, global LED sales are expected to increase by a CAGR of more than 18% between 2017 and 2021.

General lighting is expected to remain the largest segment of the LED market, accounting for 77% by 2021. Sales within the Asia-Pacific region are projected to increase at a CAGR of 21% during the forecast period. The region is expected to remain the leading consumer of LED material owing to rapid construction in many Asian countries, Government incentives to encourage use of energy-efficient lighting and the presence of the majority of the LED Industry.

8. Gold

518.23
(million tonnes) Total reserves/ resources of gold ore as on 1st April 2020

491
(thousand tonnes) Production of gold ore in 2021-22

Nil
Exports of gold ore in 2021-22

7,99,178
(kg) Imports of gold ore concentrate in 2021-22

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 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 estimates are 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 1.04.2020 (P)

(By Grades/States)

(In tonnes)

States/Grades	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconn-aissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India:Total													
Ore (Primary)	20271400	3420000	36700	23728100	4498133	3821500	1741321	9658248	109446798	238863938	126476333	494506270	518234370
Metal (Primary)	79.26	13.44	0.06	92.76	16.93	9.11	5.64	22.05	159.41	236.26	65.1	514.5	607.26
Ore (Placer)	-	-	-	-	-	-	-	-	2552000	23569000	-	26121000	26121000
Metal (Placer)	-	-	-	-	-	-	-	-	2.29	3.57	-	5.86	5.86
By States													
Andhra Pradesh													
Ore (Primary)	3221400	-	36700	3258100	2485133	1857500	1548115	291000	55000	6236150	-	12472898	15730998
Metal (Primary)	5.24	-	0.06	5.3	11.87	3.99	4.92	1.08	0.17	19.84	-	41.87	47.17
Bihar													
Ore (Primary)	-	-	-	-	-	-	-	-	-	128884860	94000000	222884860	222884860
Metal (Primary)	-	-	-	-	-	-	-	-	-	21.6	16	37.6	37.6
Chhattisgarh													
Ore (Primary)	-	-	-	-	-	-	-	-	600000	4241033	-	4841033	4841033
Metal (Primary)	-	-	-	-	-	-	-	-	1.8	3.71	-	5.51	5.51
Jharkhand													
Ore (Primary)	-	-	-	-	-	-	19206	-	4710966	4579355	767000	10076527	10076527
Metal (Primary)	-	-	-	-	-	-	0.08	-	2.24	12.49	0.62	15.43	15.43
Karnataka													
Ore (Primary)	17050000	3420000	-	20470000	2013000	1964000	174000	4304968	46495718	21773820	5813000	82538506	103008506
Metal (Primary)	74.02	13.44	-	87.46	5.06	5.12	0.64	14.13	44.17	48.91	45.68	163.71	251.17
Kerala													
Ore (Primary)	-	-	-	-	-	-	-	462280	96180	-	-	558460	558460
Metal (Primary)	-	-	-	-	-	-	-	0.17	0.03	-	-	0.2	0.2
Ore (Placer)	-	-	-	-	-	-	-	-	2552000	23569000	-	26121000	26121000
Metal (Placer)	-	-	-	-	-	-	-	-	2.29	3.57	-	5.86	5.86

(In tonnes)

States/Grades	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconn-aissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Madhya Pradesh													
Ore (Primary)	-	-	-	-	-	-	-	-	5745934	1947000	-	7692934	7692934
Metal (Primary)	-	-	-	-	-	-	-	-	6.03	2.22	-	8.25	8.25
Maharashtra													
Ore (Primary)	-	-	-	-	-	-	-	-	-	1627000	-	1627000	1627000
Metal (Primary)	-	-	-	-	-	-	-	-	-	3.64	-	3.64	3.64
Rajasthan													
Ore (Primary)	-	-	-	-	-	-	-	4600000	51743000	69507720	63000	125913720	125913720
Metal (Primary)	-	-	-	-	-	-	-	6.67	104.97	122.85	0.07	234.56	234.56
Tamil Nadu													
Ore (Primary)	-	-	-	-	-	-	-	-	-	67000	-	67000	67000
Metal (Primary)	-	-	-	-	-	-	-	-	-	1	-	1	1
West Bengal													
Ore (Primary)	-	-	-	-	-	-	-	-	-	-	12833333	12833333	12833333
Metal (Primary)	-	-	-	-	-	-	-	-	-	-	0.65	0.65	0.65

Figres rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION & PRICES

The production of gold ore at 491 thousand tonnes during 2021-22 increased by 12% as compared to that in the previous year. The quantity of ore treated also increased to 482 thousand tonnes in 2021-22 as against 456 thousand tonnes in 2020-21. There were six reporting mines of gold ore in 2021-22.

The average grade of gold ore produced in India during 2021-22 was 3.20 g/t as against 3.16 g/t in previous year whereas that of gold treated was 2.88 g/t in 2021-22 as compared to 2.76 g/t in the previous year.

Production of primary gold in 2021-22 at 1,251 kg increased by 11% as compared to that in the previous year. Karnataka was the leading producer of gold accounting for 99% of the total production. The remaining production was reported from Jharkhand.

The average daily employment of labour in 2021-22 was 3,086 as against 3,247 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, 2021-22

Name and address of the producer	Location of Mines	
	State	District
The Hutti Gold Mines Co. Ltd, Hutti, Dist. Raichur 584 115, Karnataka.	Karnataka	Raichur
Manmohan Industries (P) Ltd, Shanti Niketan,286, New Patliputra Colony, Patna, Bihar.	Jharkhand	Saraikel; Kharasw

Table – 3: Production of Gold Ore, 2020-21 and 2021-22

(By States)

(In tonnes)

State	2020-21		2021-22 (P)	
	Ore Produced	Avg. Grade (g/t)	Ore Produced	Avg. Grade (g/t)
India	**437669**	**3.16**	**491160**	**3.2**
Andhra Pradesh	-	-	849	1.2
Jharkhand	2859	4.19	3682	3.5
Karnataka	434810	3.16	486629	3.2

(p): Provisional

Table – 4: Gold Ore Treated 2020-21 and 2021-22

(In tonnes)

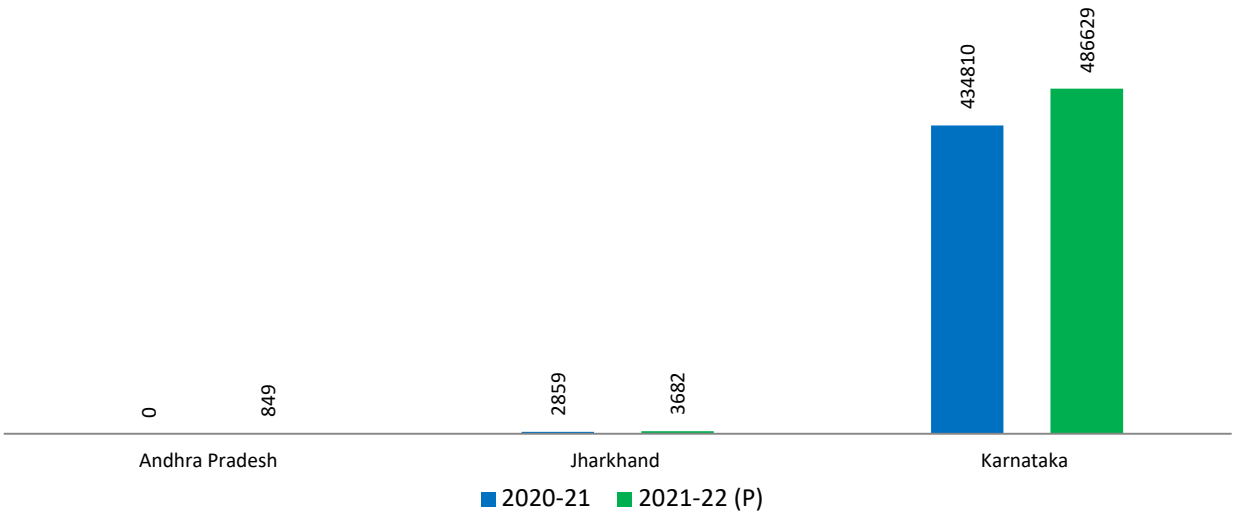


Fig.1: Statewise Production of Gold Ore

(By States)

(In tonnes)

State	2020-21		2021-22 (P)	
	Ore Treated	Avg. Grade (g/t)	Ore Treated	Avg. Grade (g/t)
India	**456217**	**2.76**	**482324**	**2.88**
Andhra Pradesh	-	-	9	5.54
Jharkhand	2880	4.2	3682	3.51
Karnataka	453337	2.75	478633	2.88

(p): Provisional

Table – 5: Production of Gold, 2020-21 to 2021-22

(By States)

(Quantity in kg; Value in ₹ '000)

State	2019-20		2020-21		2021-22 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**1742**	**6495723**	**1126**	**5475950**	**1251**	**6011677**
Primary Gold	1742	6495723	1126	5475950	1251	6011677
Jharkhand	18	64689	11	53790	12	56268
Karnataka	1724	6431034	1115	5422160	1239	5955409

Table – 6: Production of Primary Gold, 2020-21 and 2021-22

(By Sectors/States/Districts)

(Quantity in kg; Value in ₹ '000)

State/District	No. of mines	2020-21		No. of mines	2021-22 (p)	
		Quantity	Value		Quantity	Value
India	**5**	**1127**	**5475470**	**6**	**1251**	**6011677**
Public Sector	3	1116	5422160	4	1239	5955409
Private Sector	2	11	53310	2	12	56268
Primary Gold	5	1127	5475470	6	1251	6011677
Andhra Pradesh	1*	-	-	1	-	-
Kurnool	1*	-	-	1	-	-
Jharkhand	1	11	53310	1	12	56268
Saraikela kharasawan	1	11	53310	1	12	56268
Karnataka	3	1116	5422160	4	1239	5955409
Raichur	3	1116	5422160	4	1239	5955409

**: Only labour reported*
(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 2021-22 at 9,931 kg increased by 34% as compared to 7,387 kg in the previous year (Table -7).

Table – 7: Production of Gold Bullion 2020-21 to 2021-22

(Quantity in kg; Value in ₹ '000)

Year	Quantity	Value
2019-20	8382	31283423
2020-21	7387	35814249
2021-22 (P)	9931	47676677

Note: Includes gold recovered as by-product from copper concentrates by Hindalco Industries Ltd in Gujarat.

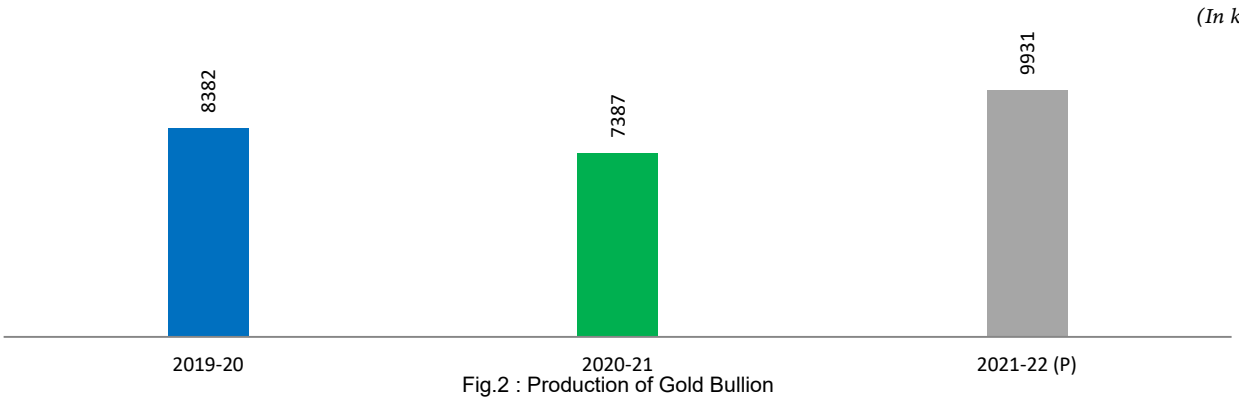


Fig.2 : Production of Gold Bullion

The prices of gold are covered in the Review on "Prices" under General Review.

MINING & MILLING

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, such as, 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 have 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 report 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 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) Amends ment 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.

ENVIRONMENTAL CONCERNS

Gold is recovered from ores by two main methods, both of which affect environment. Earlier, for recovery of gold, amalgamation processes were used in which ore was mixed with mercury that selectively dissolved gold which was then recovered by evaporation. Mercury from these operations was never recovered and remained as pollutant in many old mining areas. The cyanide process is based on the property of precious metals in forming soluble complex ions with cyanide anion. Cyanide does not dissolve quartz, iron oxides and other common gangue minerals and yields a relatively simple gold- bearing solution known as pregnant solution. In some gold mines, gold is dissolved from the ore by crushing and grinding followed by mixing with cyanide solution in large vats.

Cyanide is a highly toxic compound and requires special handling. During ore treatment, pH of cyanide solution must be kept at about 11 to prevent cyanide from reacting with hydrogen ion to produce HCN, a deadly gas. Although less toxic substitutes of cyanide are known, it is not yet clear whether such substances will be cost-effective or environment-friendly.

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)]	118400
Brazil	2400
Burkina Faso	NA
Canada	2300
China[(d)]	1900
Colombia	NA
Ghana	1000
Indonesia	2600
Kazakhstan	1000
Mexico	1400
Papua New Guinea	1100
Peru	2900
Russia	6800
South Africa	5000
Sudan	NA
Tanzania	NA
USA	3000
Uzbekistan	1800
Other countries	9200

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 3,282 tonnes in 2021 as compared to the 3,188 tonnes in the preceding year. China contributed about 10% to the world's total mine production of gold, followed by Russia (10%), Australia (9%), Canada (8%), USA (6%), Mexico (4%) and Kazakhstan (3%) and South Africa & Uzbekistan (3% each) (Table-9).

Table – 9: World Mine Production of Gold

(By Principal Countries)

(In tonnes)

Country	2019	2020	2021
World:Total (rounded off)	**3330**	**3188**	**3282**
China	380	365	329
Russia	305	308	313
Australia	326	327	311
Canada	183	182	222
USA	200	190	187
Mexico	133	110	124
Kazakhstan	106	116	114
South Africa	105	95	105
Uzbekistan	93	100	105
Other countries	1459	1361	1468

Source: BGS, World Mineral Production, 2017-2021.
(d):-Metal production

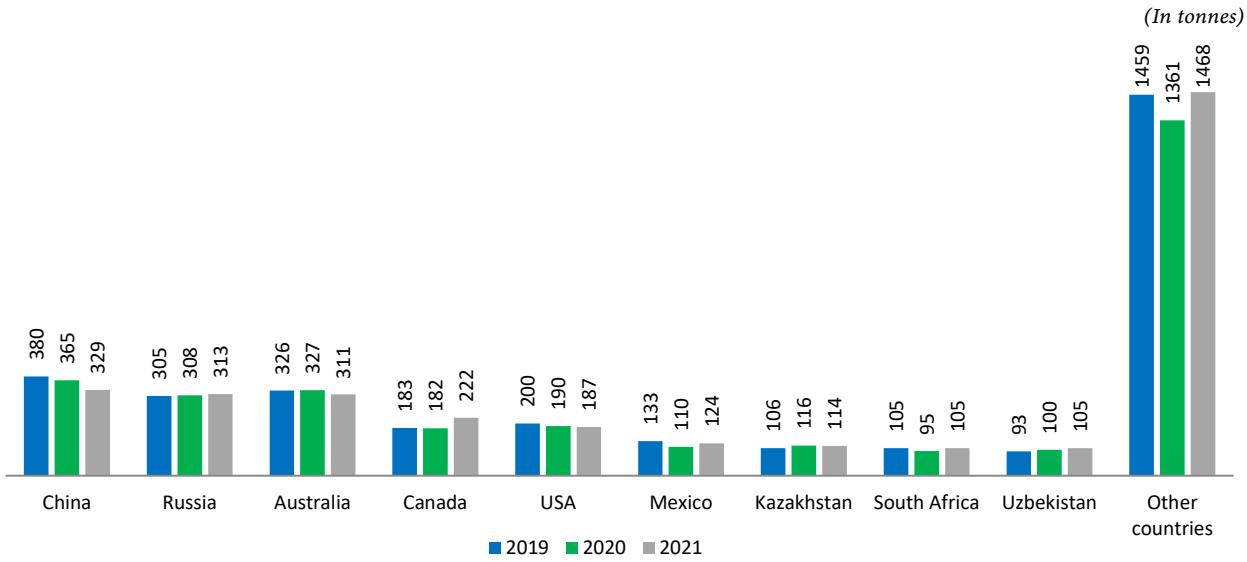


Fig.3: World Mine Production of Gold

The top five leading gold-producing countries were China, Australia, Russia, USA and Canada.

To give a generalised view of the development in various countries, countrywise description as sourced from latest available publication of U.S. Geological Survey Minerals Yearbook - 2018 is furnished below:

Australia.

In 2018, gold production in Australia was 3,15,100 kg, a 7% increase from 2017 and the sixth consecutive year of increased gold production. Some of the production increase was from Newcrest's Cadia Hill Mine, which increased production by 38% from the previous year (23,400 kg) owing to higher grades and throughput. AngloGold Ashanti Ltd. reported an increase of 12% compared with that in 2017, producing about 19,400 kg. The Sunrise Dam Mine produced 8,990 kg of gold, a 21% increase compared with 2017 production owing to higher mined grades in the first and fourth quarters. Production at the Tropicana Mine, a joint venture between Anglo Gold (70%) and Independence Group NL (30%), increased by 5% to 10,500 kg of gold in 2018 owing to higher grades and throughput. Kirkland Lake Gold Ltd.'s Fosterville Mine produced 11,100 kg of gold in 2018, a 35% increase in production compared with the previous year, as a result of higher ore grades mined.

Canada

Reported gold mine production increased by 9% in 2018 to 1,83,047 kg, mainly because it was the first full year of operation at the Brucejack and Rainy River Mines. Pretium Resources Inc.'s Brucejack Mine produced 11,700 kg of gold in 2018 and New Gold's Rainy River Mine produced 7,070 kg of gold. This increase partially offset Agnico Eagle Mines Ltd.'s Meadowbank Mine, which produced 7,750 kg of gold in 2018, 29% less than 2017 production owing to reduced output as the mine transitioned through its final full year of open pit mining operations.

China

Reported gold production in 2018 was 4,01,119 kg. While China's efforts to reduce the environmental impact of the mining industry resulted in a production decrease of 6%, it continued to be the world's leading gold producer in 2018. China's gold consumption (excluding central bank purchases) was 998 t in 2018, essentially unchanged from that in 2017, after 4 consecutive years of decline. Chinese jewelry fabrication (including the use of scrap) accounted for 69% of the country's annual gold consumption at 688 t, a slight increase compared with that in 2017. This was the first consumption growth since 2013 as the demand was fostered by the market's preference for pure gold items. Gold investment demand in China was 213 t, a 3% decrease from the previous year and the second consecutive year of decline owing to fluctuations in the yuan currency. China's scrap supply in 2018 was 222 t, essentially unchanged from that in 2017.

Indonesia

In 2018, gold production, excluding illegal artisanal and small-scale gold mining, was an estimated 1,35,000 kg, 34% more than that in 2017. Freeport-McMoRan Inc.'s (FCX) Grasberg Mine accounted for about 60% of gold production in Indonesia. Gold production at the Grasberg copper mine increased by 74% in 2018 to 83,900 kg owing primarily to higher milling rates and increases in gold ore grades. In December 2018, the Indonesian Government granted FCX a new special mining license which granted their subsidiary, PT Freeport Indonesia, an extension of mining rights through 2031, as well as rights to extend through 2041.

Russia

In 2018, gold production was about 3,11,000 kg, an increase of 15% from the previous year. A large portion of the increase was from Polyus operations, which reported a 10% increase

in gold production owing to the Natalka Mine completing its first full year in operation, and increased production at the Olimpiada, the Verninskoye, and the Kuranakh Mines.

South Africa

In 2018, gold production was 1,17,200 kg-15% less than in 2017. Sibanye Gold Ltd. operations in South Africa included the Beatrix, Cooke, Driefontein, and Kloof Mines, as well as interest in surface tailings retreatment facilities located from the East Rand to the West Rand via their 38.05% stake in DRDGOLD Ltd. Production in 2018 was about 36,600 kg of gold, 16% less than 2017 production. The primary reasons for the decrease were due to the impact of two separate safety incidents at Sibanye's Driefontein and Kloof operations that resulted in the death of 12 employees, operational disruptions including power disruption to the Beatrix operations, and seismic damage to infrastructure at the Driefontein and Kloof Mines. Gold Fields Ltd's South Deep Mine produced 4,890 kg, 44% less than that in 2017 because of large-scale restructuring, operational difficulties, and a 6-week strike.

FOREIGN TRADE

Exports

During the year 2021-22, the exports of gold ores & conc was Nil as compared to the negligible as in preceding year. Export of gold-clad metals/base metals, NES was negligible during the years i.e 2021-22 & 2020-21. 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) decreased by 126 kg in 2021-22 from 4,191 kg in 2020-21. The exports in 2021-22 were to Hong Kong (40%) followed by UAE (35%), Switzerland (16%) and negligible quantities to Guinea, Canada and Peru . (Tables- 10 to 17).

Table – 10 : Exports of Gold: Total (Non-monetary & Monetary)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**4191**	**18895717**	**126**	**463986**
Switzerland	3124	14175874	21	85874
Turkey	1048	4637250	-	-
Guinea	9	37872	5	19197
UAE	7	31523	44	147769
Hong Kong	3	11939	51	206709
Peru	-	-	2	3664
Nepal	-	-	++	482
USA	++	233	++	116
Canada	-	-	3	94
Jordan	-	-	++	83
Other countries	++	1026	-	-

Figures rounded off

Table – 11: Exports of Gold (Non-monetary)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**4191**	**18895692**	**126**	**463986**
Switzerland	3124	14175874	21	85874
Turkey	1048	4637250	-	-
Guinea	9	37872	5	19197
UAE	7	31523	44	147769
Hong Kong	3	11939	51	206709
USA	++	208	++	116
Peru	-	-	2	3662
Nepal	-	-	++	482
Canada	-	-	3	94
Jordon	-	-	++	83
Other countries	++	1026	-	-

Figures rounded off

Table – 12: Exports of Gold (Non-monetary) : Other Unwrought Forms

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**4191**	**18894458**	**114**	**423280**
Switzerland	3124	14175874	21	85874
Turkey	1048	4637250	-	-
Guinea	9	37872	5	19197
UAE	7	31523	35	107838
Hong Kong	3	11939	51	206709
Peru	-	-	2	3662

Figures rounded off

Table – 13 : Exports of Gold (Monetary)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**++**	**25**	**-**	**-**
USA	++	25	-	-

Figures rounded off

Table – 14: Exports of Gold-clad Metals/Base Metals, NES

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**++**	**306**	**++**	**770**
Nigeria	-	-	++	663
Nepal	-	-	++	54
Kenya	-	-	++	22
UK	-	-	++	11
Ireland	-	-	++	2
Sudan	++	263	-	-
Zambia	++	43	-	-

Figures rounded off

Table – 15 : Exports of Gold Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**++**	**1**	**-**	**-**
Spain	++	1	-	-

Figures rounded off

Table – 16 : Exports of Gold, Non-Monetary, Powder

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**++**	**16**	**++**	**565**
Nigeria	++	16	-	-
Nepal	-	-	++	482
Jordan	-	-	++	83

Figures rounded off

Table – 17 : Exports of Gold, Non-monetary, Other Semi-manufactured Forms

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**++**	**1218**	**12**	**40141**
Netherlands	++	946	-	-
USA	++	208	++	116
UK	++	24	-	-
Australia	++	22	-	-
Mauritius	++	18	-	-
UAE	-	-	9	39931
Canada	-	-	3	94

Figures rounded off

Imports

Imports of gold ores & concentrates increased manifolds to 7,99,178 kg during 2021-22 from 10,742 kg in the preceding year. On the other hand imports of gold (Non-monetary), powder was negligible levels in 2021-22. Negligible imports of gold-clad metal in the year 2021-22 were reported. Imports of total gold (Monetary and Non-monetary) increased substantially by 35% to 8,79,010 kg in 2021-22 from 6,51,238 kg in 2020-21. Out of the total imports of gold (Non-monetary & Monetary) the share of Non-monetary was cent per cent. The share of Non-monetary: Other Unwrought forms, was at 8,68,489 kg. Imports of gold (Non-monetary & Monetary: total) were mainly from Switzerland (41%), UAE (11%), Guinea (7%), South Africa (6%), and Peru (5%) (Tables-18 to 24).

Table – 18: Imports of Gold (Non-monetary & Monetary): Total

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**651238**	**2542884698**	**879010**	**3440928249**
Switzerland	275265	1193849372	359825	1545226314
UAE	70583	309169370	99757	434899095
South Africa	43020	187099143	57080	243116207
Peru	31429	110557375	50490	172458876
Guinea	26173	105177080	61498	247595230
Singapore	21364	92859048	14764	63499660
USA	20918	87412294	16306	58695275
Bolivia	20626	85098064	38122	153892235
Ghana	16018	66154120	19385	78410163
Australia	23596	43682461	15602	67245208
Other countries	116009	259922310	146181	375889986

Figures rounded off

Table – 19 : Imports of Gold, Non-monetary

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**651238**	**2542884698**	**879010**	**3440928249**
Switzerland	275265	1193849372	359825	1545226314
UAE	70583	309169370	99757	434899095
South Africa	43020	187099143	57080	243116207
Peru	31429	110557375	50490	172458876
Guinea	26173	105177080	61498	247595230
Singapore	21364	92859048	14764	63499660
USA	20918	87412294	16306	58695275

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
Bolivia	20626	85098064	38122	153892235
Ghana	16018	66154120	19385	78410163
Australia	23596	43682461	15602	67245208
Other countries	102246	261826371	146181	375889986

Figures rounded off

Table – 20 : Imports of Gold, Non-monetary: Other Semi-manufactured Forms

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**1864**	**7902576**	**10521**	**45336972**
USA	1003	4070158	1927	8030919
UAE	429	2015678	8020	34958901
UK	150	727309	54	232815
Singapore	88	408927	2	14768
Hong Kong	69	292488	339	1474200
Germany	72	164976	91	225075
Spain	21	94382	69	312230
Italy	21	88835	12	54839
Korea, Rep. of	++	2474	2	7401
Colombia	3	11198	3	14420
Other countries	8	26151	2	11404

Figures rounded off

Table – 21 : Imports of Gold, Non-monetary: Other Unwrought Forms

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**649374**	**2534982071**	**868489**	**3396000000**
Switzerland	275265	1193849372	359825	1545000000
UAE	70154	307153692	91737	399940194
South Africa	43020	187099143	57080	243116207
Peru	31429	110557375	50490	172458876
Guinea	26173	105177080	61498	247595230
Singapore	21276	92450121	14762	63484892
Bolivia	20626	85098064	38122	153892235
Australia	23595	43680096	15602	67242385
Ghana	16018	66154120	19385	78410163
Brazil	4682	19052891	12917	50882361
Other countries	117136	324710117	147071	373342415

Figures rounded off

Table – 22 : Imports of Gold Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**10742**	**48481**	**799178**	**2376524**
Columbia	10546	26319	798712	2320786
Peru	196	22162	466	55738

Figures rounded off

Table – 23 : Imports of Gold, Non-monetary, Powder

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**++**	**51**	**++**	**5**
UK	++	45	-	-
USA	++	6	++	5

Figures rounded off

Table – 24 : Imports of Gold-clad Metal / Base Metals, NES

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**++**	**1694**	**++**	**52**
UK	++	1694	-	-
Singapore	-	-	++	52

Figures rounded off

FUTURE OUTLOOK

Historically, purchase of gold was considered 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 and more than double the exports of gold by 2022, 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 cooperation between the States and the Centre.

9. Iron, Steel & Scrap and Slag

120.293
(million tonnes) India's crude steel production in 2021-22

2,03,435
(Rs crore) Exports of iron & steel in 2021-22

1,15,950
(Rs crore) Imports of iron & steel in 2021-22

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 113.597 million tonnes (Crude Steel Equivalent) in 2021-22. Out of this, 59.564 million tonnes was Non-Flat steel and the remaining 54.033 million tonnes was Flat steel. The contribution of non-alloy finishe d steel, alloy finished steel and stainless steel segment is 106.615 million tonnes, 4.170 million tonnes and 2.812 million tonnes respectively. The growth in the Steel Sector in the early decades after independence was mainly in the Public Sector units. However, following the adoption of new economic policy and subsequent deregulation and decontrol of Indian Iron & Steel Sector, the 1990s witnessed accelerated growth in the Private Sector, catapulting its share of finished steel production from 45% in 1992-93 to 84.52% (96.018 million tonnes) in 2021-22.

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, a rejuvenation in the Steel Sector resulted in large-scale exports of iron and steel. The total finished steel exports reached 13.494 million tonnes in 2021-22, registering a growth of 25.1% over the year 2020-21 while imports have continued the declining trend of recent years and registered a decline of 1.7 % with 4.669 million tonnes in 2021-22 compared to previous year.

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 meagre 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 introduced with the a im to pr ovide a road map o f gro wth a nd 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 glob al 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 which would promote economic growth. At the same time, as a facilitator in the present-day de-regulated, l ibe ral ised econo mic/ market scenario, the Government also a nnounced 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 t o e ncour age 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 Government of India came out with a Steel Scrap Recycling Policy in the year 2019 that aims to reduce imports, conserve resources and save energy.

STEEL POLICIES AND INITIATIVES OF THE GOVERNMENT TO BOOST THE STEEL SECTOR

National Steel Policy 2017

NSP 2017 aims to increase focus on expansion of Micro, Small and Medium Enterprises (MSME) Sector, improve raw material security, enhance R&D activities, reduce import dependency and cost of production, and thus develop at echnologically advanced and globally competitive Steel Industry that which would promote economic growth eyeing self-sufficiency in production, developing economical steel manufacturing cap abilitie s by facilitating investments and cost-efficient production with adequate availability of raw materials.

With focus on R&D through establishment of institution like Steel Research Technology Mission of India (SRTMI), the technology would be of utmost focus over the next decade and MSME steel plants would be the key drivers to achieve the additional capacity required for India's consumption led growth and improvement in the overall productivity and quality.

The principal objectives that the National Steel Policy 2017 aims to achieve are the following:

a) Build a globally competitive industry.

b)Increase per Capita Steel Consumption to 160 kg by 2030-31.

c) To domestically meet entire demand of high grade automotive steel, electrical steel, special steels and alloys for strategic applications by 2030-31.

d) Increase domestic availability of washed coking coal so as to reduce import dependence on coking coal from ~85% to ~65% by 2030-31.

e) To have a wider presence globally in value added/ high grade steel.

f) Encourage industry to be a world leader in energy efficients eel production in an environmentally sustainable manner.

g) Establish domestic industry as a cost-effective and quality steel producer.

h) Attain global standards in Industrial Safety and Health.

i) To substantially reduce the carbon foot- print of the Steel Industry.

Forecast of Iron & Steel Demand an Production (by 2030-31)

(All values in million tonnes per annum unless stated)

Sl No.	Parameters	Projections 2030-31
(i)	Total crude steel capacity	300
(ii)	Total crude steel demand/ production	255
(iii)	Total finished steel demand/ production	230
(iv)	Sponge iron demand/production	80
(v)	Pig iron demand/ production	17
(vi)	Per Capita Finished Steel Consumption (in kg)	158

Policy for providing preference to Domestically Manufactured Iron and Steel Products (DMI&SP) in Government Procurement.

The Government had introduced DMI&SP Policy on 8th May, 2017 to provide preference to domestically produced iron and steel material in Government tenders. Further, to fine tune this objective, the Policy was revised on 29th May,

2019 and on 31st December, 2020. The policy is envisaged to promote growth and development of domestic steel industry and reduce the inclination to use low quality and low cost (unfairly traded) imported steel in Government funded projects.

Steel Import Monitoring System (SIMS) for import data dissemination

SIMS platform was launched on 16th September 2019 for import consignments started at the Port of Entry w.e.f. 1st November 2019. SIMS registration is fully online and automated without any human intervention and registration number can be obtained by the steel importer after making an online payment of token registration fee prescribed for this purpose. SIMS has enabled the domestic industry to plan their pricing and production strategy and helped the country move towards self-sufficiency in steel making.

Quality Control Orders/BIS

Government has been facilitating supply of quality steel for critical end-use applications such as infrastructure, construction, housing and engineering sector.

Production Linked Incentive (PLI) Scheme

PLI Scheme for domestic production of specialty steel has been approved with an outlay of ₹ 6,322 crores by the Cabinet. The five broad categories of Specialty steel, identified under the scheme, are used in a variety of applications including white goods, automobile body and components, pipes for transportation of oil and gas, boilers, ballistic and armour sheets, high-speed railway lines, turbine components, distribution and power transformers.

The Scheme has been notified on 29.07.2021 and detailed Scheme Guidelines were published on 20.10.2021.

Decarbonization in Steel Sector

Ministry of Steel is continuously engaging with the stakeholders from the steel industry and the concerned stakeholder Ministries/ Departments such as Ministry of Environment, Forests and Climate Change (MoEF&CC), Ministry of Power, Bureau of Energy Efficiency (BEE), Ministry of New and Renewable Energy (MNRE), NITI Aayog etc to achieve net zero emissions by 2070 .

PM GatiShakti National Master Plan

With the help of Bhaskaracharya Institute for Space Applications and Geoinformatics (BiSAG-N) the infrastructure Ministries have uploaded their rail, road, port networks, etc. on PM GatiShatkti National Portal. Ministry of Steel has onboarded itself on PM Gati Shakti Portal (National Master Plan portal) with the help of a mobile application created by BiSAGN, by uploading the Geo locations of more than 2100 steel units (including big players) from across the country.

Steel Prices

Certain measures were taken by the Government to provide relief from high prices of crucial raw materials and intermediates, which included iron and steel. Accordingly, modifications were made in tariffs on raw materials of steel and other steel products vide notification dated 21.05.2022 whereby Import duty on Anthracite/Pulverized Coal Injection (PCI) coal, Coke and Semi-coke and Ferro-Nickel were reduced to zero. Export duty on Iron ores/ concentrates and iron ore pellets was raised to 50% and 45%, respectively. In addition, 15% export duty was imposed on pig iron and several steel products.

The prices of steel items declined ~15-25% across the board and stabilized consequent to the above measures. Taking in view the concerns of all stakeholders, the said notification has been rescinded vide notification dated 18.11.2022 and status prior to 21.05.2022 has been restored

Steel Scrap Recycling Policy

The Steel Scrap Recycling Policy (SSRP) was notified in the Gazette of India on 07.11.2019. The Policy provides a framework to facilitate and promote establishment of metal scrapping centres in India for scientific processing and recycling of ferrous scrap generated from various sources including end of life vehicles (ELVs). SSRP works out a model for collection, dismantling and shredding activities in an organized, safe and environmentally sound manner in order to curb pollution and pre vent he alth hazard s . T he responsibilities of dismantling centre and scrap processing centre, roles of aggregators and responsibilities of the Government, manufacturer and owner are enumerated. SSRP is an enabling Policy with the Ministry of Steel playing the role of a facilitator to establish scrapping eco-system for the entrepreneurs and investors to establish scrap centres in the country. The shredded scrap produced by recycling would be used as raw material for steel making. This will help reduce import dependency of scrap and boost imports substitution. The Policy will help transform the present p rocess of me t a l rec yc l ing fr om unorganized to organized sector. The ferrous scrap generated through recycling used for production of steel will help in judicious use of valuable natural resources like iron ore, coal and limestone, leading to Resource Efficiencies (RE) and energy savings and reduce GHG emission.

MSTC Limited, a CPSE under the Ministry of Steel, in Joint Venture (JV) with M/s Mahindra Accelo, has set up Mahindra MSTC Recycling Pvt. Ltd. (MMRPL) which has established six (6) Vehicle Scrapping Centres at Greater Noida (UP), Chennai, Pune, Indore, Ahmedabad and Hyderabad. MMRPL has planned to set up more Vehicle Scrapping Centres in the country in near future.

STRUCTURE AND ROLE OF INDIAN STEEL INDUSTRY

The important iron & steel units in India are Steel Authority of India, Rashtriya Ispat Nigam Limited, Tata Steel Group, AM/NS (erstwhile Essar Steel), JSW Steel and Jindal Steel & Power as well as large number of Mini Steel Plants based on Electric Furnaces & Energy Optimising Furnaces (EOF). Besides the steel producing units, there are a large number

of Sponge Iron Plants, Mini Blast Furnace units, Hot & Cold Rolling Mills & Galvanising/Colour Coating units which are spread across the country. The Secondary Steel Sector constitutes Electric Arc Furnace/ Induction Furnace, pig iron/sponge iron units, re- rolling units, HR units, CR units, galvanised/colour coated units, tin plate units, wire-drawing units, etc. for producing either semi-finished or finished steel.

The structure of the Indian Steel Industry in 2021-22 along with the production for 2020-21 to 2021-22 is furnished in Table-1. Production during the year 2017-18 to 2021-22 of iron & steel, crude steel, pig iron and total finished steel (Non-alloy + alloy + stainless) 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 reflected in Table-2 along with the production of sponge iron through gas-based & coal- based units. The production of iron & steel by Public and Private Sectors during 2017-18 to 2021- 22 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. The production of crude/liquid steel by BOF and Electric route (EAF/ IF) routes is given in Table-5 . Crude Steel Scenario Region / State -wise covering no. of units, annual capacity and production for the year 2021-22 is shown in Table 6. Prices of steel are provided in Table- 7.

Table – 1 : Structure of the Indian Steel Industry, 2020-21 & 2021-22

(Capacity/Production: In million tonnes)

Sector		Total Annual Capacity	2020-21	2021-22	
			Production	Production	% Capacity Utilisation
Crude Steel		**154.062**	**103.545**	**120.293**	**78%**
(A) Producer-wise					
SAIL, TSL GROUP, RINL, AM/NS, JSWL, JSPL		88.232	65.053	74.875	85%
Other Producers		65.83	38.491	45.419	69%
(B) Sector-wise					
Public Sector		26.932	19.575	22.636	84%
Private Sector		127.13	84.03	97.658	77%
Hot Metal		**84.834#**	**69.266**	**78.223**	**99.588# %**
Pig iron		NA	4.877	6.262	
Sponge Iron		49.273	34.376	39.2	79.56%
Total Finished Steel (Non alloy	**Total**	**NA**	**96.204**	**113.597**	
+ Alloy + stainless)	Total (Non-Flat)		48.725	59.564	
	Total (Flat)		47.478	54.033	
1) Finished Steel (Non-alloy)		**NA**	**90.608**	**106.615**	
A) Non-Flat Products		NA	45.157	54.998	
	Bars & Rods		37.171	46.338	
	Structural		6.494	7.314	
	Rly Material		1.493	1.346	
B) Flat Products		NA	45.451	51.617	
	PM Plates		4.246	5.355	
	HR Coil/Strip		41.204	46.262	
2) Finished Steel (Alloy)		**NA**	**3.326**	**4.17**	
A) Non-Flat Products		NA	2.99	3.832	
B) Flat Products		NA	0.336	0.337	
3) Finished Steel (Stainless)		**NA**	**2.269**	**2.812**	
A) Non-Flat Products		NA	0.577	0.733	
B) Flat Products		NA	1.692	2.078	

Source: Annual Statistics, 2021-22 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, 2017-18 to 2021-22

(In '000 tonnes)

Item/producers	2017-18	2018-19	2019-20	2020-21	2021-22(P)
I. Pig Iron : Total	**5728**	**6414**	**5421**	**4877**	**6262**
SAIL, TSL GROUP, RINL, AM/NS, JSWL, JSPL	726	1663	1193	1413	1462
Other Producers	5002	4751	4227	3464	4801
II. Sponge Iron : Total	**30511**	**34705**	**37102**	**34376**	**39200**
Gas based	6458	6899	6564	6175	8866
Coal based	24053	27806	30539	28201	30334
III. Crude Steel : Total	**103131**	**110921**	**109137**	**103545**	**120293**
SAIL, TSL GROUP, RINL, AM/NS, JSWL , JSPL					
Oxygen Route	41747	47412	46735	43947	52515
EAF Units	17639	21295	21647	21106	22359
Other Producers					
Oxygen Route	5645	2043	1838	1138	2070
EAF Route (incl.Corex & MBF / EOF)	8879	7181	6719	8301	8138
Induction Furnaces	29221	32990	32198	29052	35211
IV. Total Finished Steel (Non alloy +Alloy + Stainless)	**126855**	**101287**	**102621**	**96204**	**113597**
SAIL,TSL GROUP , RINL, AM/NS, JSWL, JSPL	69143	61283	61286	55322	65055
Other Producers	57712	40004	41336	40882	48542

Source: Annual Statistics, 2021-22 of Joint Plant Committee
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.

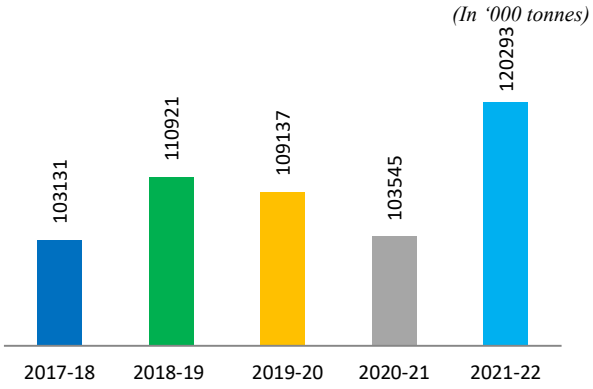


Fig 1: Production of Crude Steel 2017-18 to 2021-22

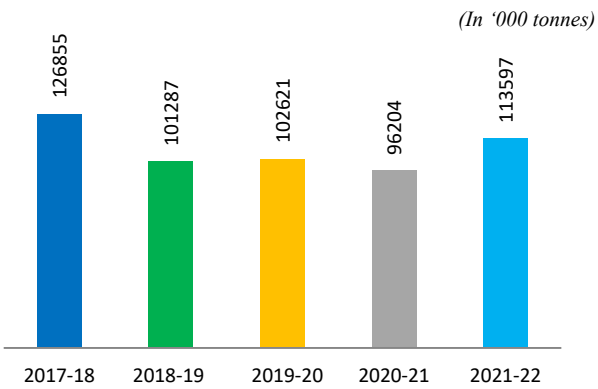


Fig 2: Production of Finished Steell 2017-18 to 2021-22

Table – 3 : Production of Iron and Steel, 2017-18 to 2021-22

(By Sectors)

(In '000 tonnes)

Item/producers	2017-18	2018-19	2019-20	2020-21	2021-22(P)
I. Pig iron : Total	**5728**	**6414**	**5421**	**4877**	**6262**
Public sector (SAIL+RINL)	364	588	614	669	634
Private sector (JSWL+JSPL+TSL Group	5364	5826	4807	4208	5628
Other Blast Furnace /Corex Unit)					
II. Hot Metal: Total	**68016**	**74376**	**73011**	**69266**	**78223**
Public sector (SAIL+RINL)	21115	23282	22598	21262	24508
Private sector (JSWL+JSPL+TSL Group/TSL	46901	51095	50413	48004	53714
+ AM/NS + Other Private Sector)					
III. Crude steel : Total	**103131**	**110921**	**109137**	**103545**	**120293**
Public sector (SAIL+RINL)	19753	21496	20905	19515	22636

(In '000 tonnes)

Item/producers	2017-18	2018-19	2019-20	2020-21	2021-22(P)
Private sector (TSL/TSL Group, AM/NS (ESL), JSWL, JSPL + Other BOF + Other EAF+ IF Units)	83378	89425	88232	84030	97658
IV. Finished steel (Non-Alloy+Alloy+ Stainless): Total	**126855**	**101287**	**102621**	**96204**	**113597**
Public sector (SAIL+RINL)	17944	16933	16029	13783	17579
Private sector {TSL/TSL Group + AM/NS (ESL) +JSWL+JSPL+Other Producers}	108911	84353	86593	82420	96017

Source: Annual Statistics, 2021-22 of Joint Plant Committee
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, 2020-21 and 2021-22

(By Principal Producers)

(In '000 tonnes)

Unit	Annual installed capacity		Production			
			Hot metal		Crude steel	
	Hot metal	Crude/ Liquid steel	2020-21	2021-22	2020-21	2021-22
Public Sector						
SAIL	-	20632	16581	18734	15213	17363
Rashtriya Ispat Nigam Ltd (Andhra Pradesh)	-	6300	4681	5774	4302	5272
Private Sector	-					
JSW Steel Ltd	-	23000	14389	16794	14780	18023
TSL Group	-	20600	17775	19405	17204	19464
AM/NS (Essar Steel Ltd)	84834*	9600	3331	3335	6696	7295
Jindal Steel & Power Ltd	-	8100	5862	6068	6859	7458
Others	-	65831	7281	6647	38491	45419
Other BOF	-	3177	-		1786	2070
Other EAF	-	11614	-		7653	8138
IF Units	-	51040	-		29052	35211

Source: Annual Statistics, 2021-22 of JPC ; # : Combine Capacity pig Iron & Hot metal

Table – 5 : Production of Crude/Liquid Steel, 2017-18 to 2021-22

(By Route)

(In '000 tonnes)

Route/plant	2017-18	2018-19	2019-20	2020-21	2021-22
All Routes: (A+B) Total	**103131**	**110921**	**109137**	**103545**	**120293**
A. Oxygen Route : Total	47392	49455	48573	45085	54585
SAIL	14829	16045	15946	15054	17153
RINL	4731	5233	4749	4302	5272
Tata Steel Ltd	12459	-	-	-	-
TSL Group	-	16038	16399	15811	17215
JSPL	-	-	-	-	2495
JSW Steel Ltd	9728	10096	9641	8780	10380
Other Oxygen Route	5645	2043	1838	1138	2070
B. Electric Route: Total	**55739**	**61466**	**60564**	**58460**	**65708**
Electric Arc Furnace	**26518**	**28476**	**28367**	**29407**	**30498**
SAIL	193	218	210	158	210
TSL Group	-	2363	2126	1392	2249
AM/NS (Essar Steel Ltd)	6753	6813	7121	6696	7295
JSW Steel Ltd	6679	6647	6329	6000	7643
Jindal Steel & Power Ltd	4014	5254	5861	6859	4963
Lloyds Steel Ltd	560	518	495	452	681

Table-4 Concld....

(In '000 tonnes)

Route/plant	2017-18	2018-19	2019-20	2020-21	2021-22
Jindal Stainless Ltd	1497	1554	1418	1458	1812
Bhushan Steel Ltd	87	-	-	-	-
Bhushan Power & Steel Ltd	2018	2778	2901	3754	2720
Other Electric Arc Furnace	4717	2331	1905	2638	2926
Electric Induction Furnace	**29221**	**32990**	**32198**	**29052**	**35211**

Source :- Annual statistics 2021-22 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: 2021-22

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**	**36**	**847**	**901**	**66295**	**36728**	**51040**	**154062**	**54585**	**30498**	**35211**	**120293**
Eastern Region	**9**	**12**	**135**	**156**	**35577**	**9257**	**12941**	**57775**	**32918**	**8199**	**8831**	**49949**
Arunachal Pradesh	-	-	1	1	-	-	72	72	-	-	69	69
Assam	-	-	8	8	-	-	163	163	-	-	108	108
Bihar	-	-	12	12	-	-	812	812	-	-	529	529
Jharkhand	3	1	22	26	17477	1000	2029	20506	15011	684	1399	17094
Meghalaya	-	-	6	6	-	-	201	201	-	-	56	56
Odisha	4	7	46	57	13400	7676	3511	24587	13451	7129	2660	23241
Tripura	-	-	1	1	-	-	30	30	-	-	17	17
West Bengal	2	4	39	45	4700	581	6122	11403	4456	386	3994	8836
Western Region	**2**	**15**	**255**	**272**	**12000**	**23682**	**18586**	**54268**	**5594**	**18604**	**12538**	**36735**
Chhattisgarh	1	5	89	95	7000	6303	7597	20900	4875	4294	5731	14900
Dadra and Nagar Haveli	-	-	14	14	-	-	286	286	-	-	253	253
Daman and Diu	-	-	3	3	-	-	50	50	-	-	46	46
Goa	-	-	10	10	-	-	495	495	-	-	407	407
Gujarat	-	2	73	75	-	9750	3762	13512	-	7321	1868	9189
Madhya Pradesh	-	-	13	13	-	-	987	987	-	-	569	569
Maharashtra	1	8	53	62	5000	7630	5409	18038	718	6990	3663	11370
Northern Region	**0**	**7**	**268**	**275**	**0**	**1609**	**10950**	**12558**	**0**	**1200**	**7630**	**8831**
Delhi	0	0	2	2	0	0	16	16	0	0	5	5
Haryana	0	3	12	15	0	847	209	1056	0	776	165	941
Himachal Pradesh	0	0	26	26	0	0	1740	1740	0	0	1265	1265
Jammu & Kashmir*	0	0	8	8	0	0	189	189	0	0	146	146
Punjab	0	4	113	117	0	762	4744	5506	0	424	3239	3663
Rajasthan	0	0	28	28	0	0	933	933	0	0	621	621
Uttar Pradesh	0	0	39	39	0	0	1606	1606	0	0	1197	1197
Uttarakhand	0	0	40	40	0	0	1512	1512	0	0	991	991
Southern Region	**7**	**2**	**189**	**198**	**18718**	**2180**	**8564**	**29462**	**16072**	**2494**	**6212**	**24778**
Andhra Pradesh	2	0	18	20	6600	0	1912	8512	5567	-	1529	7096
Karnataka	4	1	21	26	11118	2000	1131	14249	9764	2376	906	13046
Kerala	0	0	27	27	0	0	473	473	0	0	325	325
Puducherry (UT)	0	0	10	10	0	0	451	451	0	0	215	215
Tamil Nadu	1	1	86	88	1000	180	2564	3744	742	119	1773	2634
Telangana	0	0	27	27	0	0	2033	2033	0	0	1464	1464

** Jammu & Kashmir,vide enactmentof Jammu & Kashmir Reorganisation Act,2019, is a Union Teritory*

Table – 7: Prices of Steel, 2018-19 to October 2023

(Domestic Markets)

(In ₹ per tonne)

Grade	Market	2018-19	2019-20	Oct-23
MS Squares (8 mm)	Delhi	45044	50525	62200
MS Angles (25 x 3 mm)	"	45135	50265	62700
Channels (75 x 40 mm)	"	44827	49560	62400
Joists (150 x 75 mm)	"	44546	51325	60700
Melting Scrap	"	26217	39775	39200
Induction Ingots	"	35698	33517	48200
				Contd.....
TMT Bars (local-8 mm)	Mumbai	44998	43838	62000
MS Rounds (8 mm)	"	43658	42258	60000
MS Angles (40 x 6 mm)	"	46071	44619	62000
Joists (150 x 75 mm)	"	44538	42977	59000
Melting Scrap (Foundry G.)	"	-	-	47150
Melting Scrap (Steel G.)	"	-	-	48000
Melting Scrap (CRCA)	"	-	-	44575
Induction ingots	"	36119	33170	47200
Arc Ingots	"	36238	33835	48000
Concast Billet ingots	"	36529	34148	48000
TMT Bars (ISI, 8 mm)	Kolkata	46447	45398	56800
MS Squares (8 mm)	"	45726	44944	55000
MS Angles (25 x 3 mm)	"	45242	44773	61000
Channels (75 x 40 mm)	"	47124	44898	62500
Joists (150 x 75 mm)	"	44633	43079	58000
Induction Ingots	"	36190	33982	48000
Arc Ingots	"	36329	34257	48500
Concast Billet Ingots	"	36433	34444	48000
Induction Ingots (round)	Gobind	35970	31693	47000
Blooms (SAIL, 150 mm)	"	36016	31660	48000
Old Ship Breaking Scrap	"	29510	29126	51000
Melting Scrap (Rolling)	"	33271	28166	40950
MS Rounds (10 mm)	"	45075	43367	51800
MS Squares (8 mm)	"	47033	46018	56000
MS Angles (25 x 3 mm)	"	45313	44051	52000
MS Sponge Iron	"	26529	24566	35000
MS Flat (3 x 20 mm)	"	45300	43339	55000
Pig Iron (Foundry Grade) –A*	Mumbai	-	-	49750
Pig Iron (Foundry Grade) –B**	Punjab	-	-	47125
Pig Iron Steel Grade	Punjab	-	-	41500

Source: Minerals & Metals Review : November-2023
A : Low Sulphur/Phosphorus, i.e., 0.09% max. which is used in Critical automotive engine components & specialise casting.*
*B** : High Sulphur/Phosphorus, i.e., above 0.09% which is used in Non-critical castings.*
1. Prices are inclusive of GST. 2. All rates are monthly averages and indicatives.
3. Gobind = Mandi Gobindgarh in Punjab; FG stands for Foundry Grade & SG stands for Steel Grade.
4. MMR Pig Iron & Scrap prices are Basic Rates (Additional 18% GST & Frieght as applicable)

A.Crude Steel

At 120.293 million tonnes (mt) in 2021-22, India's crude steel production increased by 16.2 % as compared to 103.54 million tonnes in 2020-21. Given the above production for 2021-22 and with capacity at 154.062 million tonnes, crude steel capacity utilisation stood at 78% during 2021-22 as compared to 72% of last year. The Crude Steel working Capacity and Capacity Utilisation during the last five years are furnished at Table- 8.

Table- 8: Production and Working Capacity Crude Steel (2017-18 to 2021-22)

(Quantity in million tonnes)

Year	Working capacity	Production	% Utilisation capacity
2017-18	137.975	103.131	75%
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%

Source: JPC Performance Review Iron & steel 2021-22
Figures rounded off.

With 81 % share, the Private Sector produced 97.658 million tonnes crude steel in 2021-22. In fact, India's crude steel production has been consistently led by the Private Sector in the last five years.

With a 62% share, SAIL, RINL, TSL Group, AM/NS, JSWL & JSPL together produced 74.874 million tonnes of crude steel in 2021-22, while the rest 38% was the share of the other producers during this period.

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 66.295 million tonnes and produced 54.585 million tonnes of crude steel through BOF route in 2021-22 at 82 % 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 36 working units with total capacity of 36.728 million tonnes and produced 30.498 million tonnes crude steel through EAF route in the year 2021-22 at 83 % 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 847 IF working units with total capacity of 51.040 million tonnes which produced 35.211 million tonnes crude steel through IF route in 2021-22 at 69 % 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	2017-18	2018-19	2019-20	2020-21	2021-22
BOF	47.392	49.455	48.573	45.085	54.585
EAF	26.518	28.476	28.367	29.407	30.498
IF	29.221	32.99	32.198	29.052	35.211
Total	**103.131**	**110.921**	**109.137**	**103.545**	**120.293**

Source : Performance Review Iron & Steel 2021-22, 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 : Percentage wise Process route share in total Production

Process Route	2017-18	2018-19	2019-20	2020-21	2021-22
BOF	46	44	45	44	46
EAF	26	26	26	28	25
IF	28	30	29	28	29

Source : Performance Review Iron & Steel 2021-22, JPC

B. Hot Metal

At 78.223 million tonnes in 2021-22, hot metal production increased by 12.9% over 2020-21.

With 69% share, the Private Sector produced 53.714 million tonnes hot metal in 2021-22. In 2021-22 , with a 90% share, SAIL, RINL, TSL Group, AM/NS , JSWL and JSPL together produced 70.111 million tonnes, a growth of 12% as compared to that in 2020-21. The other producers produced 8.112 million tonnes hot metal in the year 2021-22 which also showed a growth of 22% as compared to that in 2020 - 21.

C. Total Finished Steel (Crude SteeL Equivalent)

1. Trend in Production of Total Finished Steel

In the year 2021-22, the production of finished steel, measured in terms of crude steel equivalent, stood at 113.597 million tonnes showing a growth of 18% over last year.

With a 85% share, the Private Sector produced 96.017 million tonnes finished steel equivalent in 2021- 22 while 15% (17.579 million tonnes) was the share of the Public Sector during this period. In fact, India's production of finished steel has been consistently led by the Private Sector in the last five years.

With a 57% share, SAIL, RINL, TSL Group, AM/ NS, JSWL, JSPL taken together produced 65.055 million tonnes of finished steel in 2021-22 while other producers shared rest 43% (48.542 million tonnes) during the period. In fact, the trend of last five years ending 2021-22 indicates that India's production of total finished steel is driven by these six producers taken together.

Non-alloy Finished steel production during this period was 106.615 million tonnes, while 4.170 million tonnes and 2.812 million tonnes were those of alloy and stainless steel, respectively.

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 Non-flat Segment stood at 54.998 million tonnes.

•While that of the Non-alloy Finished Steel flat Segment stood at 51.617 million tonnes.

•Contribution of the Alloy Steel Non-flat Segment stood at 3.832 million tonnes.

•While that of the Alloy Steel Flat Segment stood at 0.337 million tonnes.

•Contribution of the Stainless Steel Non-flat Segment stood at 0.733 million tonnes

•While that of the Stainless Steel Flat Segment stood at 2.078 million tonnes.

Analysing by segments within this broad group, it can be noted that —

•In the Non-flat, Non-alloy Segment,

production of bars & rods stood at 46.338 million tonnes while production of Structural and Rly. Materials 7.314 million tonnes and 1.346 million tonnes respectively.

•For the Flat Non- alloy Segment, the production of Plate Mill Plates stood at 5.355 million tonnes while production of HR Coil/Strip stood at 46.262 million tonnes.

•In the Non-flat, Alloy Steel Segments, the overall production of all items stood at 3.832 million tonnes.

•Flat alloy Steel production stood at 0.337 million tonnes.

•In the Non-flat, Stainless Steel Segment, the overall production of all items stood at 0.733 million tonnes.

•Flat Stainless Steel production stood at 2.078 million tonnes.

2. Trends in Consumption of Total Finished Steel

Finished Steel consumption stood at 105.752 million tonnes in 2021-22 as compared to 94.891 million tonnes during 2020-21, showing a growth of

11.4 %. Data on overall consumption of total finished steel (non-alloy + alloy + stainless) during the last five years is provided in Table-11 which indicates a steady growth in domestic steel consumtion during this period, barring only 2020-21 when pandemic-induced slump took a toll on domestic consumption of finished steel. Table-12 highlights the growth pattern yoy alongwith percentage share of domestic total finished steel consumption in terms of non-alloy, alloy & stainless in the year 2020-21 and 2021-22.

Table – 11 : Total Finished Steel Consumption (Non-alloy + alloy + stainless steel)

(2017-18 to 2021-22)

(In '000 tonnes)

Year	Total Finished Steel Consumption	% yoy change
2017-18	90706	7.9
2018-19	98708	8.8
2019-20	100171	1.5
2020-21	94891	-5.3
2021-22	105752	11.4

Source : Performance Review Iron & Steel 2021-22, JPC

(In '000 tonnes)

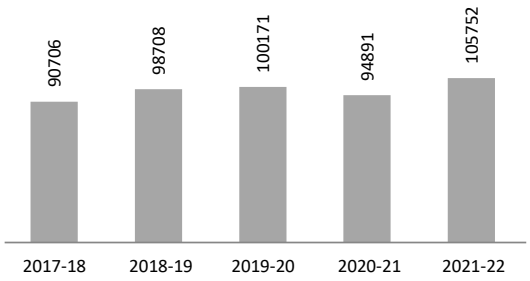


Fig 4:Total Finished Steel Consumption 2017-18 to 2020-22

Table- 12 : Total Finished Steel Consumption - Non-alloy / alloy / stainless steel wise Crude Steel Equivalent (2020-21 to 2021-22)

(In '000 tonnes)

ITEM	2020-21		2021-22		% yoy Change
	Qty	% share	Qty	% share	
Total Finished Steel (Non alloy+ alloy + stainless)	**94891**	**-**	**105752**		**11.4**
Non-alloy Finished Steel	88667	93.4	98194	93	10.7
Alloy Finished Steel	3833	4	4514	4	17.8
Stainless steel	2392	2.6	3044	3	27.2

Source : Performance Review 2021-22, JPC

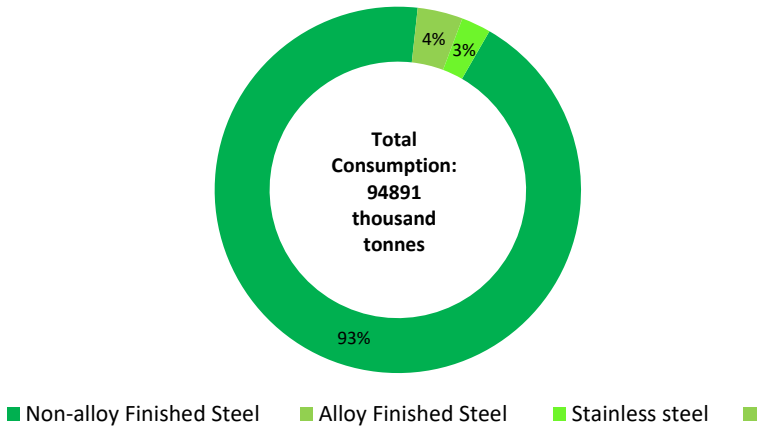


Fig 5: Percentage share of Total Finished Steel Consumption –Non-alloy / alloy / stainless steel wise 2020-21 to 2021-22

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 2020-21 and 2021-22. Both these components include non-alloy, alloy and stainless steel constituents as well.

Table- 13 : Total Finished Steel Consumption— Non - flat/Flat wise Crude Steel Equivalent (2020-21 to 2021-22)

(include non-alloy + alloy + stainless)

(In '000 tonnes)

ITEM	2020-21		2021-22		% yoy Change
	Qty	% share	Qty	% share	
Total Finished Steel (Non Flat+ Flat)	**94891**		**105752**		**11.4**
Non-Flat Finished Steel	51354	54.1	58780	55.6	14.5
Flat Finished Steel	43537	45.9	46972	44.4	7.9

Source : Annual Statistics 2021-22; JPC, Performance Review 2021-22 JPC

Table-14 shows detailed consumption data for major categories of finished steel in 2020-21 over 2021-22 in terms of crude steel equivalent of finished steel as per the present reporting system.

Table – 14 : Detailed Consumption for Major Categories of Total Finished Steel in 2020-21 & 2021-22

(Crude Steel Equivalent)

(In '000 tonnes)

ITEM	2020-21	2021-22	% yoy Change
Total Finished Steel (Non-alloy + Alloy + Stainless)	**94891**	**105752**	**11.4**
1. Finished Steel (Non-alloy)	88667	98194	10.7
a) Non-Flat Products	47789	54665	14.4
Bars & Rods	39679	46017	16
Structural	6562	7229	10.2
Rly Material	1548	1419	-8.3
b) Flat Products	40878	43529	6.5
PM Plates	4242	4651	9.6
HR Coil/Strip	36635	38878	6.1
2. Finished Steel (Alloy)	3833	4514	17.8
a Non-flat Products	3099	3543	14.3
b) Flat Products	734	971	32.3
3. Finished Steel (Stainless)	2392	3044	27.3
a) Non-flat Products	466	572	22.7
b) Flat Products	1925	2472	28.4

Source : Annual Statistics 2021-22; JPC & Performance Review 2021-22.

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 2021-22 was reported as 84.834 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 6.262 million tonnes in 2021-22, a growth of 28.4% as compared to the production of 4.877 million tonnes in the last year.

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

Contd.....

Table-15 Concld....

Sl.No.	Plants/unit	Location	Capacity
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
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

Source : JPC

Table-16 : State-wise Capacity and Production of Hot metal and Pig Iron (2021-22)

(In '000' tonnes)

State	No.of working Units	Working Capacity	Annual Production	
			Hot metal	Pig Iron
Jharkhand	8	16835	17084	496
Odisha	11	17954	17692	1250
West Bengal	13	6852	6112	1697
Andhra Pradesh	4	7140	6467	470
Karnataka	5	13223	12774	1041
Tamil Nadu	1	1000	1048	21
Chhattisgarh	4	8238	8314	442
Goa	1	625	474	789
Gujarat	2	3767	3458	5
Maharashtra	3	9200	4799	52
Total	**52**	**84834**	**78223**	**6262**

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. With 90 % share, the Private Sector (5.628 million tonnes, up by 33.7 % over 2020- 21) led pig iron production in 2021-22, with the average share of the Sector at 90% in the last five years ending 2021-22. The share of Public Sector in 2021-22 was about 10 % (0.634 million tonnes, down by 5 % over previous year).

With a 77 % share, the Other Producers (4.801 million tonnes, up by 38.6% over 2020-21) led pig iron production in 2021-22 while the rest 23 % was the share contributed by SAIL, RINL, TSL Group, AM/NS(Essar Steel), JSWL, JSPL taken together.

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 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 49.273 million tonnes in 2021-22. The total number of working units is 288 out of which 284 are coal-based units and 4 are gas-based units. The DRI operating capacity got increasingly built up during 2015-16 to 2021-22. At 39.2 million tonnes in 2021-22, India's sponge iron production was up by 14% over that of 2020-21.

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 77.4% (30.334 million tonnes, up by 7.5%) of total sponge iron production in the country in 2021-22, with the average share of the Route at 80% in the last five years ending 2021-22. State-wise capacity and production of sponge iron are reflected in Table- 17.

Table-17: State-wise Capacity and Production of Sponge Iron (2021-222)

(In '000' tonnes)

State	No.of working Units	Working Capacity	Annual Production
Total	**288**	**49273**	**39200**
Western Region	**90**	**21044**	**16666**
Chhattisgarh	69	9284	8217
Goa	3	221	217
Gujarat	9	8027	6151
Maharashtra	9	3512	2080
Eastern Region	**135**	**21273**	**17188**
Jharkhand	24	3443	2431
Odisha	76	12508	9675

Contd.....

Table-15 Concld....

State	No.of working Units	Working Capacity	Annual Production
West Bengal	35	5323	5082
Northern Region	**4**	**537**	**385**
Uttar Pradesh	4	537	385
Southern Region	**59**	**6419**	**4961**
Andhra Pradesh	5	761	438
Karnataka	38	4643	3784
Tamil Nadu	6	528	342
Telangana	10	487	397

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- 18: Indian Iron & Steel Industry at a Glance : 2021-22

(In '000' tonnes)

Sl. No.	Type of Industry	No.of working Units	Working Capacity ('000 tonnes)	Production ('000 tonnes)
I	**Pellets**	**40**	**105966**	**79021**
II	**Sponge Iron**	**288**	**49273**	**39200**
III	**Blast Furnace(Hot Metal & Pig Iron)**	**52**	**84834**	**78223(Hot Metal)**
				6262(Pig iron)
IV	**Crude Steel (1-3)**	**901**	**154062**	**120293**
	1 BOF	18	66295	54585
	2 Electric Arc Furnace	36	36728	30498
	3 Induction Furnace	847	51040	35211
V	**Finished Steel (Crude Steel to Finished Steel Equivalent)**			
	4 Re-rolling (Non Flat & Flat)	1053	92736	60590 (Non Flat)
				3230(Flat)
	5 HR Product(PM Plate & HR Coils)	22	60075	49777
VI	**Value - added steel**			
	6 HR Product (HR Sheets & HSM Plates)	22	60075	3060
	7 CR Product	72	28483	20603
	8 GP/GC Sheets	29	11442	8126
	9 Colour Coated	18	3641	2541
	10 Tin plate	5	849	606
	11 Pipes	106	10823	3898

Source : Annual Statistics 2021-22; 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 form of scrap, i.e., end-of-life cycle scrap or obsolete scrap 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. There is a worldwide trend to increase steel production using scrap as the main raw material because recycling of scrap helps in conservation of vital natural resources besides other

numerous benefits. The use of every ton of scrap shall save 1.1 ton of iron ore, 630 kg of coking coal and 55 kg of limestone.

There shall be considerable saving in specific energy consumption also as the same will reduce from around 14 MJ/Kg in BF/BOF route to less than 11 MJ/ Kg in EAF/ IF route, i.e. savings in energy by 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.

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.

Currently, there are 153 plots at Alang where ageing ships are beached to be broken down. Alang is currently equipped to recycle 400-450 ships a year. On an average it has been producing 3.5 million tonnes of steel annually from recycling about 200 ships.

The Government of India, Ministry of Ports, Shipping and Waterways has notified recycling of Ships Act, 2019 to provide for the regulation of recycling of ships by setting certain international standards and laying down statutory mechanism for enforcement of such standards. The Government has also decided to accede to the Hong Kong International Convention for Safe and Environmentally Sound Recycling of Ships, 2009. Accordingly, India has acceded to Hong Kong International Convention for Safe and Environmentally Sound Recycling of Ships, 2009 on 28th November, 2019. This Act restricts and prohibits the use or installation of hazardous materials, which applies irrespective of whether a ship is meant for recycling or not. The Act imposes a statutory duty on ship recyclers to ensure safe and environmentally sound removal and management of hazardous waste from ship. Further , accession to Hong Kong Convention by India and enactment of Recycling of Ships Act, 2019 will raise the profile of Indian Ship Recycling Industry as being environment-friendly and safety conscious and would go a long way in consolidating India's position as market leader.

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 channelising 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.

SLAG — IRON & STEEL

Slag is a by-product generated during manufacturing of pig iron and steel. It is produced by action of various fluxes upon gangue materials within the iron ore during the process of

pig iron making in blast furnace and steel manufacturing in steel melting shop. Primarily, slag consists of calcium, magnesium, manganese and aluminium silicates and oxides in various combinations. The cooling process of slag is responsible mainly for generating different types of slags required for various end-use consumers. Although the chemical composition of slag may remain unchanged, physical properties vary widely with the changing process of cooling.

In an integrated steel plant, 2-4 tonnes of wastes (including solid, liquid and gas) are generated for every tonne of steel produced. The major wastes produced in integrated steel plants (ISP) include BF iron slag. Steel slag accounting for nearly more than half a tonne gets generated for each tonne of steel produced in ISPs. Among all the solid/liquid wastes, slags generated at iron making and steel making units are in such a large quantities that management of slag has become a critical component of steel production. Over the last few years, with better understanding of slags, its functions and improvements in process technologies have led to a significant reduction in the volume of slag generated. At the same time, the re-use of iron and steel has led to a significant reduction in the environmental impact of these by- products.

The slag produced at blast furnace during pig iron manufacturing is called blast furnace slag. The slag produced at steel melting shop is known as steel slag. Slag output obtained during pig iron and steel production is variable and depends mainly on composition of raw materials and type of furnace. Typically, for ore feed containing 60 to 65% iron, blast furnace (BF) slag production ranges from about 300 to 540 kg per tonne of pig or crude iron produced, whereas in steel making 150 to 200 kg per tonne of slag is generated per tonne of liquid steel. Lower grade ores yield much higher slag fractions, sometimes as high as one tonne of slag per tonne of pig iron produced. Steel slag output is approximately 20–30% by mass of the crude steel output in the country.

Ferro Scrap Nigam Ltd (FSNL), a wholly owned subsidiary of MSTC Ltd renders its specialised services of scrap and slag management to plants at SAIL-Rourkela, Burnpur, Bhilai, Bokaro, Durgapur, Bhad ravati, Salem, RINL- Visakhapatnam, NINL-Duburi, BHEL-Haridwar, RWF (Rail Wheel Factory) -Bengaluru, Air India- Mumbai and Essar-Hazira.

The information regarding plant-wise capacity of iron & steel slag in the country is reflected in Table- 19.

Table – 19 : Plant-wise Capacity of Iron and Steel Slag in the Country

Steel Plant	Capacity
	('000 tpy)
Bhilai Steel Plant, Durg, Chhattisgarh	2675
Bokaro Steel Plant, Bokaro, Jharkhand	7884
Rourkela Steel Plant, Rourkela, Odisha	1570
Durgapur Steel Plant, Durgapur,West Bengal	566
IISCO Steel Plant, Burnpur, West Bengal	400
	kg/THM*
Visvesvaraya Iron & Steel Plant,	400
Bhadravati, Karnataka	kg/THM*
Rashtriya Ispat Nigam Ltd,	
Visakhapatnam, Andhra Pradesh	1440
IDCOL Kalinga Iron Works Ltd,	
Barbil, Odisha	53
JSW Steel Ltd, Ballari, Karnataka	NA
Tata Steel Ltd, Jamshedpur, Jharkhand	2100
Visa Steel Ltd, Kalinganagar, Odisha	175
Neelachal Ispat Nigam Ltd	-
Kalinganagar, Odisha	

Blast Furnace Slag

In the blast furnace, the slag floating over molten pig iron (hot metal) is flushed out in slag pot and then sent to slag granulating plant or to cooling pits.

Depending upon the cooling process, three types of slags are generated, namely, air-cooled slag, granulated slag and expanded slag.

Air-cooled slag is produced by allowing the molten slag to cool under atmospheric conditions in a pit. Under slow cooling conditions, escaping gases leave behind porous and low-density aggregates with special physical properties, making it suitable for many applications. When formed under controlled cooling, the slag tends to be hard and dense, making it especially suitable for use in ready-mixed concrete, concrete products, road bases and similar applications in construction.

Granulated slag is produced by quenching the molten slag by means of high-pressure water jets. Quenching prevents crystallisation, thus resulting in granular, glassy aggregates. This slag is crushed, pulverised and screened for use in various applications, particularly in cement production because of its pozzolanic characteristics. Steel plants utilise cold slag for internal consumption and also for outside sale. The slag after cooling is crushed and used as road metal and railway ballast. Granulated slag produced in steel plants is also sold outside to cement plants. Slag application also reduces the overall cost of production of cement.

Expanded slag is formed through controlled cooling of molten slag in water or water with combination of steam and compressed air. Formation of steam and other gases enhances the porosity and vesicular nature of slag, resulting in light weight aggregate suitable for use in concrete. However, expanded slag is not produced at any domestic iron and steel plant.

Another product made from blast furnace slag is mineral wool/slag wool. Cooled slag for this purpose is melted and poured through an air stream or a jet of dried stream of other gases to produce a spray of molten droplets or the same is also formed by passing the melt through a perforated or fast-spinning disc. The droplets, elongate to long fibres, are collected mechanically and layered. The material has excellent thermal insulation properties.

The five different slags generated at various points of the steel-making process are described below:

HMT Slag: This slag is primarily generated after de-siliconisation or de-phosphorisation treatment. It has high content of silica and lime. Sometimes it also contains BF slag.

HMDS Slag: This is the raked slag at the de-sulfurisation station. These slags are poorly mixed composites of spilled BF slag, spent and/or unreacted de-sulphurisation agents, lime fines and trapped droplet of hot metal and raked iron.

LD Slag: These slags are a well mixed aggregate of FeO, lime, silica and MgO generated at the LD converter. They are in the form of di-calcium and tri- calcium silicates. These slags also contain free lime and metal, which create problems due to expansion characteristics.

Steel Slag: These slags vary in composition with respect to the varied treatment. The common steel slags are fused calcium aluminates with less than 2% (FeO+MnO). These readily crumble to dust due to allotropic phase transformation at lower temperatures and are difficult to manage.

SGP Slag: LD slag is subjected to granulation through a quenching technology adopted at JSW, which houses the first of its kind in India. Due to sudden quenching of the molten slag, contraction of metal and slag occurs and results in good separation of metal and slag. Adequate granulation takes place and leads to good stability of the final slag. Process can be described as an accelerated ageing process that reduces the free lime content. As a result of rapid cooling, it generates more glassy structure than the BOF slag. Removal of free lime also confirms its volumetric stability.

Steel Slag

BOF slag, commonly known as steel slag, is another waste from Iron & Steel Industry. It has shown potential for use as a raw mix component up to 10% in the manufacture of cement clinker. Steel slag can also replace granulated blast furnace slag up to 10% in the manufacture of Portland Slag Cement. Steel slags are produced at steel melting shop during steel manufacturing. To produce steel, removal of excess silicon and carbon from iron is achieved through oxidation by adding limestone and coke. The steel slag contains higher amount of iron and its physical characteristics are similar to air-cooled iron slag. The LD slag is cooled, crushed and screened. The fines are utilised in sinter making and lumps are charged in the blast furnace.

The iron content is the major basic difference between BF slag and steel slag. In BF slag, FeO is around 0.70%, whereas in case of steel slag, the total iron content varies from 16 to 25%.

JSW Steel has set up a unique BOF slag granulation plant, producing slag with lower free lime content and is vigorously pursuing the matter with BIS. JSPL has set up a plant to produce around 4.0 lakh brick products/day by utilising fly ash and slag generated from integrated steel plant.

Uses of Slag

Slag, based on their types, has different uses. The air-cooled BF slag is crushed, screened and used mainly as road metal and bases, asphalt paving, track ballast, landfills and concrete aggregate. The expanded or foamed slag binds well with cement and is used mainly as aggregate for light weight concrete. However, it is not produced by domestic steel plants. Granulated BF slag is used as a pozzolanic material for producing portland slag cement. It is also used for soil conditioning. BF slag is used in making mineral wool for insulation purposes.

Steel slag has found use as a barrier material remedy for waste sites where heavy metals tend to leach into the surrounding environment. Steel slag forces the heavy metals to drop out of solution in water run off because of its high oxide mineral content. Steel slag has been used successfully to treat acidic water discharges from abandoned mines.

Slags are useful alternative raw material for clinker production and such use can reduce a cement plant's fuel consumption and overall emission of carbon dioxide per tonne of cement.The granulated slag obtained from various steel plants is dried in slag dryer. The clinker is ground in ball mill with 40–50% dry slag and 6% gypsum. The resultant product is portland slag cement. Portland blast

furnace slag cement contains up to 60% ground granulated slag from steel production processes.

Slag cement has low heat of hydration, low alkali aggregate reaction, high resistance to chlorides and sulphate and it can substitute the use of 43 and 53 grades of ordinary Portland Cement. For other consuming sectors like road making, landfilling and ballasting, the cooled slag is crushed by machines or broken manually by hammers into smaller pieces and supplied to the various end-use consumers. The utilisation of SMS (particularly LD) slag is limited due to its (i) Phosphorous content (ii) high free lime content and (iii) higher specific-weight.

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 2021 was about 1,443 million tonnes which increased marginally by about 2% as against 1,418 million tonnes in 2020. China (60%), India (8%), Japan (5%), Russia (4%), Republic of Korea (3%) and Iran, Brazil, Germany & USA (2%-each), were the main producers of pig iron including sponge iron and direct reduced iron (DRI) (Table-20).

Table – 20 : World Production of Pig Iron

(By Principal Countries)

(In tonnes)

Country	2019	2020	2021
World Total	**1383000000**	**1418000000**	**1443000000**
China	809365000	888976100	868600000
India	111574000	101400000	116600000
Japan	74907006	61600469	70344478
Russia	51200000	52000000	53900000e
Korea, Rep. of	47521000	45359000	46440000
Iran	31000000	33300000	32500000
Brazil	30901000	29655000	28500000
Germany	25400000e	25500000e	26200000
USA	22301000	21700000	23400000e
Ukraine	20055900	20238000	21200000
Other countries	159094862	138109553	155621107

Figures rounded off ;
Source: BGS, World Mineral Production, 2017-2021
** India's production of Pig Iron during 2019-20, 2020-21 and 2021-22 was 54,21,000 tonnes, 48,77,000 and 62,62,000 tonnes, respectively.*
Note: The data in this table include sponge iron and direct reduced iron (DRI),where these have been separately identified.

The world crude steel production in 2021 marginally increased by about 3% to 1,915 million tonnes from 1,863 million tonnes in 2019. China was the top producer accounting for 54% of world's crude steel production, followed by Japan & India (5% each), USA, Russia & Republic of Korea (4% each), and Turkey, Germany & Brazil (2% each) (Table-21).

Table – 21 : World Production of Steel Crude

(By Principal Countries)

(In tonnes)

Country	2019	2020	2021
World Total	**1857000000**	**1863000000**	**1915000000**
China	996342000	1064766800	1032790000
Japan	99284114	83186485	96032787
India[(d)]	102058000	95122000	93800000[e]
USA	87761200	72732100	85800000[e]
Russia	73740141	74600000e	77850000[e]
Korea, Rep. of	71411000	67082000	70418000
Turkey	33743100	35810300	40360000
Germany	39667000	35658000	40000000

Contd....

Table-21 Concld....

Country	2019	2020	2021
Brazil	32569000	31415000	36039400
Italy	23190000	20379000	24413000
Other countries	297534411	282067772	317057982

Figures rounded off;
Source: BGS, World Mineral Production, 2017-2021,
** India's production of crude steel during 2019-20, 2020-21 and 2021-22 was 1,09,137,000 tonnes, 1,03,545,000 and 1,20,293,000 tonnes, respectively.*
(d) Years ended 31st March following that stated.

Exports

In terms of value, exports of iron & steel (total) increased by 66 % to ₹ 2,03,435 crore in the year 2021-22 from ₹ 1,22,510 crore in the previous year. Iron & Steel exports in 2021-22 comprised mainly of Semi-finished Steel (including Steel Ingots) with ₹ 87,497 crore (43%) and Finished Steel Including Cold Rolled Sheet with ₹ 60,774 crore (30%) and Other Finished Steel, NES with ₹ 46,463 crore (23%). Other items together accounted for the remaining 4% exports. In terms of value, exports of iron & steel in the year 2021-22 were mainly to USA (12%), Italy (8%), Belgium & UAE (6% each), Nepal & Vietnam (5% each), Turkey (4%) and China, UK & Germany (3% each) (Tables- 22 to 32).

While in terms of quantity, the exports of Pig and Cast Iron including Spiegeleisen increased by 11 % to 1,251 thousand tonnes in 2021-22 from 1, 124 thousand tonnes in the previous year. Exports were mainly to China (27 %), USA (21 %), followed by Taiwan (9%), Turkey & Oman (8% each) (Table- 33)

However, in terms of quantity, the exports of slag (dross, etc.) in 2021-22 increased by 90 % to about 290 thousand tonnes from 153 thousand tonnes in the previous year. Exports were mainly to Philippines (51%), Vietnam (23%), Malaysia (14%), and Nepal & China (4 % each) (Table-34).

Table – 22 : Exports of Iron & Steel (Total)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**1225105321**	**	**2034353812**
USA	**	119370682	**	245606335
Italy	**	75130322	**	155462318
Belgium	**	48319029	**	126461596
UAE	**	63799755	**	121686163
Nepal	**	76806887	**	110497157
Vietnam	**	77714158	**	106986718
Turkey	**	12013136	**	79020874
China	**	152007711	**	66437021
UK	**	27046766	**	57639929
Germany	**	32998105	**	54252017
Other countries	**	539898770	**	910303684

Figures rounded off

Table – 23 : Exports of Iron & Steel (Finished Steel Including CR Sheet)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6108963**	**358432755**	**6798430**	**607736761**
USA	129635	24633704	377390	64019634
Belgium	294746	22484302	587246	61891663
Nepal	1077289	36877715	1086071	51728527
Italy	159829	15666462	484039	49801439
China	1206831	35099422	594831	30481803
UAE	187626	14960010	271528	26356053
Poland	93425	8374030	187303	23966389
Spain	105414	8968412	203577	23728126
UK	97037	7266223	229289	22136783

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Indonesia	226448	9358946	330708	20090307
Other countries	2530683	174743529	2446448	233536037

Figures rounded off

(In ₹ '000 tonnes)

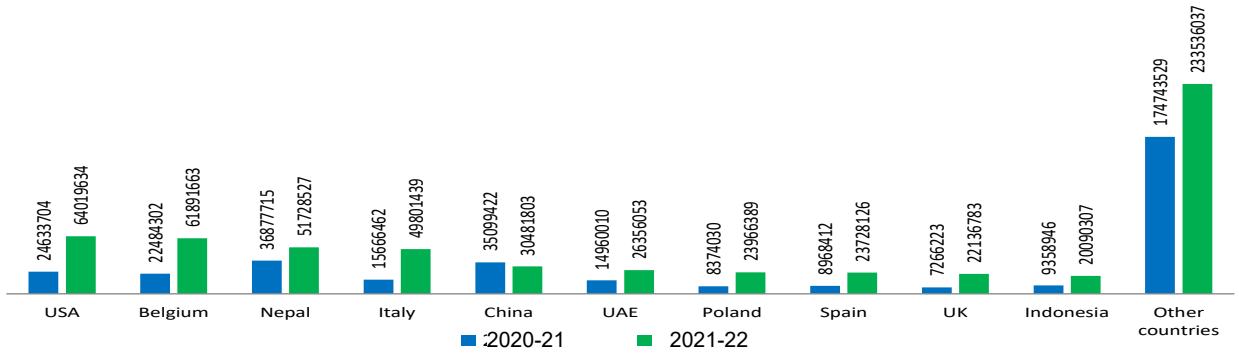


Fig 6: Countrywise Value of Export of Iron & Steel

Table – 24 : Exports of Iron & Steel (Steel wire)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**169631**	**25750975**	**250944**	**48353501**
USA	21538	4032087	40286	9590759
Netherlands	16695	2861241	21835	5182686
Germany	6419	1369530	10687	2806086
France	8978	1650759	11418	2717725
Italy	5479	1089365	9487	2498473
Turkey	10125	1672341	10467	2326751
UAE	8516	986881	15878	1816494
Russia	7986	1551073	6196	1663773
Brazil	3191	637435	8550	1409291
UK	3792	715614	5681	1362339
Other countries	76912	9184649	110459	16979124

Figures rounded off

Table – 25 : Exports of Iron & Steel (Other Finished Steel, NES)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**340587784**	**	**464631364**
USA	**	85605428	**	143329003
Germany	**	20652426	**	29428809
UK	**	16687853	**	24120806
UAE	**	15912729	**	19267085
Netherlands	**	9508219	**	16449086
Italy	**	9220254	**	12922196
Canada	**	8511984	**	11531486
Australia	**	7362939	**	11026880
Saudi Arabia	**	9595069	**	10767560
Bangladesh	**	7434064	**	9519129
Other countries	**	150096819	**	176269324

Figures rounded off

Table – 26 : Exports of Iron & Steel (Semi-finished Steel Including Steel Ingot)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**12577510**	**480956813**	**13492292**	**874972590**
Vietnam	2244954	73639866	1688207	102256201
Italy	1109787	49058758	1301053	89333448
UAE	781766	31056671	1090106	73511960
Turkey	62201	6171542	1062348	67724283
Belgium	386942	20451813	689151	56128203
Nepal	762992	28207151	689218	38078439
China	3973874	113757925	719299	31759110
Hong Kong	331957	11557452	576524	28547341
USA	24593	4308672	340953	24818390
Sri Lanka	292628	10255726	474376	23273864
Other countries	2605816	132491237	4861057	339541351

Figures rounded off

Table – 27 : Exports of Iron & Steel : Alloy Steel (Granules)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**422**	**29056**	**678**	**45269**
UAE	121	5349	162	9295
Taiwan	99	4152	144	7857
Oman	-	-	75	5077
Portugal	14	2384	20	3660
Nepal	11	693	37	3484
Saudi Arabia	15	830	45	3141
Bangladesh	33	2359	36	2569
USA	23	7579	1	2155
Malaysia	27	1221	28	1721
Nigeria	27	1641	29	1569
Other countries	52	2848	101	4741

Figures rounded off

Table – 28 : Exports of Iron & Steel: Alloy Steel (Powder)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**4**	**1760**	**129**	**66798**
China	++	140	40	33558
Turkey	1	839	58	18931
Taiwan	1	163	14	6565
UAE	-	-	10	4236
Bangladesh	-	-	4	2340
Indonesia	2	544	2	920
Israel	-	-	++	79
Czech Republic	++	22	++	73
Kenya	-	-	1	42
Thailand	-	-	++	26
Other countries	++	52	++	28

Figures rounded off

Table – 29 : Exports of Iron & Steel (Scrap)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**25613**	**649151**	**11492**	**941199**
Sweden	1368	208921	2223	566603
Bhutan	20609	244302	6246	156385
Germany	25	1445	622	81272
Brazil	413	42620	459	55592
Oman	25	723	468	14365
Singapore	1217	14997	620	11024
Nepal	114	5421	134	8659
Malaysia	987	22423	168	7369
UAE	189	72586	57	7361
Thailand	182	7965	88	5872
Other countries	484	27748	407	26697

Figures rounded off

Table–30 : Exports of Iron & Steel (Sponge Iron)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**524566**	**11248671**	**789189**	**25256226**
Bangladesh	278459	5983287	401223	12770585
Nepal	161972	3556579	343687	10956055
Bhutan	68390	1268552	34786	1107956
Madagascar	1761	41479	2746	110402
USA	274	44545	585	96447
Thailand	2002	41929	2492	81267
Sri Lanka	1376	33098	1530	49242
Malaysia	4674	114303	1307	39297
Korea	123	23370	93	16104
Kenya	2271	67416	387	12403
Other countries	3264	74113	353	16468

Figures rounded off

Table – 31 : Exports of Iron & Steel (Stainless Steel)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**12889**	**3197360**	**16901**	**4444268**
USA	1250	285639	6774	2154252
UAE	545	189237	1684	238708
France	350	657506	77	225170
Saudi Arabia	289	115661	401	192157
Nigeria	2239	344675	768	169611
Bangladesh	4025	370134	1322	122338
Thailand	50	35882	12	90708
Zambia	92	24229	211	77677
Nepal	154	15684	407	71827
Italy	223	95339	124	67629
Other countries	3672	1063374	5121	1034191

Figures rounded off

Table–32 : Exports of Iron & Steel Material

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**70062**	**4250996**	**92907**	**7905836**
USA	6147	450033	18487	1595684
Belgium	3143	395078	12758	1144327
Italy	++	92	8439	838475
Korea	-	-	4924	623987
UAE	11471	612288	5057	474579
Turkey	9020	414925	6579	447316
Brazil	11306	535792	7556	362402
Thailand	520	30582	4956	314487
Qatar	4118	174490	4339	302449
Puerto Rico	6688	362413	2927	205315
Other countries	17649	1275303	16885	1596815

Figures rounded off

Table – 33 : Exports of Pig & Cast Iron (Including Speigeliesen)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1123792**	**30155194**	**1250907**	**49495194**
China	637214	15383161	332396	12410756
USA	215373	6803201	265667	10992715
Taiwan	7539	291501	107933	4101134
Turkey	36498	1322513	97324	3915008
Oman	85799	1897118	97299	3615115
Korea	786	45414	73223	2776330
Bangladesh	88895	2468097	60924	2451345
Thailand	7451	229210	51628	2153968
Italy	20	2672	48015	1925182
UAE	16498	641140	36325	1635781
Other countries	27719	1071167	80173	3517860

Figures rounded off

Table – 34 : Exports of Slag (Dross etc. from Iron and Steel Exc. Granulated)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**152818**	**951045**	**289895**	**2753273**
Philippines	88000	655043	148500	1721372
Vietnam	23600	153353	65828	531037
Malaysia	23858	81107	41040	380681
China	1166	6747	11032	77124
Angola	362	2750	1595	19055
Nepal	12672	30075	12750	18722
Bangladesh	-	-	9000	4165
South Africa	750	6129	100	689
Mozambique	99	553	31	270
Senegal	-	-	13	107
Other countries	2311	15288	6	51

Figures rounded off

Imports

Like exports, the total of value of imports of iron & steel in 2021-22 increased by 40% to ₹ 1,15,950 crore from ₹ 82,638 crore in the previous year. Iron & steel imports in 2021-22 comprised mainly of finished Steel Including Cold Rolled Sheet with ₹ 40,043 crore (34%), Scrap with ₹ 32,351 crore (28%), Other Finished Steel, NES with ₹ 23,966 crore (21%) and Semi-finished Steel including Ingots with ₹ 11,688 crore (10%). Other items together accounted for the remaining 7% imports. In terms of value, the imports in 2021-22 were mainly from China & Republic of Korea (18% each) followed by Japan (8%), UAE (6%) and USA (5%) and (Tables- 35 to 45) .

Similarly, in terms of quantity, the imports of Pig and Cast Iron (including Spiegeleisen) increased by 18% to 44 thousand tonnes in 2021-22 from 37 thousand tonnes in the previous year. Imports were mainly from South Africa (25%), China (12%), Germany(8%), Sweden (7%), Taiwan & Thailand (6% each) and USA (5%) (Table-46). In terms of quantity, the imports of slag increased by 11 % to 95 thousand tonnes in 2021- 22 from 85 thousand tonnes in the previous year. Imports were mainly from Rep. of Korea (84%) and Japan & Oman (7% each) (Table-47).

Table - 35 : Imports of Iron & Steel (Total)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**826381853**	**	**1159500736**
China	**	153661953	**	210209567
Korea	**	140136092	**	208888470
Japan	**	67911395	**	96870320
UAE	**	36377761	**	65196125
USA	**	43110658	**	53370197
Indonesia	**	14321897	**	52145651
Germany	**	32042498	**	43803504
Singapore	**	27885974	**	39360812
Vietnam	**	26444970	**	29312311
Malaysia	**	24673252	**	28863142
Other countries	**	259815403	**	331480637

Figures rounded off

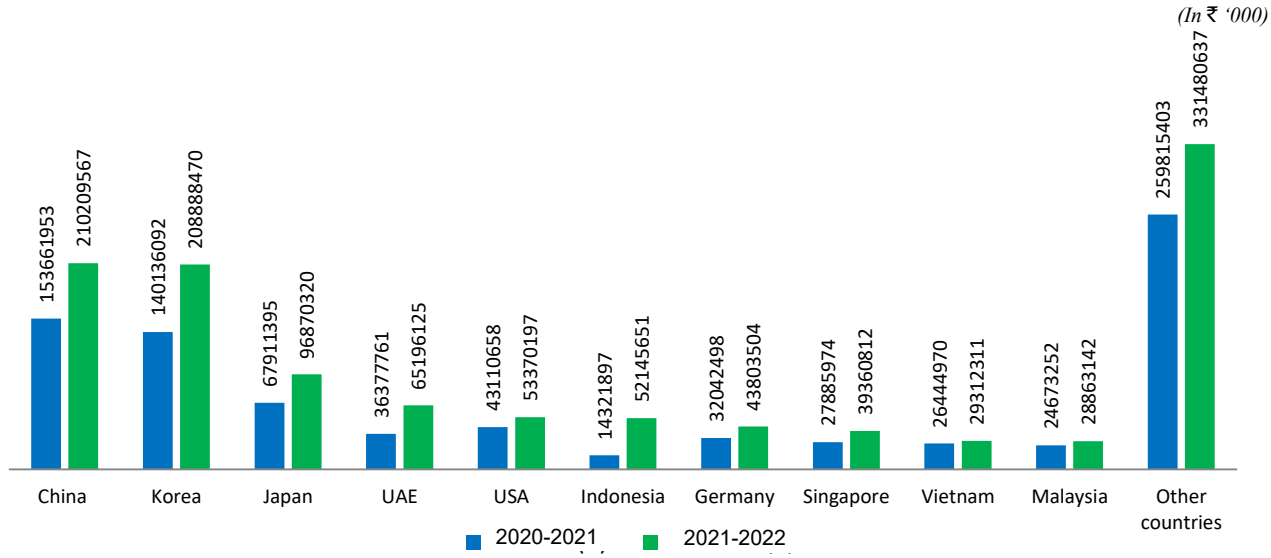


Fig 8: Countrywise Value of Import of Iron & Steel

Table – 36 : Imports of Iron & Steel (Finished Steel Including CR Sheet)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**3123084**	**281364644**	**3186329**	**400431501**
China	908307	76871110	915194	111065196
Korea	722938	56701936	758990	79176258
Japan	485725	44102605	595076	63724629
Indonesia	52344	6555312	202840	42683436
Germany	40058	8009947	44167	9986483
Vietnam	113528	9260800	55068	8517831
UK	9486	1741594	9186	6845797
Russia	51417	4460400	47055	6774443
USA	54558	6017647	34416	6559580
Hong Kong	21966	1495505	88568	6430966
Other countries	662757	66147788	435769	58666882

Figures rounded off

Table – 37 : Imports of Iron & Steel (Steel Wire)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**151105**	**15473255**	**149312**	**21164209**
China	58769	5436942	61878	8285680
Korea	22503	2150814	34119	3991246
Japan	5316	1727262	7852	2638152
Malaysia	22717	1780729	14872	1525865
Vietnam	8655	649393	8299	816738
Germany	973	464100	1381	644970
France	3041	337048	3151	402955
Thailand	6459	539811	3670	392756
Indonesia	2998	311196	2946	375702
U S A	902	301207	402	351310
Other countries	18772	1774753	10742	1738835

Figures rounded off

Table – 38 : Imports of Iron & Steel (Other Finished Steel, NES)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**	**187149323**	**	**239661220**
China	**	60848505	**	75763884
Korea	**	15497795	**	21717882
Japan	**	13033669	**	19056216
Germany	**	14015783	**	18519560
U S A	**	10867738	**	12660918
Thailand	**	8001613	**	11707848
Italy	**	7273790	**	9650488
Malaysia	**	4189760	**	8135758
Vietnam	**	6720669	**	7839347
Singapore	**	7585258	**	7756839
Other countries	**	39114743	**	46852480

Figures rounded off

Table – 39 : Imports of Iron & Steel (Semi-finished Steel Including Steel Ingots)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1848059**	**97340310**	**1504120**	**116884064**
Korea	1179765	55092241	1094507	73920037
Japan	89374	5702327	83853	7625663
China	114215	6814712	79532	7197291
Belgium	80463	5001515	60440	4924708
Sweden	7071	1852028	8997	3653638
Italy	25706	2017162	32296	3326105
Taiwan	8963	1447116	12983	2954699
Indonesia	24230	1037560	36140	2553811
France	50000	3841671	27308	2517746
Germany	12234	1481362	11780	1946044
Other countries	256038	13052616	56284	6264322

Figures rounded off

Table – 40 : Imports of Iron & Steel: Alloy Steel (Granules)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**17284**	**1015659**	**18629**	**1463023**
France	5870	317289	7232	512053
Germany	1414	110734	2338	283644
Thailand	1968	101633	2944	203630
China	3044	168417	2457	159373
Spain	1728	99971	1130	81938
Taiwan	960	53109	910	66631
Turkey	234	11922	688	45316
Netherlands	492	38994	405	35705
Japan	104	22244	134	27309
Belgium	7	6388	25	25357
Other countries	1463	84958	366	22067

Figures rounded off

Table-41: Imports of Iron & Steel: Alloy Steel (Powder)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	2596	590464	3450	911990
UK	233	146086	271	202067
China	600	102983	572	150019
Canada	528	45771	1376	136002
Japan	67	90538	23	88167
Germany	747	87770	449	68197
Sweden	147	17250	485	63686
USA	95	35846	113	60279
Netherlands	58	45837	61	57271
Belgium	28	6119	67	46558
Singapore	3	6396	7	31251
Other countries	90	5868	26	8493

Figures rounded off

Table-42 : Imports of Iron & Steel (Scrap)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	5393385	213404783	4976246	323514680
UAE	874594	29380968	1209633	57704441
U S A	621408	24833165	452657	32684436
Singapore	377204	14622849	335279	27567740
Malaysia	186401	11925230	147033	17546814
Netherlands	110936	8339788	121286	15460688
UK	544678	14918210	260957	12295941
Korea	72761	4769675	96179	10637963
Canada	180010	7329732	158457	10139970
Thailand	84608	7068178	70544	8763085
Germany	96537	6264725	65355	7835374
Other countries	2244248	83952263	2058866	122878228

Figures rounded off

Table-43 : Imports of Iron & Steel (Sponge Iron)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	68343	1315159	37451	1088387
South Africa	30222	604310	33500	981032
UAE	9509	245709	1264	37539
Egypt	23281	350321	1199	25742
Canada	21	466	654	18921
Singapore	780	16346	525	11743
U K	-	-	5	4712
Ukraine	-	-	156	4374
Kuwait	-	-	148	4106
Hong Kong	-	-	++	181
U S A	++	9	++	37
Other countries	4530	97998	++	++

Figures rounded off

Table – 44 : Imports of Iron & Steel (Stainless Steel)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	39876	7480309	32950	7510586
China	15264	2313116	14226	3181341
Vietnam	11757	2241642	10649	2371136
Italy	4123	1055086	3734	634300
UAE	583	71286	972	256192
Germany	150	109746	201	141990
USA	934	173251	259	131126
Belgium	342	414539	233	116626
Korea	1089	88820	1163	112272
Japan	628	136155	323	107230
Netherlands	506	99141	88	69361
Other countries	4500	777527	1102	389012

Figures rounded off

Table–45: Imports of Iron & Steel Material

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	385727	21247947	526903	46871076
Korea	115886	5824150	216038	19329450
Taiwan	149993	6129693	173862	12770556
China	15967	1062758	40118	4379897
Germany	19262	1498319	49402	4377242
Vietnam	55950	3797203	23773	3577630
Belgium	1968	153732	8737	652659
Japan	1924	302698	3752	450469
Singapore	4579	367983	3339	335135
France	2114	210221	2291	228480
Thailand	26	3125	1020	153689
Other countries	18058	1898065	4571	615869

Figures rounded off

Table-46 : Imports of Pig & Cast Iron (Incl. Speigeliesen)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	36920	3368526	43732	4890464
China	6399	679636	5173	937226
USA	1642	271021	2073	479720
Japan	421	262244	609	406711
South Africa	4597	159502	10947	396939
Germany	3777	347360	3552	380879
Sweden	424	54239	2873	341196
UK	529	197121	1311	281385
Italy	1236	184092	1284	223641
Thailand	2884	158436	2801	215966
Taiwan	3577	153425	2866	188405
Other countries	11434	901450	10243	1038396

Figures rounded off

Table – 47 : Imports of Slag (Dross etc. from Iron and Steel exc. Granulated) (Steel Wire)

(By Countries)

Country	2020-21(R)		2021-22(P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	68343	1315159	37451	1088387
South Africa	30222	604310	33500	981032
UAE	9509	245709	1264	37539
Egypt	23281	350321	1199	25742
Canada	21	466	654	18921
Singapore	780	16346	525	11743
U K	-	-	5	4712
Ukraine	-	-	156	4374
Kuwait	-	-	148	4106
Hong Kong	-	-	++	181
U S A	++	9	++	37
Other countries	4530	97998	++	++

Figures rounded off

FUTURE OUTLOOK

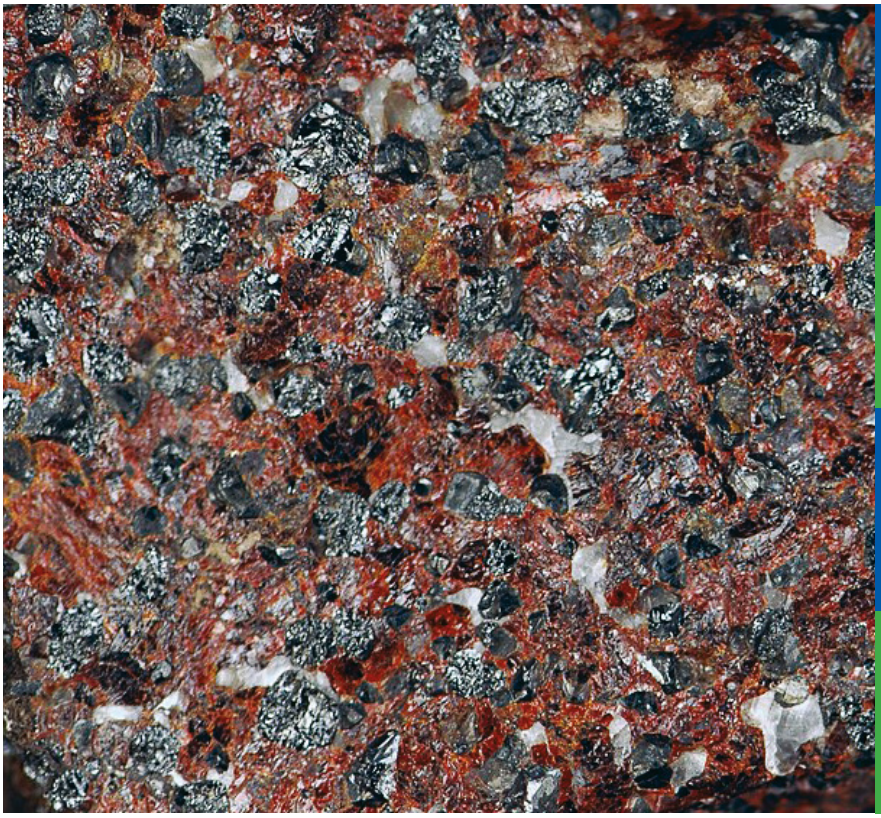
Steel is one of the most important products of the modern world and of strategic importance to any industrial nation from construction, industrial machinery to consumer products; steel finds its way into a wide variety of applications.

Steel is a de-regulated sector, Government acts as a facilitator, by creating conducive policy environment for development of the steel sector. Government of India has notified National Steel Policy, 2017 which envisages development of a technologically advanced and globally competitive steel industry that provides environment for attaining self-sufficiency in steel production by providing policy support and guidance to steel producers. National Steel Policy covers all aspects of steel sector such as steel demand, steel capacity, raw material security, infrastructure and logistics, Research & Development (R&D) and energy efficiency.

The Indian steel industry ended 2021-22 on a buoyant note, with leading growth parameters bouncing back to pre-COVID levels and growth rates firming up encouragingly. Be it crude steel, sponge iron, finished steel-data released by JPC indicated that supported by a robust policy framework/ guidance and helped to a large extent by the inherent strength of the industry itself. The lndian steel industry crossed the pre-COVID-19 levels in almost every sphere of operation in 2021-22, a commendable feat indeed. Not only that,the year also saw the industry retain all its global rankings intact - be it the largest sponge iron producer, the 2nd largest crude steel producer or even the 2nd largest finished steel Consumer. At the end of 2021-22, operating under the New Normal, the Indian steel industry is on a stable footing, with the spread of the pandemic controlled to a great extent through rigorous focus on testing and vaccination.

As per World Steel Association, in 2022, the world crude steel production reached 1885.4 million tonnes (MT). World Steel Association in its Short-Range Outlook, October 2023 forecasts that steel demand will grow by 1.8% in 2023 and reach 1,814.5 MT after contracting by 3.3% in 2022. In 2024, steel demand will see a further increase of 1.9% to 1,849.1 MT. India is the second largest producer of crude steel. China was world's largest crude steel producer in 2022 (1018.0 MT) followed by India (125.3 MT), Japan (89.2 MT) and the USA (80.5 MT). Per capita finished steel consumption in 2022 was 221.8 kg for world and 645.8 kg for China. The same for India was 86.7 kg in 2022-23.

10. Lead & Zinc



766.49
(million tonnes) Total reserves/ resources of lead and zinc ore as on 1st April 2020

16.34
(million tonnes) Production of lead and zinc ore in 2021-22

12
(tonnes) Exports of lead and zinc ore and concenfrates in 2021-22

5,325
(tonnes) Imports of lead ores & concentrates in 2021-22

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.

HZL is the only producer of primary lead and primary zinc in 2021-22 due to shut down of the operation of Edayar Zinc Limited (EZL).

RESERVES/RESOURCES

The total reserves/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 classified 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 resrves/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 Ore as on 1.4.2020 (P)

(By Grades/States)

(In '000 tonnes)

Grade /State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconn-aissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India:Total													
Ore	**28791**	**63331**	**11153**	**103275**	**4627**	**23663**	**13784**	**51613**	**196911**	**368094**	**4530**	**663222**	**766497**
Lead metal	503.7	1188.47	208.02	1900.19	140.42	534.83	286.02	1117.33	2283.43	6607.77	-	10969.8	12869.99
Zinc metal	2356.56	4592.03	489.46	7438.05	448.15	1121.12	599.62	3540.38	5840.74	14080.66	101.65	25732.32	33170.37
Lead & Zinc metal	-	-	-	-	-	-	-	-	-	120.76	22.37	143.13	143.13
By Grades													
Ore with (+)10%													
Pb & Zn	14500	24600	-	39100	155	148	81	9900	3920	44225	-	58429	97529
Ore with 5–10 %													
Pb & Zn	13310	28600	8580	50490	3223	7991	10796	35987	52913	118658	-	229569	280059
Ore with (-)5%													
Pb & Zn	981	10131	2573	13685	1249	15524	2907	5726	140078	205211	4530	375225	388909
Lead metal	503.7	1188.47	208.02	1900.19	140.42	534.83	286.02	1117.33	2283.43	6607.77	-	10969.8	12869.99
Zinc metal	2356.56	4592.03	489.46	7438.05	448.15	1121.12	599.62	3540.38	5840.74	14080.66	101.65	25732.32	33170.37
Lead & Zinc metal	-	-	-	-	-	-	-	-	-	120.76	22.37	143.13	143.13
By States													
Andhra Pradesh													
Ore	-	-	-	-	-	-	-	1000	4159	17530	-	22689	22689
Lead metal	-	-	-	-	-	-	-	28.7	119.53	688.65	-	836.88	836.88
Zinc metal	-	-	-	-	-	-	-	12.4	43.57	7.19	-	63.16	63.16
Bihar													
Ore	-	-	-	-	-	-	-	-	435	11000	-	11435	11435
Lead metal	-	-	-	-	-	-	-	-	-	24	-	24	24
Zinc metal	-	-	-	-	-	-	-	-	14.75	24	-	38.75	38.75

(In '000 tonnes)

Grade /State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconn-aissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Gujarat													
Ore	-	-	-	-	2013	2371	969	129	-	200	-	5682	5682
Lead metal	-	-	-	-	81.94	88.2	34.41	3.9	-	-	-	208.45	208.45
Zinc metal	-	-	-	-	111.73	111.44	37.13	1.1	-	-	-	261.4	261.4
Lead & Zinc metal	-	-	-	-	-	-	-	-	-	0.9	-	0.9	0.9
Madhya Pradesh													
Ore	-	-	-	-	129	117	-	1510	6396	7765	3150	19067	19067
Lead metal	-	-	-	-	-	-	-	26.12	5.13	5.04	-	36.29	36.29
Zinc metal	-	-	-	-	5.2	4.71	-	114.76	44.67	200.07	101.12	470.53	470.53
Maharashtra													
Ore	-	-	-	-	-	-	-	1967	6305	1000	-	9272	9272
Zinc metal	-	-	-	-	-	-	-	133.56	428.11	28	-	589.67	589.67
Meghalaya													
Ore	-	-	-	-	-	-	-	-	880	-	-	880	880
Lead metal	-	-	-	-	-	-	-	-	16.5	-	-	16.5	16.5
Zinc metal	-	-	-	-	-	-	-	-	14	-	-	14	14
Odisha													
Ore	-	-	-	-	-	961	119	-	-	670	-	1750	1750
Lead metal	-	-	-	-	-	34.32	4.25	-	-	38.39	-	76.96	76.96
Rajasthan													
Ore	28791	63331	11153	103275	2485	19779	12632	43337	172985	328784	1380	581381	684656
Lead metal	503.7	1188.47	208.02	1900.19	58.48	405.41	245.68	917.5	1972.47	5832.19	-	9431.73	11331
Zinc metal	2356.56	4592.03	489.46	7438.05	331.22	992.09	559.35	3112.59	5052.47	13779.72	0.53	23827.97	301266.02
Lead & Zinc metal	-	-	-	-	-	-	-	-	-	119.86	22.37	142.23	142.23
Sikkim													
Ore	-	-	-	-	-	436	64	300	-	150	-	950	950
Lead metal	-	-	-	-	-	6.9	1.68	-	-	-	-	8.58	8.58

(In '000 tonnes)

Grade /State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconn-aissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Zinc metal	-	-	-	-	-	12.88	3.14	3	-	1.05	-	20.07	20.07
Tamil Nadu													
Ore	-	-	-	-	-	-	-	200	590	-	-	790	790
Lead metal	-	-	-	-	-	-	-	2.26	5.48	-	-	7.74	7.74
Zinc metal	-	-	-	-	-	-	-	11.76	24.76	-	-	36.52	36.52
Uttarakhand													
Ore	-	-	-	-	-	-	-	3170	1790	660	-	5620	5620
Lead metal	-	-	-	-	-	-	-	138.85	34.25	9.5	-	182.6	182.6
Zinc metal	-	-	-	-	-	-	-	151.21	87.99	27.63	-	266.83	266.83
West Bengal													
Ore	-	-	-	-	-	-	-	-	3371	335	-	3706	3706
Lead metal	-	-	-	-	-	-	-	-	130.07	10	-	140.07	140.07
Zinc metal	-	-	-	-	-	-	-	-	130.42	13	-	143.42	143.42

Figures rounded off

DEVELOPMENT

The Exploration & Development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION & STOCKS

Lead & Zinc Ores and Concentrates

The production of lead and zinc ore at 16.34 million tonnes in 2021-22 increased 5.7% as compared to that in the previous year.

The metal content of lead and zinc in the ore produced in 2021-22 works out to 2,10,659 tonnes and 8,26,020 tonnes respectively as against the corresponding figures of 2,74,836 tonnes and 8,41,947 tonnes in the previous year. During the year under review, 16.29 million tonnes of lead & zinc ore was treated as against 15.46 million tonnes in previous year (Tables-2 - 4).

Table - 2 : Producers of Lead & Zinc Ore, Concentrates & Metals, 2021-22

Name and address of the producer	Location of Mines	
	State	District
Hindustan Zinc Ltd, Yashad Bhavan, Udaipur - 313 004, Rajasthan.	Rajasthan	"Ajmer Bhilwara Rajsamand Udaipur!

Table – 3 : Production of Lead and Zinc Ore, 2020-21 and 2021-22

(By State)

(In tonnes)

State	2020-21			2021-22 (P)		
	Ore Produced	Metal content		Ore Produced	Metal content	
		Lead (Pb)	Zinc (Zn)		Lead (Pb)	Zinc (Zn)
India	**15455342**	**274836**	**841947**	**16338461**	**210659**	**826020**
Rajasthan	15455342	274836	841947	16338461	210659	826020

(p) : Provisional

Table – 4 : Lead and Zinc Ore Treated, 2020-21 and 2021-22

(By State)

(In tonnes)

State	2020-21			2021-22 (P)		
	Ore Produced	Metal content		Ore Produced	Metal content	
		Lead (Pb)	Zinc (Zn)		Lead (Pb)	Zinc (Zn)
India	**15458066**	**274704**	**842474**	**16292735**	**269196**	**883932**
Rajasthan	15458066	274704	842474	16292735	269169	883932

(p) : Provisional

The production of lead concentrates in 2021-22 at 3,68,040 tonnes decreased by 2.4% as compared to that in the previous year. Entire production of lead concentrate was reported from Rajasthan (Tables-5 & 6).

Table – 5 : Production of Lead Concentrates, 2019-20 to 2021-22

(By State)

(Quantity in tonnes; Value in ₹'000)

State	2019-20		2020-21		2021-22 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**351749**	**18260832**	**376923**	**18810483**	**368040**	**22366174**
Rajasthan	351746	18260832	376923	18810483	368040	22366174

(p) : Provisional

Table – 6 : Production of Lead Concentrates, 2020-21 and 2021-22

(By Sector/State/Districts)

(Quantity in tonnes; Value in ₹'000)

State/District	No.of mines	2020-21			No.of mines	2021-22 (P)		
		Quantity	Pb%	Value		Quantity	Pb%	Value
India	**10**	**376923**	**57.11**	**18810483**	**10**	**368040**	**58.76**	**22366174**
Public Sector	2	-	-	-	2	-	-	-
Private Sector	8	376923	57.11	18810483	8	368040	58.76	22366174
Rajasthan	**10**	**376923**	**57.11**	**18810483**	**10**	**368040**	**58.76**	**22366174**
Ajmer*	1	-	-	-	1	-	-	-
Bhilwara	1	79537	56.97	3147436	1	81132	62.41	4138068
Rajsamand	3	194850	55.26	8802684	3	187584	55.86	10515327
Sirohi	1	-	-	-	1	-	-	-
Udaipur	4	102536	60.75	6860363	4	99324	61.25	7712779

**: 34RAJ01001 - Reported production of lead and zinc ore only and processing is done along with ore produced from Rampura Agucha mine at Bhilwara.*
34RAJ24001 reported employment but no production 34RAJ 27007 has not submitted Annual Returns for both years. Estimation is done from Monthly Returns. It has 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 15,13,996 tonnes in previous year to 15,94,087 tonnes in the 2021-22. 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.

Table – 7 : Production of Zinc Concentrates, 2019-20 to 2021-22

(By State)

(Quantity in tonnes; Value in ₹'000)

State	2019-20		2020-21		2021-2022 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**1446824**	**60438504**	**1513996**	**63127101**	**1594086**	**81815818**
Rajasthan	1446824	60438504	1513996	63127101	1594086	81815818

Table – 8 : Production of Zinc Concentrates, 2020-21 & 2021-22

(By Sector/State/Districts)

(Quantity in tonnes; Value in ₹'000)

State/ District	No.of mines	2020-21			No.of mines	2021-22 (P)		
		Quantity	Zn%	Value		Quantity	Zn%	Value
India	**-**	**1513996**	**50.07**	**63127101**	**-**	**1594086**	**50.16**	**81815818**
Private Sector	-	1513996	50.07	63127101	-	1594086	50.16	81815818
Rajasthan	**-**	**1513996**	**50.07**	**63127101**	**-**	**1594086**	**50.16**	**81815818**
Bhilwara	-	943093	49.98	34787718	-	978250	50.38	45537513
Rajsamand	-	400197	49.47	16959450	-	426384	48.55	23118848
Sirohi	-	-	-	-	-	-	-	-
Udaipur	-	170706	52	11379933	-	189452	52.61	13159457

(p): provisional

Grade Analysis

All-India average metal content of ore treated during 2021-22 worked out to 7.08% (1.65% Pb and 5.43% Zn) as against 7.23% (1.78% Pb and 5.45% Zn) in previous year. The metal content of ore treated at Rampura Agucha mine in Bhilwara district of Rajasthan was the highest at 11.51% (1.47% Pb and 10.04% Zn). The lead concentrates produced in Rajasthan during 2021-22 was of grade 58.76% Pb as against 57.11% Pb in previous year. Metal content of zinc concentrates produced in Rajasthan worked out to 50.16% Zn in 2021-22 as against 50.07% Zn in the previous year.

Stock

Mine-head closing stock of lead concentrates in 2021-22 was 30,961 tonnes as against 2,447 tonnes in previous year. (Table-9).

Table – 9 : Mine-head Closing Stocks of Lead Concentrates, 2020-21 & 2021-22

(By State)

(In tonnes)

State	2020-21	2021- 22(P)
India	**2447**	**30960**
Rajasthan	2447	30961

(p): Provisional

Mine-head closing stock of zinc concentrates in 2021-22 was 34,023 tonnes as against 28,926 tonnes in previous year. (Table-10).

Table – 10 : Mine-head Closing Stocks of Zinc Concentrates, 2020-21 & 2021-22

(By State)

(In tonnes)

State	2020-21	2021- 22(P)
India	**28926**	**34023**
Rajasthan	28926	34023

(p): Provisional

Employment

The average daily labour employed in lead and zinc mines during the year under review was 12,948 as against 8,535 in previous year.

Lead and Zinc Metals

The production of primary lead during the year 2021-22 decreased to 1,91,185 tonnes from 2,14,399 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 7,75,808 tonnes in 2021-22 increased by 8.4% 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, 2019-20 to 2021-22

(Quantity in tonnes; Value in ₹ '000)

Year	Lead Primary	
	Quantity	Value
2019-20	181365	29111241
2020-21	214399	34531700
2021-22 (P)	191185	34944601

(p): Provisional

Table – 12 : Production of Zinc Metal, 2019-20 to 2021-22

(Quantity in tonnes; Value in ₹ '000)

Year	Zinc Ingots	
	Quantity	Value
2019-20	688282	137840297
2020-21	715445	147976396
2021-22 (P)	775808	202092083

(p): Provisional

Table – 13 : Production of Lead (Primary), 2020-21 and 2021-22

(By State/Plant)

(Quantity in tonnes; Value in ₹ '000)

State	Plant	2020-21		2021-22 (P)	
		Quantity	Value	Quantity	Value
India		**214399**	**34531700**	**191185**	**34944601**
Rajasthan	HZL Chanderiya/ Dariba	214399	34531700	191185	34944601

Table – 14 : Production of Zinc (Ingots), 2020-21 and 2021-22

(By State/Plant)

(Quantity in tonnes; Value in ₹ '000)

State	Plant	2020-21		2021-22 (P)	
		Quantity	Value	Quantity	Value
India		**715445**	**147976396**	**775808**	**202092083**
Rajasthan	HZL Chanderiya/Debari/Dariba	715445	147976396	775808	202092083

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 4.51 million tonnes of lead & zinc ore. Sindesar Khurd mine is highly mechanised and the largest ore producing underground mine with annual production capacity of 5.23 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 1.08 million tonnes, 4.41 million tonnes and 0.94 million tonnes of lead & zinc ore respectively (Table-15).

Table – 15 : Ore Production Capacity of HZL Mines

Mine	Ore	Capacity (million tpy)
Total		**16.33**
Zawar Mines, Distt Udaipur, Rajasthan.	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

source : Annual report 2021 -22

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. In 2021-22, the Zawar group of mines produced 4.41 million tonnes ore.

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 2021-22, Rajpura Dariba Mine produced 1.2 million tonnes ore. 2% Pb feed-grade. 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. The Mine has achieved highest truck filling hours and exploration drilling resulting in its readiness for expansion.

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 2021-2022, the production of ore was carried out by underground mining at 4.5 million tonnes. 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. 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.

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 average reserve grade of Sindesar Khurd mine is 5.35% with its silver-rich lead-zinc deposit. The mine lies on the same geological belt as the Rajpura Dariba mine. During the year 2021-22, Sindesar Khurd mine produced 5.2 million tonnes ore.

Kayad mine is a newly developed underground mine near Ajmer, Rajasthan. It was commissioned in 2014 having small but high-grade ore at 5.23% Pb & Zn ore deposit. In Kayad mine, 21 tonnes capacity of LHD and 65 tonnes capacity of LPDT are used to produce 1.2 million tonnes of ore per annum. The mine has access through a single decline from surface portal to the top of the orebody 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 2021-22, the Kayad mine produced 0.93 million tonnes ore. The ore from Kayad mine is treated at Rampura Agucha's beneficiation plant.

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

(In tonnes)

Company	Lead capacity	Production		Zinc capacity	Production	
	tpy	2019-20	2020-21 (P)	tpy	2019-20	2020-21 (P)
Hindustan Zinc Ltd	210000	214399	191185	913000	715445	775808
Edayar Zinc Ltd	-	-	-	38000	-	-
Total	**210000**	**214399**	**191185**	**951000**	**715445**	**775808**

The smelting capacity of HZL for zinc is distributed among 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 of silver per annum. HZL is India's largest manufacturer of sulphuric acid which is by-product of its smelting operations. In 2019-20, HZL produced 1.24 million tonnes of sulphuric acid, as compared to 1.28 million tonnes in the previous year.

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 2019-20, Chanderia lead-zinc smelter produced 4,25,780 tonnes of zinc and 94,916 tonnes of lead as compared to 4,24,803 tonnes of zinc and 85,916 tonnes of lead in the previous year.

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 92,000 tonnes of zinc per annum. The present capacity has now reached 88,000 tonnes of zinc per annum. 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 2019-20, Zinc Smelter Debari produced 62,817 tonnes of zinc as compared to 67,968 tonnes of zinc in the previous year.

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 2019-20, the smelter produced 2,00,689 tonnes of zinc and 86,454 tonnes of lead metal as compared to 2,03,512 tonnes of zinc and 1,11,922 tonnes of lead metal in the previous year. Dariba Smelting Complex lead plant steam was utilised in Dariba Smelting Complex Captive Power Plant (CPP) for reducing the auxiliary steam consumption. In 2019-20, Dariba Smelting Complex produced 4,26,623 tonnes of sulphuric acid as compared to that of 4,77,217 tonnes in the previous 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.

POLLUTION CONTROL & ENVIRONMENTAL MANAGEMENT EFFORTS

The standard for Emission or Discharge of Environment Pollutant from lead & zinc smelting is prescribed in Schedule-I of the Environment (Protection) Rules, 1986. The standards for Particulate Matter Emission in concentrator for lead & zinc smelter is 150 mg per normal cubic metre and the standard for emission of oxides of sulphur in smelter & convertor is that off-gases must be utilised for sulphuric acid manufacture. The limit of sulphur dioxide emission from stock shall not exceed 4 kg per tonne of concentrate (one hundred per cent acid produced).

At underground mines, the tailings generated after

beneficiation are utilised to backfill the underground mined stopes and the remaining tailings are stored in tailing dam at various mines location. During the process of recovery of metal at smelters, waste is generated. The waste contains toxic element, i.e., waste water effluent sludge, smelter slag leach residues, Suspended Particulate Matter (SPM), SO_2, NO_X and toxic metal fumes which are harmful at low exposure generated during the production of lead & zinc metal.

Smelting and mining operations of HZL are working on zero discharge principle and the Company is committed for efficient utilisation of waste generated at its mines and smelter. The Company has adopted Fumer technology to reduce jarosite generation, which is known to be successful in a few Chinese and Korean Zinc Plants.

Hindustan Zinc Limited runs a 25 MLD STP in Udaipur for treating municipal sewage. The enhancement of capacity of STP to 45 MLD and establishment of another STP of 15 MLD capacity is in progress. This STP is a unique PPP initiative of the Company and is counted among the best functioning STPs in the country.

HZL is using internal waste for paste filling of stopes in mines. Remote operations and autonomous fleet in mines keep people away from risk. Some other initiatives in pipeline include ventilation on demand in mines to reduce energy consumption and use of advance flotation & ore retreatment technology to increase ore-to-metal ratio which is aimed at reducing waste and increasing output.

The sewage treatment plants at Debari and Chanderiya smelters were operated continuously and the recovered water was reutilised in the smelter and for plantation in the colony. Over the years, the Company has been voluntarily filing Carbon Disclosure Project (CDP) responses as a proactive step towards reporting carbon footprint emissions.

HZL has entered into a charter on Corporate Responsibility for Environmental Protection (CREP) with MoEF, Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) for achieving a quantum jump in its environmental performance in the coming years.

Many of the secondary lead producing units have operated in the Unorganised Sector and they create major pollution by emission of lead vapour and SO_X. The small-scale units generally do not control process parameters, such as smelting temperature, charge to fuel ratio and leakages in the body. As per the National Ambient Air Quality standards, the permissible concentration of lead in ambient air is 0.50 $\mu g/m^3$ while the permissible limit for SO_X is 50 $\mu g/m^3$.

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 are performed, 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, 2020 and issued Gazette Notification No. S.O. 770 (E) dated 20th Feb. 2020 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. 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.

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 2020-21 and 2021-22 was calculated on the basis of production of lead (primary) and imports & exports of refined lead (unwrought). The apparent consumption thus arrived at was 1,79,135 tonnes in 2020-21 and 83,012 tonnes in 2021-22 (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 Production of Lead (Primary), and Imports & Exports of Refined Lead, Unwrought)

(In tonnes)

Item	2020-21	2021-22
Total Production Lead (Primary)	214399	191185
Total Imports*	89777	51810
Total Exports*	125041	159983
Apparent Consumption (Primary)	179135	83012

** DGCIS, &, 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 2020-21 and 2021-22 was calculated on the basis of production of zinc, import & export of zinc (not alloyed). The apparent consumption, thus arrived at was 5,19,008 tonnes in 2020-21 and 5,94,809 tonnes in 2021-22 (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 Production of Zinc (Ingots) and Imports & Exports of Zinc (not alloyed)

(In tonnes)

Item	2020-21	2021-22
Total Production Zinc	715445	775808
Total Imports*	84980	86667
Total Exports*	281417	267666
Apparent Consumption	519008	594809

**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

Lead

The world's reserves of lead were estimated at 90 million tonnes in terms of lead content. Australia possesses 41% of the world's reserves followed by China (20%), Peru (7%), Mexico & USA (6% each) and Russia (5%) (Table- 19).

Table – 19 : World Reserves of Lead

(By Principal Countries)

(In '000 tonnes of lead content)

Country	Reserves
World: Total (rounded off)	**90000**
Australia(a)	37000
Bolivia	1600
China	18000
India*	2500
Kazakhstan	2000
Mexico	5600
Peru	6400
Russia	4000
Sweden	1100
Tajikistan	NA
Turkey	860
USA	5000
Other countries	5900

Source: USGS, Mineral Commodity Summaries, 2022.
(a) For Australia, Joint Ore Reserve Committee- compliant reserves were about 12 million tonnes.
** 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)

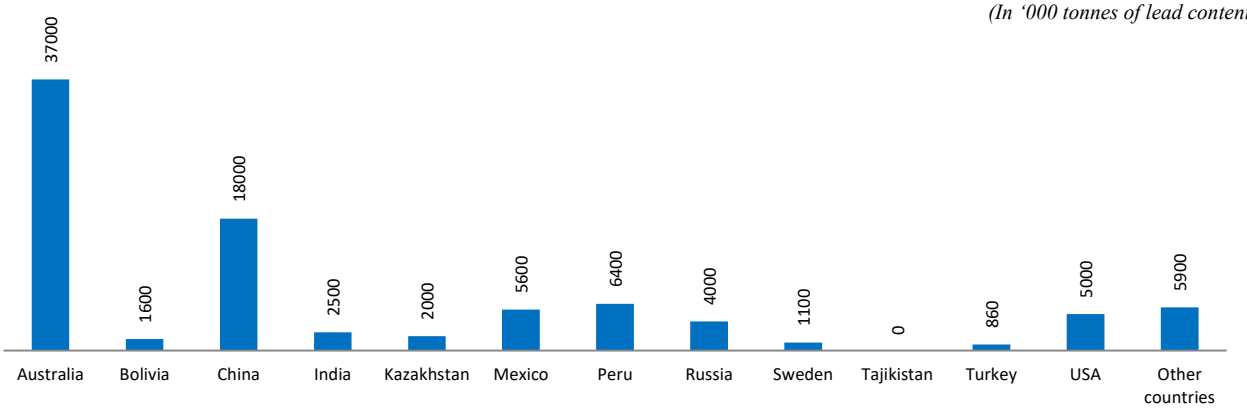


Fig 2: Countrywise Reserves of Lead

Zinc

The world's reserves of zinc were estimated at 250 million tonnes of zinc content. Australia accounts for 28% of world's zinc reserves, followed by China (18%), Russia (9%), Kazakhstan (5%), USA (4%), etc. (Table-20).

Table – 20 : World Reserves of Zinc

(By Principal Countries)

(In '000 tonnes of zinc content)

Country	Reserves
World: Total (rounded off)	**250000**
Australia[a]	69000
Bolivia	4800
Canada	5400
China	44000
India*	9400
Kazakhstan	12000
Mexico	1900

(In '000 tonnes of zinc content)

Country	Reserves
Peru	1900
Russia	22000
Sweden	3700
USA	9000
Other countries	34000

Source: USGS, Mineral Commodity Summaries, 2022.
(a) For Australia, Joint Ore Reserve Committee- compliant reserves were about 25 million tonnes.
** India's total reserves/ 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)

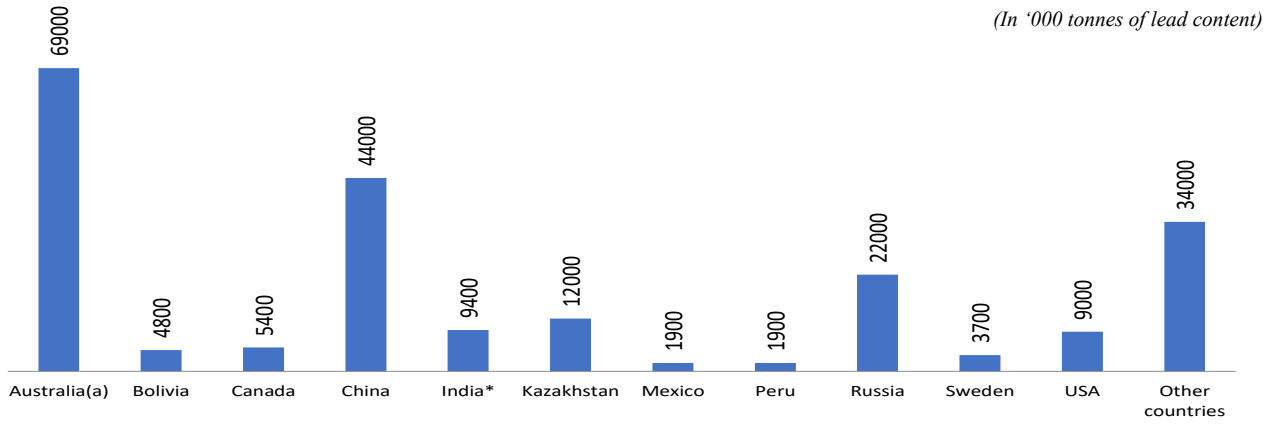


Fig 2: Countrywise Reserves of Lead

PRODUCTION

Lead

World mine production of lead in terms of metal content was about 4.60 million tonnes in the year 2021 which is 1.2% more as compared to 4.54 million tonnes in the previous year. China is foremost amongst producing countries with about 2.00 million tonnes (43%) followed by Australia (11%) and USA , Mexico Peru (6% each) (Table-21).

Table – 21 : World Mine Production of Lead

(By Principal Countries)

(In '000 tonnes of metal content)

Country	2019	2020	2021
World: Total (rounded off)	**4818746**	**4543981**	**4600000**
China	2006000	1970000	2000000
Australia	500985	494271	487563
USA	266000	297000	286000
Mexico	372106	260390	272200
Peru	308116	241548	264124
Russia	207900*	200000	200000
India*(c)	202964(c)	217787	182500
Turkey	71500*	81500	93700
Bolivia	88002	64679	92767
Iran	72500*	70000	70000
Other countries	740815	645825	472218

Source: BGS, World Mineral Production, 2017-21
** India's production of primary lead in 2018-19, 2019-20 and 2020-21 was 202 thousand tonnes 217 thousand tonnes and 182 thousand tonnes respectively.*
(c) Year ended 31st March following that stated
(d) Metal content of ore
(e):Estimated

(In '000 tonnes of Metal content)

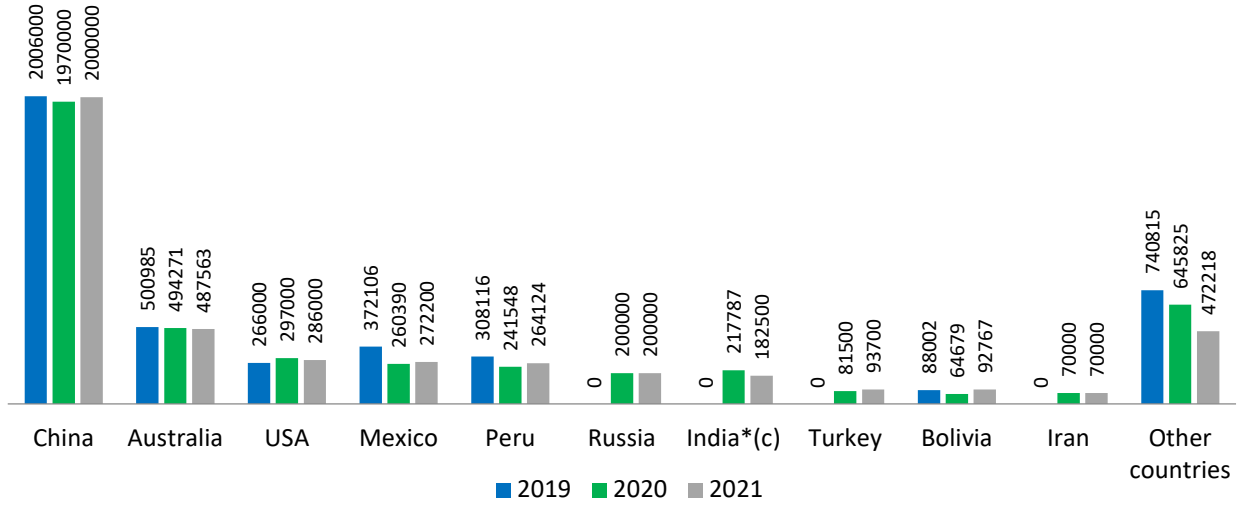


Fig 4: Countrywise Production of Lead

Zinc

World mine production of zinc ore was at 13.50 million tonnes in terms of zinc content in the year 2021 which increased by 17% from 11.53 million tonnes in the year 2020. China is at top position with 4.73 million tonnes (35%) followed by Peru (11.34%), Mexico , USA & India (5% each) & Bolivia (4%) Kazakhsthan (2%), etc. (Table- 22).

Table – 22 : World Mine Production of Zinc

(By Principal Countries)

(In '000 tonnes of metal content)

Country	2019	2020	2021
World:Total (rounded off)	**12483251**	**11530291**	**13500000**
China	3700000*	3200000	4737000
Peru	1404382	1334570	1532043
Mexico	859194	688461	742900
USA	753000	718000	740000
India*[(b)]	723412[(b)]	756998	735000
Bolivia	527521	358411	499257
Kazakhstan	321900	335400	326900
Canada	323019	371491	310158
Russia	275400*	280000	280000
Sweden	247657	234811	246316
Other countries	2258102	2172050	1719193

Source : BGS, World Mineral Production, 2017-21
** India's production of primary zinc in 2018-19, 2019-20 and 2020-21 was 723 thousand tonnes, 756 thousand tonnes and 735 thousand tonnes respectively.*
(b) Year ended 31st March following that stated
(e): Estimated

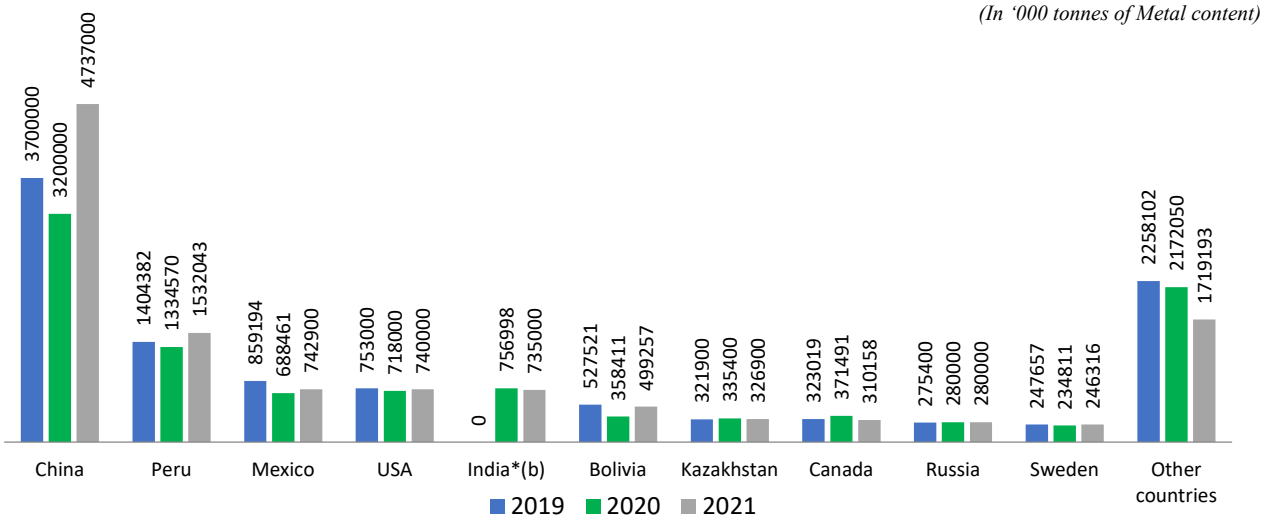


Fig 5: Countrywise Production of Zinc

Lead

As per USGS Minerals Yearbook, world refined lead production (including secondary production) was 11.40 million tonnes in which secondary lead production was 6.6 million tonnes in the year 2018. Secondary lead production represented about 58% of total refined lead production worldwide in 2018 which was 55% in 2017. The global production of refined lead in the year 2018 is the same as that of the previous year. China is the largest producer of refined lead with 4.91 million tonnes in the year 2018 and contributed 43 % of world refined lead production followed by USA (10%), Republic of Korea (7%), India (5%), Mexico (4%), etc.

World consumption of refined lead was 11.87 million tonnes in the year 2018 (including secondary lead) which is 1.2% more than that of the previous year. China is the largest refined lead consuming country with 4.9 million tonnes consumption during the year 2018 which was 42% of world refined lead consumption followed by European countries (17%), USA (14%), Republic of Korea & India (5% each), etc. After falling by 3.9% in 2020, International Lead & Zinc Study Group (ILZSG) forecasted the global demand for refined lead metal to rise by 5.5% to 12.39 million tonnes in this year and by 1.7% to 12.61 million tonnes in 2022.

A generalised view of the development in various countries along with the country-wise description sourced from latest available publication of Minerals Yearbook of 'USGS', 2016 & 2017 is furnished as below.

Australia

In 2016, lead mine production in Australia decreased by 31% as a result of the closure of Glencore plc's (Switzerland) Black Star Mine, which had a lead production capacity of 75,000 t/yr and was a part of the Mount Isa mining complex. Black Star was placed on care-and-maintenance status in November 2016 owing to reserve depletion.

China

In 2016, China continued to be the leading global producer and consumer of lead and the leading producer of lead-acid batteries. China produced 4.67 Mt of refined lead, essentially unchanged from that in 2015 and accounting for about 42% of global refined lead. China's secondary lead production was about 28% of total secondary world refined lead production in 2016, slightly less than that in 2015. China's refined lead production consisted of 64% primary and 36% secondary lead production. In 2016, two lead refineries opened a 40,000 t/yr secondary smelter owned by Yunnan Xiangyun Feilong Nonferrous Metal Co. Ltd in China and Aqua Metal's 30,000 t/yr secondary plant in the United States (International Lead and Zinc Study Group, 2017). Lead in concentrate production in 2016 was estimated to be about 2.34 Mt, unchanged from that in 2015. According to the ILZSG, consumption of lead in China decreased slightly to 4.64 Mt in 2016 from 4.71 Mt in 2015.

USA

In 2017, domestic mine production of recoverable lead was 3,02,000 tonnes, 10% less than that in 2016. There were 9 lead producing mines operating in the United States in 2017. Alaska and Missouri accounted for most of the US mine output of lead. Lead was also mined in Idaho and Washington. Domestic mine production data were collected by the U.S. Geological Survey (USGS) from a voluntary survey of lode mines. Eight lead-producing mines responded to the survey in 2017, accounting for about 90% of US production.

According to the ILZSG, global consumption of refined lead in 2017 was 11.7 Mt, 5% more than that in 2016. The leading refined-lead-consuming countries in 2017 were China (42%), USA (15%), India (5%), Republic of Korea (5%) and Germany (3%) .

Zinc

As per USGS Minerals Yearbook, world refined zinc production was 13.7 million tonnes in the year 2019 which increased by 3% from that of the previous year.

China was the largest producer of refined zinc with 6.16 million tonnes in the year 2019 which contributed

45% of world refined zinc production followed by Republic of Korea (7%), Canada & India (5% each), Japan (4%), Australia (3%), etc.

The world consumption of refined zinc was 13.69 million tonnes in the year 2018 which is 2% less than the previous year. China was the largest refined zinc consuming country with 6.52 million tonnes in 2018 which accounted for 48% of world consumption followed by European countries (18%), USA (6%), India (5%) and Republic of Korea (4%), etc.

ILZSG forecasts that world demand for refined zinc metal will rise by 6.2% to 14.09 million tonnes in 2021 and will further increase by 2.3% to 14.41 million tonnes in 2022.

A summary of generalised view of the development in various countries in respect of zinc, which include country-wise description sourced from latest available publication of Minerals Yearbook of 'USGS', 2017 is furnished as below.

Australia

Zinc mine production in Australia decreased by 5% in 2017 as compared with that of 2016 mainly as result of several mine closures. Three mines opened in Australia in 2017 and therefore it is expected that production would increase in 2018. During the second quarter of 2017, Auctus Minerals Pty. Ltd, restarted production at 20,000 tonnes per annum Mungana zinc mine in Northern Queensland. In September, 2017, Red River Resources Ltd restarted production at 21,000 tonnes per year from Thalang zinc-copper-lead mine in Queensland. The mine was placed on care-and-maintenance status in 2012 and reope ned after the processing plant was refurbished. Minerals and Metals Group opened Dugald River zinc mine in Northe western Queensland and commercial pro- duction was expected to commence in 2018 at 1,70,000 tonnes per year.

Canada

Zinc mine production in Canada was 3,44,000 tonnes in 2017 , 7 % more than that in 2016 . Production increased in 2017 owing mostly to an increase in zinc production at Trevali Mining Corp.'s Caribou Mine. In October 2017, Coeur Mining Inc. acquired the Silvertip silver-zinc-lead mine in British Columbia and production was expected to commence in the first quarter of 2018. Zinc smelter production in Canada was at 6,08,000 tonnes in 2017, 12% less than that in 2016. Smelter production decreased mainly as a result of the nine month strike at Noranda Income Fund's zinc refinery in Salaberryde Valleyfield, Quebec. During the strike, the facility operated at a partial production level, although the reduced rate was not disclosed.

China

Zinc mine production in China decreased by 8% in 2017 from that of 2016 to 4.4 million tonnes. According to Beijing Antaike Information Development Co. Ltd, decreased production was attributed to the closure of mines owing to increased environmental protection measures, lower than expected production from new mines and a decrease in ore grades. As a result of the decrease in mine production, China's net imports of zinc in concentrate increased by 22% in 2017 to about 2.4 million tonnes. About 60% of China's zinc concentrate imports (gross weight) were sourced from Australia, Peru and Russia.

Zinc metal production in China decreased slightly in 2017 from that of 2016 to 6.14 million tonnes. Despite the slight production decrease, two smelters of 1,00,000 tonnes per year capacity opened in China, i.e., Hualian Zinc and Indium Co.'s Hulian zinc smelter in Yunnan Province and Huili Lead and Zinc Co.'s Huili zinc smelter in Sichuan Province. Antaike attributed the decrease in zinc smelter production to refinery maintenance, a shortage of zinc concentrates and stricter environmental regulations.

China's net imports of refined zinc increased by 67% in 2017 to about 0.66 million tonnes. Increased imports were attributed to the tight domestic supply. About 66% of China's refined zinc imports were sourced from Australia, Kazakhstan and Spain.

China's zinc consumption increased in 2017 from that of 2016. ILZSG reported a 4% increase in zinc consumption in 2017 as against 9% increase in 2016.

Cuba

In 2017, construction was completed on the Castellanos lead and zinc mine near Santa Lucia, Pinar del Rio. This was the first new mining project in Cuba in more than 20 years. The mine, operated by Empresa Minera del Caribe, was expected to commence commercial production during the first half of 2018. Trafigura reported that the mine was expected to ramp up throughout the year and produce 1,00,000 tonnes of zinc concentrate when it reached full capacity.

Peru

Zinc mine production in Peru increased by 10% in 2017 from that of 2016 as a result of increased production at the Antamina copper-zinc mine and the opening of two mines. Zinc production nearly doubled at Antamina in 2017 to 3,72,100 tonnes, primarily as a result of increased processing of copper-zinc ores and significantly higher zinc grades and recoveries. Copper and zinc production at Antamina can vary significantly from year to year, owing to the geology of the deposit and the proportion of copper to copper-zinc ore produced.

In 2017, a new mine and a capacity expansion opened in

Peru. In January, Compania de Minas Buenaventura S.A.A. commisioned the 10,000 tonnes per year Tambomayo Mine near Chilcaymarca, Arequipa. In May 2017, Shougang Group Co. Ltd added 30,000 tonnes per year of capacity by reprocessing the tailings at the Marcona Mine near San Juan de Marcona. The Company also planned to produce copper and iron.

Thailand

Zinc mine production ceased in Thailand in 2017 after closure of Padaeng Industry Public Co. Ltd's Mae Sod Mine in 2016. The mine closed owing to the depletion of reserves and ceased operations by the end of 2017. In 2017, zinc metal production decreased by 73% from that of 2016. Padaeng Industry's smelter in Tak Province processed the remaining zinc concentrate from Mae Sod in 2017 and operations at the plant ceased in the second quarter of 2017. The refinery had a production capacity of 1,05,000 tonnes per year.

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 9 tonnes in 2020-2021 increaed to 12 tonnes in 2021-22. Bangladesh is the sole country which imports lead ores & concentrates from India.

Exports of lead & alloys including scrap increased by 30% to 2,29,864 tonnes during 2021-22 as compared to 1,76,601 tonnes in the preceding year. Similarly, export of lead and alloys also increased by 30% to 2,29,727 tonnes in 2021-22 as compared to 1,76,569 tonnes in the previous year. Exports of refined lead unwrought also increased by 28% to 1,59,983 tonnes in 2021-22 as compared to 1,25,041 tonnes in the previous year. (Tables- 23 to 29).

Table – 23 : Exports of Lead and Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**176569**	**25841849**	**229727**	**40523557**
Korea, Rep. of	69336	9803170	135896	23625355
Thailand	17440	2645595	21942	3962844
Vietnam	16591	2430259	29794	5514652
Taiwan	14250	2031656	3448	625827
Bangladesh	13326	1988441	5069	883128
UAE	11540	1819996	11838	2130948
Belgium	1051	206061	1966	483627
Singapore	6202	851671	3052	593726
Oman	4584	692525	3726	691397
Japan	3066	520185	2525	474486
Other countries	19183	2852290	10471	1537567

Figures rounded off

Table – 24 : Exports of Lead Ores & Concentrates

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**9**	**21076**	**12**	**1595**
Bangladesh	9	700	12	1290
Sri Lanka	++	176	++	45
Canada	++	110	++	--
Iraq	++	59	--	62
South Africa	++	24	++	--
USA	++	7	--	

Figures rounded off

Table – 25 : Exports of Lead & Alloys Including scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**176601**	**25845466**	**229864**	**40542449**
Korea, Rep. of	69336	9803170	135896	23625355
Thailand	25498	3821467	17440	2645595
Vietnam Soc Rep	16591	2430259	29794	5514652
Taiwan	14250	2031656	3448	625827
Bangladesh Pr	13326	1988441	5069	883128
UAE	11540	1820001	11972	2148902
Singapore	6202	851671	3052	593726
Oman	4584	692525	3726	691397
Japan	3066	520185	2525	474486
Belgium	1051	206061	1966	483627
Other Countries	19215	2855902	10474	1538505

Figures rounded off

Table – 26 : Exports of Lead and Waste & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**32**	**3617**	**137**	**18892**
UK	27	2491	--	--
Nepal	4	913	1	248
Uganda	++	118	++	3
Bhutan	1	90	++	18
UAE	++	5	134	17954
Mozambique	—	—	++	1
Canada	—	—	2	305
Ghana	—	—	2	305
Tanzania	—	—	++	1
USA	—	—	++	35

Figures rounded off

Table – 27 : Exports of Refined Lead Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**125041**	**17711659**	**159983**	**27714832**
Korea, Rep. of	57095	8010251	104708	17751098
Indonesia	694	90670	744	131394
Vietnam	11555	1646508	23767	4399066
Thailand	10384	1480455	13981	2393953
Taiwan	14249	2031320	3053	557525

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
Singapore	6032	810675	2206	436927
Bangladesh	4725	692814	1964	335052
UAE	4206	627828	4468	760493
Belgium	307	61573	1251	254676
Qatar	1550	235663	2017	357877
Other countries	14244	2023902	1824	336771

Figures rounded off

Table – 28 : Exports of Lead & Alloys Unwrought, NES

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**31878**	**5105512**	**41844**	**8169395**
Korea, Rep. of	9163	1348577	21879	4183917
Thailand	6923	1141304	7425	1451694
Oman	3615	548344	3028	570970
UAE	2982	521682	2472	494075
Vietnam	3220	512255	2995	577459
Bangladesh	2517	390239	825	148031
Japan	1174	225339	802	168319
Indonesia	903	145148	450	87156
Belgium	744	144470	641	205721
Sri Lanka	50	9817	476	107887
Other countries	587	118337	851	174166

Figures rounded off

Table – 29 : Exports of Lead (Pig Lead)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**—**	**—**	**++**	**205**
Nepal	—	—	++	25
Oman	—	—	++	180

Figures 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 decreased to 5,325 tonnes in 2021-22 as compared to 5,473 tonnes in 2020-21. Imports were mainly from UAE (38%), Argentina (27%), Morocco (7%) and Taiwan (6%). The total imports of lead & alloys including scrap decreased marginally by 10% in 2021-22 with 3,14,954 tonnes as compared to 3,48,747 tonnes during 2020-21, of the total imports of lead and alloys including scrap. Imports of lead and alloys during 2021-22 were 2,25,448 tonnes as compared to 2,45,841 tonnes in 2020-21. (Tables- 30 to 36).

Table – 30 : Imports of Lead Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**5473**	**146234**	**5325**	**255224**
Turkey	1574	1107	122	7575
UAE	2196	101447	2033	90006
Morocco	276	19963	354	22289
Sudan	316	12421	194	7637
Argentina	212	8710	1418	61012
Ghana	322	7141	215	8111
Jordan	101	4385	138	6358
Taiwan	--	--	312	18580
Tanzania	--	--	141	16407
Cameroon	--	--	147	6441
Other countries	476	24803	251	10808

Figures rounded off

Table – 31 : Imports of Lead and Alloys Including Scrap : Total

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**348747**	**49923441**	**314954**	**45882809**
Korea, Rep. of	68876	10913957	64132	10047758
USA	31192	4246560	29942	4125992
UAE	27657	3884470	27109	3952987
Australia	15330	2215733	24631	3597602
Malaysia	32955	4673445	20411	2925282
Vietnam	23196	3299440	20436	2915131
UK	31520	4232373	17340	2414745
Singapore	8587	1271828	15612	2312748
Japan	5468	830031	7483	1165366
Philippines	7562	1082965	6485	930088
Other countries	96399	13272639	81373	11495110

Figures rounded off

Table – 32 : Imports of Lead & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**245841**	**36498550**	**225448**	**40056256**
Korea Rep.	64132	10047758	58025	11416895
UAE	25190	3689200	35893	6319169
Senegal	4023	536116	8272	1234691
Vietnam	20436	2915131	5208	906636
Malaysia	19727	2835078	17302	2982150
Sri Lanka	3951	567711	7006	1178659
Singapore	14944	2222329	14401	2524294
Philippines	6295	904353	11541	1993641
Tanzania	5471	768310	9954	1674550
Mozambique	5333	725802	5379	838124
Other countries	76339	11286762	52467	8987447

Figures rounded off

Table – 33 : Imports of Lead and Waste & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**69113**	**9384259**	**78125**	**12913604**
USA	29111	4008027	25957	4763985
UK	14957	2034671	15650	2579214
Australia	3333	443539	3510	609271
Qatar	961	105500	8150	992953
UAE	1919	263787	2092	366884
Canada	1758	232161	1856	323476
Spain	1707	226882	2301	376473
Belgium	1807	212306	2237	334530
Kuwait	752	106532	2136	330950
Netherlands	1113	139473	2513	392704
Other countries	11695	1611381	11723	1843164

Figures rounded off

Table – 34 : Imports of Lead (Pig Lead)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3091**	**446955**	**3168**	**548109**
UAE	2393	347242	2151	385190
South Africa	384	55459	91	15699
Nepal	169	23913	151	22032
Turkey	94	12990	—	—
Oman	51	7351	—	—
Nigeria	—	—	425	72583
Korea, Rep. of	—	—	350	52605

Figures rounded off

Table – 35 : Imports of Lead Unrefined, NES

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**76619**	**10883029**	**92646**	**15812725**
USE	13370	1925738	22752	3976487
Philippines	4781	687182	9802	1703083
Tanzania	4635	647258	8977	1509429
Singapore	6375	923452	5956	1068009
Senegal	2604	347763	6021	973265
Mozambique	4075	553340	5379	838124
Vietnam	17825	2549515	3808	666120
Malaysia	3036	433410	2983	514619
Thailand	1428	202084	2822	492213
Zambia	771	109855	2596	453592
Other countries	17719	2503432	21550	3617784

Figures rounded off

Table – 36 : Imports of Refined Lead Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**89777**	**13415047**	**51810**	**9125700**
Korea, Rep. of	44988	6773388	30934	5622611
Australia	15764	2302577	296	46630
Nepal	1267	181274	2151	346125
UAE	4216	615859	6534	1129796
Malaysia	3707	541480	1007	176683
Tanzania	376	57158	651	113331
UK	2378	370189	3891	641994
Sri Lanka	2225	318846	3753	628072
Russia	1770	278778	670	99153
Germany	252	38045	663	111068
Other countries	12834	1937453	1260	210237

Figures 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 1762 tonnes in 2021-22 as against 399 tonnes in the previous year. Republic of Korea is the main export destination of zinc ores & concentrates and accounted for 49% of all the exports of zinc ores & concentrates followed by China (38%).

Exports of zinc & alloys including scrap during 2021-22 were 2,83,204 tonnes as against 3,00,018 tonnes in the preceding year. Almost entire exports during 2021-22 were of zinc & alloys while those of scraps were nominal. UAE (18%), Taiwan (16%), Singapore (13%), Thailand (8%), Indonesia (7%) and Republic of Korea (6%) were the main export destinations for zinc alloys & scrap. Exports of zinc (scrap) were at 4 tonnes in 2021-22 as compared to 82 tonnes in the preceding year (Tables- 37 to 40).

Table – 37 : Exports of Zinc Ores & Concentrates

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**399**	**20716**	**1762**	**46757**
Cuba	150	17276	100	10689
China	249	3440	672	20337
Netherland	—	—	100	12367
Korea, Rp. of	—	—	890	3342
USA	—	—	++	22

Figures rounded off

Table – 38 : Exports of Zinc & Alloys Including Scrap : Total

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**300018**	**55103971**	**283204**	**74950497**
Malaysia	95207	15880500	12973	3366333
Singapore	72651	13296034	36877	8862815
Taiwan	30349	5684418	47569	12427104
Korea. Rep. of	19462	3619387	19179	4888152
Thailand	14109	2832734	27597	7319273
UAE	13401	2594864	51188	14027340
Nepal	12622	2457205	12622	3106318

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
Vietnam	3361	703327	10064	2648860
Indonesia	7749	1469272	20096	5456259
Saudi Arabia	2710	528251	10914	3166543
Other countries	28397	6037979	34125	9681500

Figures rounded off

Table – 39 : Exports of Zinc & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**299936**	**55094321**	**283200**	**74949996**
Malaysia	95207	15880500	12973	3366333
Singapore	72651	13296034	36877	8862815
Taiwan	30349	5684418	47569	12427104
Korea, Rep. of	19462	3619387	19179	4888152
Thailand	14109	2832734	27597	7319270
UAE	13401	2594864	51185	14027005
Nepal	12618	2456700	12621	3106157
Saudi Arabia	2710	528251	10914	3166543
Indonesia	7749	1469272	20096	5456259
Vietnam	3361	703327	10064	2648860
Other countries	28319	6028834	34125	9681498

Figures rounded off

Table – 40 : Exports of Zinc (Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**82**	**9650**	**4**	**501**
Hong Kong	52	6206	—	—
China	26	2939	—	—
Nepal	4	505	1	161
UAE	—	—	3	335
Thailand	—	—	++	3
Bhutan	—	—	++	1
Guinea	—	—	++	1

Figures 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, mazak, etc.

Imports of zinc ores & concentrates during 2021-22 were at 720 tonnes as against 804 tonnes import during the previous year. Imports were mainly from UAE (46%), Imports of zinc & alloys during 2021-22 were at 1,48,376 tonnes as compared to 1,39,769 tonnes in 2020-21. Imports of zinc (scrap) were 79048 tonnes during 2021-22 as compared to 49,428 tonnes in 2020-21. Imports of zinc or spelter were at 1,19,157 tonnes in 2021-22 as compared to 1,18,333 tonnes during the previous year. The major suppliers of zinc & alloys including scrap during 2020-21 were Republic of Korea (43%), Japan (9%), and USA - UAE (6% each) (Tables- 41 to 45).

Table – 41 : Imports of Zinc Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**804**	**9530**	**720**	**24772**
Belgium	804	9513	—	—
USA	++	17	++	56
Ethiopia	—	—	240	5031
U Arab Emts	—	—	328	14212
Zambia	—	—	128	3052
Mexico	—	—	24	2421

Figures rounded off

Table – 42 : Imports of Zinc and Alloys Including Scrap: Total

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**189197**	**34313169**	**227424**	**50722547**
Korea, Rep. of	88877	16988711	98412	24171382
Japan	31867	6297778	20835	5064363
USA	9544	1472753	13596	2669794
UAE	9788	1463781	13237	2574177
Australia	3936	772291	4916	1033054
Italy	3999	693321	4411	976911
Malaysia	3341	539389	4481	891737
Singapore	1143	166615	4003	891239
Netherlands	3048	465791	7639	1402450
Germany	2637	437731	7419	1504532
Other countries	31017	5015008	48475	9542908

Figures rounded off

Table – 43 : Imports of Zinc & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**139769**	**27338160**	**148376**	**36587059**
Korea, Rep. of	88866	16987074	98410	24171001
Japan	31643	6267634	20672	5037439
Australia	3848	760630	4853	1022524
UAE	3411	602970	5839	1375424
China	909	419540	1151	616750
Switzerland	1879	385274	3520	870334
Singapore	71	12684	2400	612586
Uzbekistan	203	31304	1292	328964
Belgium	816	191588	990	296032
Myanmar	998	189027	1117	285415
Other countries	7125	1490435	8132	1970590

Figures rounded off

Table – 44 : Imports of Zinc or Spelter

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**118333**	**22644454**	**119157**	**28626796**
Korea, Rp. of	73744	13989990	78076	18913268
Japan	31372	6189217	20190	4911919
Australia	3844	759038	3878	780989
UAE	2325	433102	4449	1086595
Switzerland	1829	374946	3519	865724
Myanmar	998	189027	1117	285415
Singapore	—	—	2172	555179
Kenya	672	107305	772	156582
Uzbekistan	203	31304	1292	328964
Congo P Rep	—	—	843	230194
Other countries	3346	570525	2849	511967

Figures rounded off

Table – 45 : Imports of Zinc (Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**49428**	**6975009**	**79048**	**14135488**
USA	8453	1243249	12743	2457975
UAE	6377	860811	7398	1198753
Italy	3393	493975	3907	760398
Saudi Arabia	3269	470225	3959	695111
Netherlands	2808	426371	7116	1288768
Malaysia	2503	364714	3804	705340
Germany	2397	346003	7246	1424661
Indonesia	1996	261024	4177	671929
UK	1782	243296	2617	459968
Thailand	703	95115	3263	409948
Other countries	15747	2170226	22818	4062637

Figures rounded off

FUTURE OUTLOOK

International Lead & Zinc Study Group (ILZSG) forecasted the global demand for refined lead metal to rise by 1.7% to 12.61 million tonnes in 2022. ILZSG also forecasted that world demand for refined zinc metal would rise by 6.2% to 14.09 million tonnes in 2021 and would further increase by 2.3% to 14.41 million tonnes in 2022. These projections would be due to a number of new projects and expansions in existing capacity in India, Kazakhstan, Mexico and Portugal.

HZL has ambitious plans to expand in mining extraction & production of zinc, depending on the country's need while in lead, the reycling sector is likely to emerge as the major sector in future.

As per Ministry of Mines report on"National Non-Ferrous Metal Scrap Recycling Framework, 2020", Lead finds its use in storage batteries, also in dubbed lead acid batteries. India is likely to witness a substantial growth in the demand for lead batteries given that several sectors, including automotive, telecommunication, railways and defence, 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 Indian market for lead acid batteries is currently estimated at US$7 billion, driven by the Automotive Sector, which consumes ~60% of lead acid batteries. The demand of Lead has been increasing with a CAGR of 3.8%, while there has been a consistent level of imports over last five years.

In case of zinc, the demand has increased at CAGR 1.89% in last five years. The production, however has declined and has a negative, -1.3% CAGR. Dependence on imports has grown over the years at the rate of CAGR 2.10%. 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 by about 4 to 5% along with increasing necessity of erection of mobile towers for which higher investment in infrastructure would have to be met. Railways will also lead in the use of galvanised steel.

11. Lithium

26 (million tonnes) Total estimated reserves of lithium in the word	₹ 26.96 (crore) exports of lithium oxide and hydroxide in 2021-22	₹ 195.85 (crore) imports of lithium oxide and hydroxide in 2021-22

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. In 2021, Lithium is mostly used for making lithium-ion batteries for electric cars and mobile devices.

WORLD REVIEW

The Democratic Republic of Congo is known to have the largest lithium spodumene hard-rock deposit in the world. In 2018, 2.5 million tonnes of high-grade lithium resources along with uranium resources were found in the Falchani hard rock deposit in the region Puno, Peru. In 2020, Australia granted Major Project Status (MPS) to the Finniss Lithium Project for a strategically important lithium deposit that comprises an estimated 3.45 million tonnes (Mt) of mineral resource at 1.4 per cent lithium oxide. The Pampean Pegmatite Province in Argentina is known to have a total of at least 2,00,000 tons of spodumene with lithium oxide (Li_2O) grades varying between 5 and 8 wt %.

The world lithium reserves are estimated at 26 million tonnes. Lithium reserves are mainly located in Chile which contributes (36%) to the total reserves followed by Australia (24%) and Argentina (10%). Besides, major reserves are also located in China (8%) and United States & Canada (4% each). The world reserves of lithium are provided in Table-1.

Table-1: World Reserves

(In '000 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

The world lithium minerals production was 2.34 million tonnes in 2021. The Australia dominated the world production by accounting for 86% output which was followed by Chile (9%) and Argentina (3%). The details are furnished in Table-2.

Table 2 : World Production

(In tonnes)

Country	Sub-commodity	2019	2020	2021
Argentina	Carbonate	30009	26846	47917
Argentina	Chloride	4284	7705	6017
Argentina	Lithium minerals			
	(Carbonate–Li-content)	5642	5047	9008
Argentina	Lithium minerals			
	(Chloride–Li-content)	698	1256	981
Australia	Lithium minerals			
	(Li content)	44217	41200	55281
Australia	Spodumene	1588263	1477240	1966744
Bolivia	Carbonate	400*	191	540
Bolivia	Lithium minerals			
	(Li content)	75*	36*	102
Brazil	Lithium minerals			
	(Li content)	111	88	93*
Brazil	Spodumene	4000	3200	3300*
Canada	Lithium minerals			
	(Li content)	263*	0	0
Canada	Spodumene	9000*	0	0
Chile	Carbonate	100787	114260	150348

Country	Sub-commodity	2019	2020	2021
Chile	Chloride	1886	0	0
Chile	Lithium minerals			
	(Carbonate–Li-content)	18948	21481	28265
Chile	Lithium minerals			
	(Chloride–Li-content)	307	0	0
Chile	Lithium minerals			
	(Li-content)[(a)]	1639	1490	2001
Chile	Lithium minerals			
	(hydroxide)	9934	9030	12129
China	Lithium minerals			
	(Li content)	10800*	13300*	14000*
Nigeria	Lithium minerals			
	(Li content)	2*	2*	2
Nigeria	Petalite	133*	130*	130
Portugal	Lepidolite	59912	23185	18533
Portugal	Lithium minerals			
	(Li content)	417	161	129
USA	Lithium minerals			
	(Li content)(c)	4000	4000*	5000*
Zimbabwe	Lithium minerals			
	(Li content)	1191	397	775
Zimbabwe	Petalite	62623	20859	40726

Source: BGS, World Mineral Production, 2018-2021.
*(c) : carbonate * : estimate (a): hydroxide*

FOREIGN TRADE

Exports

In 2021-22, exports of lithium oxide and hydroxide by value increased substantially by 130% to ₹ `26.96 crore from ₹ `11.69 crore in the previous year. Exports were mainly to UAE (39%), Netherlands (21%), and USA (14%). In 2021-22, exports of lithium carbonate by value increased substantially by 90 % to ₹ `10.31 crore from ₹ `5.43 crore in the previous year. Exports were mainly to Vietnam (37%), UAE (14%), USA (12%), Switzerland (11%) and Bangladesh (7%). In 2021-22, exports of lithium-ion (cell/battries) by value increased substantially by 190% to ₹ `143.17 crore from ₹ `49.44 crore in the previous year. Exports were mainly to Japan (40%), Germany (15%) and Poland, Korea, Republic of & Indonesia (7% each) (Tables-3 to 5).

Table-3 : Countrywise Export of Lithium Oxide and Hydroxide

(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Argentina	**++**	**261**	**++**	**105**	**++**	**3.67**
Bangladesh	47	11776	8	2546	-	-
Brazil	++	99	++	90	-	-
Canada	-	-	-	29	++	214
Taiwan	-	-	-	-	-	19
China	-	-	0	16	-	-
Czech Republic	-	-	3	339	-	-
Egypt	1	540	-	-	++	132
Finland	-	-	-	-	++	122
Germany	++	49	0	3	++	148
Indonesia	-	-	8	4033	6	5518
Israel	-	-	20	13320	++	906
Italy	0	5	-	-	-	-
Japan	-	-	-	-	19	-
Jordan	-	-	-	-	++	90

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Kenya	1	477	2	1191	++	918
Korea, Rep. of	-	-	48	5735	-	55
Kuwait	6	4112	-	-	++	29
Myanmar	3	1771	2	1209	-	-
Mexico	10	7248	-	-	-	-
Nepal	14	13377	10	7371	7	9692
Netherlands	-	-	-	-	60	57195
Nigeria	-	-	++	742	-	-
Peru	++	26	-	-	++	43
Qatar	7	6229	6	3268	12	22791
Saudi Arabia	5	4713	2	1397	2	2258
South Africa	0	2	0	4	-	-
Sri Lanka	-	-	-	-	3	2678
Sudan	5	2818	-	-	18	14591
Tanzania Rep.of	5	3404	-	-	-	-
Thailand[d]	12	8716	6	3934	8	6744
Turkey	0	2	-	-	++	56
UAE	46	40545	130	69159	114	106141
UK	0	1	-	-	-	36
USA	++	331	1	845	40	38877
Zambia	1	411	2	1565	-	-

Figures rounded off

(++): negligible

Table-4: Countrywise Export of Lithium Carbonates

(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Argentina	-	-	++	33	++	218
Bangladesh	3	3347	26	8837	15	7066
Bhutan	++	11	0	40	-	-
Bolivia	-	-	-	-	0	1
Botswana	-	-	-	-	++	36
Canada	-	-	-	10	++	73
Taiwan	11	1390	5	707	5	704
China	7	2933	-	-	0	14
Colombia	-	-	0	1	0	3
Dominic Rep.of	1	861		-	1	956
Ecuador	-	-	2	268	9	1024
Egypt	++	373	++	472	++	51
Fiji Is	0	1	-	-	-	-
Gambia	-	-	-	3	-	-
Germany	-	-	++	458	++	106
Indonesia	++	18	++	20	0	6
Iran	20	52400	-	-	-	-
Israel	++	172	-	-	++	364
Japan	-	-	0	72	-	-
Jordan	-	-	++	30	-	-
Kenya	-	-	1	200	++	178

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Korea, Rep. of	-	1	-	10	++	188
Kuwait	-	-	++	20	0	18
Lebanon	++	341	++	43	-	-
Malawi	++	14	-	-	-	-
Malaysia	1	4844	1	4042	1	5665
Mauritius	-	-	-	-	0	4
Morocco	-	-	0	10	++	142
Nepal	1	1638	++	711	2	1817
Nigeria	6	533	-	-	0	62
Oman	-	-	0	20	-	-
Paraguay	-	-	-	-	++	109
Peru	++	51	++	26	0	9
Philippines	++	4	-	-	++	23
Qatar	-	-	0	13	-	-
Russia	-	-	++	10	-	-
Saudi Arabia	++	360	0	3	-	-
Singapore	-	-	++	60	-	-
South Africa	-	-	-	3	0	14
Spain	-	-	-	-	++	807
Sri Lanka	0	18	++	86	++	24
Switzerland	-	169	++	1948	2	11330
Thailand	5	695	11	3952	2	4974
Tunisia	-	-	-	-	++	14
Turkey	++	2	-	-	++	151
Uganda	-	-	-	-	++	3
UAE	++	361	++	22	5	14351
USA	5	6336	++	623	11	11981
Uruguay	++	403	++	1903	1	2327
Vietnam	343	38970	275	29650	406	38281
Zimbabwe	-	-	-	-	++	42

Figures rounded off

(++): negligible

Table-5: Countrywise Export of LIithium-ion (Cell/Batteries)

(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Afghanistan	++	4				
Australia	1	972	++	96	0	12
Austria	1	70	0	9	0	2899
Azerbaijan	++	51	-	-	-	-
Bangladesh	62	13923	51	23446	23	12401
Belgium	++	160	++	121	-	-
Benin	++	1100	++	1518	-	-
Bhutan	1	573	2	5171	5	4760
Botswana	4	179	2	11	-	-
Burkina Faso	++	9864	-	-	-	-
Cameroon	-	-	-	-	++	2
Cambodia	-	-	++	50	-	-
Canada	0	44	++	489	-	-

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Chile	-	-	-	-	++	69
Taiwan	++	717	++	264	++	1715
China	56	64290	252	42662	37	21303
Czech Republic	++	62	-	-	-	-
Denmark	-	-	-	-	-	0
Ecuador	++	141	-	-	6	49199
Ethiopia	0	32	0.01	23	-	-
Fiji Is	1	507	++	174	++	96
France	++	1256	++	742	++	1821
Gambia	-	-	0.02	57	-	-
Germany	++	323	-	-	292.55	221,572
Ghana	-	-	++	3	++	275
Guinea	++	450	++	32	-	-
Hong Kong	1,165	239,319	590	169,112	37	4006
Hungary	-	-	-	-	++	38107
Iceland	++	50	-	-	-	-
Indonesia	++	28	0	0	3	105,032
Iran	++	35	++	17	-	-
Iraq	-	-	++	14	1	4
Ireland	-	-	-	-	0	2
Israel	-	-	-	-	++	616
Italy	-	-	++	161	2	923
Cote D' Ivoire	-	-	1	395	-	-
Japan	++	498	3	11759	12	577,713
Kenya	0	76	1	2999	6	6499
Korea, Rep. of	12	8433	3	8173	508	96255
Kuwait	++	428	-	-	-	-
Lebanon	-	-	0	53	-	-
Lesotho	-	-	++	11	-	-
Liberya	-	-	-	-	0.13	144
Madagascar	-	-	-	-	0	112
Malaysia	1	9742	++	7922	++	46
Maldives	++	161	++	254	1	339
Mauritania	-	-	0	13	-	-
Mauritius	0	51	0	1	0.16	91
Mozambique	0	287	-	-	-	-
Namibia			0.1	56	-	-
Nepal	1	1003	14	13162	66	27808
Netherlands	3	58425	5	46161	3	55364
New Zealand	0	4	-	-	-	-
Nicaragua	++	60	-	-	-	-
Niger	++	9864	2	49271	-	-
Nigeria	1	4852	++	1055	++	1464
Norway	-	-	1	1189	-	-
Oman	-	-	++	61	++	1259
Papua N Guinea	-	-	0	69	-	-
Peru	-	-	-	-	0	26
Philippines	-	-	++	1588	-	-
Poland	-	-	-	-	75601	101,946
Portugal	-	-	-	-	0	174

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Qatar	++	99	++	108	++	26
Romania	++	330	++	67	++	86
Rwanda	++	289	-	-	-	-
Saudi Arabia	0.14	7305	++	254	0.04	254
Senegal	-	-	-	-	0.02	79
Seychelles	-	-	++	67	-	-
Sierra Leone	0	4	-	-	++	115
Singapore	2	6569	1	18294	2	21593
Somalia	-	-	-	-	++	255
South Africa	0	2	++	7612	++	46
Spain	++	29	-	-	-	-
Sri Lanka	-	-	-	-	6	3973
Sudan	36	55894	11	5001	0	36
Swaziland	-	-	++	34	-	-
Sweden	++	3889	-	-	++	174
Switzerland	0	11	-	-	1	641
Tanzania	++	34	0	3	6	6251
Thailand	18	9689	82	43812	-	-
Togo	-	-	-	-	1	24497
Turkey	-	-	-	-	++	118
Uganda	2	2728	++	2619	1	11970
UAE	3	1415	11	2137	98	8211
Uk	++	455	++	231	++	285
Usa	12	167,649	18	4880	2	3034
Uzbekistan	0	3	0	1889	-	-
Vietnam	23	5574	54	16513	36	15817
Congo, D. Rep.	++	13	0	29	++	197
Zambia	-	-	++	1002	-	-
Zimbabwe	-	-	0.04	1495	++	42

Figures rounded off (++): negligible

Imports

In 2021-22, imports of lithium oxide and hydroxide by value increased by 59% to ₹ `195.85 crore from ₹ `123.36 crore in the previous year. Imports were mainly to Russia (44%) and Belgium (24%). In 2021- 22, imports of lithium carbonate by value increased marginally by 2% to ₹ `64.82 crore from ₹ `63.41 crore in the previous year. Imports were mainly to Belgium (41%), Ireland (24%) and Netherlands (16%). In 2021-22, imports of lithium-ion (cell/battries) by value increased substantially by 68% to ₹ `13,672.63 crore from ₹ `8,125.78 crore in the previous year. Imports were mainly to Vietnam (30%), Singapore (25%), China (27%) and South Africa (9%) (Tables-6 to 9).

Table-6 : Countrywise Import of Lithium Oxide and Hydroxide

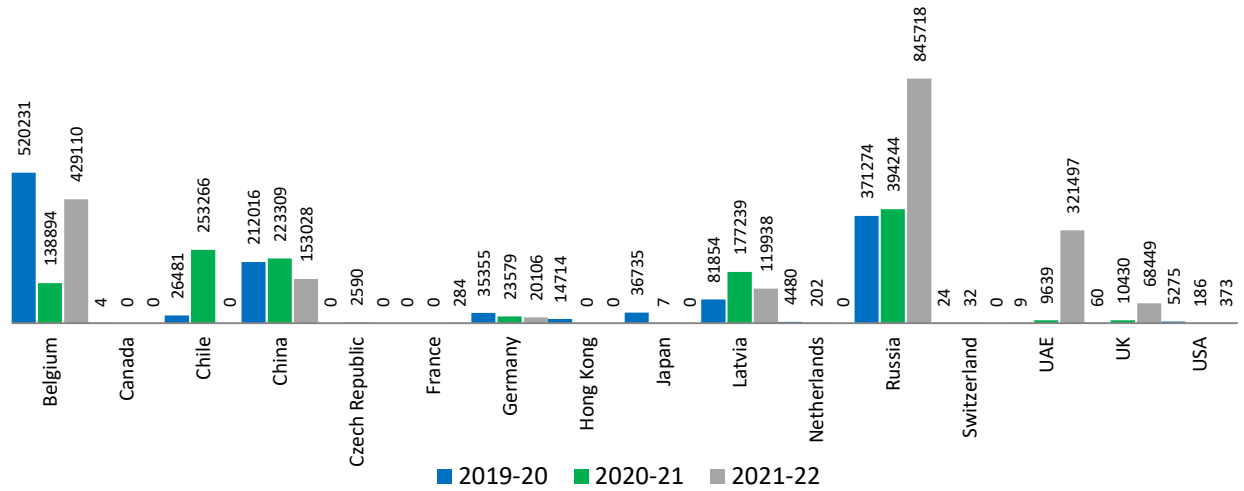
(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Belgium	616	520231	260	138894	473	429110
Canada	0	4	-	-	-	-
Chile	40	26481	540	253266	-	-
China	283	212016	436	223309	149	153028
Czech Republic	-	-	2	2590	-	-
France	-	-	-	-	1	284
Germany	24	35355	19	23579	25	20106
Hong Kong	20	14714	-	-	-	-

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Japan	52	36735	-	7	-	-
Latvia	108	81854	380	177239	120	119938
Netherlands	5	4480	++	202	-	-
Russia	590	371274	960	394244	863	845718
Switzerland	++	24	++	32	-	-
UAE	++	9	23	9639	267	321497
UK	++	60	20	10430	80	68449
USA	11	5275	++	186	++	373

Figures rounded off (++): negligible

Value (₹ '000)



Countrywise Import of Lithium Oxide and Hydroxide

Table-7 : Countrywise Import of Lithium Carbonates

(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Argentina	56	46516	60	25693	40	30557
Austria			3	8829	10	34638
Belgium	206	173,657	266	129247	510	257,388
Canada			9	3409	4	14602
Chile	95	93883	71	47063	38	20920
China	57	45063	57	27069	24	26164
Germany	++	1051	120	48268	46	27671
Ireland	100	3635	400	16189	300	12590
Italy	1	1753	1	772	1	1156
Japan	12	12216	++	60	-	-
Malaysia	++	1142	-	-	-	-
Netherlands	400	14368	100	4294	200	8370
Russia	0	3	-	-	-	-
Singapore	23	60525	21	56174	5	13455
Slovenia	15	45239	-	-	10	34677
UK	20	14596	13	5861	20	12441
USA	133	280,878	122	261187	34	153,617

Figures rounded off (++): negligible

Table-8 : Countrywise Import of Lithium-ion (Cell/Batteries)

(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Australia	++	7302	1	1708	++	420
Austria	2	9553	3	19538	3	15098
Baharain	-	-	++	81	-	-
Bangladesh	-	-	-	-	++	0.64
Belgium	5	45630	3	32195	6	81152
Brazil	-	-	-	-	0	169
Cambodia	-	-	-	-	++	57
Canada	++	3357	1	2232	++	2568
Chile	-	-	-	-	17	4826
Taiwan	528	318,649	195	192,846	921	695,054
China	367,717	47,135,991	375,831	51,652,062	459,552	83,473,439
Cyprus	-	-	0	109	-	-
Czech Republic	++	39	++	992	++	6409
Denmark	++	3511	1	1910	3	2514
Estonia	++	117	++	1052	-	-
Finland	3	1456	++	1505	++	205
France	2	156,001	1	48210	1	11742
Germany	19	75688	89	111,883	23	161,159
Ghana	-	-	27	529	-	-
Hong Kong	137,473	24,799,490	121,335	25,480,547	120,859	34,804,408
Hungary	12	15777	23	11003	15	7359
Indonesia	1,090	96238	349	22790	699	60012
Ireland	35	22366	++	1593	++	2126
Israel	1	5206	1	3569	13	9180
Italy	1	20434	1	3486	3	7595
Japan	895	2,175,995	551	2,219,211	1,557	2,852,389
Jordan	-	-	0	26	-	-
Korea, Rep. of	2,823	1,654,271	1,405	721,019	21,379	5,514,740
Lithuania	0	477	-	-	-	-
Luxembourg	0	86	++	279	83	21503
Malaysia	4,260	734,102	-	429,632	796	304,722
Malta	-	-	-	46	-	-
Mexico	1	3953	-	3673	5	1378
Morocco	-	-	-	-	0	362
Netherlands	41	100,186	-	90035	9088	376,280
New Zealand	1	2871	-	1980	++	2697
Norway	++	3601	-	59	++	177,426
Philippines	1	1283	-	61	16	1619
Poland	2	1842	-	793	3	42
Portugal	-	-	-	-	0	154
Romania	++	778	-	122	-	-
Slovak Rep.	++	88	-	155	++	681
Singapore	2779	654095	-	801217	415957	4521563
Slovenia	-	-	--	-	0	20
South Africa	-	-	-	-	++	648
Spain	++	32	-	40080	++	94026
Sri Lanka	-	-	-	-	1	3455
Sweden	1	1901	-	148471	3	166286

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Switzerland	3	42806	-	17173	1	12998
Thailand	1484	116555	48	5199	32	57215
Turkey	++	2322	-	3	9	774
UAE	34	11085	1	3193	102	4102
Uk	7	130349	-	34603	8285	41970
UsA	411	215711	-	298111	136095	874402
Vietnam	19797	9614886	-	5709521	500547	2354456

Figures rounded off (++): negligible

Table 9 : Countrywise Import of Lithium Perfluorooctane Sulphonate

(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
Germany	-	11	-	30	-	-
Hong Kong	-	2821	-	-	-	-

Figures rounded off

FUTURE OUTLOOK

There is very high demand for lithium batteries in Mobile and Automotive Sector. India solely depends 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.

12. Molybdenum

27.20
(million tonnes) Total reserves/ resources of molybdenum ore in 2020-21

435
(tonnes) Production of ferromolybdenum in 2021-22

Negligible exports of molybdenum ores concentrates in 2021-22

9,114
(tonnes) Imports of molybdenum ores & concentrates in 2021-22

Molybdenum (Mo) is a refractory metal used principally as an alloying agent in steel, cast ron & 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 intermittently 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 UNF C 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).

Table – 1 : Reserves/Resources of Molybdenum as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

Grade/State	Reserves	Remaining Resources						
	Total	Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total	Total Resources
	(A)	STD221	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total								
Ore -	-	1500000	2382000	3269204	19884394	167800	27203398	27203398
Contained MoS_2	-	1050	1599.54	1733.29	12457.39	50.34	16890.56	16890.56
By States								
Karnataka								
Ore		-	-	-	1320900	-	1320900	1320900
Contained MoS_2	-	-	-	-	1718.7		1718.7	1718.7
Madhya Pradesh								
Ore		-	-	-	8000000		8000000	8000000
Contained MoS_2	-	-	-	-	5020		5020	5020
Tamil Nadu								
Ore		1500000	2382000	3269204	10563494	167800	17882498	17882498
Contained MoS_2	-	1050	1599.54	1733.29	5718.69	50.34	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".

USES

Molybdenum is a versatile alloying agent for alloy steel, cast iron, nickel, cobalt and titanium alloys. For desired metallurgical properties, it is used in the form of molybdic oxide or ferro-molybdenum. It is used in different proportions for imparting desired properties, such as, increased strength, hardness and resistance to corrosion, temperature and chipping. It also finds application in permanent magnet alloys. As a refractory metal, it is used in many electrical and electronic components and as resistance element in electric furnaces and other equipment which are operated at extremely high temperatures. Its non-metallurgical uses are in lubricants, catalysts, pigments, as an additive in oil and greases, in aerosol sprays, in reducing surface friction and as an antiwear and antifriction agent in plastics. Molybdenum plays a vital role in the Energy Industry and it may become an increasingly essential factor in green technology.

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 subsititute vis-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.

INDUSTRY 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 428 tonnes in 2020-21 to 435 tonnes in 2021-22 (Table-2).

Table – 2 : Production of Ferromolybdenum

2017-18 to 2021-22

(In tonnes)

Year	Production
2017-18	1205
2018-19	1003
2019-20	527
2020-21(P)	428
2021-22(P)	435

Source: Monthly Statistics of Mineral Production, March, 2021, IBM

(In tonnes)

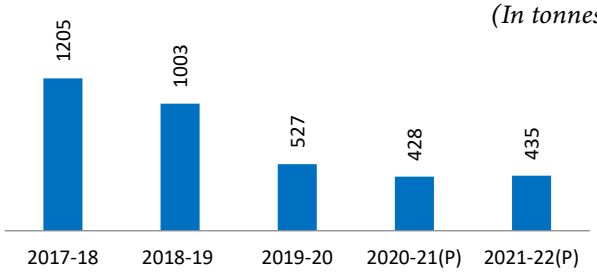


Fig. 1: Production of Ferromolybdenum 2017-18 to 2021-22

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 (MoS_2), 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
Canada	1400
Russia	430
Turkey	360
Armenia	150
Mexico	130
Argentina	100
Chile	72
Iran	43
Korea, Rep. of	8
Mongolia	NA

Source: USGS, Mineral Commodity Summaries, 2023.

The world mine production of molybdenum in terms of metal content decreased marginally by 5% to 2.98 lakh tonnes in 2021 from 3.12 lakh tonnes in 2020. China with 44% production was the main producer of molybdenum in the world followed by Chile (17%), USA (14%), Peru (11%) and Mexico (5%) (Table-4).

Table-4:World Mine Production of Molybdenum

(By Principal Countries)

(In tonnes of metal content)

Country	2019	2020	2021
World:Total (rounded off)	**281000**	**312000**	**298000**
China	104435	120000	130000
Chile	53541	59319	49403
USA	43600	51100	41100
Peru	30441	32185	34148
Mexico	21694	20577	16319
Armenia	7360	12691	11310
Iran[(a)]	8711	6762	*6800
Mongolia	2492	2889	2973
Canada	3955	2671	2023
Other countries	3702	4246	3843

Source: BGS World Mineral Production, 2017-21,

(a) years ended 20th March following that stated.

(In tonnes of metal content)

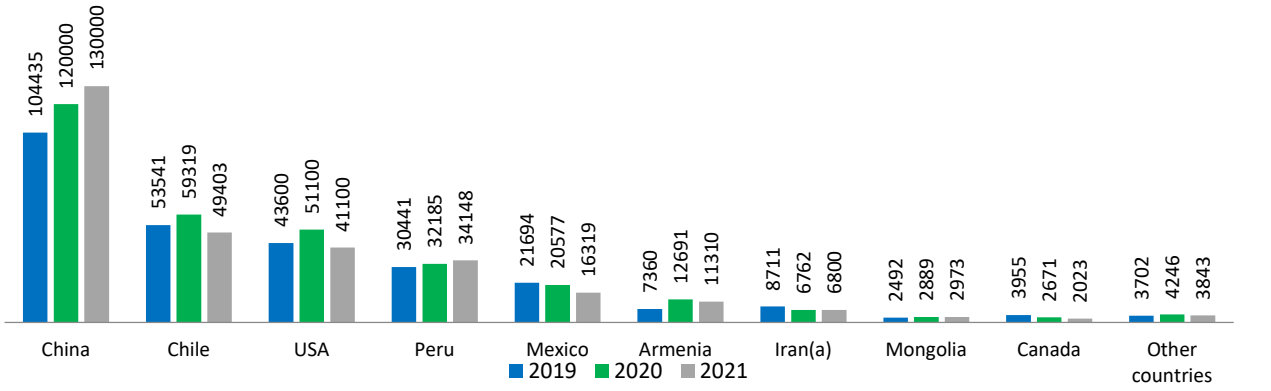


Fig. 2: Countrywise Production of Molybdenum

To give a generalised view of the development in various countries, the countrywise description sourced from available publication, i.e., Minerals Yearbook of USGS, 2018 is furnished below.

Canada

Teck Resources Ltd announced that its Highland Valley Mine in south-central British Columbia produced 3,900 tonnes of molybdenum in concentrate in 2018, about 7% decrease from the 4,200 tonnes produced in 2017. The Company attributed the decrease to lower ore grades.

At its Gibraltar Mine in south-central British Columbia, Taseko Mines Ltd produced 1,070 tonnes of molybdenum, about 11% decrease from the record 1 , 200 tonnes of molybdenum in concentrate produced in 2017.

Chile

Amerigo Resources Ltd (Canada) reported that it produced 860 tonnes of molybdenum in 2018, compared with 730 tonnes of molybdenum in 2017 at its Minera Valle Central processing facility in central Chile. Amerigo forecast production of 1,100 tonnes of molybdenum in 2019.

Antofagasta plc (United Kingdom) announced that by-product molybdenum production at its 60% owned Los Pelambres Mine was 13,300 tonnes in 2018 a 27% increase compared with 10,500 tonnes produced in 2017. Antofagasta also announced that its new molybdenum plant at the 70% owned Centinela Mine produced 300 tonnes of molybdenum in concentrate in 2018. The Centinela molybdenum plant started production in the third quarter of 2018 and had a capacity to produce an average of 2,400 tonnes per year of molybdenum in concentrate. The Centinela Mine is 1,350 kilometers north of Santiago in

the Antofagasta Region. The company expected Centinela of produce aprroximately 2,000 tonnes of molybdenum in concentrate 2019. corporacion Nacional del Cobre de Chile (CODELCO), the state- controlled copper and molybdenum producer, announced that it produced 24 ,000 tonnes of molybdenum in 2018 compared with 28,700 tonnes in 2017. The Sierra Gorda Mine produced 6,900 tonnes of molybdenum in concentrate in 2018, a decrease from 2017 molybdenum production. The company attributed the decrease to lower grade ore.

Mexico

Southern Copper Corp. (a subsidiary of Grupo Mexico S.A.B. de C.V.) reported that it produced 21,990 tonnes of molybdenum in concentrate in 2018, a 3% increase from 21,330 tonnes in 2017, owing mainly to higher production at the Buenavista Mine. The Buenavista Mine produced 8,400 tonnes of molybdenum in concentrate in 2018 as compared with 3,460 tonnes in 2017. Southern Copper reported that its La Caridad Mine, in northeastern Sonoro, produced 9,800 tonnes of molybdenum in concentrate in 2018, compared with 9,900 tonnes in 2017. The molybdenum recovery plant had a capacity to process 2,000 tonnes per day of copper-molybdenum concentrates.

Peru

Teck announced that it produced 4,600 tonnes of molybdenum in concentrate in 2018 at its Antamina copper-zinc mine in Peru, 17% more than that in 2017 . Copper, molybdenum and zinc production at Antamina can vary significantly from year to year owing to the geology of the deposit and proportion of copper to copper-zinc ore processed. The Cerro Verde Mine is an open pit copper and molybdenum mining complex with the production in 2018 was approximately 12,700 tonnes of molybdenum in concentrate as compared with 12,200 tonnes in 2017. Southern Copper produced 3,100 tonnes of molybdenum in concentrate at its Cuajone operation in 2018 as compared with 3,700 tonnes in 2017. Production at the Cuajone operation began in 2016.

China

China's molybdenum production took place predominantly in Hebei, Henan, and Shaanxi Provinces and the Nei Mongol Autonomous Region. China had a large number of small-scale mining operations that were susceptible to changes in prices and also were able to quickly increase or decrease production during price fluctuations. Environmental inspections at molybdenum mines and processing facilities continued in 2018 and disrupted production at a variety of molybdenum producers. Jiangxi Copper Co. Ltd, produced 7,500 tonnes of molybdenum concentrate in 2018, a 3% increase from 2017.

Jinduicheng Molybdenum Co. Ltd announced that it was expected to produce 48,000 tonnes of 45% grade molybdenum concentrate in 2019 as compared with 47,500 tonnes in 2018. China announced that it was expected to impose a 5% tariff on imports of both roasted and unroasted molybdenum concentrates, effective September 24, 2018.

Armenia

The Zangezur Copper-Molybdenum Combine continued to produce molybdenum at its Kajaran Mine. According to Cronimet Mining AG, the Kajaran Mine is the leading copper and molybdenum mine in Armenia. Zangezur's company shareholders are Cronimet Mining (60%), Pure Iron Plant OJSC (15%), Armenian Molybdenum Production Ltd (12.5%), and Zangezur Mining Ltd (12.5%).

FOREIGN TRADE

Exports

Exports of molybdenum ores & concentrates was negligible in 2021-22 from 45 tonnes in 2020-21. Exports were mainly to Mexico & South Africa. Exports of molybdenum and scrap also increased sharply 106 % to 365 tonnes in 2021-22 from119 tonnes in 2020-21. Exports were mainly to Netherlands (83%), and Germany (14%) (Tables-5 to 8).

Table – 5 : Exports of Molybdenum Ores & Conc.

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**45**	**43181**	**++**	**120**
Mexico	-	-	++	90
South Africa	-	-	++	21
Austria	-	-	++	9
Korea, Rep. of	40	41622	-	-
Kenya	5	1559	-	-

Figures rounded off

Table – 6 : Exports of Molybdenum & Scrap

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**119**	**182537**	**365**	**342257**
Netherlands	23	4400	303	106840
Germany	63	31197	51	76887
Austria	6	72646	6	67219
China	1	20820	1	30848
USA	2	11987	++	17583
Belgium	++	4347	1	9730
Brazil	++	1545	++	6379
Poland	1	5219	1	5718
Bangladesh	1	2799	1	2799
Japan	++	2582	++	2249
Other countries	22	24995	1	16005

Figures rounded off

Table – 7 : Exports of Molybdenum Powders.

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3**	**8907**	**++**	**261**
France	++	31	++	188
Egypt	++	9	++	69
Canada	-	-	++	4
Thailand	-	-	++	++
Malaysia	3	8698	-	-
UAE	++	169	-	-
Kazakhstan	++	++	-	-

Figures rounded off

Table –8: Exports of Molybdenum: Worked

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**18**	**152861**	**14**	**208691**
Austria	6	72646	6	67219
Germany	2	17909	3	50422
China	1	20820	1	30848
USA	2	11987	++	17583
Belgium	++	4347	1	9730
Brazil	++	1545	++	6379
Poland	1	5219	1	5718
Bangladesh	1	2799	1	2799
Japan	++	2582	++	2249
Italy	++	150	++	2073
Other countries	5	12857	1	13671

Figures rounded off

Imports

Imports of molybdenum ores & concentrates decreased by 1% to 9,114 tonnes in 2021-22 from 9117 tonnes in 2020-21. Imports were mainly from Chile (48%) , Thailand (14%), UAE (12%), and Netherlands (8%). Imports of molybdenum and scrap increased to 554 tonnes in 2021-22 from 430 tonnes in 2020-21. Imports were mainly from China (58%), Austria (10%) and USA (10%) (Tables-9 to 13).

Table – 9 : Imports of Molybdenum Ores and Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**9177**	**8848441**	**9114**	**15470962**
Chile	3567	3190606	4376	6700724
Thailand	1977	2082011	1330	2677220
UAE	756	748294	1114	1999829
Netherlands	622	597959	734	1370753
USA	1300	1302431	877	1327059
China	150	146839	210	430143
Korea, Rep.of	274	317728	172	415532
Luxembourg	-	-	138	259116
Switzerland	95	137817	53	138738
Germany	43	28603	72	45419
Other countries	393	296153	38	66429

Figures rounded off

Table – 10: Imports of Molybdenum & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**430**	**1540722**	**554**	**2453374**
China	323	964917	324	1242523
Austria	45	293841	53	475271
USA	20	81188	59	312761
UAE	1	1793	30	111426
Singapore	4	38224	18	110780
Germany	19	56291	9	46360
Hong Kong	2	10747	11	45057
Korea, Rep. of	++	472	35	34202
Italy	1	1076	5	26676
Malaysia	-	-	5	11849
Other countries	15	92173	5	36469

Figures rounded off

Table –11: Imports of Molybdenum Powders

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**12**	**62407**	**12**	**62407**
USA	8	32025	8	32025
Singapore	2	17840	2	17840
Japan	++	5539	++	8180
Germany	++	241	3	5695
Hong Kong	++	2344	1	5043
Korea	-	-	23	4283

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
China	1	1889	1	2960
Italy	1	947	3	2559
Belgium	++	1538	++	1437
Canada	++	44	++	517
Other Countries	-	-	++	396

Figures rounded off

Table –12: Imports of Molybdenum :Worked

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**231**	**1047016**	**315**	**1696847**
China	140	540752	193	800322
Austria	45	293841	53	475271
USA	12	49146	46	251208
Singapore	2	20384	6	61733
Germany	19	56050	6	40665
Itaiy	++	19	2	24078
Malaysia	-	-	5	11849
Australia	-	-	1	10712
Hong Kong	++	4522	1	9654
Russia	++	31267	2	5037
Other countries	13	51035	++	6318

Figures rounded off

Table –13: Imports of Molybdenum :Unrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**187**	**431299**	**193**	**639861**
China	182	422276	130	439241
UAE	1	454	30	111426
Hong Kong	2	3881	9	30360
Korea, Rep. of	-	-	12	28857
Singapore	-	-	10	24997
Netherlands	2	4130	2	4934
Italy	++	110	++	39
USA	++	17	++	7
Belgium	++	420	-	-
UK	++	11	-	-
Other countries	-	-	-	-

Figures rounded off

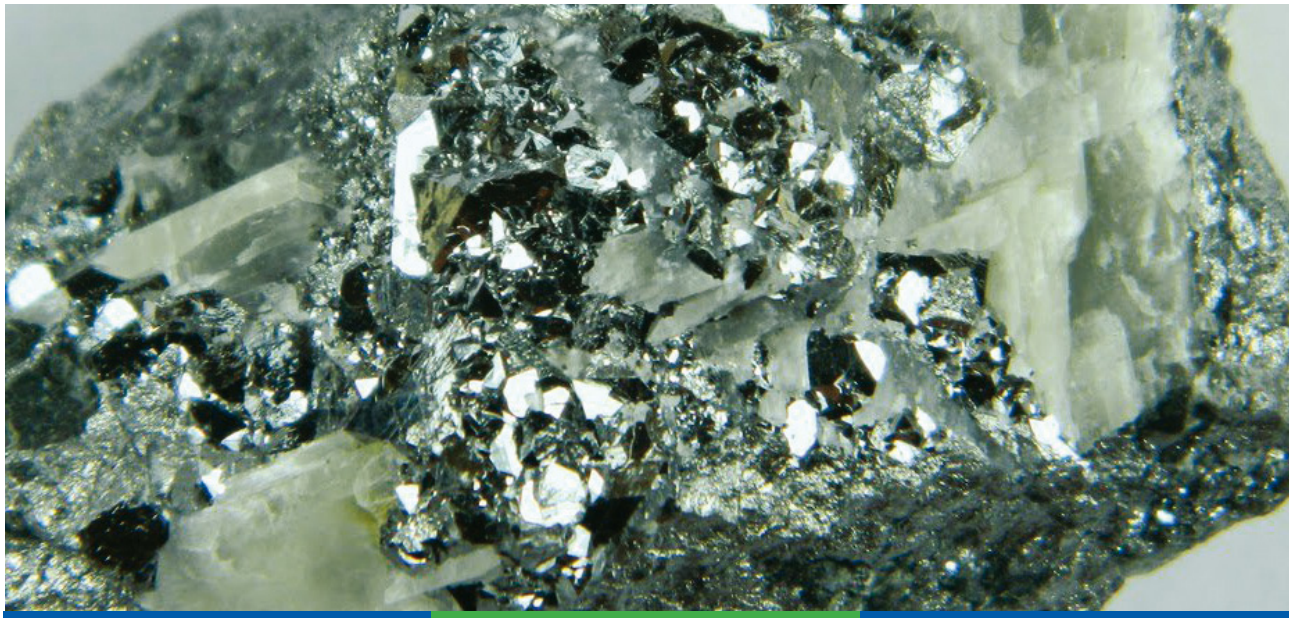
FUTURE OUTLOOK

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.

13. Nickel



189
(million tonnes) Total reserves/ resources of nickel have been established as on 1st April 2020

5,893
(tonnes) Exports of nickel and alloys including scrap wire exported in 2021-22

51,519
(tonnes) Imports of nickel & alloys including scrap in 2021-22

Nickel is a lustrous, silvery-white metal. It is the 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 at a 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 magnetised. 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 principally as oxides, sulphides and silicates in India. Important occurrence is nickeliferous limonite in the overburden of chromite in Sukinda Valley, Jajpur district, Odisha. In addition, nickel is found associated with uranium deposits at Jaduguda, Jharkhand and a process is 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 found to occur in three districts, namely, 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 (P)

(By Grades/States)

(In million tonnes)

Grades/States	Total Reserves (A)	Remaining Resources						Total Reserves (A+B)
		Pre-feasibility	Measured	Indicated	Inferred		Total	
		STD221	STD222	STD331	STD332	STD333	(B)	
All India : Total	**–**	**21**	**21**	**31**	**53**	**63**	**189**	**189**
By Grades								
+ 0.9% Ni	–	13	7	–	18	3	42	42
0.5 to 0.9% Ni	–	7	13	31	21	21	94	94
(+) 0.5% Ni, unclassified	–	–	–	–	14	39	53	53
Not-known	–	–	–	–	–	0.23	0.23	0.23
By States								
Jharkhand	–	–	–	–	2	7	9	9
Karnataka	–	–	–	–	–	0.23	0.23	0.23
Nagaland	–	–	–	–	–	5	5	5
Odisha	–	21	21	31	51	51	175	175

Figures rounded off

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

INDUSTRY

HCL produced nickel sulphate as a by-product at its Ghatsila Copper Smelter in Jharkhand. The sulphide copper ore from Ghatsila area contains nickel in small quantity along with other important metals like gold and cobalt. HCL, by means of imported EMEW technology from Canada, developed capabilities to recover LME-Nickel, a grade cathode from lower concentration of copper in spent electrolyte, which otherwise was not possible by conventional means. Besides this, the technology also enabled HCL to recover nickel from the spent electrolyte at ICC refinery. Another technology of Acid Purification Unit (APU) again imported from Canada, which is an eco-friendly technology that allowed reduction of liquid effluent and facilitates recovery of nickel in the downstream process. HCL has installed capacity of 390 MT to recover nickel sulphate. However, production of nickel sulphate has not been reported since 2004-05. The Nicomet Industries Ltd located at Goa is presently engaged in production of nickel metal and their derivatives and its annual production capacity from its Goa plant is about 5,400 MTPA.

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'S first complete and holistic TRL- 4 Process for Extraction and Nickel and other metals from spent lithium battery 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 pyrometallurgical 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%) could be reused in Battery industry. (b) 25% nickel requirment in steel making is met from secondary sources, so this alloy can fulfill some of the requirement.

USES

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 recognisable 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, aluminium, 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.

CONSUMPTION

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 specialised industrial, aerospace and military applications. About 9% is used in plating and 6% in other uses, including coins and a 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 speciality steels are sometimes used in place of stainless steel within the power-generating, petrochemical and petroleum industries. Titanium alloys or speciality 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.

TRADE POLICY

As per Foreign Trade Policy, 2015-2020, imports of nickel ores & concentrates (Heading no. 2604) and Nickel waste & scrap (Heading no. 75030010) are allowed free. However, some forms of metal waste & scrap (ITC-HS Code No. 7503 0090) are restricted.

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 is in laterites 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 2021, world mine production of nickel increased considerably to 2.81 million tonnes as compared to 2.49 million tonnes of metal content in the previous year (Table-3). The chief producers of nickel in the world in 2021 were Indonesia (42%), Philippines (14%), Russia (7%), New Caledonia (6%), Canada & Australia (5% each), China (4%), etc. (Table-3).

Table – 3: World Mine Production of Nickel

(By Principal Countries)

(In tonnes of metal content)

Country	2019	2020	2021
World: Total	**2673000**	**2492000**	**2813000**
Indonesia	1036200	816700	1173200
Philippines	323325	328372	386359
Russia	223200	237200	*190000
New Caledonia	208185	199475	186284
Australia	158751	169344	150876
Canada	180904	167243	133581
China	104674	104674	98602
Brazil	55700	77100	76000
Guatemala	36300	50300	64900
Other countries	345744	341351	353578

Source: BGS World Mineral Production, 2017-21

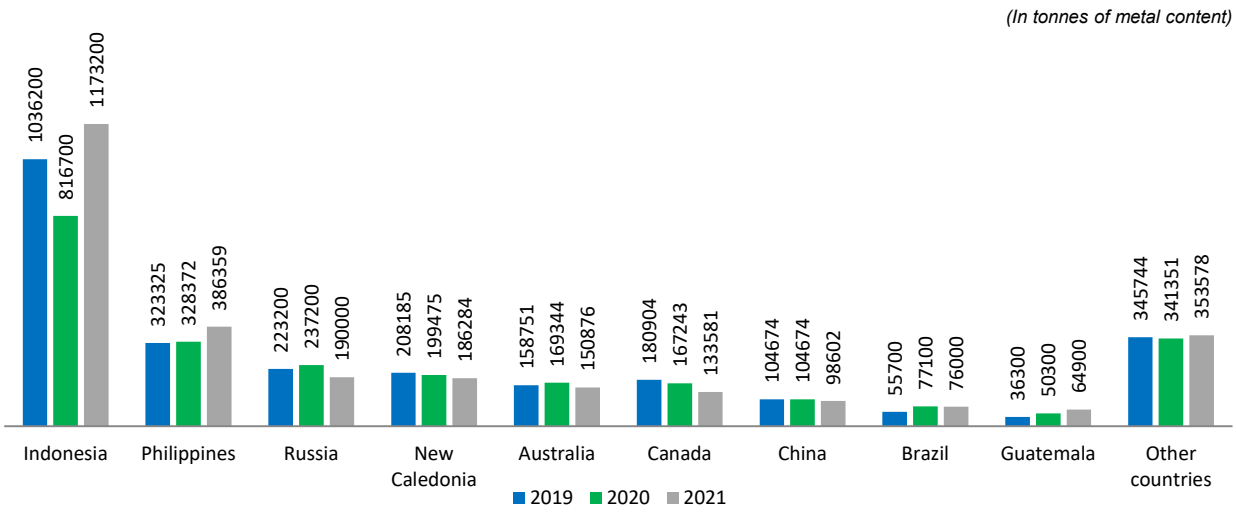


Fig 1: World Mine Production of Nickel

FOREIGN TRADE

Exports

Exports of nickel ores and concentrates were 20 tonnes in the current year. However, there were negligible tonnes exports of nickel ores & concentrates in the preceding year. On the other hand, exports of nickel and alloys including scrap increased drastically by 100% to 5,893 tonnes in 2021-22 from 2,937 tonnes in the previous year. Out of the total alloys and scrap exported in 2021-22, nickel & alloys were 4,199 tonnes, while nickel waste & scrap were1,694 tonnes. Exports of nickel and alloys including scrap were mainly to China (14%), UK (15%), Singapore (11%), Mexico (7%), and USA (9%), (Tables-4 to 18).

Table – 4: Exports of Nickel Ores and Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**-**	**-**	**20**	**5183**
Brazil	-	-	20	5183

Figures rounded off

Table – 5: Exports of Nickel and Alloys Including Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2937**	**4147078**	**5893**	**9407073**
China	603	732297	799	1384723
Singapore	32	49511	626	1186321
USA	161	382978	509	947716
UK	332	263743	882	861527
Mexico	193	330936	409	813651
Korea	127	179750	358	535976
UAE	96	182322	284	495901
Saudi Arabia	45	134758	92	298523
Thailand	77	114149	245	296068
Turkey	187	308047	169	278385
Other countries	1084	1468587	1520	2308282

Figures rounded off

Table – 6: Exports of Nickel & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2269**	**3763280**	**4199**	**8103812**
China	603	732297	798	1382691
Singapore	32	49511	626	1186321
Mexico	193	330936	409	813651
USA	159	381353	366	806372
Korea, Rep. of	127	179750	358	535976
UAE	96	182322	284	495901
Saudi Arabia	45	134758	92	298523
Turkey	187	308047	169	278385
Brazil	98	152797	140	262843
Thailand	77	114149	127	217784
Other countries	652	1197360	830	1825365

Figures rounded off

Table – 7: Exports of Nickel Waste & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**668**	**383798**	**1694**	**1303216**
UK	297	181612	798	682783
USA	2	1625	143	141344
Sweden	177	104595	192	132285
Netherlands	55	24942	240	115486
Japan	41	24241	109	86268
Thailand	-	-	118	78284
Germany	17	5456	45	38519
Malaysia	60	34127	32	18031
Taiwan	-	-	5	4208
Belgium	15	4931	7	2729
Other countries	4	2269	5	3324

Figures rounded off

Table – 8 : Exports of Electroplated Anode of Nickel

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value ('000)
All Countries	**64**	**31638**	**14**	**13359**
Saudi Arabia	7	4558	14	12421
Singapore	-	-	++	368
Israel	++	79	++	197
Maldives	-	-	++	150
USA	++	1	++	123
Qatar	-	-	++	47
New Zealand	-	-	++	17
Japan	-	-	++	15
Bangladesh	++	2	++	13
UAE	1	648	++	5
Other countries	56	26350	++	3

Figures rounded off

Table – 9 : Exports of Nickel Oxide Sinters & Other Intermediate

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**127**	**++**	**83**
USA	++	28	++	62
Czech Republic	++	99	++	21

Figures rounded off

Table – 10 : Exports of Nickel Mattes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**142**	**++**	**44**
Bangladesh	-	-	++	27
Bhutan	-	-	++	12
Nepal	-	-	++	5
Turkey	++	142	-	-

Figures rounded off

Table – 11 : Exports of Nickel Electroplated Anode

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**3998**	**++**	**2307**
Bangladesh	-	-	++	1085
Qatar	-	-	++	1050
Netherlands	-	-	++	172
Kenya	++	1445	-	-
UK	++	1294	-	-
Nepal	++	600	-	-
Bulgaria	++	398	-	-
USA	++	261	-	-

Figures rounded off

Table – 12 : Exports of Nickel : Worked

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**253**	**370849**	**290**	**529209**
Brazil	39	58637	59	109678
Germany	10	13343	60	105130
Romania	-	-	56	101522
Philippines	21	31264	24	45562
Turkey	21	31273	19	33795
Colombia	6	9132	16	32315
USA	6	8306	13	27194
Saudi Arabia	7	10519	15	23220
Mexico	-	-	13	21423
Italy	++	1079	7	11331
Other Countries	143	207296	8	18039

Figures rounded off

Table – 13 : Exports of Nickel & Alloys: Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3**	**6481**	**8**	**7365**
Nepal	++	626	4	2847
Germany	-	-	4	2583
Italy	-	-	++	497
Australia	++	30	++	489
Turkey	++	2466	++	199
Gabon	-	-	++	176
Bangladesh	-	-	++	129
Israel	-	-	++	104
UAE	-	-	++	91
Kenya	++	136	++	78
Other countries	3	3223	++	172

Figures rounded off

Table – 14 : Exports of Nickel & Alloys : Worked, Nes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**157**	**608831**	**147**	**630701**
Hungary	20	64008	16	84573
Korea, Rep of	25	28772	52	75926
USA	15	58571	14	58462
Germany	17	58865	15	57605
Indonesia	7	33893	6	44971
Mexico	4	25692	2	30674
Thailand	4	20008	3	28828
Singapore	5	19388	7	25649
China	1	5820	2	19581
UAE	2	9159	2	18092
Other countries	57	284655	28	186340

Figures rounded off

Table – 15 : Exports of Nickel & Alloys: Worked

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**186**	**253186**	**282**	**499470**
Turkey	52	61574	95	132474
Saudi Arabia	10	32091	22	95362
USA	10	11639	47	81361
South Africa	12	15273	16	22325
Philippines	13	14136	8	21248
UK	2	2054	10	18323
Romania	++	152	11	17101
Brazil	6	6765	13	16932
UAE	2	5069	8	16453
Colombia	10	15091	11	14678
Other countries	69	89342	41	63213

Figures rounded off

Table – 16 : Exports of Bars, Rods, Plates, Sheets, Foils of Nickel Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**321**	**473082**	**353**	**722636**
Korea Rep.of	56	88230	57	108437
USA	30	52351	31	70222
France	13	22500	35	64478
Turkey	76	82100	29	64272
Thailand	15	22633	33	63283
Japan	11	20454	25	48936
Brazil	32	48231	25	48373
Mexico	7	10354	25	46615
Philippines	2	2731	20	40252
Saudi Arabia	2	10635	4	22010
Other countries	77	112863	69	145758

Figures rounded off

Table – 17 : Exports of Bars,Rods,Plates,Sheets,Foils of Nickel Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1310**	**2001393**	**1730**	**3232817**
Mexico	182	294890	359	700463
USA	98	250041	261	569016
Korea Rep.of	46	62748	249	351496
China	602	725058	195	317345
UAE	72	137860	89	156800
Saudi Arabia	21	58502	48	145889
UK	26	52247	68	139594
Italy	8	16439	86	131287
Thailand	42	54655	87	119141
Brazil	21	38716	41	72371
Other countries	192	310237	247	529415

Figures rounded off

Table – 18 : Exports of Nickel Electroplated Anode

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹''000)
All Countries	**++**	**3998**	**++**	**2307**
Bangladesh	-	-	++	1085
Qatar	-	-	++	1050
Netherlands	++	-	++	172
Kenya	++	1445	-	-
UK	++	1294	-	-
Nepal	++	600	-	-
Bulgaria	++	398	-	-
U SA	++	261	-	-

Figures rounded off

Imports

Imports of nickel ores & concentrates were 106 tonnes in the year 2021-22. Imports of nickel & alloys including scrap were at 51,519 tonnes in 2021-22 which decreased by 9% from that of 56,536 tonnes in the previous year. Out of the total alloys and scrap imported in 2021-22, nickel & alloys were at 48,437 tonnes as compared to 53,248 tonnes in the previous year, while nickel waste & scrap were 3,082 tonnes as compared to 3,288 tonnes in the previous year. Imports of nickel and alloys including scrap in 2021-22 were mainly from Netherlands (11%), Norway (11% each), UAE (9%), and Japan (8%) (Tables-19 to 33).

Table –19: Imports of Nickel Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**37**	**6404**	**106**	**16165**
USA	-	-	22	9783
Saudi Arabia	-	-	84	6382
Japan	14	3504	-	-
UAE	3	1634	-	-
Indonesia	20	1266	-	-

Figures rounded off

Table – 20: Imports of Nickel and Alloys Including Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**56536**	**55125443**	**51519**	**79427347**
Netherlands	1704	2032483	5965	9177044
Norway	5885	6935479	5766	8469753
UAE	1506	1201433	5247	6604258
Japan	5715	7387333	4066	6066640
South Africa	2923	3450761	4199	5890817
Russia	1249	1458302	3525	5348328
China	2775	3850114	2508	4331903
UK	1599	2718478	2354	4282779
USA	2927	4302850	1813	4173314
Singapore	1497	1883577	1649	3589939
Other countries	28756	19904633	14427	21492572

Figures rounded off

Table – 21: Imports of Nickel & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**53248**	**53022663**	**48437**	**77416339**
Netherlands	1620	1982477	5939	9164183
Norway	5861	6905374	5766	8469753
UAE	949	961851	4698	6229351
Japan	5514	7224603	4047	6061110
South Africa	2923	3450761	4199	5890817
Russia	1249	1458302	3525	5348328
China	2775	3850114	2508	4331903
UK	1558	2692889	2350	4279035
USA	2349	3944331	1797	4159180
Singapore	1393	1834252	1380	3430644
Other countries	27057	18717709	12228	20052035

Figures rounded off

Table – 22: Imports of Electroplated Anode of Nickel

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**78724**	**40534144**	**96488**	**68600951**
Tanzania	11439	5562294	33749	24622075
South Africa	46821	24112578	32085	22462691
Mozambique	12601	5774332	23923	16304490
Philippines	7284	4764104	3706	3113963
Namibia	-	-	2545	1714810
Malaysia	255	144449	234	182036
USA	212	121052	196	154242
China	58	18465	27	19822
UK	1	3166	2	9857
Singapore	3	1937	12	9553
Other countries	50	31767	9	7412

Figures rounded off

Table –23: Imports of Nickel Oxide Sinters & Other Intermediate

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**14098**	**2122865**	**362**	**745568**
Australia	-	-	12	460110
Singapore	-	-	120	191778
UAE	20	4059	211	61759
Netherlands	-	-	19	29051
China	++	7	++	1819
France	-	-	++	751
USA	51	12063	++	300
Papua New Guinea	13788	2054289	-	-
Indonesia	78	16402	-	-
Saudi Arabia	78	16318	-	-
Other countries	83	19722	-	-

Figures rounded off

Table –24: Import of Nickel Mattes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**407**	**++**	**293**
UK	++	396	++	249
USA	++	11	++	44

Figures rounded off

Table –25: Imports of Nickel Except Elecroplated Anode

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**27586**	**31317895**	**37248**	**54838895**
Netherlands	1362	1534814	5602	8650476
Norway	5861	6905365	5766	8469724
South Africa	2879	3406237	4199	5890587
UAE	540	635807	3600	5329686
Russia	1239	1368013	3507	5243210
Japan	3933	4546886	2918	4022005
Canada	2895	3149912	2139	2843415
France	295	309689	1633	2551454
Korea, Rep.of	1255	1367722	1676	2446677
UK	800	979006	1606	2371668
Other countries	6563	7114444	4602	7019993

Figures rounded off

Table – 26: Imports of Nickel :Worked

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**13**	**23174**	**14**	**23092**
Netherlands	-	-	14	20726
USA	++	175	++	1705
France	++	1316	++	263
China	7	11917	++	215
U K	3	3525	++	114
Taiwan	-	-	++	36
Germany	1	4006	++	33
Indonesia	-	-	++	++
Colombia	2	2170	-	-
Hong Kong	++	65	-	-
Other countries	-	-	-	-

Figures rounded off

Table – 27: Imports of Nickel & Alloys:Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1027**	**896439**	**343**	**484635**
UAE	175	59528	120	183549
Japan	10	8400	105	68581
Netherlands	71	80939	43	56511
Korea, Rep. of	100	115549	40	53203
USA	327	157541	13	52107
UK	101	189316	6	25308
China	5	14930	7	17189
Slovenia	3	11352	6	14655
Germany	++	119	2	7549
Turkey	++	1952	1	4057
Other countries	235	256813	++	1926

Figures rounded off

Table – 28: Imports of Nickel & Alloys :Worked,Nes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**368**	**2324709**	**457**	**3254660**
Singapore	4	296963	3	1264830
USA	29	270431	21	407650
China	120	214536	277	388538
Hong Kong	2	858714	1	305654
Japan	28	114782	31	211469
Germany	17	158720	12	201257
Korea, Rep.of	69	136597	57	133492
UK	24	73537	16	102624
Mexico	4	22865	6	72181
Italy	6	26238	10	52787
Other countries	65	151326	23	114178

Figures rounded off

Table – 29: Imports of Nickel & Alloys :Worked

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3634**	**5138634**	**3696**	**6440725**
China	844	1353439	1040	1981064
Sweden	1109	807595	924	870063
UK	260	592537	377	862152
USA	169	419682	210	602893
Germany	210	336399	284	482729
Taiwan	121	223227	208	377012
Japan	327	553483	178	343481
Italy	79	112395	158	248013
Brazil	210	343829	126	238998
Singapore	47	74395	73	152574
Other countries	258	321653	118	281746

Figures rounded off

Table – 30: Imports of Bars, Rods, Plates, Sheets, Foils of Nickel

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**531**	**1118988**	**893**	**1865739**
UK	182	363272	178	410550
China	45	101769	159	386080
USA	55	124592	137	279997
Netherlands	94	130554	147	243806
Singapore	4	37672	7	80345
UAE	2	11701	142	74761
Germany	47	92479	20	60215
Romania	-	-	18	56744
France	21	50484	22	54987
Korea, Rep. of	4	11955	12	37894
Other countries	77	194510	51	180360

Figures rounded off

Table –31: Imports of Bars, Rods, Plates, Sheets, Foils of Nickel Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**5971**	**10049732**	**5424**	**9757301**
USA	1695	2931058	1410	2803923
Germany	830	1615107	759	1625030
Japan	1196	1978821	812	1407921
China	333	639491	476	658992
UAE	203	232136	622	563681
UK	188	491300	167	506332
France	186	443015	197	489642
Italy	161	318947	182	467031
Sweden	153	151049	105	156997
Malaysia	55	33894	145	145464
Other countries	971	1214914	549	932288

Figures rounded off

Table – 32: Imports of Nickel Electroplated Anode

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**20**	**29820**	**++**	**5431**
Canada	++	42	++	3149
USA	++	2046	++	1419
Singapore	++	1484	++	746
UAE	-	-	++	54
UK	-	-	++	38
Switzerland	-	-	++	17
Netherlands	-	-	++	7
France	++	153	++	1
Italy	20	21009	-	-
Germany	++	4709	-	-
Other countries	++	377	-	-

Figures rounded off

Table – 33: Imports of Nickel Waste & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3288**	**2102780**	**3082**	**2011008**
Saudi Arabia	278	141539	1311	856954
UAE	557	239582	549	374907
Singapore	104	49325	269	159295
Bangladesh	113	93487	165	133804
Korea	99	40702	174	85565
Lebanon	-	-	80	67625
Kuwait	17	11346	64	44538
Malaysia	103	71658	36	38033
Qatar	206	79725	56	33291
Italy	99	45545	67	25551
Other countries	1712	1329871	311	191445

Figures rounded off

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 in popularity and increasingly by getting established as the battery of choice.

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.

14. Platinum and Palladium

20.92
(tonnes) Metal content as per NMI database, based on UNFC System

472
(tonnes) World mine production of PGMs in 2021

9,603
(kg) Imports of platinum alloys and related metals in 2021-22

1,194
(kg) Exports of platinum alloys and related metals in 2021-22

Platinum Group of Metals (PGM) is a family comprised 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 to 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 %) with negligible amount (Table-1).

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 to0.15 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 1,500 ppb of palladium were established (Table-1).

Table – 1: Reserves/Resources of PGM as on 1.4.2020 (P)

(In tonnes of metal content)

State	Reserves	Remaining Resources				Total Resources
	Total	Indicated	Inferred	Reconnaissance	Total	Total
	A	STD332	STD333	STD334	(B)	(A+B)
India	**-**	**11.66**	**7.4**	**1.86**	**20.92**	**20.92**
Karnataka	-	-	-	1.5	1.5	1.5
Kerala	-	-	0.18	-	0.18	0.18
Odisha	-	7.7	6.5	-	14.2	14.2
Tamil Nadu	-	0.61	0.72	0.36	1.69	1.69
Uttar Pradesh	-	3.35	-	-	3.35	3.35

Figures rounded off

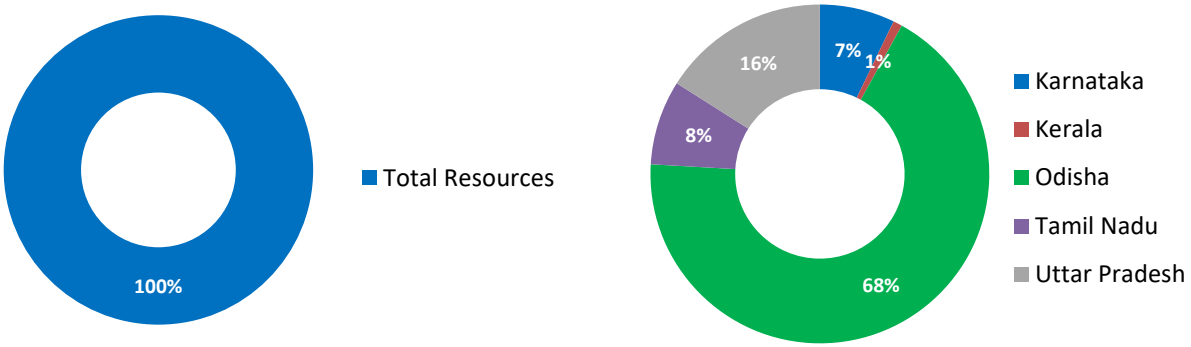


Fig 1: Resources of PGM in India

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews"

USES

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).

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.

TECHNICAL POSSIBILITIES

The spent converters contain platinum and palladium in 3:1 ratio, but heavy shift towards use of palladium to meet stringent emission controls will change this proportion of recovery.

The emergence of Polymer Electrolytic Membrane (PEM) fuel cells developed for passenger cars and trucks will boost prospects of platinum in near future by replacing the high energy battery-operated options for emission controls. The costs of higher range of driving and quick refuelling of fuel cells are, however, 10 times more than the cost of petrol engine.

The development of Solid Oxide Fuel Cell (SOFC) in Japan will eliminate the use of platinum converter as it is compact and gives consistent performance as conversion of conventional fuels into hydrogen is avoided.

Recycling is a significant factor in the supply of many of the metals used in our society. It plays an important role in lowering the environmental foot-print of global PGM production. Over 95% of the PGM content of spent automotive catalysts can be repeatedly recovered. Cellphones are one of the major sources of secondary metals. Falconbridge Ltd estimated that in 1 tonne of obsolete cellphones (excluding batteries) the average palladium and platinum was about 130 g and 8g respectively.

RESEARCH & DEVELOPMENT

The Mineral Processing Department of the Institute of Minerals & Material Technology (IMMT), Bhubaneswar (CSIR) had envisaged projects to pursue research focused on recovery of PGE values from the low tenor hosts like Boula–Nuasahi igneous complex by adopting suitable beneficiation tests and development of process flow sheet for recovery of PGE from Indian ores. The methods adopted elsewhere in the world perhaps may not suit in India because the PGE occurs in oxide of chromium and sulphide facies in very fine inclusions & exsolution form.

Bench-scale beneficiation of low-grade PGM samples from T2 sector, Tasampalayam block in Sitampundi Anorthosite complex in Tamil Nadu for GSI was carried out at the Modern Mineral Processing Laboratory and Pilot Plant, IBM, with the objective of enriching platinum group metal present in the sample and to evolve a suitable process flow sheet for recovery of PGM concentrate and chromite. The study indicated that the samples are amenable to beneficiation to produce platinum group of minerals.

WORLD REVIEW

The world reserves of PGM are estimated at 70,000 tonnes concentrated mostly in South Africa (90%) followed by Russia (8%), Zimbabwe (2%) and USA (1%) (Table - 2).

Table–2: World Reserves of Platinum Group Metals

(By Principal Countries)

(In kilograms of PGM content)

Country	Reserves
World: Total (rounded off)	**70,000,000**
USA	900,000
Canada	310,000
Russia	5,500,000
South Africa	63,000,000
Zimbabwe	1,200,000
Other countries	NA

Source: USGS Mineral Commodity Summaries, 2023,

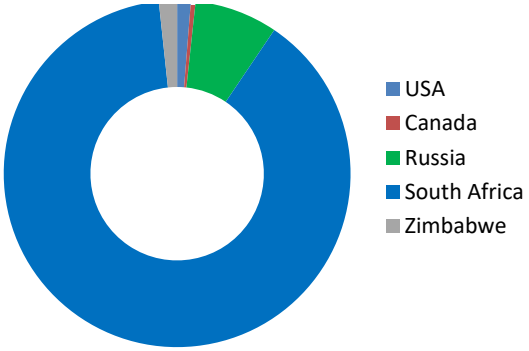


Fig.2 :Country wise Reserves of PGM

World mine production of PGMs increased by 10% to 472 tonnes of metal content in 2021 from 431 tonnes of metal content in 2020 (Table-3).

South Africa, which accounted for 60% of the total PGM mine production in 2021 was followed by Russia (23%), Zimbabwe (6%), Canada (5%), USA (4%) while other countries contributed the remaining 2 per cent.

To provide a generalised view of the development in various countries, the countrywise description, as sourced from the latest available publication of Minerals Yearbook 'USGS' 2018 is furnished below:

Table – 3 : World Mine Production of PGMs

(By Principal Countries)

(In kilograms of metal content)

Country	2019	2020	2021
World:Total (rounded off)	**461 000**	**431 000**	**472 000**
Finland			
Platinum	953	1 276	1 447
Palladium	699	858	1 036
Other platinum metals	52964	54395	46835
Poland			
Platinum [(a)]	* 8	* 8	* 8
Palladium[(a)]	* 7	* 7	* 7
Russia			
Platinum	22 100	23 500	* 21 000
Palladium	86 600	92 300	* 85 000
Other platinum metals	2 100	1 800	1 600
Serbia			
Platinum[(e)]	* 10	* 20	* 20
Palladium[(e)]	100	* 100	* 100
Ethiopia			
Platinum	* 2	* 2	* 2
South Africa			
Platinum	132 989	111 993	141 626
Palladium	80 684	66 264	84 336
Other platinum metals	54 395	46 835	59 344
Zimbabwe			
Platinum	13 857	15 004	14 732
Palladium	11 639	12 890	12 619
Other platinum metals	2 800	3 231	3 195
Canada			
Platinum	* 10 300	* 10 700	* 7 600
Palladium	* 17 900	* 18 600	* 13 300

Country	2019	2020	2021
Other platinum metals	* 1 200	* 1 200	* 900
USA			
Platinum	4 150	* 4 500	* 4 500
Palladium	14 300	* 14 800	* 14 800
Other platinum metals	* 100	* 100	* 100
Colombia	178	414	618
China			
Platinum	* 2 500	* 2 500	* 2 500
Palladium	* 1 300	* 1 300	* 1 300
Australia	**483**	**522**	**470**

Source: BGS, World Mineral Production, 2016-2020.
(a) Sales from mine production and stocks.
(b) Years ending 7th July of that stated.

Canada

In October, North American Palladium Ltd announced the results of a new feasibility study for its Lac des Iles Mine in northwestern Ontario. The report extended mine life by 1 year to 2027 with the average ore production rate doubling to 12,000 tonnes per day. In December, North American Palladium Ltd announced that it had entered into a contract with mining engineering firm Redpath Canada Ltd for a major expansion project for the Lac des Iles Mine. The mine development was predicted to take 2 years to complete.

China

Heraeus Precious Metals GmbH & Co. KG announced the opening of its new precious-metals plant in Nanjing, Jiangsu Province. The facility would increase the company's precious-metals and chemical products refining and recycling capacities, especially for PGMs. Its recycling rate and chemical production capacity were expected to increase to 3,000 tonnes per year (t/yr) and threefold, respectively.

Russia

In 2018, PJCS MMC Norilsk Nickel (Nornickel), a leading PGM producer in Russia, produced palladium and platinum at its two production assets in Russia— JSC Kolskaya Mining and Metallurgical Company (Kola MMC) on the Kola Peninsula and the Polar Division on the Taymyr Peninsula. Nornickel's PGM production decreased slightly compared with that in 2017 owing to a decrease in the amount of third-party material processed. In February, Nornickel and Russian Platinum LLC signed a deal to develop three PGM ore deposits in the Norilsk Industrial District in a 50–50 joint venture. The three deposits would produce a combined 70 to 100 t/yr of PGMs, 50,000 t/ yr of nickel, and 70 , 000 t /yr of copper. A feasibility study was scheduled to be completed by the end of 2019, with the project beginning in 2020 and the first salable material expected in 2023.

South Africa

On April 2, six miners employed by African Rainbow Minerals Ltd were killed on their way to the Modikwa Mine. Since the beginning of 2016, more than 400 incidents of social unrest took place in the eastern portion of South Africa's platinum belt, according to data from Anglo American Platinum Ltd. The incidents were reportedly linked to conflicts between rival unions and grievances over jobs and revenue flows.

On August 2, Impala Platinum Holdings Ltd (Implats) published a strategic review of its Rustenburg operations in South Africa aimed at ensuring long-term profitability. The strategy would involve decreasing the operational mine shafts from 11 to 6 and cutting 13,000 jobs over the next 2 years. Annual production after the changes to operations was estimated to be 16,000 kg of PGMs, down from the current production of about 23,000 kg of PGMs. Implats clarified that the changes would affect only its Rustenburg operations and would not affect jobs at its mines in Zimbabwe.

Acquisitions of assets in South Africa that took place in 2018 included Northam Platinum Ltd's acquisition of Glencore plc's Eland platinum mine in January and Anglo American Platinum Ltd's acquisition of its joint-venture partners' shares in the Mototolo operations in November. Another new PGM project, the Waterberg joint venture, was announced by Platinum Group Metals Ltd, and a mining rights application was accepted by the South African Department of Mineral Resources in October. Other partners involved in the venture included Implats, Mnombo Wethu Consultants (Pty) Ltd, the Japan Oil, Gas and Metals National Corporation, Hanwa Co. Ltd, and Hosken Consolidated Investments Ltd.

Zimbabwe

In June, Zimplats Holdings Ltd (a subsidiary of Implats) announced that it had agreed to release 23,903 hectares of

mining claims back to the Government of Zimbabwe. In 2013, the Government planned to compulsorily acquire a portion of Zimplats' mining claims to allocate to other investors, which the company initially opposed. Karo Mining Holdings Ltd was awarded mining rights to the land area. The Government of Zimbabwe announced plans to construct a base- and precious- metals refinery that would be capable of processing all platinum material mined within the country. The Government also planned to place a 5% tax on expor ted platinum concentrates beginning in 2019 to encourage domestic refining.

FOREIGN TRADE

Exports

Exports of platinum alloys and related metals increased by about 94% to 1,194 kg valued at ₹ 479.51 crore in 2021-22 from 616 kg valued at ₹ 353.50 crore in the previous year. Exports were mainly to UK (88%), Italy (6%) and USA (3%). Exports in 2021-22 comprised of platinum (unwrought) at 869 kg and platinum (others) at 200 kg. During 2020-21, exports of other metals of platinum group were 125 kg as compared to 63 kg during the preceding year while that of platinum-powder were negligible as compared to 9 kg in the previous year (Tables- 4 to 11).

Table – 4: Exports of Platinum Alloys & Related Metals: Total

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**616**	**3535012**	**1194**	**4795081**
UK	381	2798842	1047	4338221
Italy	16	35268	72	333322
USA	65	246419	32	76559
Japan	8	195961	1	28189
UAE	++	2	6	12791
Israel	1	358	++	2996
Bahrain	++	638	++	1592
Belgium	—	—	++	493
Bangladesh	130	93	35	404
Germany	1	15435	++	212
Other countries	14	241996	1	302

Figures rounded off

(In₹ '000)

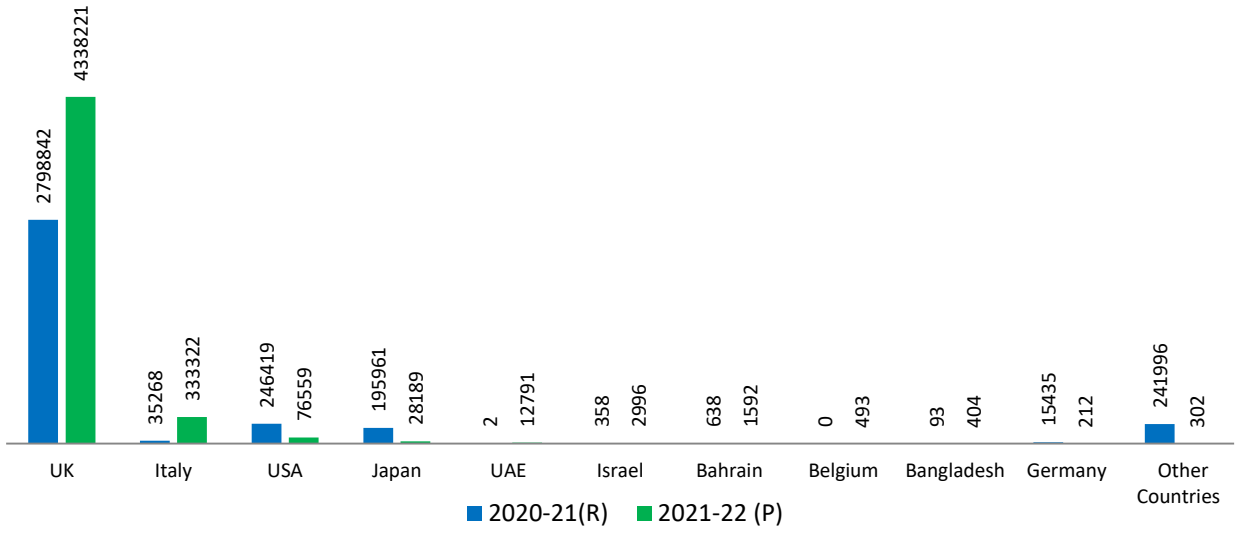


Fig 3: Countrywise Exports of Platinum alloys & Related Metals

Table – 5 : Export of Platinum (Powder, Unwrought & Others)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**507**	**552422**	**869**	**917208**
UK	307	255329	836	832403
USA	60	143589	31	76264
Japan	-	-	++	3103
Israel	1	318	++	2781
Bahrain	++	638	++	1592
Belgium	-	-	++	493
Bangladesh	130	93	++	400
Netherlands	-	-	1	114
Nepal	-	-	++	19
Australia	-	-	++	16
Other Countries	9	152455	1	23

Figures rounded off

Table – 6 : Exports of Platinum (Unwrought)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**498**	**401315**	**869**	**914077**
UK	**307**	**255329**	**836**	**832403**
USA	60	143589	31	76252
Israel	1	318	++	2781
Bahrain	++	638	++	1592
Belgium	-	-	++	493
Bangladesh	130	93	++	400
Netherlands	-	-	1	114
Nepal	-	-	++	19
UAE	-	-	1	15
Korea, Rep. of	-	-	++	8
Other Countries	++	1348	++	++

Figures rounded off

Table –7 : Exports of Platinum (Others)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**46**	**343359**	**200**	**1555483**
UK	38	206137	111	1280086
Italy	2	11235	52	249860
Japan	6	125985	1	25086
Germany	-	-	++	212
Nepal	-	-	++	144
USA	-	-	1	90
Bangladesh	-	-	35	4
Oman	-	-	++	1

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
Malaysia	-	-	++	++
UAE	++	2	-	-
Other Countries	-	-	-	-

Figures rounded off

Table – 8 : Exports of Platinum (Powder)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**9**	**151107**	**++**	**3131**
Japan	-	-	++	3103
Australia	-	-	++	16
USA	-	-	++	12
Singapore	9	151107	-	-

Figures rounded off

Table – 9 : Exports of Other Metals of Platinum Group

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**63**	**2639231**	**125**	**2322390**
UK	36	2337376	100	2225732
Italy	14	24033	20	83462
UAE	-	-	5	12776
Israel	++	40	++	215
USA	5	102830	++	205
Singapore	5	89454	-	-
Japan	2	69976	-	-
Germany	1	15435	-	-
Sweden	++	87	-	-

Figures rounded off

Table – 10 : Exports of Platinum-Clad Base/Precious Metal

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**700**	**50**	**70**	**6**
Mauritius	-	-	70	6
Bangladesh	700	50	-	-

Figures rounded off

Table –11: Exports of Other Metals of Platinum

Group (Iridium, Osmium, Ruthenium etc. unwrought)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**109**	**2982590**	**325**	**3877873**
UK	74	2543513	211	3505818
Italy	16	35268	72	333322
Japan	8	195961	1	25086
UAE	++	2	5	12776
U S A	5	102830	1	295
Israel	++	40	++	215
Germany	1	15435	++	212
Nepal	-	-	++	144
Bangladesh	-	-	35	4
Oman	-	-	++	1
Other Countries	5	89541	++	++

Figures rounded off

Imports

Imports of platinum alloys and related metal decreased slightly by 10% to 9,603 kg valued at ₹3,756 crore during 2021-22 as compared to 10,719 kg valued at ₹3,833 crore in the previous year. Imports were mainly from UK (37%), South Africa (19%), Germany (14%) and USA (9%). Imports in 2021-22 comprised of platinum (powder, unwrought & others) at 6,020 kg, platinum (others) 2,371 kg and other metals of platinum group (iridium, osmium, rothenium etc. unwrought) at 1,212 kg. Imports of other metals of platinum group were mainly from UK & South Africa (22% each), USA & Hong Kong (21% each) and Germany (10%). During 2021-22, imports of platinum-clad base (precious metals) increased substantially by 149% to 178 kg as compared to 73 kg in the previous year. Imports were mainly from USA (56%), Italy (23%) and Spain (17%). During 2021-22, imports of platinum powder were at 530 kg as compared to 786 kg in the preceding year. Imports were mainly from USA (53%), Germany (18%) and South Africa (14%) (Tables-12 to 19).

Table – 12 : Imports of Platinum Alloys and Related Metals : Total

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**10719**	**38332024**	**9603**	**37563471**
UK	4307	15000141	3549	12116931
Germany	1678	7732200	1390	8241153
South Africa	1527	6584804	1843	8048617
USA	1632	7047110	911	4334047
Italy	486	862554	649	1439156
Russia	60	386469	172	1254043
Belgium	++	342	72	731752
UAE	62	161208	261	699525
Hong Kong	745	343291	295	330042
Ecuador	-	-	2	110924
Other countries	222	213905	459	257281

Figures rounded off

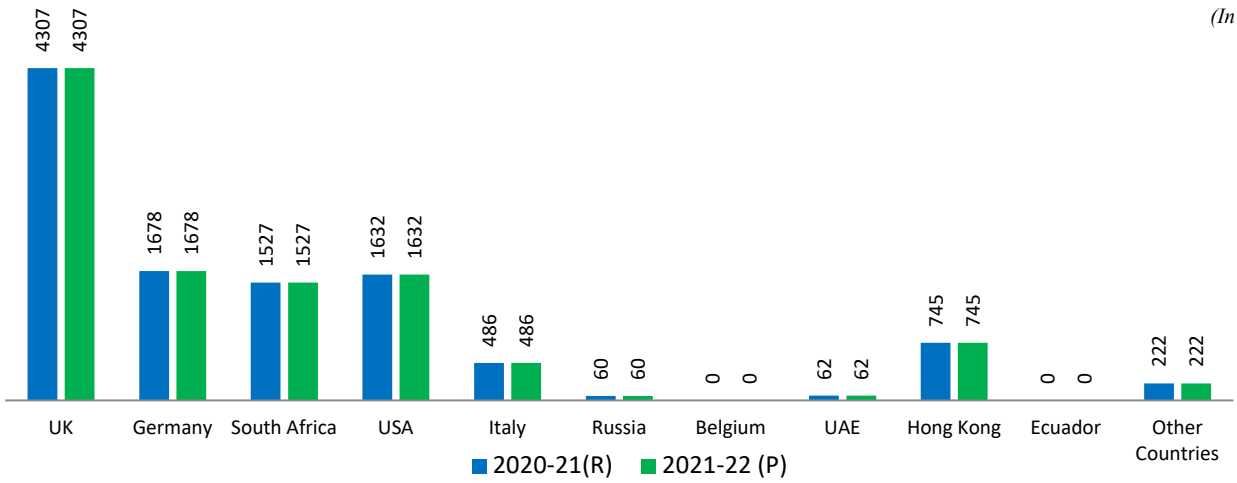


Fig.4 : Country wise Imports of Platinum alloys & Related Metals

Table – 13 : Imports of Platinum (Powder, Unwrought & Others)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (`'000)	Qty (kg)	Value (`'000)
All Countries	**5184**	**11561645**	**6020**	**14641574**
UK	2488	5415404	2572	6380571
South Africa	655	1493557	1105	2798201
Germany	927	2114544	884	2190021
USA	807	1742403	538	1397343
Italy	144	374638	322	781370
UAE	62	161208	261	699525
Hong Kong	22	49906	44	116135
Russia	19	41440	40	97722
Czech Republic	17	71696	145	60747
Belgium	++	342	24	54049
Other Countries	43	96507	85	65890

Figures rounded off

Table – 14 : Imports of Platinum–Unwrought

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**4398**	**9874821**	**5490**	**13309778**
UK	2463	5355270	2560	6345842
South Africa	606	1385586	1029	2642518
Germany	772	1759798	788	1937685
Italy	144	374638	322	781370
UAE	62	161208	261	699525
USA	269	619870	255	660059
Hong Kong	22	49906	44	116135
Czech Republic	17	71696	145	60747
Switzerland	++	1857	11	25333
Norway	-	-	8	20521
Other countries	43	94992	67	20043

Figures rounded off

Table – 15: Imports of Platinum (Others)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value ((₹'000)'000)	Qty (kg)	Value ((₹'000)'000)
All Countries	**3676**	**19444680**	**2371**	**14122761**
UK	1323	7413686	706	4459397
South Africa	543	2991103	468	3479679
Germany	692	4715147	389	3148306
Russia	41	345029	132	1156321
Italy	341	480220	327	657786
Belgium	-	-	44	529879
USA	605	3481428	114	478295
Ecuador	-	-	2	110924
France	++	1942	3	38321
Switzerland	++	48	8	35800
Other Countries	131	16077	178	28053

Figures rounded off

Table – 16 : Imports of Platinum – Powder

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**786**	**1686824**	**530**	**1331796**
USA	538	1122533	283	737284
Germany	155	354746	96	252336
South Africa	49	107971	76	155683
Russia	19	41440	40	97722
Belgium	-	-	23	54042
UK	25	60134	12	34729

Figures rounded off

Table – 17: Imports of Other Metals of Platinum Group

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**5535**	**26770379**	**3583**	**22921897**
Germany	751	5617656	506	6051132
UK	1819	9584737	977	5736360
South Africa	872	5091247	738	5250416
USA	825	5304707	373	2936704
Russia	41	345029	132	1156321
Belgium	-	-	48	677703
Italy	342	487916	327	657786
Hong Kong	723	293385	251	213907
Ecuador	-	-	2	110924
Singapore	40	29768	45	52860
Other Countries	122	15934	184	77784

Figures rounded off

Table – 18 : Imports of Platinum - Clad Base / Precious Metal

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**73**	**42046**	**178**	**72575**
USA	10	33322	100	64513
Spain	4	4014	30	4198
Italy	58	2151	41	2225
France	-	-	2	1316
Netherlands	1	795	5	323
UK	++	1552	-	-
Germany	++	212	-	-

Figures rounded off

Table – 19: Imports of Other Metals of Platinum Group

(Iridium, Osmium, Ruthenium etc. unwrought)

(By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (kg)	Value (₹ '000)	Qty (kg)	Value (₹ '000)
All Countries	**1859**	**7325699**	**1212**	**8799136**
Germany	59	902509	117	2902826
USA	220	1823279	259	2458409
South Africa	329	2100144	270	1770737
UK	496	2171051	271	1276963
Hong Kong	723	293355	251	213907
Belgium	-	-	4	147824
Singapore	30	21701	40	28470
Italy	1	7696	-	-
Japan	1	5964	-	-

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, May, 2021 of "Johnson Matthey Platinum Group Metals Service" PGM supply and demand fell in 2020, on account of covid related slump that affected the imports the automotive, industrial and jewellery sectors. However demand for platinum is forecast to bounce back strongly in 2021. 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.

15. Selenium and Tellurium

81,000
(tonnes) of world reserves of Selenium have been established

32,000
(tonnes) of world reserves of Tellurium have been established

39
(tonnes) Exports of selenium in 2021-22

508
(tonnes) Imports of selenium in 2021-22

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 anode mud 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

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.

Selenium is proving to be a useful Solar PV material in increasing the efficiency of absorption of light.

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, resistance 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-indiumgallium-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%).

Tellurium

Tellurium (Te) element lies on the borderland between metals and non-metals. It is added to non- ferrous metals like aluminium, tin, copper and lead to modify certain physical properties, like ductility, hardness, mechinability, toughness, strength and resistance. Tellurium 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.

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 81,000 tonnes or 0.08 million tonnes only cover the estimated selenium content of copper reserves, with the exception of China. Selenium was obtained as a byproduct with copper. Substantial resources also exist in association with other metals and in uneconomic copper deposits. Selenium reserves are mainly found in Russia (25%), Peru (16%), USA (12%), China (8%) and Canada (7%) (Table-1).

Table – 1 : World Reserves of Selenium

(By Principal Countries)

(In tonnes of Selenium content)

Country	Reserves
World: Total (Rounded off)	**81000**
Belgium	-
Canada	6000
China	6100
Finland	NA
Germany	-
Japan	-
Peru	13000
Poland	3000
Russia	20000
Sweden	500
Turkey	NA
United States	10000
Other countries	22500

Source: USGS, Mineral Commodity Summaries, 2023.

The world production of refined selenium is furnished in Table-2. The chief producers of selenium in the world in 2021 were China, Japan, Germany, Belgium and Russia. In addition to the countries listed, Australia, Iran, Republic of Korea and Zimbabwe 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	2019	2020	2021
World total	**3557**	**3543**	**3538**
China	1358	1400	1400
Japan	740	740	750
Germany[(a)]	300	300	200
Belgium	200	200	200
Russia	184	190	194
Mexico	127	106	135
USA	144	66	112
Canada	57	102	100
Chile	90	100	100
Other countries	357	339	347

Source: BGS, World Mineral Production, 2017-2021

(a): Includes selenium produced from imported material

(In tonnes)

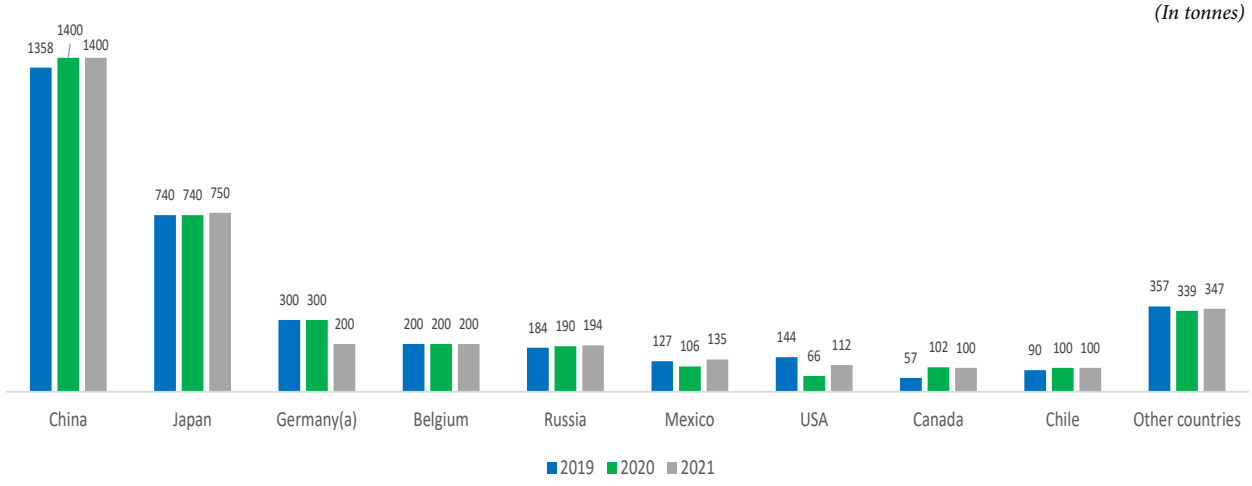


Fig 1: Country wise Production of Selenium

Tellurium

The world reserves of tellurium were at 32,000 tonnes contained in copper resources. Tellurium reserves are mainly located in Russia (14%), USA (11%), China (9%), Canada & South Africa (3% each) and Sweden (2%). In addition to the countries listed, Australia, Belgium, Chile, Colombia, Germany, Kazakhstan, Mexico, Philippines and Poland may produce refined tellurium, but output was not reported and available information was inadequate to make reliable production and reserves estimates. 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).

More than 90% of tellurium is produced from anode slimes collected from electrolytic copper refining and the remainder is derived from skimmings at lead refineries and from flue dust 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. The chief producers of refined tellurium in the world in 2021 were China, Japan, Russia, Sweden, Canada and Bulgaria. These countries together contributed as an estimated 549 tonnes to the world production in 2021 as compared to 523 tonnes produced in 2020. In addtion to the countries listed, Germany and Belgium are also believed to produce refined tellurium (Table-4).

Table – 3 : World Reserves of Tellurium

(By Principal Countries)

(In tonnes of Tellurium content)

Country	Reserves
World: Total (rounded off)	**32000**
Bulgaria	NA
Canada	800
China	3000
Japan	-
Russia	4500
South Africa	800
Sweden	670
USA	3500
Other countries	19000

Source: USGS, Mineral Commodity Summaries, 2023.

Table – 4 : World Production of Tellurium, Refined

(By Principal Countries)

(In tonnes

Country	2019	2020	2021
China	461	330	349
Japan	50	70	75
Russia	50	55	56
Sweden	41	42	41
Canada	15	23	25
Bulgaria	3	3	3

Source: BGS, World Mineral Production, 2017-2021.

(In tonnes

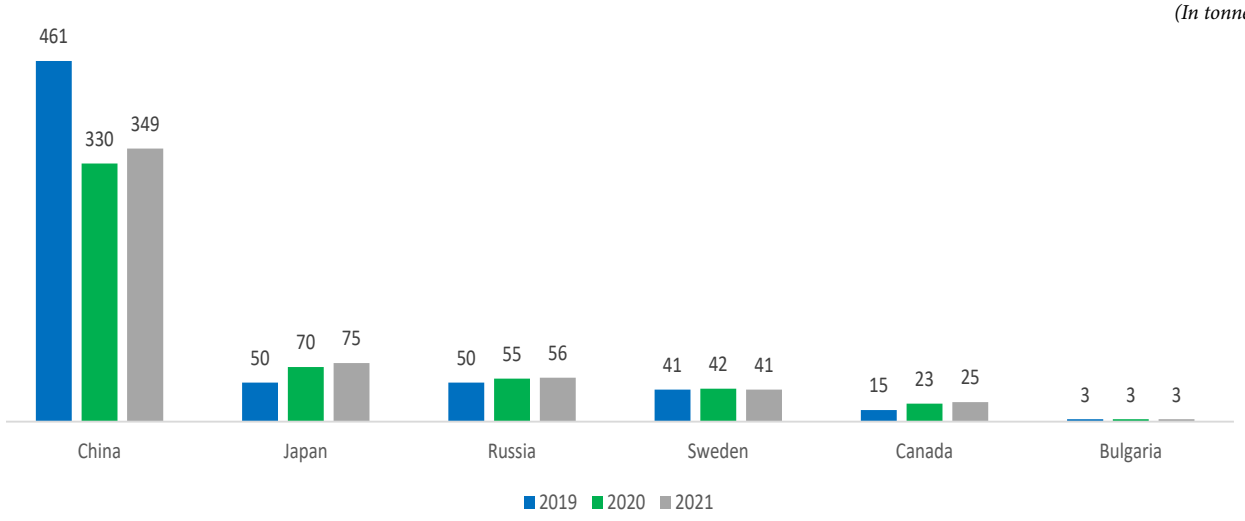


Fig 2: Countrywise Production of Tellurium

To give a generalised view of the development in various countries, the counrywise description as sourced from latest available publication of Minerals Yearbook 'USGS' 2018 is furnished below.

China

China was the leading global producer of selenium and tellurium and accounted for 33% and 61% of world production, respectively. China produced an estimated 930 tonnes of selenium in 2018, unchanged from that in 2017. Estimated production of tellurium in China was 280 tonnes, a 3% decrease from 290 tonnes in 2017. In 2018, the Government of China's National Development and Reform Commission (NDRC) announced the installation of 30 GW of solar capacity, down from the 53 GW of solar capacity in 2017. The NDRC also announced a cut in the national subsidy for solar power generated, in order to reduce overcapacity of photovoltaic power stations. This shift in policy was to be kept in place until at least 2020 and new solar projects that required subsidies were unlikely to be approved.

According to the China Nonferrous Industry Association, the estimated selenium consumption in China decreased by 6% to 2,100 tonnes in 2018 from 2,240 tonnes in 2017. The electrolytic manganese industry remained the leading consumer of selenium in China, accounting for 46% of selenium consumption in 2018, followed by glass production, 19%; agriculture, 15%; electronics, 12%; and pigments, 8%. The selenium consumption was estimated to be less than the supply. Estimated tellurium consumption in China in 2018 increased to approximately 150 tonnes from 130 tonnes in 2017 , and consumption was expected to be less than supply. Tellurium in China was consumed for various uses: thermal coolers (53%), metallurgy (27%), chemicals a nd photovoltaics (6% each), and other (8%).

Sweden

By product tellurium production at Boliden AB's Kankberg gold-tellurium mine increased by 28% in 2018 to 44,641 kg from 34,979 kg in 2017. Boliden reopened the Kankberg Mine in 2012, and the mine's life was expected to extend into 2020.

FOREIGN TRADE

Exports

Exports of selenium during 2021-22 decreased marginally by 2.5% to 39 tonnes from 40 tonnes in 2020-21. Exports were mainly to Philippines (31%), China (26%), Netherlands (13%), Ukraine (8%) and Canada & Indonesia (5% each). There were negligible amount of exports of selenium from Iran, UAE & USA (3% each) during 2021-22. Exports of tellurium were negligible during 2021-22 (Tables-5 & 6).

Table – 5 : Exports of Selenium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**40**	**43423**	**39**	**81781**
Philippines	1	555	12	16561
China	-	-	10	15139
Ukraine	3	13775	3	14741
Netherlands	5	4159	5	6965
Canada	4	12893	2	6089
Iran	1	5813	1	5999
USA	++	923	1	3538
Spain	-	-	++	2360
Indonesia	-	-	2	2277
UAE	1	1099	1	1895
Other countries	25	4206	2	6217

Figures rounded off

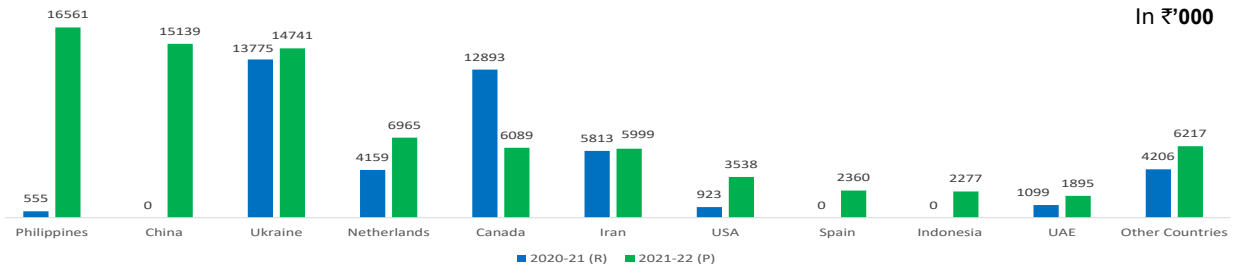


Fig 3: Countrywise Value of Export of Selenium

Table – 6 : Exports of Tellurium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**37**	**++**	**17**
South Africa	-	-	++	6
Singapore	-	-	++	6
Azerbaijan	-	-	++	5
Belgium	++	37	-	-

Figures rounded off

Imports

Imports of selenium during 2021-22 decreased substantially by 28% to 508 tonnes as compared to 701 tonnes in the preceding year. Imports were mainly from Japan (40%), Republic of Korea (23%), Belgium (16%), Germany (9%), Philippines, Hong Kong & China (3% each), Netherlands (2%) and Italy (1%). Imports of tellurium increased substantially by 50% to 3 tonnes as compared to 2 tonnes in the preceding year. Imports were mainly from Belgium (67%) and China (33%). Negligible quantities were also imported from other countries (Tables-7 & 8).

Table – 7 : Imports of Selenium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**701**	**681519**	**508**	**712159**
Japan	186	187058	202	303678
Korea, Rep. of	142	128783	116	151179
Belgium	206	200846	83	96825
Germany	48	49138	48	70084
China	5	6959	14	35773
Philippines	47	42209	16	18344
Hong Kong	17	16582	15	18095
Netherlands	22	22370	10	10544
Italy	6	5551	4	3728
Canada	-	-	++	2738
Other countries	22	22023	++	1171

Figures rounded off

(In ₹ '000)

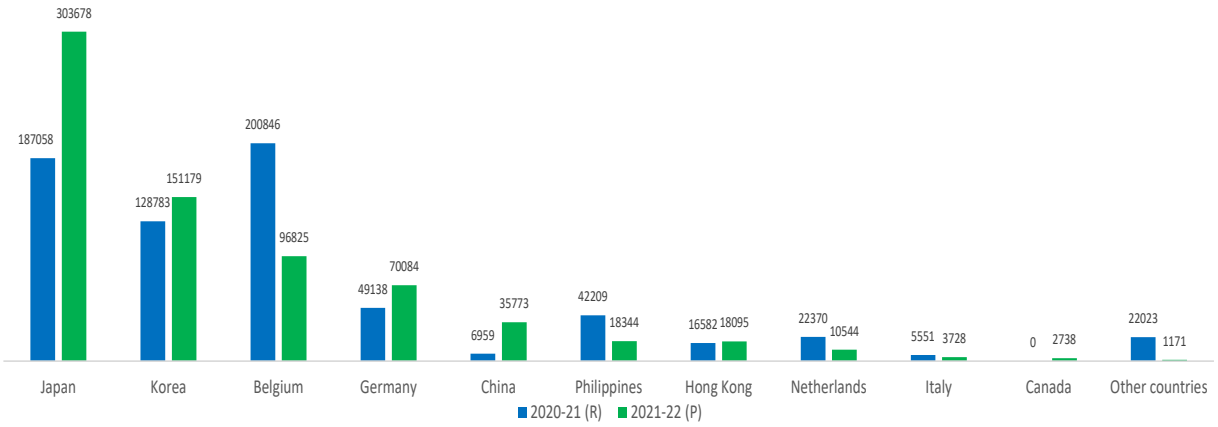


Fig 4: Countrywise Value of Import of Selenium

Table – 8 : Imports of Tellurium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2**	**21250**	**3**	**18935**
China	2	11901	1	5984
Canada	++	2633	++	5564
Belgium	++	8	2	3913
Germany	++	2494	++	1670
Japan	++	387	++	1037
Luxembourg	++	313	++	560
USA	++	295	++	207
Hong Kong	++	2948	-	-
Italy	++	271	-	-

Figures rounded off

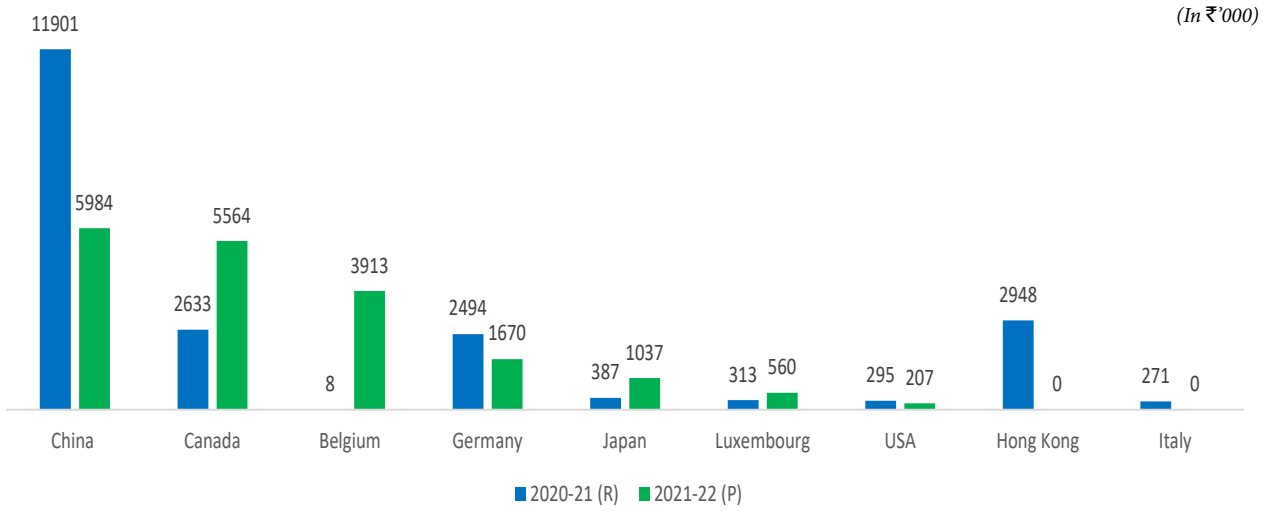


Fig 5: CountrywiseValue of Import of Tellurium

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 be en 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.

16. Silver

568.64
(million tonnes) Total reserves/ resources of siler ore as on 1st April 2020

800
(tonnes per annum) Silver refining capacity as per Annual Report of HZL 2021-22

89
(tonnes) Exports of silver in 2021-22

4,422
(tonnes) Imports of silver in 2021-22

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 while Karnataka with 5%, Jharkhand with 4% and Andhra Pradesh 3% were among the States next in the order. Madhya Pradesh, Uttarakhand, Odisha, Meghalaya, Sikkim, Tamil Nadu and Maharashtra together shared 3% of the ore reserves/remaining resources (Table-1). As per reserves & resources summary of HZL 2021-22, grade of silver was 58 gram/tonne under Total Reserves category, 66 gram/tonne under Measured and Indicated Resources category and 60 gram/ tonne under Inferred Resources categories.

Table – 1 : Reserves/Resources of Silver as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

State/Grade	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total													
Ore	**61604192**	**67971000**	**40870828**	**170446020**	**2330000**	**18445543**	**53914460**	**41320000**	**70926000**	**211261729**	**-**	**398197732**	**568643752**
Metal	**2155.3**	**4981.73**	**570.04**	**7707.07**	**172.2**	**824.44**	**663.67**	**3881.88**	**4575.73**	**12442.92**	**-**	**22560.84**	**30267.91**
By State													
Andhra Pradesh													
Ore	-	-	-	-	-	-	16950000	-	-	-	-	16950000	16950000
Metal	-	-	-	-	-	-	128.13	-	-	-	-	128.13	128.13
Jharkhand													
Ore	-	-	-	-	-	-	-	-	-	23840000	-	23840000	23840000
Metal	-	-	-	-	-	-	-	-	-	5.22	-	5.22	5.22
Karnataka													
Ore	17480000	4640000	-	22120000	-	-	69462	-	1490000	2254150	-	3813612	25933612
Metal	4.43	1	-	5.43	-	-	0.48	-	0.39	3.42	-	4.29	9.72
Madhya Pradesh													
Ore	-	-	-	-	-	-	-	-	2096000	1120000	-	3216000	3216000
Metal	-	-	-	-	-	-	-	-	150.61	9.25	-	159.86	159.86
Maharashtra													
Ore	-	-	-	-	-	-	-	-	-	235000	-	235000	235000
Metal	-	-	-	-	-	-	-	-	-	0.23	-	0.23	0.23
Meghalaya													

State/Grade	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconna-issance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
Ore	-	-	-	-	-	-	-	-	880000	-	-	880000	880000
Metal	-	-	-	-	-	-	-	-	19.8	-	-	19.8	19.8
Odisha													
Ore	-	-	-	-	-	960500	119000			670000	-	1749500	1749500
Metal	-	-	-	-	-	27.34	3.4			34.17	-	64.91	64.91
Rajasthan													
Ore	44124192	63331000	40870828	148326020	2330000	17049200	36712218	39420000	64730000	182142579	-	342383997	490710017
Metal	2150.87	4980.73	570.04	7701.64	172.2	781.85	531.62	3720.28	4384.86	12349.76	-	21940.57	29642.21
Sikkim													
Ore	-	-	-	-	-	435843	63780	300000	-	150000	-	949623	949623
Metal	-	-	-	-	-	15.25	0.04	27.6	-	13.8	-	56.69	56.69
Tamil Nadu													
Ore	-	-	-	-	-	-	-	-	330000	460000	-	790000	790000
Metal	-	-	-	-	-	-	-	-	15.87	26.68	-	42.55	42.55
Uttarakhand													
Ore	-	-	-	-	-	-	-	1600000	1400000	390000	-	3390000	3390000
Metal	-	-	-	-	-	-	-	134	4.2	0.39	-	138.59	138.59

Figures rounded off

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 2021-22, 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 2021-22, the production of silver at 6,47,140 kg decreased by 8% as compared to the previous year. The production of silver from gold refining was 127 kg in 2021-22 as against 120 kg in 2020-21. One Private Sector and one Public Sector undertaking reported production of silver during 2021-22 (Tables- 2 to 4).

Table – 2 : Principal Producers of Silver, 2021-22

Name and address of the producer	Name of Plant	Location of the plant	
		State	District
Hindustan Zinc Ltd, Yashad Bhavan, Udaipur- 313 004, Rajasthan	Chanderiya	Rajasthan	Chittorgarh
The Hutti Gold Mines Co. Ltd, Hutti, Distt-Raichur-584 115, Karnataka	Hutti	Karnataka	Raichur

Table – 3 : Production of Silver*, 2019-20 to 2021-22

(By States)

(Quantity in kg; Value in ₹ '000)

State	2019-20		2020-21		2021-22 (P)	
	Qty	Value	Qty	Value	Qty	Value
India	609340	25616104	705796	42664424	647140	42123586
Karnataka	187	8066	120	7244	127	8168

** Excludes by-product recovery of silver by Hindalco Industries Ltd at Dahej, Gujarat from imported copper concentrates*

Table – 4 : Production of Silver*, 2020-21 and 2021-22

(By Sectors/States/Districts)

(Qty in kg; Value in ₹ '000)

State/District	2020-21		2021-22 (P)	
	Qty	Value	Qty	Value
India	**705796**	**42664424**	**647140**	**42123586**
Public sector	120	7244	127	8168
Private sector	705676	42657180	647013	42115418
Karnataka/Raichur	120	7244	127	8168
Rajasthan/Chittorgarh	705676	42657180	647013	42115418

** 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 Chanderiya, lead-zinc smelters of HZL.
iii) Excludes by-product recovery of 66,497 kg and 40,582 kg silver from imported copper concentrates in 2021-22 and 2020-21, respectively.

In addition, Hindalco Industries Limited reported production of 66,497 kg and 40,582 kg silver from imported copper concentrates in 2021-22 and 2020-21 respectively.

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 2022 report, Global silver recycling rose by almost 7% in 2021, to an eight year high of 173.0 moz (5,382 tonnes). 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 5,50,000 tonnes. Peru (18%), Australia (17%), China (13%), Poland (12%), Russia (8%), Mexico (7%), Chile (5%), Bolivia & USA (4% each) are the major countries having silver reserves (Table-5).

Mexico, Peru, China, Poland, Russia, Australia, Chile, Bolivia and Kazakhstan are the main producers of silver. The total world mine production of silver in metal content was reported at 26,156 tonnes during the year 2021 which decreased by 1% as compared to 26,542 tonnes in the preceding year. Mexico was the leading producer with 23% share in the total production followed by China & Peru (13%), Poland (6%) and Chile, Australia, Bolivia & Russia (5% each). World mine production of silver is furnished in Table- 6.

Table – 5 : World Reserves of Silver

(By Principal Countries)

(In tonnes1 of silver content)

Country	Reserves
World: Total (rounded off)	**550000**
Argentina	6500
Australia[a]	92000
Bolivia	22000
Chile	26000
China	71000
Kazakhstan	NA
Mexico	37000
Peru	98000
Poland	65000
Russia	45000
USA	23000
Other countries	64200

Source: USGS Mineral Commodity Summaries, 2023.
1:One tonne (1,000 kilograms)=32,150.7 troy ounces,
a: For Australia, Joint Ore Reserves Committee-compliant reserve were 27,000 tonnes.

Table – 6 : World Mine Production of Silver

(By Principal Countries)

(In Kilograms of metal content)

Country	2019	2020	2021
World:Total	**28387186**	**26541528**	**26155877**
Mexico	7485602	7424554	6097500
China	3443128	3405800	3511554
Peru	3860306	2723879	3309647
Poland	1455000	1423000	1522000
Chile	1309321	1575794	1383041
Australia	1325089	1337344	1329718
Bolivia	1152628	929909	1289456
Russia [(a)]	1407000	1380000	1213000
Kazakhstan	1022068	1035181	1004789
USA	981000	1030000	1000000
Other countries	4946044	4276067	4495172

Source: BGS World Mineral Production, 2017-21.
(a):- Smelter and/or refinery production.
c:- Years ended 31 March following that stated.

(In Kilograms of metal content)

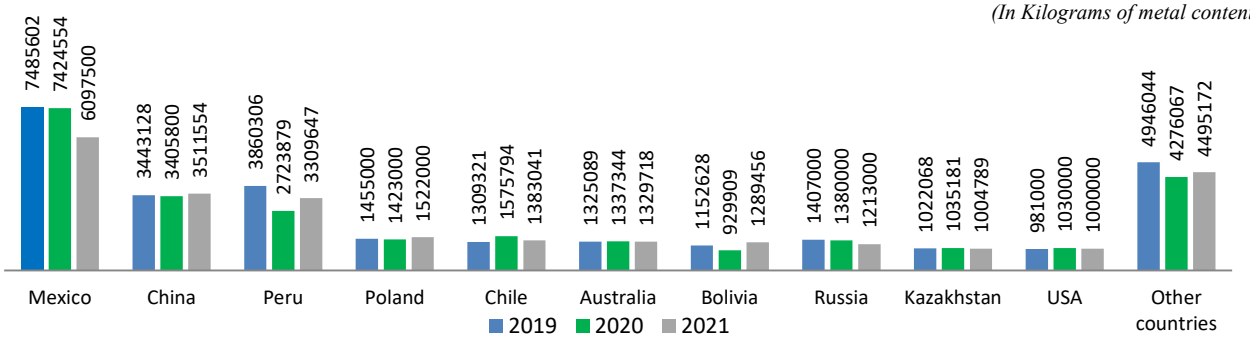


Fig 1: Countrywise Production of Silver

To provide a generalised view of the development in various countries the country-wise description sourced from the latest available publication of 'USGS' 2018 Minerals Yearbook, 'Silver [Advance Release]' is furnished below.

Argentina

In 2018, silver production in Argentina increased by 3% to 1,024 tonnes from 2017 owing to increased production from Yamana Gold Inc.'s Cerro Moro Mine, which produced 128 tonnes of silver after beginning commercial production on June 26. SSR Mining Inc.'s Puna operations decreased by 39% to 117 tonnes of silver in 2018 from 192 tonnes produced in the previous year.

Australia

In 2018, silver production in Australia increased by 12% to 1,254 tonnes from 1,120 tonnes (revised) in 2017. South32 Ltd's Cannington silver mine produced 416 tonnes of silver in 2018, an 11% increase from 2017 production of 375 tonnes. MMG Australia Ltd's Rosebery Mine produced 91 tonnes, a 25% increase from 73 tonnes in 2017, and the Dugald River Mine began operations in 2018, producing 28 tonnes. BHP Group Ltd's Olympic Dam Mine produced 30 tonnes, a 43% increase from 21 tonnes in 2017.

Bolivia

Silver production in Bolivia in 2018 was 1,191 tonnes, essentially unchanged compared with 1,196 tonnes (revised) in 2017. During 2018, the San Bartolomé Mine produced an estimated 136 tonnes of silver. In February 2018, Coeur and its subsidiaries completed the sale of Empress Minera Manquiri, S.A. (the operator of the San Bartolomé Mine) to Ag-Mining Investments, AB Production of silver at the San Vincente Mine was 110 tonnes in 2018, a slight decrease compared with 112 tonnes in 2017.

Canada

Most of the silver in Canada was produced as a co-product or by-product of other metals in 35 mines. Silver production in Canada was 353 tonnes in 2018, a 4% decrease from 366 tonnes (revised) in 2017. This decrease was attributed to a decrease in production at Teck's Trail operation, Vale S.A.'s Sudbury operations, Glencore plc's Kidd Creek Mine and Agnico Eagle Mines Ltd's LaRonde operations. Teck's Trail operation had an incident of fire in its silver refinery, reducing refined silver production by 311 tonnes (47%) from 2017. Vale's Sudbury operations produced less silver owing to reduced throughput. Glencore's Kidd Creek and Agnico Eagle's LaRonde operations had lower ore grades in 2018.

China

Silver production in China was 3,574 tonnes in 2018, a slight increase from that in 2017. About 90% of the silver produced in the country was produced as a by-product of copper, lead, and zinc mining, and about 9% was from primary silver mines. In 2017, increased attention to environmental protection by the Government led to decreased lead and zinc production, resulting in a decrease in silver production. In 2018, some mines met the new Government requirements and increased silver production.

Mexico

In 2018, Mexico was the leading producer of silver in the world with production of 6,049 tonnes, a slight decrease from the 6,109 tonnes in 2017. At Minera Fresnillo plc's Herradura Mine, higher grades of ores, improved recovery rates, and the ramp up of the San Julian operations increased silver production. Minera Frisco, S.A.B de C.V.'s production decreased by 240 tonnes (8%), owing to a decrease in throughput with the cessation of operations at the Porvenir and San Felipe open pit mines.

Peru

In 2018, Peru was the second-leading producer of silver in the world with a production of 4,160 tonnes, a 3% decrease from that in 2017. The leading silver producer was Compañía de Minas Buenaventura S.A.A. with production from the following mines Uchucchacua (480 tonnes), Cerro Verde (142 tonnes), Tambomayo (122 tonnes), El Brocal (121 tonnes), Julcani (77 tonnes), Yancocha (33 tonnes), Tantahuatay (25 tonnes), Mallay (16 tonnes), Orcopampa (10 tonnes), and La Zanja (7 tonnes). Of the 1,030 tonnes of silver produced by Buenaventura mines, 836 tonnes was attributed to the company because of the partial ownership of El Brocal (61.43%), La Zanja (53.06%), Yanacocha (43.65%), Tantahuatay (40.10%), and Cerro Verde (19.58%). Silver production at Uchucchachua decreased by 10% to 480 tonnes in 2018 from 535 tonnes in 2017 because of reduced ore grades and two temporary shutdowns, one in August and one in December.

Russia

In 2018, Russia was estimated to have produced 2,040 t of silver compared with 2,030 tonnes (revised) in 2017. Silver production as a by product in gold mines in Russia increased by 392 tonnes (32%). However, this increase was offset by a 50-tonnes decrease in production at Polymetal International plc's Dukat and Lunnoune silver mines, which had lower ore grades in 2018.

FOREIGN TRADE

Exports

Exports of silver decreased manifold to 89 tonnes in 2021-22 as compared to 615 tonnes in the preceding year. Exports were mainly to UK (46%), USA (27%), Germany (8%). Exports of silver-clad base metals also decreased to 2,979 kg during 2021-22 from 6,026 kg in 2020-21. Exports of Semi-manufactured silver decreased manifold to 77 tonnes in 2021-22 as compared to 569 tonnes in the preceding year. Exports of silver-unwrought were 10 tonnes during the year 2021-22. Similarly, exports of silver powder were two tonnes during the year 2021-22 (Tables-7 to 11).

Table – 7 : Exports of Silver

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**615**	**33934966**	**89**	**3633631**
UK	479	29198348	41	2507513
USA	66	987913	24	392109
Germany	5	90279	7	156453
Italy	1	28768	4	121278
Taiwan	++	8533	1	62057
Puerto Rico	-	-	2	60282
Canada	34	1820793	3	59246
Turkey	1	49527	1	38948
Denmark	-	-	3	35311
Poland	++	25360	1	30910
Other countries	29	1725445	2	169524

Figures rounded off

Table – 8 : Exports of Silver-clad Base Metals

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**6026**	**23892**	**2979**	**14664**
Sri Lanka	5269	18053	2785	11118
USA	5	103	162	3426
Australia	4	15	30	119
Germany	18	472	2	1
Saudi Arabia	730	5245	-	-
Mauritius	++	3	-	-
Singapore	++	1	-	-

Figures rounded off

Table – 9 : Exports of Silver: Semi-manufactured

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**569**	**33851111**	**77**	**3512744**
UK	479	29198154	41	2507513
USA	20	906204	13	325417
Germany	5	90279	7	156453
Italy	1	28768	4	121126
Taiwan	++	8533	1	62057
Canada	34	1820793	3	58334
Turkey	1	49527	1	38948
Denmark	-	-	3	35311
Poland	++	25360	1	30910
Sweden	2	32397	1	25163
Other countries	27	1691096	2	151512

Figures rounded off

Table – 10 : Exports of Silver: Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**45**	**13671**	**10**	**4177**
USA	45	13353	10	2680
Canada	-	-	++	802
Bhutan	-	-	++	385
Nepal	++	9	++	87
Italy	-	-	++	86
New Zealand	++	72	++	72
Australia	++	6	++	44
Botswana	-	-	++	20
Cambodia	-	-	++	1
UK	++	194	-	-
Other countries	++	37	-	-

Figures rounded off

Table – 11 : Exports of Silver: Powder

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1**	**70184**	**2**	**116710**
USA	1	68356	1	64012
Puerto Rico	-	-	1	51711
China	-	-	++	443
Hong Kong	-	-	++	169
Canada	-	-	++	110
Italy	-	-	++	66
Israel	++	65	++	58
Australia	-	-	++	53
New Zealand	-	-	++	45
Netherlands	-	-	++	19
Other countries	++	1763	++	24

Figures rounded off

Imports

Imports of silver increased drastically by 198% to 4,422 tonnes in 2021-22 as compared to 1,484 tonnes in the preceding year. Imports were mainly from the UK (39%), Hong Kong (35%), Russia (6%), China (4%) and Kazakhstan & Switzerland (3% each). Imports of silver-clad base metals also increased to 4,862 kg in 2021-22 as against 500 kg in the previous year. Imports were mainly from China (82%) and Thailand (15%).

Imports of semi-manufactured silver were at 4,092 tonnes during the year 2021-22 as compared to 1,195 tonnes in the previous year. Besides, imports of silver unwrought were at 304 tonnes during the year 2021-22 as compared to 279 tonnes in the previous year. Imports were mainly from Singapore (20%) and UK (19%). In 2020-21, imports of silver powder increased to 26 tonnes in 2021-22 from 10 tonnes reported in the previous year (Tables-12 to 16).

Table – 12 : Imports of Silver

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1484**	**59602766**	**4422**	**244542763**
UK	213	8572283	1736	97563798
Hong Kong	630	25251729	1547	86656215
Russia	140	5599051	250	14013300
China	86	3882315	189	10441947
Kazakhstan	-	-	144	8344177
Switzerland	21	725252	142	8018583
Singapore	43	1986814	90	5198263
Uzbekistan	-	-	60	3263901
Italy	46	1766814	74	2928731
USA	37	1364430	81	2584295
Other countries	268	10454078	109	5529553

Figures rounded off

Value in ₹ '000

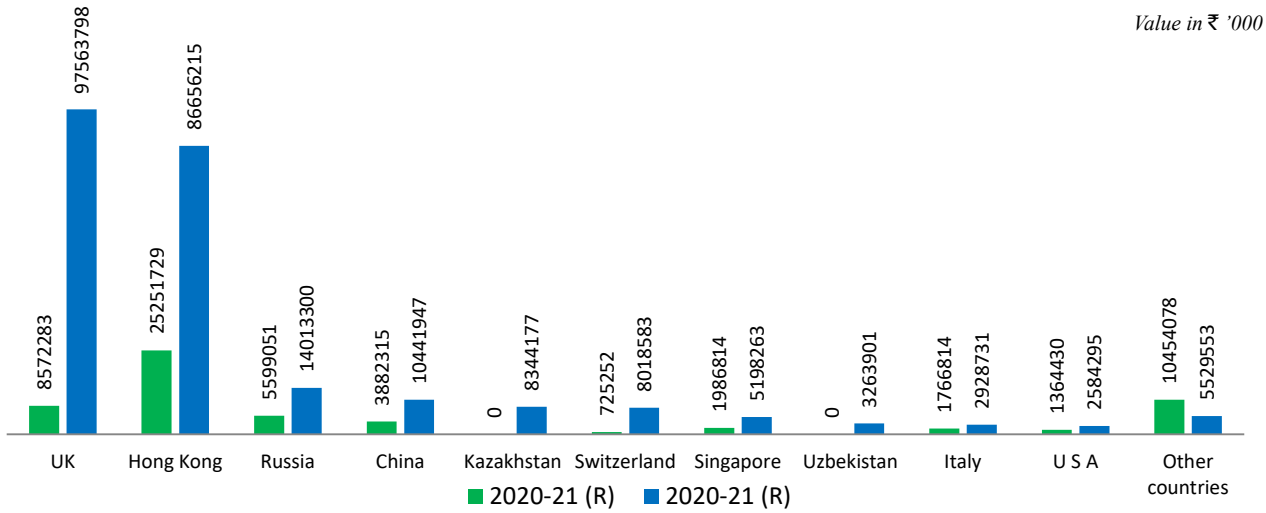


Fig 2: Countrywise Value of Import of Silver

Table – 13 : Imports of Silver-clad Base Metals

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**500**	**7518**	**4862**	**22436**
China	-	-	4000	9812
Thailand	120	2252	750	9696
USA	10	356	112	2928
Italy	300	3939	-	-
Germany	19	516	-	-
Malaysia	5	314	-	-
Japan	46	141	-	-

Figures rounded off

Table – 14 : Imports of Silver: Semi-manufactured

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1195**	**48096027**	**4092**	**227283914**
UK	213	8571878	1677	94225764
Hong Kong	494	20179854	1491	83447086
Russia	140	5595929	250	14012470
China	86	3876130	189	10441947
Kazakhstan	-	-	144	8344177
Switzerland	1	31001	115	6454827
Uzbekistan	-	-	60	3263901
Singapore	7	496734	27	1672428
USA	27	864966	46	1619823
Italy	27	652430	42	997451
Other countries	200	7827105	51	2804040

Figures rounded off

Table – 15 : Imports of Silver: Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**279**	**11350070**	**304**	**16957397**
Singapore	30	1457232	62	3522024
UK	++	405	59	3338034
Hong Kong	136	5071875	56	3209129
Italy	19	1111913	32	1929978
Switzerland	20	694251	27	1563756
South Africa	-	-	18	1027078
Germany	7	424407	27	915578
USA	8	481223	12	849822
UAE	3	153326	7	390979
Indonesia	-	-	4	186829
Other countries	56	1955438	++	24190

Figures rounded off

Table – 16 : Imports of Silver : Powder

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**10**	**156669**	**26**	**301452**
Brazil	2	79950	2	152275
USA	2	18241	23	114650
Germany	++	20037	++	28328
Singapore	6	32848	1	3811
Italy	++	2471	++	1302
Russia	++	3122	++	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 in 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 damand for silver. 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.

17. Strategic and Critical Minerals

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.

21.82
(thousad tonnes) world beryl production was reported in 2021.

881
(tonnes) world indium production was reported in 2021.

316
(thousand tonnes) world tantalun and niobium production was reported in 2021.

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 Indian Minerals Yearbook 2022.

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 21.82 thousand tonnes in 2021. The Namibia dominated the world production by accounting for 69% output which was followed by USA (19%) and China (8%) (Table-1).

Table – 1: World Production of Beryl

(In tonnes)

Country	2019	2020	2021
China	1750*	1750*	1750
Madagascar	16*	16*	16*
Mozambique	45	80	330
Namibia	-	-	15000
USA(c)	4000*	4130*	4250*
Uganda	15	186	473
Zambia	6*	6*	3

Source: *BGS, World Mineral Production, 2018-2021.*
** Estimate (a) Include ornamental and industrial products*
(c) Includes bertrandite ore, calculated as equivalent to beryl containing 11% beryllium oxide.

FOREIGN TRADE

Exports

In 2021-22, exports of other beryllium by value increased manifold to ₹ 2.65 lakh from ₹ 0.30 lakh in the previous year. Exports were mainly to Japan (99%) (Table-2).

Imports

In 2021-22, imports of beryllium by value increased manifold to ₹ 2.6 crore from ₹ 0.18 crore in the previous year. Imports were mainly from Hong Kong (37%), Mexico (32%) and Japan (17%) (Table-3).

Table-2 : Countrywise Export of other Beryllium

(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All countries	**++**	**30**	**++**	**30**	**-**	**265**
Iran	-	-	-	-	-	2
Japan	-	-	-	-	-	263
Kenya	-	-	++	19	-	-
Nepal	++	30	-	-	-	-
Qatar	-	-	++	11	-	-
UAE	-	-	-	-	-	-

Figures rounded off
(++): Negligible

Table-3 : Countrywise Import of other Beryllium

(By Countries)

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**1**	**1791**	**++**	**972**	**102**	**26014**
Austria	++	799	++	800	-	-
China	-	-	-	-	-	41
Germany	++	230	++	149	++	3029
Hong Kong	-	-	-	-	43	9614
Japan	-	-	-	-	20	4399
Mexico	-	-	-	-	39	8414
Singapore	-	-	0	2	-	-
UAE	++	342	-	-	-	-
UK	1	420	-	-	-	9
USA	-	-	++	21	++	508

Figures rounded off
(++): negligible

INDIUM-BEARING MINERALS

Resources & Production

There is no production of Indium bearing minerals in India.

Uses

It is primarily used in electronics especially in the production of flat panel display, touch screens and solar 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.

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 881 tonnes in 2021. China dominated the world production by accounting for 66% output which was followed by Republic of Korea (11%), Japan (8%), Canada (5%) and France (4%) (Table-4).

Table – 4: World Production of Indium

(By Countries)

(in tonnes)

Country	2019-20	2020-21	2021-22
Belgium	20*	20*	20*
Brazil	5*	5*	5*
Canada	61*	61	44
China	534*	500*	580*
France	40*	38*	38*
Italy	5*	5*	5*
Japan	70	70	70
Korea, Rep. of	100*	100*	100*
Peru	12	12*	12*
Russia	7*	7*	7*

Source: *BGS, World Mineral Production, 2018-2021*
** 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
Russia	310

Source: *USGS Mineral Commodity Summaries, 2023*

The world production of rhenium was 54 tonnes in 2021. Chile dominated the world production by accounting for 56% output which was followed by Poland & USA (17% each), China (6%), Russia (4%) and Kazakhstan (2%) (Table-6).

Table – 6 : World Production of Rhenium

(By Principal Countries)

(In '000 tonnes)

Country	2019	2020	2021
Chile	30*	30*	30*
China	3*	3*	3*
Kazakhstan	1*	1*	1*
Poland	8	10	9
Russia	2*	2*	2*
USA	8	9	9*

Source: *BGS, World Mineral Production, 2018-2021.*

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

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 beryl. They are also found to occur in alluvial deposits.

World Review

The world reserves of tantalum are estimated about 319 thousand tonnes. 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 thouand tonnes)

Country	Reserves
Australia	99@
Brazil	40
China	180

Source: USGS Mineral Commodity Summaries, 2023
@ For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 39,000 tons.

The world production of tantalum and niobium was 316 thousand tonnes in 2021. Brazil dominated the world production by accounting for 90% output which was followed by Canada (6%) (Table-9).

Table 9 : World Production of Tantalum and Niobium Minerals

(In tonnes)

Country	Sub-commodity	2019	2020	2021
Australia	Tantalite	247	153	213
Australia	Tantalite–Ta content	121	75	102
Bolivia	Tantalite	40*	40*	2*
Bolivia	Tantalite–Ta content	20*	20*	1*
Brazil	Columbite	10278	9960	10782
Brazil	Columbite–Nb content	1357	1315	1424
Brazil	Pyrochlore	228885	154048	198777
Brazil	Pyrochlore–Nb content	86402	58152	75036
Brazil	Tantalite	414	380	419
Brazil	Tantalite–Ta content	119	125	101
Burundi	Columbite-tantalite–			
	Nb content		8	16
Burundi	Columbite-tantalite–			
	Ta content	3	3	7
Canada	Pyrochlore	12600*	11900*	13900*
Canada	Pyrochlore–Nb content	4800*	4500*	5200*
China	Columbite–tantalite	304*	296*	304*
China	Columbite-tantalite–			
	Nb content	118*	115*	118*
China	Columbite-tantalite–			
	Ta content	47*	46*	47*
Congo, Dem.				
Rep.	Columbite–tantalite	1256	1712	2422
Congo, Dem	Columbite-tantalite			
Rep	–Nb content	369	503	711
Congo, Dem.	Columbite-tantalite–			
Rep.	Ta content	360	491	694
Ethiopia (p)	Tantalum & Niobium			
	(Nb content)	7*	7*	12*
Ethiopia (p)	Tantalum & Niobium			
	(Ta content)	25*	10*	19*
Malaysia	Struverite	12	9	0
Malaysia	Struverite (Ta content)	1	1	0
Mozambique	Tantalite	132	209	178
Mozambique	Tantalite–Ta content	65	103	88
Nigeria	Columbite	1721	1700*	1378
Nigeria	Columbite–Nb content	670	662*	537
Nigeria	Columbite–Ta content	266	263*	213

Count...

Table-9 Counded....

Country	Sub-commodity	2019	2020	2021
Nigeria	Tantalite	1	1*	44
Nigeria	Tantalite–Ta content	1	1*	22
Russia	Tantalum & Niobium			
	(Nb content)	461	431	454
Russia	antalum & Niobium			
	(Ta content)	26	49	34
Rwanda (a)	Columbite–tantalite	1519	1201	1118
Rwanda (a)	Columbite–tantalite			
	–Nb content	591	468	435
Rwanda (a)	Columbite–tantalite			
	–Ta content	235	186	173
Spain	Tantalum & Niobium			
	(Ta content)	12	11	12
Uganda	Columbite–tantalite	7	173	404
Uganda	Columbite–tantalite			
	–Nb content	3	69	161
Uganda	Columbite–tantalite			
	– Ta content	1	21	50
Zimbabwe	Columbite–tantalite	7	4	-
Zimbabwe	Columbite–tantalite			
	–Nb content	3	2	-
Zimbabwe	Columbite–tantalite			
	– Ta content	1	1	-

Source: *BGS, World Mineral Production, 2018-2021.*
**Estimate*
(p) : Years ended 7 July of that stated,
(a) : Years ended 30th June of that stated & exports.

FOREIGN TRADE

Export

In 2021-22, exports of ferroniobium by value increased by 177% to ₹ 695.28 lakh from ₹ 251.14 lakh in the previous year. Exports were mainly to Malaysia (32%), Peru (30%), South Africa (15%) and China (12%). On the other hand, in 2021-22, exports of niobium or tantalum ores and concentrates in terms of value drastically decreased by 92% to ₹ 0.18 lakh from ₹ 2.17 lakh in the previous year. Exports in 2021-22 were mainly to Turkey (Tables- 10 & 11).

Table-10 : Countrywise Export of Ferroniobium

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**27**	**52730**	**14**	**25114**	**26**	**69528**
Canada	-	-	++	20	-	-
China	-	-	-	-	3	8614
Chile	++	34	-	-	-	-
Egypt	++	602	++	534	-	-
France	-	-	++	36	++	268
Indonesia	++	563	-	-	1	1351
Italy	-	-	-	-	++	123
Malaysia	1	1137	++	640	9	22061
Peru	-	-	-	-	7	20981
Saudi Arabia	-	-	-	-	++	492
South Africa	-	-	-	-	4	10739
Thailand	-	-	-	-	++	895
Turkey	-	-	-	-	0	3
Pakistan	++	386	-	-	-	-
Saudi Arabia	++	122	-	-	-	-
UAE	26	49886	14	23884	2	3863
UK	-	-	-	-	++	138

Figures rounded off (++): negligible

Table-11 : Countrywise Export of Niobium or Tantalum Ores and Concentrates

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**361**	**943**	**-**	**217**	**-**	**18**
Bangladesh	361	379	-	-	-	-
Poland	0	18	-	-	-	-
Spain	++	546	-	-	-	-
USA	-	-	++	217	-	-
Turkey	-	-	-	-	0	18

Figures rounded off

(++): negligible

Import

In 2021-22, imports of ferroniobium by value increased by 48% to ₹ 86,428 lakh from ₹ 58,578 lakh in the previous year. Imports by value were mainly from Singapore (66%) and Brazil (22%). On the other hand, in 2021-22, imports of niobium or tantalum ores and concentrates remained almost the same with respect to the previous year. Imports were mainly from France (Tables-12 & 13).

Table-12 : Countrywise Import of Ferroniobium

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**2778**	**5465972**	**3027**	**5857814**	**3982**	**8642844**
Belgium	-	-	2	3223	-	-
Brazil	765	1,532,168	879	1,480,909	1065	1866600
Canada	171	414,428	276	653,843	265	595637
China	28	76340	-	-	-	-
Hong Kong	60	88767	68	70128	32	31120
Korea, Rep. of	6	176.14	-	-	33	110276
Malaysia	104	28538	4	9651	-	-
Netherlands	45	89805	27	62304	38	119934
Netherlands Antilles	-	-	-	-	20	42834
Senegal	-	-	20	36901	-	-
Singapore	1,582	3,203,128	1,681	3,397,956	2456	5713088
South Africa	-	-	-	-	8	14067
Sweden	-	-	++	531	-	-
Switzerland	-	-	30	47403	6	21546
UAE	17	32526	40	94965	59	127723
UK	++	85	-	-	-	-
USA	-	11	-	-	0	19

Figures rounded off

(++): negligible

Table-13 : Countrywise Import of Niobium or Tantalum Ores and Concentrates

Country	2019-20		2020-21		2021-22	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**16**	**21764**	**2**	**489**	**2**	**488**
France	2	439	1	233	2	488
Italy	-	-	1	256	-	-
Madagascar	14	21325	-	-	-	-

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.

18. Tin

83.72
(million tonnes) Total reserves/ resources of tin ore as on 1st April 2020

26,292
(kg) Production of tin concentrates in 2021-22

1,191
(tonnes) Exports of tin & alloys including scrap in 2021-22

10,809
(tonnes) Import of tin & alloys including scrap in 2021-22

Tin is one of the earliest metals known and used mainly in bronze implements. It is a scarce element with incidence of about 2 ppm in the earth's crust. Its unique combination of properties like non- toxic nature, high malleability, chemical inertness and ease with which it can form an amalgam and alloy with other metals has given it a special status among non-ferrous metals. Pure tin is a silvery-white metal which is soft and malleable. It does not occur naturally as metal. By far, the most important tin mineral is cassiterite (SnO_2), which theoretically, in its purest form contains 78.77% tin. But usually it includes impurities of Nb,Ta, Zr, Sc, W and Fe. The less common tin ore is stannite (Cu_2SnFeS_4). Tin is used mostly for tin plating, soldering special alloys and in the production of bronze.

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 t in 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)

State/Grades	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total													
Ore	2075	-	25	2101	22594540	3213	31330134	168457	561080	29063370	-	83720794	83722895
Metal	963.19	-	10.8	973.99	33384.66	1116.41	54089.46	813.29	231.63	13147.46	-	102782.91	103756.9
By States													
Chhattisgarh													
Ore	2075	-	25	2101	1791	2560	94	168457	559914	29062361	-	29795176	29797277
Metal	963.19	-	10.8	973.99	1122.95	603.94	29.07	813.29	209.43	13130.9	-	15909.58	16883.57
Haryana													
Ore	-	-	-	-	22580000	-	31330000	-	-	-	-	53910000	53910000
Metal	-	-	-	-	32187.8	-	54032.8	-	-	-	-	86220.6	86220.6
Odisha													
Ore	-	-	-	-	12749	653	40	-	1166	1010	-	15618	15618
Metal	-	-	-	-	73.91	512.47	27.59	-	22.2	16.56	-	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. As on 31.03.2021 (P), a total of 15 leases for tin have been granted to the various parties.

PRODUCTION, STOCKS & PRICES

Concentrates

The production of tin concentrates in 2021-22 was at 26,292 kg as against 16,865 kg in the preceeding year. One public sector and five private sector mines reported production in 2021-22. All these mines are lo- cated in Chhattisgarh.The mine-head closing stock of tin concentrates was 260 kg in 2021-22 as against 8,520 kg in 2020-21.

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 the CMDC Ltd, where as Precious Minerals and Smelt-ing Ltd employed 12 workers in the current year and 9 workers in theprevious year. (Tables-2 to 5).

Table – 2 : Principal Producers of Tin Con-centrates, 2020-21

Name & address of the producer	Location of the mine	
	State	District
Chhattisgarh Mineral Dev. Corpn Ltd, Sona Khan Bhawan, Ring Road No.1, Raipur- 492006, Chhattisgarh.	Chhattisgarh	Dantewada
Precious Minerals and Smelting Ltd, Semi Urban Industrial Estate, Frezerpur, Jagdalpur - 494001, Chhattisgarh.	Chhattisgarh	Dantewada

Table – 3 : Production of Tin Concentrates, 2019-20 to 2021-22

(By State)

(Quantity in kg; Value in ₹'000)

State	2019-20		2020-21		2021-22 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**15530**	**10337**	**16865**	**9413**	**26292**	**31979**
Chhattisgarh	15530	10337	16865	9413	26292	31979

(In kg)

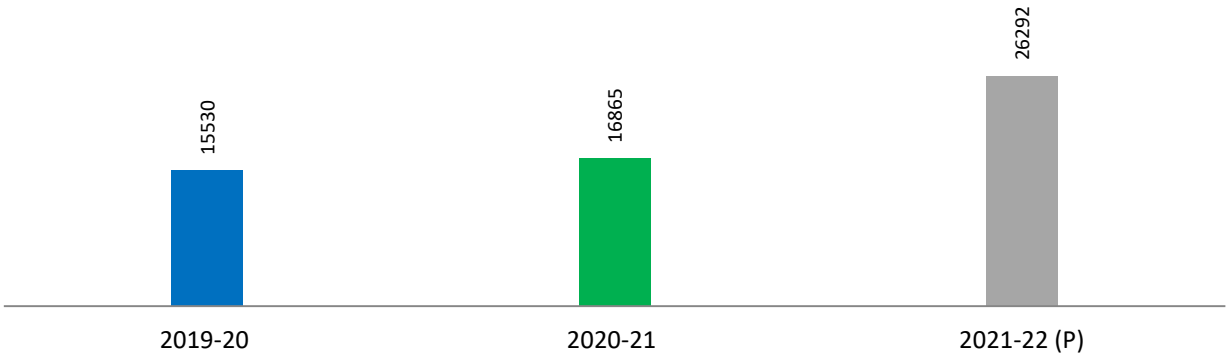


Fig 1: Production of Tin Ore

Table – 4 : Production of Tin Concentrates, 2020-21 and 2021-22

(By Sectors/State/District)

(Quantity in kg; Value in ₹'000)

State	2019-20		2020-21		2021-22 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**5**	**16865**	**10337**	**6**	**262292**	**31979**
Public sector	1	13859	7815	1	24813	30522
Private sector	4	3006	2598	5	1479	1457
Chhattisgarh	5	16865	10413	6	26292	31979
Dantewada	5	16865	10413	5	26250	31894
Sukma	-			1	42	85

Table – 5 : Mine-head Closing Stocks of Tin Concentrates, 2020-21 & 2021-22

(By State)

(In kg)

State	2020-21	2021-22 (P)
India	**8520**	**260**
Chhattisgarh	8520	260

(P): Provisional

Tin Metal

The plant owned by Precious Minerals and Smelting Ltd. reported production of tin metal was 4868 kg in 2021-22 as against 4337 kg in the preceeding year. The plant is located at Jagdalpur in Dantewada district of Chattisgarh. (Table-6).

Table – 6 : Production of Tin Metal 2019-20 to 2021-22

(Quantity in kg; Value in ₹'000)

Year	Production	
	Quantity	Value
2019-20	6063	7361
2020-21	4337	5400
2021-22 (P)	4868	7307

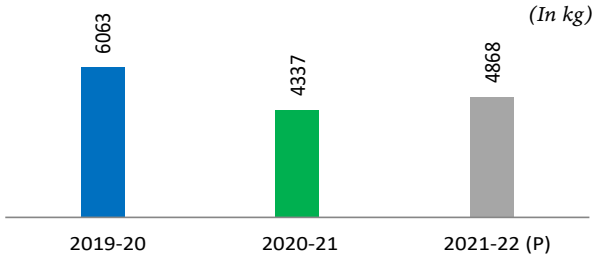


Fig 2: Production of Tin Metal

MINING

Tin ore is known as cassiterite, which was reported in Dantewada district by the Directorate of Geology and Mining and was found being associated with the lepidolite-bearing pegmatites. In Govindpal –Tongpal area of Dantewada district, Chhattisgarh, tin in the form of cassiterite is being mined from the sediments deposited in the streams. The stream sediments are dug manually with conventional implements. Subsequent panning of these sediments helps in separating the lighter gangue minerals, while the heavier part is recovered as cassiterite. Chhattisgarh is the only tin producing State in India. CMDC has an arrangement of collecting tin ore from cooperative societies of tribals in Dantewada district of Chhattisgarh. The Precious Minerals & Smelting Limited (PMSL) (An ISO 9001:2000 Company), is a flagship Company of Lunia Group. The PMSL is the first Joint Venture Company set up with the Chhattisgarh Mineral Development Corporation Limited (A Government of Chhattisgarh Enterprise), for identification, exploration and exploitation of tin- bearing areas of Chhattisgarh State. The PMSL has commissioned a tin manufacturing facility at Jagdalpur.

USES & SPECIFICATIONS

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. The tin plate is manufactured by depositing tin on iron plate of thickness ranging from 0.17 mm to 0.60 mm. IS 1993:2006 (fourth revision, Reaffirmed Sept. 2011) has specified the requirement for cold reduced electrolytic tin plate. The specifications for tin ingot which is to be used for various purposes is as per IS : 26:1992 (Fourth Revision, Reaffirmed Feb. 2014). There shall be two grades of tin ingot, viz, Sn 99.85% and 99.75%. BIS has prescribed IS : 4280-1992 (Reaffirmed Feb. 2014) for refined secondary tin ingots.

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. Powder containing 60% silver, 27% tin and 13% copper when mixed with appropriate quantity of mercury forms excellent dental amalgam to be used for filling dental cavities.

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.

INDUSTRY/CONSUMPTION

In India, the main consumers of tin are the Tin Plate Industry and Solder Industry. The latter advancing to become the biggest single end-use sector, over the last decade. The domestic tin plate market is categorised broadly into three basic packaging market segments – edible oil/vanaspati & cashew, processed food and non-processed food. The consumption in IT Industry and in food/beverages Packaging Industry has increased in the recent years. Tin plate companies, namely, Tin Plate Company of India Ltd, JSW Steel Ltd, GPT Steel Industries Ltd, Vardhaman Industries Ltd, SAIL's Rourkela Steel Plant, Kaira Can Company Ltd, Hindustan Tin Works Ltd etc. use tin metal in appreciable quantities for the manufacture of tin plate.

The Tin Plate Company of India Ltd consumes tin at its Golmuri Works, Jamshedpur in East Singhbhum, Jharkhand. TCIL is the pioneer and leading producer of tin mill products in India. It was incorporated in 1920 and has evolved as one of the important regional players in Asia. The Company is a subsidiary of Tata Steel Limited with the parent company holding 74.96% stake in TCIL. The manufacturing facility of the Company is located at Jamshedpur in the State of Jharkhand with an installed capacity of 3,79,000 tonnes per annum. It caters to 60% of the prime tinplate market and 40% of the overall domestic market. TCIL produced 2,90,807 tonnes & 3,74,182 tonnes of Electrolytic Tinplate in the year 2020-21 & 2021-22, respectively. Similarly, in cold rolling mill during 2020-21 and 2021- 22, the C.R. products produced were of 3,10,092 tonnes and 3,94,079 tonnes, respectively. GPT Steel Industries Ltd an ISO 9001:2008 accredited unit, was established in 2003 to manufacture Cold rolled products & Tinplate products. GPT is 2nd largest producer of tin plate in India with largest capacity for producing tin plates. GPT Steel has set up two complete Cold Rolling Mills (4Hi & 6Hi Mill) and state-of-the-art Electrolytic Tinplate Line (ETL) located at Gandhidham, Kuchchh district, Gujarat.

SUBSTITUTES

The most important use of tin is in making packing materials, as it is environment-friendly. Aluminium, glass, paper, plastic, or tin-free steel are among the major substitute for tin. A number of materials can replace tin in its various applications, such as, tetrapack for liquid food items; plastic/ polycontainers for solid, semi-solid food; aluminium, glass, tin-free steel can be used in place of tin cans and containers. Tin-Free Steel (TFS) is an electrolytic chrome plated steel consisting of a thin layer of chromium and a layer of chromium oxide deposited on the steel base which gives it a beautiful, lustrous metallic finish on both sides. TFS offers outstanding corrosion resistance, lacquer adhesion as well as printability. Additional features of TFS are filiform rust resistance, sulphur blackening resistance and coating. For tin solders new epoxy resins; for bronze-aluminium alloys, copper-base alloys and plastic; plastic for bearing metals that contain tin; compounds of lead and sodium for some tin chemicals are the other substitutes now in use in place of tin.

WORLD REVIEW

The world reserves of tin metal estimated in 2022 were 4.6 million tonnes, located mainly in Indonesia (17%), china (16%), Burma (15%), Brazil and 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 (rounded off)	**4600**
Australia	570
Bolivia	400
Brazil	420
Burma[e]	700
China[e]	720
Congo (Kinshasa)[e]	130
Indonesia[e]	800
Laos[e]	NA(
Malaysia	NA
Nigeria[e]	NA
Peru	130
Russia	430
Rawanda	430
Vietnam	NA
Other Countries	310

Source: USGS, Mineral Commodity Summaries, 2022.
a: For Australia, Joint Ore Reserves Committee-compliant or equvalent reserves were about 2,61,000 tonnes.
e: estimated

The world mine production decreased marginally by 8% during 2021 to 2,57,000 tonnes as compared to that 2,78,000 tonnes in the preceding year (Table-8). China which continued to be the largest producer of tin in 2021 with contribution of about 31% share in the total world production was followed by Indonesia (13%), Myanmar (12%) and Peru (11%).

Table – 8 : World Mine Production of Tin

(By Principal Countries)

(In tonnes of metal content)

Country	2019	2020	2021
World: Total (rounded off)	**311000**	**278000**	**257000**
China	85840	94463	80000
Indonesia	77468	52617	34466
Myanmar	50000	36000	32000
Peru[(a)]	19853	20647	26995
Bolivia	17147	14709	19628
Congo, D. Rep. of	12431	13526	15963
Brazil	117000	16893	15517
Australia	7738	8118	8772
Vietnam	6369	6798	6000
Other countries	16815	14570	2143

Source: BGS, World Mineral Production, 2017-2021
(a) Recoverable
** Estimated*

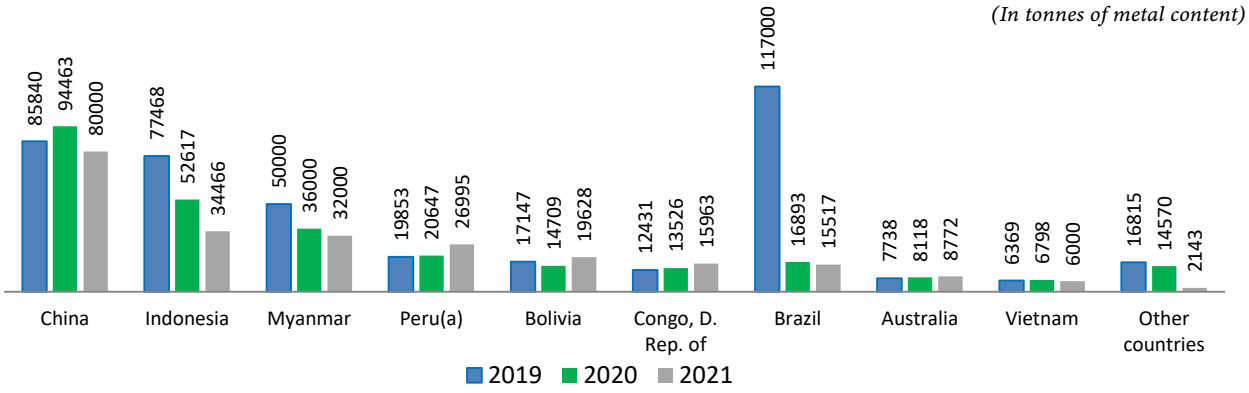


Fig 3: Countrywise Production of Tin

A generalised view of the development in various countries, along with country- wise description sourced from latest available publication of Minerals Yearbook of 'USGS' 2018 are presented as below:

China

Effective November 1, China reduced import tariff rates on more than 1,500 products including tin ore (cassiterite ore). The average import tariff rates for all products were reduced to 7.8% from 10.5%. The import tariff rate on tin ore (cassiterite ore) decreased to 5% from 5.5% (Argus Metals International, 2018a; Yao, 2018). In October, the Gejiu City government of Yunnan Province ordered an estimated 50 ore processing plants to close or agree to relocate to a new industrial park.

Congo (Kinshasa)

A mining law March 2018 which raised mineral royalties in the Democratic Republic of Congo. increased the royalty rate on tin to 3.5% from 2%; increased state ownership of mining projects to 10%; eliminated the 10-year grace period for compliance to the increased royalty rate by existing licensees; imposed a new tax triggered by high commodity prices; and reduced contract stability guarantees to 5 years from 10 years completed the crushing circuit at its Bisie tin minerefinery in Sao Paulo, which produced 6,582 tonne of refined tin in 2017, 12% more than in 2016.

Germany

Thyssenkrupp AG announced an agreement to create a 50–50 joint venture by combining its European steel operations, Thyssenkrupp Steel Europe, with India's Tata

Steel BSL Limited. The company expected an annual cost savings of 400 million to 500 million euros ($468 million to $585 million1). The new company would be named Thyssenkrupp Tata Steel B.V. and would create Europe's second largest steel producer with a 50% share of the European market.

Namibia

In October, AfriTin Mining Ltd. completed construction of the phase 1 processing plant at its Uis project. AfriTin Mining Ltd. expected the phase 1 processing plant to process 500,000 metric tons per year (t/yr) of tin ore and produce 720 t/yr of tin concentrate. Phase 2 was planned to increase the plant's processing capacity to 3 million metric tons per year of tin ore producing 66,000 t/yr of tin concentrate. In December, mining commenced at the Uis project followed by tin-ore stockpiling.

Spain

W Resources Plc began production of t in concentrate at the La Parrilla open pit mine. Initial production rates of 10 to 15 t/mo were expected to increase to full-scale production rates by the second quarter of 2019. At full production, the mine was expected to produce about 500 t/yr of tin concentrate.

United Kingdom

Wolf Minerals Ltd. increased tin outputnat its Drakelands open pit tungsten-tin mine (formerly known as the Hemerdon Mine) in Devon, United Kingdom, to 324 tn of tin in concentrate in fiscal year 2018 (July 1, 2017, through June 30, 2018) from 194 t of tin in concentrate in fiscal year 2017 (July 1, 2016, through June 30, 2017) . In October, Wolf Minerals Ltd. stopped mining at the Drakelands Mine.

FOREIGN TRADE

Exports

There were nil exports of tin ores & concentrates during the year 2020-21 and 2021-22. Exports of tin & alloys including scrap increased by 49% to 1191 tonnes in 2021-22 as compared to 750 tonnes in the preceding year. Out of the total exports in 2021-22, tin & alloys reported 721 tonnes (26%), tin & alloys (worked) was 469 tonnes (62%) and tin waste & scrap were negligible. Exports of tin & alloys including Scrap were mainly to Nepal (38%), UAE (22%) and Republic of Korea (15%) (Tables - 9 to 17).

Table – 9 : Exports of Tin Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	-	-	-	-

Figures rounded off

Table – 10 : Exports of Tin & Alloys Incl. Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**750**	**784385**	**1191**	**1494894**
UAE	161	286412	263	510605
Korea, Rep. of	237	186018	182	252837
USA	43	27065	68	144506
Saudi Arabia	18	28552	39	121274
Belgium	54	66776	62	93261
Sri Lanka	13	26394	19	69851
UK	20	29999	26	69223
Nepal	106	18939	447	48540
Singapore	++	953	19	47674
Kenya	13	18603	12	20208
Other countries	85	94674	54	116915

Figures rounded off

Table – 11 : Exports of Tin & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**570**	**731861**	**721**	**1432470**
UAE	160	285280	261	502990
Korea, Rep. of	236	185246	182	252449
USA	9	12560	52	136279
Saudi Arabia	15	23778	39	121274
Belgium	54	66589	62	92103
UK	18	29253	23	68408
Sri Lanka	10	23424	18	67177
Singapore	++	953	17	42539
Nepal	5	7551	12	19147
Kenya	11	17284	6	18279
Other Countries	52	79943	49	111825

Figures rounded off

Table – 12 : Exports of Tin & Alloys:Worked

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**178**	**51368**	**469**	**62201**
Nepal	100	11003	434	29212
USA	34	14498	16	8227
UAE	1	1132	2	7609
Singapore	++	++	2	5135
Sri Lanka	3	2970	1	2674
Kenya	2	1310	6	1929
South Africa	++	8	++	1186
Belgium	++	187	++	1158
UK	2	746	3	814
Qatar	++	764	++	720
Other Countries	36	18750	5	3537

Figures rounded off

Table - 13 : Exports of Tin Waste & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2**	**1156**	**1**	**223**
Nepal	1	385	1	181
Bangladesh	-	-	++	23
Bhutan	-	-	++	12
UAE	-	-	++	6
UK	-	-	++	1
Algeria	-	-	++	++
Swaziland	1	744	-	-
Colombia	++	11	-	-
Kenya	++	9	-	-
USA	++	7	-	-
Other Countries	-	-	-	-

Figures rounded off

Table - 14 : Exports of Tin & Alloys : NES

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**380**	**423846**	**349**	**606809**
Korea, Rep. of	236	185246	182	251691
UAE	48	114878	119	221985
UK	18	29253	20	62409
Sri Lanka	1	4067	3	12434
USA	1	1396	5	10974
Hong Kong	6	9482	3	6901
Singapore	++	355	3	6092
Japan	2	3327	2	5627
Bangladesh	2	2804	2	4997
Ghana	-	-	2	4525
Other countries	66	73038	8	19174

Figures rounded off

Table - 15 : Exports of Tin : Anode, Cathode etc. of Tin Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**44**	**70911**	**128**	**356713**
Saudi Arabia	14	22778	38	119279
USA	++	493	44	115664
UAE	6	7930	7	21177
Kenya	11	17284	6	18279
Nepal	4	6570	7	17574
Tanzania	-	-	6	16298
Sri Lanka	5	7669	7	16157
Congo D. Rep.	2	3274	5	12832
Uganda	++	464	2	6815
Senegal	-	-	2	6044
Other countries	2	4449	4	6594

Figures rounded off

Table – 16 : Exports of Tin Blocks

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**547**	**++**	**1483**
Singapore	-	-	++	835
Nepal	++	6	++	559
Denmark	-	-	++	83
Bhutan	-	-	++	6
Oman	++	537	-	-
Cameroon	++	4	-	-
Fiji Is	++	++	-	-

Figures rounded off

Table – 17 : Exports of Tin (Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2**	**1156**	**1**	**223**
Nepal	1	385	1	181
Bangladesh	-	-	++	23
Bhutan	-	-	++	12
UAE	-	-	++	6
UK	-	-	++	1
Algeria	-	-	++	++
Swaziland	41	744	-	-
Colombia	++	11	-	-
Kenya	+	9	-	-
USA	++	7	-	-
Other countries	-	-	-	-

Figures rounded off

Imports

The imports of tin ores & concentrates in 2021- 21 was negligible as that of the previous year. Imports of tin & alloys including scrap were at 10,809 tonnes in 2021-22 from 1,10,797 tonnes recorded in the previous year. Imports of tin & alloys were mainly from Indonesia (70%), Singapore (21%) and Malaysia (5%). In 2021-22, imports of tin & alloys were at 10,333 tonnes as compared to 1,10,382 tonnes in the previous year. Imports of tin & alloys (worked) were at 476 tonnes, while imports of tin alloys (NES) were at 79 tonnes. (Tables -18 to 26).

Table – 18 : Imports of Tin Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2**	**899**	**++**	**299**
Korea, Rep. of	++	131	++	244
Cameroon	-	-	++	37
USA	-	-	++	16
Nigeria	2	768	++	2

Figures rounded off

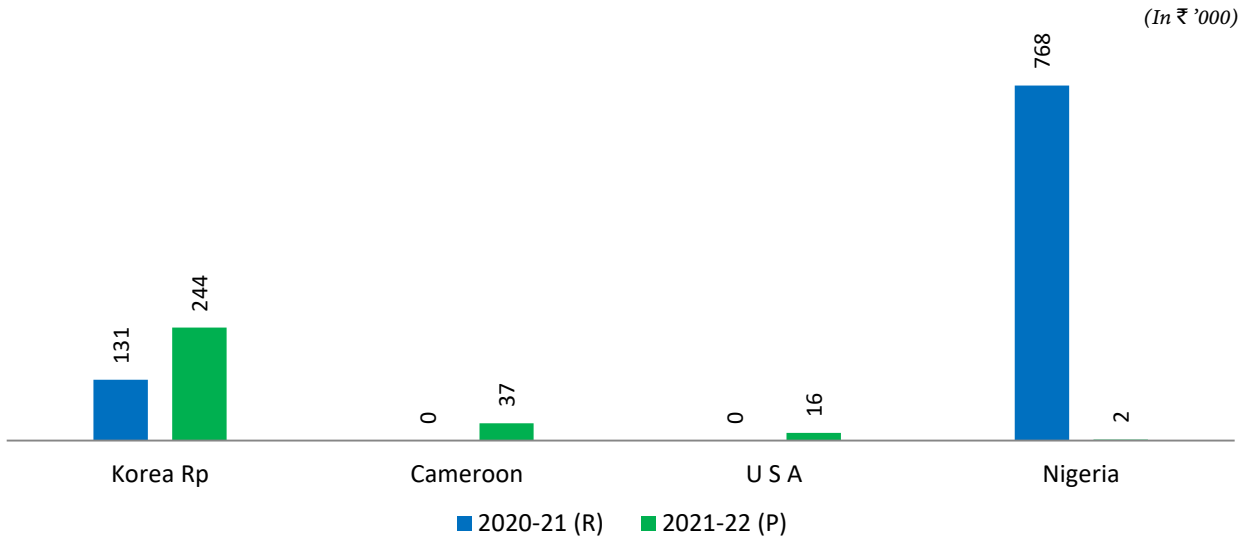


Fig 4: Countrywise Value of Import of Tin

Table – 19 : Imports of Tin & Alloys, Incl. Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**10797**	**14848133**	**10809**	**28696669**
Indonesia	7517	10413091	7209	19284978
Singapore	1331	1822729	2142	6081353
Malaysia	1145	1712445	608	1936557
China	415	234296	419	296370
Japan	25	56106	95	246153
Germany	61	95835	85	228023
Korea, Rep. of	34	86007	71	216989
Tanzania	164	268817	44	116193
Taiwan	16	28570	28	78801
Myanmar	-	-	22	71139
Other countries	89	130237	86	140113

Figures rounded off

Table – 20 : Imports of Tin & Alloys

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**10382**	**14585191**	**10333**	**28331809**
Indonesia	7517	10413091	7209	19284978
Singapore	1331	1821181	2136	6065498
Malaysia	1122	1677012	599	1912094
Korea, Rep. of	29	84814	54	212469
Germany	59	89456	79	211035
Japan	1	3186	79	197974
China	81	104787	69	136324
Tanzania	164	268817	44	116193
Taiwan	16	28570	28	78716
Myanmar	-	-	22	71139
Other countries	62	94277	14	45389

Figures rounded off

Table – 21 : Imports of Tin & Alloys : Worked

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**415**	**262942**	**476**	**364860**
China	334	129509	350	160046
Japan	24	52920	16	48179
Hong Kong	14	9634	51	43674
Italy	8	12772	12	29383
Malaysia	23	35433	9	24463
Germany	2	6379	6	16988
Singapore	++	1548	6	15855
Spain	5	6486	7	12952
USA	++	1219	1	6540
Korea, Rep. of	5	1193	17	4520
Other countries	++	5849	1	2260

Figures rounded off

Table – 22 : Imports of Tin (Scrap)

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**--**	**--**	**--**	**--**
Singapore	--	--	--	--
China	--	--	--	--

Figures rounded off

Table – 23 : Imports of Tin Alloys, NES

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**73**	**145069**	**79**	**213609**
Germany	50	78695	73	195272
Malaysia	19	59383	5	15528
Singapore	1	1073	1	2460
Italy	1	1716	++	115
Japan	-	-	++	114
Poland	-	-	++	56
Hong Kong	2	3098	++	31
UK	-	-	++	27
Bangladesh	-	-	++	5
China	++	596	++	1
Other Countries	++	508	++	++

Figures rounded off

Table – 24: Imports of Tin & Alloys : Worked

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**217**	**344238**	**309**	**810355**
Korea, Rep. of	29	83511	54	211267
China	81	104191	69	136323
Malaysia	33	50716	43	133210
Singapore	26	39863	44	117831
Indonesia	20	17514	60	100386
Taiwan	10	18541	20	57325
Germany	9	10652	6	15292
Hong Kong	2	6028	4	11436
Canada	6	9274	3	10419
Japan	1	3186	4	5925
Other countries	++	762	2	10941

Figures rounded off

Table – 25: Imports of Tin: Anode, Cathode Etc of Tin Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**10085**	**14084187**	**9937**	**27285876**
Indonesia	7497	10395577	7149	19184592
Singapore	1304	1780242	2091	5945207
Malaysia	1070	1566913	551	1763356
Japan	-	-	75	191935
Tanzania	164	268817	44	116193
Myanmar	-	-	22	71139
Spain	-	-	3	6743
Peru	-	-	2	4953
Korea, Rep. of	++	1138	++	1079
USA	++	56	++	533
Other countries	50	71444	++	146

Figures rounded off

Table – 26 : Imports of Tin Blocks

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**7**	**11697**	**8**	**21969**
Taiwan	6	10029	8	21391
Germany	-	-	++	455
Korea, Rep. of	++	165	++	123
Finland	1	1500	-	-
Singapore	++	3	-	-

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. Provisional estimates of total global tin use, including refined and unrefined forms, totalled 4,36,100 tonnes in 2021, up 3.9% from that of 2020. The Recycling Input Rate (RIR) was calculated to be 28.21% in 2021 and is forecast to increase slightly to 28.5% in 2022.

During the year 2021-22 demand for Tin plate in domestic market increased by 4%. In addition, the Government's focus on the rural economy and farm sector is expected to boost overall consumption and this is evident in policies being showcased by the Ministry of Food Processing Industries at various Industry workshops and exhibitions.

World tin reserves appeared to be adequate to meet short-term demand. Secondary sources of tin are likely to become an increasingly important component to meet supply demands especially in the United States. Domestic tin requirements are expected to continue to be met primarily through imports. As per global tin market overview of ITA, around 3,86,100 tonnes of refined tin were produced in 2021, 30% of which was from recycled sources.

The per capita consumption of tin plate in India is considerably low (0.49kg per capita) when compared to many developed countries (8-12kg per capita) and developing economies like China (4.75kg 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.

The feedstock supply of and consumer demand for tin is expected to be steady throughout the near term. World tin reserves appear to be adequate to meet any short-term demand.

19. Tungsten

89.43
(million tonnes) Total reserves/ resources of tungsten as on 1st April 2020

Nil
There was no reported production of tungsten ore/concentrate during 2021-22

1,209
(tonnes) Exports of tungsten and alloys including scrap in 2021-22

364
(tonnes) Imports of tungsten and alloys including scrap in 20 21-22

Tungsten, also known as 'wolfram' is a very dense lustrous greyish white to steel-grey metal. It is inherently brittle, therefore, making it more difficult to work with. Tungsten is a metal of strategic importance and is essential for the industrial development of the country. Tungsten does not occur naturally as free metal. The major sources of tungsten are minerals scheelite (Calcium tungstate, $CaWO_4$) and Wolframite [mixture of ferrous tungstate and manganous tungstate, $(Fe,Mn)WO_4$] which are predominantly hydrothermal in origin. Tungsten has a melting point of 3,422 °C, the highest of all metals and is resistant to all acids at ordinary temperatures. It has good corrosion resistance, good thermal & electrical conductivity and low co-efficient of expansion. It is elastic, ductile and has high tensile strength and can be drawn into very thin 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, a protective oxide is formed on the surface of the metal, but tungsten can be oxidised more fully at high temperature. When alloyed in small quantities with steel, tungsten greatly increases the hardness of steel.

The domestic requirements of tungsten and its products are met mainly through imports. A significant amount of tungsten is recovered through recycling of tungsten and its alloys including waste & scrap.

RESERVES/RESOURCES

The total resources of tungsten ore in the country, as per NMI data, as on 1.04.2020 based on UNFC system, has been estimated at 89.43 million tonnes with WO_3 content of 1,44,650 tonnes. All these resources are placed under '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).

Table –1 : Reserves/Resources of Tungsten as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

Grade/State	Reserve	Remaining Resources							Total
	Total	Feasibility	Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	(A)	STD211	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total									
Ore	**-**	**2230000**	**173063**	**23276152**	**23259954**	**23912049**	**16581246**	**89432464**	**89432464**
Contained WO_3	**-**	**3568**	**450**	**19298.8**	**16994.84**	**99772.15**	**4566.28**	**144650.1**	**144650.1**
By States									
Andhra Pradesh									
Ore	-	-	-	3640000	4700800	5952500	509000	14802300	14802300
Contained WO_3	-	-	-	5096	6574.64	8273.65	318.28	20262.57	20262.57
Haryana									
Ore	-	2230000	-	-	-	-	-	2230000	2230000
Contained WO_3	-	3568	-	-	-	-	-	3568	3568
Karnataka									
Ore	-	-	-	15361152	11805499	172921	9338246	36677818	36677818
Contained WO_3	-	-	-	2915	1775	142	1403	6235	6235
Maharashtra									
Ore	-	-	-	4275000	5461250	386000	-	10122250	10122250
Contained WO_3	-	-	-	11287.8	7117.92	185	-	18590.72	18590.72
Rajasthan									
Ore	-	-	-	-	963666	17000628	5964000	23928294	23928294
Contained WO_3	-	-	-	-	1421.44	90171.5	2115	93707.94	93707.94
Tamil Nadu									
Ore	-	-	-	-	-	-	250000	250000	250000
Contained WO_3	-	-	-	-	-	-	50	50	50
Uttarakhand									
Ore	-	-	-	-	138000	-	520000	658000	658000
Contained WO_3	-	-	-	-	25	-	680	705	705
West Bengal									
Ore	-	-	173063	-	190739	400000	-	763802	763802
Contained WO_3	-	-	450	-	80.84	1000	-	1530.84	1530.84

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_3 in Kuhi block, 0.13 to 0.38% WO_3 in Khobana block and 0.48% WO_3 in 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.

EXPLORATION & DEVELOPMENT

The details on exploration and development, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION & PRICES

There was no reported production of tungsten ore/ concentrate during 2021-22. In the past, production of tungsten was reported from Degana in Rajasthan and Chendapathar in West Bengal. The domestic prices of tungsten ore and concentrate are furnished in the General Review on 'Prices'.

MINING & PROCESSING

Deposits of wolframite that were established at Degana in Rajasthan and at Chendapathar in West Bengal are found associated with quartz veins, with width that varied from a few centimetres to three metres or sometimes even more. In Degana, it is also associated with gravel beds overlain by 2.5 m thick sand.

Gravel mining was carried out in the past in selected areas where wolframite was found to be concentrated. The overburden sand was at first loosened and loaded manually and transported by tractor unit to dump sites. The payable gravel was then worked.

In case of vein deposits, the orebody was cut with chisel and hammer at convenient places to form undercuts. At Degana, tungsten orebody occurs as vein, stockwork and alluvial deposits. Inclined veins were developed by putting adits in the stockwork.

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.

As per Annual Report of NMDC for 2020-21, the Company has submitted a proposal for reservation of Khobna Tungsten Block located inNagpur District, Maharashtra under Section 17(A) (2A) of MM (D&R) Amendment Act, 2015, for tungsten prospecting and exploitation.

The matter is being pursued with Govt. of Maharashtra. NMDC has a majority stake of 90.05% in Legacy Iron Ore Limited, an ASX listed entity based in Perth, Australia which has iron ore (magnetite), gold, nickel, base metal and tungsten interests (total 21 tenements) in Western Australia.

USES

Tungsten is mainly used in the form of ferro- tungsten 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 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 alloys and tungsten composites are used as a substitute for lead in bullet and shot. 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.

SUBSTITUTES

Tungsten remains essentially unsubstitutable in its use for production of filaments, electrodes and contacts in lamp & lighting applications. However, an electrodeless, non-tungsten lamp is available as alternative for commercial and industrial uses. Titanium, tantalum and niobium carbides can be used in certain wear-resistant applications. Molybdenum tool steels and tungsten tool steels are interchangeable. In some cutting tool applications, bulk ceramic is an alternative. In some applications, substitution would most often result in increased cost or reduction in product performance.

TECHNICAL POSSIBILITIES

Further development of new metal shaping methods, i.e., laser is becoming a viable proposition. Development of new cutting tool materials coating on cemented carbide parts, that increase their useful life could reduce the usage

of tungsten. There is increase in the use of tungsten scrap. The recycling of tungsten-bearing scrap and the recovery of tungsten from scrap materials are well-established practices for a number of reasons. The value of tungsten and other metals present in the scrap, such as, cobalt, columbium, copper, nickel, rhenium, silver, titanium and tantalum, is worthy enough reason to recycle them from scrap. Recycling of tungsten in high speed steel is high and a typical melt contains about 60-70% of the metal scrap, including from that of internally generated scrap. On the other hand, recycling in such applications as lamp filaments, welding electrodes and chemicals uses is also considered viable. Recycling is more environment-friendly and more practicable in economic terms than disposing as waste. Scrap recycling is an important factor in the world's tungsten supply.

POLICY

As per the Foreign Trade Policy, 2015-20, the imports and exports of tungsten ores and concentrates (HS Code 26110000) are allowed free.

CONSUMPTION

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.

WORLD REVIEW

World tungsten resources are geographically widespread. China ranks first in the world in terms of tungsten resources and reserves and has some of the largest deposits. The world reserves of tungsten in terms of metal content are about 3.8 million tonnes, distributed broadly amongst China (47%), Russia (11%), Vietnam (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	10
Bolivia	NA
China	1800
Portugal	3.1
Russia	400
Rwanda	NA
Spain	56
USA	NA
Vietnam	100
Other countries	1400

Source: USGS, Mineral Commodity Summaries, 2022

The world mine production of tungsten in terms of metal content in 2021 increased marginally by 9% to 1,00,700 tonnes from 92,500 tonnes in 2020. China was the leading producer (75%) followed by Vietnam (15%), Russia (3%) and Austria, Bolivia, & Rwanda (1% each) (Table-3).

Table – 3 : World Mine Production of Tungsten

(By Principal Countries)

(In tonnes of metal content)

Country	2019	2020	2021
World:Total (rounded)	**90400**	**92500**	**100700**
Austria	892	896	919
Bolivia	813	1030	1194
China	75452	76000	76000
Congo, Dem. R.	700	128	127
Rep.of Korea	1130e	1100e	500
Russia	2825	2692	2700
Rwanda[a]	1303	956	1281
Spain	414	184	643
Vietnam	4816	8066	15858
Other countries	2055	1463	1947

Source: BGS, World Mineral Production, 2016-2020.

a:Includes exports and year ended 30 June of that stated

FOREIGN TRADE

Exports

Exports of tungsten and alloys including scrap increased by 314% to 1,209 tonnes in 2021-22 from 292 tonnes in the previous year. Exports were mainly to Germany (57%), USA (22%), Netherlands and Japan (5% each), Vietnam (3%), Singapore (1%). In the year 2020-21 and 2019-20, exports of tungsten ore & concentrates were reported as Nil (Tables-4 to 11) Fig -1.

Table-4: Exports of Tungsten and Alloys Incl. Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**292331**	**835275**	**1209171**	**2600160**
Germany	148034	227357	692745	1277587
USA	315543	42911	263618	460630
Japan	18744	108756	61672	249530
Sweden	20575	48912	20982	66287
Netherlands	40	3916	62795	63901
Singapore	4294	51744	13134	52820
Vietnam	-	-	40000	50028
Italy	2886	24552	3535	43700
Poland	1852	33891	2438	43658
Bangladesh	4904	40165	1360	35023
Other countries	75459	253071	46892	256996

Figures rounded off

(In ₹ '000)

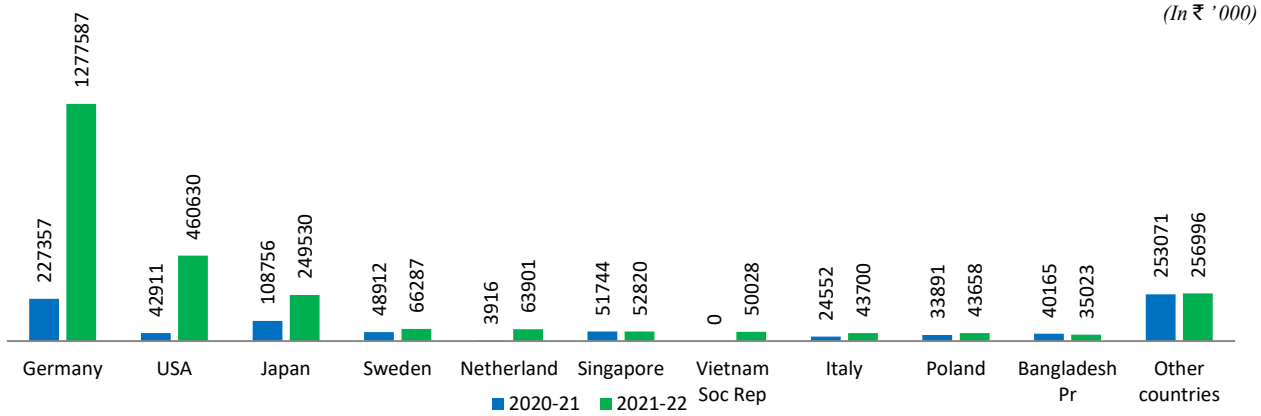


Fig 1: Countrywise Value of Export of Tungsten

Table-5: Exports of Tungsten Wire

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**16999**	**296924**	**32589**	**461540**
Japan	5338	93616	12535	170941
Germany	2445	55020	9001	84318
Poland	1852	33891	2438	43658
U S A	610	14110	765	38227
Italy	1858	22503	2138	28660
Sweden	564	8930	981	19607
France	745	12023	926	15456
Switzerland	546	9611	727	14616
Korea Rp	919	14684	796	12809
China P Rp	346	10127	716	7638
Other countries	1776	22409	1566	25610

Figures rounded off

Table-6: Exports of Tungsten Waste & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**87**	**20798**	**25**	**14810**
U K	-	-	++	4306
Korea Rp. of	10	3197	5	3452
Germany	-	-	5	3095
U S A	45	6321	11	2181
Netherlands	6	1983	4	1646
Saudi Arabia	-	-	++	130
Estonia	26	8779	-	-
USE	++	498	-	-
Sudan	++	20	-	-

Figures rounded off

Table-7: Exports of Tungsten Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**48391**	**58097**	**138260**	**252246**
Germany	32910	38030	130450	233890
Taiwan	-	-	6445	12169
U S A	-	-	1175	5153
Nigeria	997	711	46	346
Tanzania	11	25	52	296
Bangladesh	105	26	41	132
Oman	10	27	6	67
Mexico	-	-	1	52
Singapore	3	35	1	42
Algeria	-	-	10	28
Other countries	14355	19243	33	71

Figures rounded off

Table-8: Exports of Tungsten Filament

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**5027**	**51388**	**4428**	**54764**
Bangladesh	4341	39933	1100	34655
Italy	-	-	1278	13220
Sri Lanka	178	3338	152	3689
China	28	923	20	1325
Korea Rp. of	3	41	15	572
Austria	-	-	27	513
Kenya	-	-	1801	422
UAE	38	777	5	329
Nigeria	10	108	++	16
Zambia	6	15	12	13
Other countries	423	6253	18	10

Figures rounded off

Table-9: Exports of Tungsten & Alloys Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**77307**	**254587**	**421077**	**861375**
Germany	5479	9801	179772	316167
U S A	14933	28801	169168	266605
Sweden	20011	39982	20001	46680
Singapore	4291	51709	2047	35953
Netherlands	29	3580	16026	33410
Mexico	3626	26612	4438	29699
Austria	1043	2380	11230	27759
Thailand	5459	25002	3629	25379
Taiwan	1575	16413	325	12901
Japan	-	-	8316	12041
Other countries	20861	50307	6125	54781

Figures rounded off

Table-10: Exports of Tungsten Powder

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**8083**	**17188**	**42344**	**46348**
USA	7663	15684	41268	43833
Malaysia	300	1033	600	2171
Serbia	-	-	50	166
Cameroon	-	-	400	88
Puerto Rico	-	-	20	79
Egypt	100	426	2	9
Somalia	-	-	3	2
Thailand	-	-	1	++
Sri Lanka	20	45	-	-

Figures rounded off

Table-11: Exports of Tungsten & Alloys: Worked Nes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**69224**	**237399**	**378733**	**815027**
Germany	5479	9801	179772	316167
U S A	7270	13117	127900	222772
Sweden	20011	39982	20001	46680
Singapore	4291	51709	2047	35953
Netherlands	29	3580	16026	33410
Mexico	3626	26612	4438	29699
Austria	1043	2380	11230	27759
Thailand	5459	25002	3628	25379
Taiwan	1575	16413	325	12901
Japan	-	-	8316	12041
Other Countries	20441	48803	5050	52266

Figures rounded off

Imports

Imports of tungsten and alloys including scrap increased by 12% to 364 tonnes in 2021-22 from 326 tonnes in the previous year. Imports were mainly from China (53%), Austria (15%), Korea, Rep. of (13%), Israel (6%), USA (4%) Argentina (3%) . Imports of tungsten ores and concentrates increased by 25% from to 121 tonnes in 2020-21 from 151 tonnes in the previous year. Imports were mainly from Netherlands (87%) followed by Japan (13%) (Tables-12 to 21) Fig.-2.

Table –12: Imports of Tungsten & Alloys Incl. Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**326673**	**1451447**	**364880**	**1805805**
China	141891	522068	193706	751235
Austria	51301	448758	53442	509209
Korea, Rep. of	44631	142538	48166	176738
Singapore	9643	57729	4547	67070
Israel	8062	20522	20700	61552
USA	42767	100869	13626	59072
Germany	8316	40968	7108	56867
Argentina	7000	30091	10000	42772
Switzerland	1285	15366	2187	16012
Vietnam	-	-	6000	15895
Other countries	11777	72538	5398	49383

Figures rounded off

(In ₹ '000)

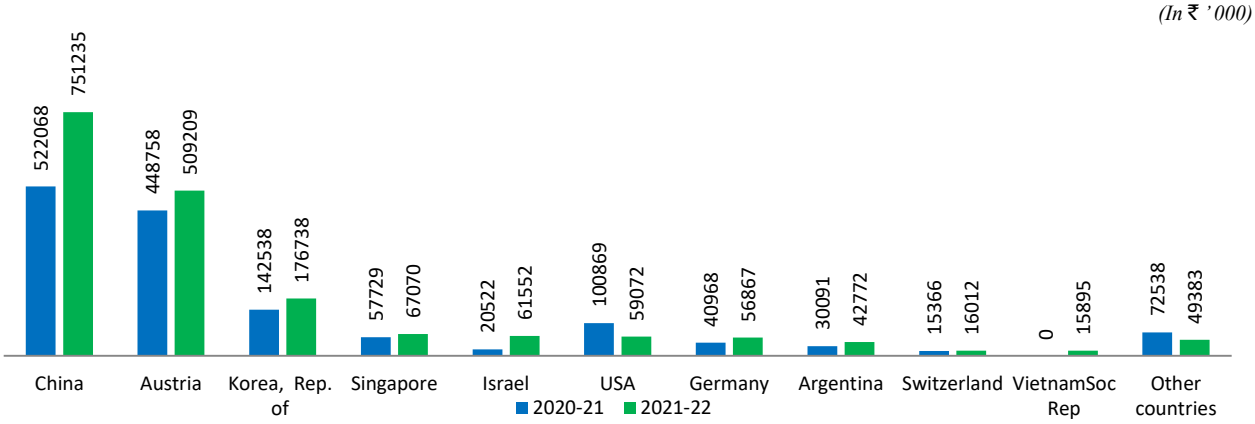


Fig 2: Countrywise Value of Import of Tungsten

Table - 13: Imports of Tungsten Ores & Conc.

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**121**	**9104**	**151**	**14800**
Netherlands	61	3542	132	31703
Japan	42	3334	19	3334
Belgium	18	1789	--	1789
Singapore	++	431	--	439

Figures rounded off

Table-14: Imports of Ferro-Tungsten

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**13**	**23282**	**2**	**4892**
China	9	15511	2	4892
Belgium	4	7448	-	-
USA	++	171	-	-
Turkey	-	152	-	-

Figures rounded off

Table-15: Imports of Tungsten Wire

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**106049**	**565540**	**105309**	**671803**
Austria	31614	253195	35613	334826
China	68502	296869	67771	311494
Singapore	1	24	1174	5852
Hong Kong	23	856	200	2612
Japan	71	182	27	2345
U S A	17	261	72	1594
Germany	-	-	25	698
Switzerland	14	127	10	470
UK	648	1419	210	468
Hungary	107	2323	2	84
Other countries	52	501	3	7

Figures rounded off

Table-16: Imports of Tungsten Waste & Scrap

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**--**	**--**	**-**	**-**
UK	--	--	-	-
Belgium	--	--	-	-
Germany	--	--	-	-

Figures rounded off

Table-17: Imports of Tungsten Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**41373**	**141036**	**60232**	**188890**
China	23787	62078	47610	145888
Vietnam	-	-	6000	15895
U S A	10693	30037	5080	13565

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
Germany	1611	6115	533	5160
Italy	798	4195	602	3449
Austria	3123	25184	186	1564
Canada	-	-	58	1245
Singapore	-	-	102	1083
Japan	-	-	61	1041
U K	208	7687	-	-
Other Countries	1153	5740	-	-

Figures rounded off

Table-18: Imports of Tungsten Filament

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1155**	**36975**	**976**	**33532**
Korea, Rep. of	540	21610	547	15854
Taiwan	143	7057	132	10370
Germany	79	1928	49	2517
China P Rp	192	2436	116	1896
Singapore	1	100	53	1761
USA	15	441	25	851
Switzerland	1	27	10	159
Austria	9	94	5	61
Japan	4	300	++	19
Italy	-	-	++	15
Other countries	171	2982	39	29

Figures rounded off

Table-19: Imports of Tungsten Powder

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**99353**	**273186**	**101914**	**367127**
Korea, Rep. of	43550	117607	47305	158287
Israel	8000	19977	20700	61552
China	12411	33759	16119	52969
Argentina	7000	30091	10000	42772
Germany	3521	20327	4665	29397
U S A	24431	48979	2406	19097
France	251	1796	490	2034
U K	-	-	200	783
Singapore	10	67	29	236
Thailand	150	499	-	-
Other countries	29	84	-	-

Figures rounded off

Table-20: Imports of Tungsten & Alloys: Worked Nes

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**78743**	**434710**	**96449**	**544453**
China	36999	126926	62090	238988
Austria	16555	170285	17638	172758
Singapore	4525	45456	4159	52553
USA	7557	21230	6088	23214
Germany	3088	12337	1789	18199
Switzerland	1284	15339	2152	15155
Japan	579	12147	377	8230
France	178	2031	1104	5998
Canada	-	-	336	2631
Korea, Rp. of	536	3292	311	2590
Other countries	7442	25667	405	4137

Figures rounded off

Table-21: Imports of Tungsten & Alloys Unwrought

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**178096**	**707896**	**198363**	**911580**
China	49410	160685	78209	291957
Austria	16555	170285	17638	172758
Korea, Rep. of	44086	120899	47616	160877
Israel	8058	20512	20700	61552
Singapore	4535	45523	4188	52789
Germany	6609	32664	6454	47596
Argentina	7000	30091	10000	42772
U S A	31988	70209	8494	42311
Switzerland	1284	15339	2152	15
Japan	579	12147	377	8230
Other countries	7992	29542	2535	15583

Figures rounded off

FUTURE OUTLOOK

Strong growth in tungsten market is driven by the surging demand for downstream tungsten products in varied end-user sectors including automotive, industrial engineering, energy and aviation. Apart from that, the uncovering of a wide- range of applications in allied industries like medical, defence and electric & electronic, has had an impelling effect on growth of the tungsten market.

Based on application, global tungsten market has been segmented into tungsten carbide, metal alloys, mill products and other applications, such as, salts, tungstates, sulfides, oxides, etc. Carbide is the largest application segment and usage of these products as drilling, boring and cutting tools in various industries will drive its market. Mill products of tungsten and their applications are another important segment. Mill products are pure tungsten metal products, such as, electrodes, lighting filaments, electrical & electronic contacts, sheets, wires, rods, etc. Developments in the Electronics Industry will be the major factor driving the mill tungsten market growth.

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 WO^3 in the tailing dumps of Kolar can be worked on priority basis to meet the demand.

World tungsten supply was dominated by production

in China and exports from China. China's 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. Scrap continued to be an important source of raw material for the Tungsten Industry worldwide. China was the world's leading tungsten consumer.

As per Tungsten - Outlook to 2030, 15th Edition by Roskill, China has for several decades been the world's largest mine and refined producer of tungsten, accounting for just over 80% of mine output in 2020. It is similarly dominant in the production of the tungsten intermediates ammonium paratungstate and tungsten oxide, and of tungsten metal powder and tungsten carbide. A large proportion of this output feeds the country's substantial Cemented Carbide Tool Sector, but there is also sizeable export of tungsten refined and finished products to the rest of the world – making Chinese mine and refined production of tungsten integral to conditions in the global market.

20. Vanadium

24.63
(million tonnes) Total reserves/ resources of vanadium ore as on 1st April 2020

168
(tonnes) Exports of ferrovanadium in 2021-22

900
(tonnes) Imports of ferrovanadium in 2021-22

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 1,910 ^{0}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.

RESERVES/RESOURCES

In India, vanadium is associated with titaniferous magnetite which contains 0.8 to 3% V_2O_5. It also occurs in significant amounts in association with chromite, laterite, bauxite and ferromagnesian-rich rocks, such as, pyroxenite, base a northosite 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 (P)

(By Grades/States)

(In tonnes)

State/Grades	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconna-issance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total													
By Grades													
Ore	0	0	0	0	276530	1720000	4108100	0	232000	18297225	0	24633855	24633855
Contained V_2O_5	0	0	0	0	1106.12	2835	6032.4	0	487.2	54133.29	0	64594.01	64594.01
By States													
Karnataka													
Ore	0	0	0	0	0	500000	4000000	0	0	14884430	0	19384430	19384430
Contained V_2O_5	0	0	0	0	0	700	5600	0	0	43197.55	0	49497.55	49497.55
Maharashtra													
Ore	0	0	0	0	276530	0	108100	0	0	0	0	384630	384630
Contained V_2O_5	0	0	0	0	1106.12	0	432.4	0	0	0	0	1538.52	1538.52
Odisha													
Ore	0	0	0	0	0	1220000	0	0	232000	3412795	0	4864795	4864795
Contained V_2O_5	0	0	0	0	0	2135	0	0	487.2	10935.74	0	13557.94	13557.94

Figures rounded off

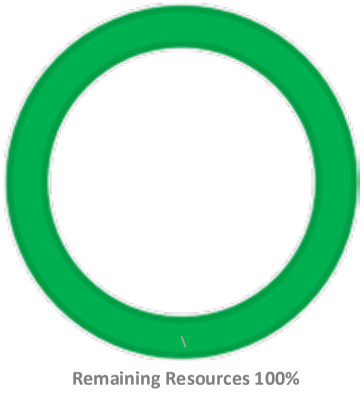


Fig 1: Reserves/Resources of Vanadium (Ore)

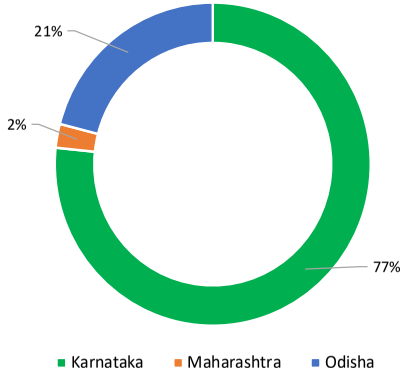


Fig 2: State wise Resources of Vanadium in India

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.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review of "Exploration & Development" under "General Reviews".

USES

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 (V2O5) 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_2O_5) 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 were 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 USA & 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 these cases, extraction depends on economic recovery of the product.

Table – 2 : World Reserves of Vanadium

(By Principal Countries)

(In '000 tonnes of vanadium content)

Country	Reserves
World: Total (rounded off)	**26,000**
USA	45
Australia	7400
Brazil	120
China	9,500
Russia	5,000
South Africa	3,500

Source: USGS, Mineral Commodity Summaries, 2022
 # For Australia, Joint Ore Reserves Committee-Compliant reserves were 1.1 million tonnes

The world production of vanadium in 2021 was 1,16,000 tonnes of metal content.This includes vanadium in slag product and from refining and burning of heavy oils. Major producing countries were China (63%), Russia (17%) and South Africa (13%) (Table-3).

Remaining countries together contributed 6% of the total world mine production. Most of the world's vanadium supply originates from primary sources or co-production.

Table – 3 : World Mine Production of Vanadium

(By Principal Countries)

(In tonnes of metal content)

Country	2019	2020	2021
World: Total (rounded off)	**95000**	**112000**	**116000**
China	54000	70000	73000
Russia	18380	19533	20058
South Africa	14858	14421	15424
Brazil	5923	6622	5779
Kazakhstan	1000	1000	1000
India	400	400	400
USA	460	17	-

Source: BGS, World Mineral Production, 2017-21

(In tonnes of metal content)

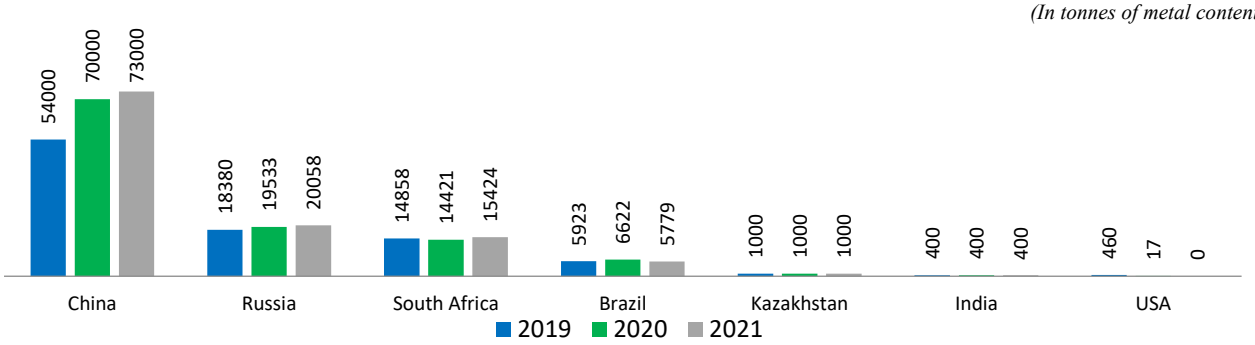


Fig 3: Countrywise Production of Vanadium

A generalised view of the development in various countries with countrywise description sourced from latest available publication of Minerals Yearbook 'USGS' 2018 is furnished as below:

Australia

In November, Neometals Ltd announced that it would update the 2009 Definitive Feasibility Study (DFS) of the salt roast-leach operation at its Barrambie vanadium-titanium-magnetite project, approximately 80 kilometers (km) northwest of Sandstone in Western Australia. The company had a mining permit for Barrambie and owned 100% of the project through its subsidiary Australian Titanium Pty Ltd. The DFS was expected to be complete in the second quarter of 2019 .

Brazil

Largo Resources Ltd.'s (Toronto, Ontario, Canada) Maracás Menchen Mine, located 813 km northeast of Brasilia, produced 9,830 tonnes of V_2O_5 in 2018, a 6% increase compared with the 9,300 tonnes of V_2O_5 produced in 2017. The company was expected to produce between 10,000 and 11,000 tonnes/year of V_2O_5 in 2019. According to the company, the vanadium is contained within a massive titaniferous magnetite deposit that has much higher grades of V_2O_5 and iron than any other vanadium deposit in the world. The very low level of contaminants in the deposit, particularly silica, was expected to make the extraction and processing of vanadium much easier. This in turn was expected to lower operating costs and produce a superior high-purity concentrate.

Canada

In February, VanadiumCorp Resource Inc. announced that it filed for an international patent application to secure rights for the new VanadiumCorp-Electrochem Processing Technology (VEPT). According to the companies, VEPT efficiently recovers vanadium compounds including vanadium pentoxide, vanadyl sulfate, as well as others from a variety of feedstocks containing vanadium.

Russia

EVRAZ Nizhny Tagil Metallurgical plant (NTMK), an integrated metallurgical complex located in Nizhny Tagil in the Sverdlovsk region, continued to be one of the world's leading processors of VTM. The Vanady Tula facility, located 200 km south of Moscow, used low-cost, highly efficient technology to process the vanadium slag produced by NTMK. Vanady Tula had a capacity of 5,000 tonnes/year of FeV and 7,500 tonnes/year of V_2O_5 in its electrometallurgical and hydrometallurgical plants.

China

Many vanadium producers in the Panzhihua Vanadium and Titanium High-Tech Industrial Development Zone continued to suspend or decrease vanadium production owing to local governments conducting environmental inspections following the discovery of polluted water in the Jinsha River in Panzhihua. Tighter environmental controls were also expected in other vanadium-producing regions. Pangang Group Vanadium Titanium & Resources Co., Ltd. continued to be the leading Chinese vanadium producer, with operations located in Panzhihua. The company had the capacity to produce approximately 24,000 tonnes/year of vanadium.

In February 2018, the Standardisation Administration of China (SAC) released a new standard for high-strength rebar that would decrease the use of sub-standard steels in construction to make buildings in China more earthquake resistant. The implementation date for the new standard was November 1, 2018. The new rebar standard would eliminate the low-strength Grade 2 rebar, and the SAC authorised Grade 3, Grade 4, and Grade 5 high-strength standards. The newly authorized standards would have 0.03% vanadium in Grade 3, 0.06% vanadium in Grade 4, and more than 0.1% vanadium in Grade 5 rebar. The increase of vanadium in rebar was expected to increase the overall consumption of vanadium in China by approximately 10,000 tonnes/year. However, this consumption estimate was expected to vary depending on the enforcement of these new rebar standards.

In January 2019, China's State Bureau of Quality and Technical Supervision conducted quality inspections of rebar producers in small steel mills to ensure that they had adopted the new rebar standards. It was reported that approximately 30% to 40% of mills had not fully switched to the new standards. Many of the small mills could not afford to implement the technology needed to produce the upgraded rebar. At yearend 2017, five Government agencies, including the Ministry of Environmental Protection and the Ministry of Commerce, jointly issued an import ban on 24 types of solid waste, including vanadium slag. The ban on four types of vanadium slag imports was expected to reduce the amount of raw material available for V_2O_5 production in China. In April 2018, authorities issued an additional import ban on vanadium waste and scrap that would go into effect at yearend 2019. Additional measures to further restrict the import of solid waste were expected to be announced. Some of the China- based VRFB companies included Dalian Rongke Power Co. Ltd, Golden Energy Century Ltd, Golden Energy Fuel Cell Co. Ltd, Shanghai Shenli Technology Co., Ltd, and VRB Energy. According to the company, Shanghai Shenli Technology was funded by the Ministry of Science and Technology of China and was financially supported by the Shanghai municipal government.

In 2017, the China National Development and Reform Commission called for more investment in energy storage, specifically flow batteries. One such project underway was the 800-megawatthour vanadium energy storage project in Dalian in northern China. The project, built by UniEnergy Technologies LLC (Seattle, WA) and Rongke Power, was expected to come online in 2020. VRB Energy commissioned a 12-megawatthour energy storage project in Hubei Province. This demonstration project was expected to serve as an example for larger future projects.

Czechia

EVRAZ Nikom had one processing facility, which was used to process V_2O_5 from Russia and China and also vanadium trioxide from Bushveld Minerals Ltd's Vametco Mine into FeV. Nikom's FeV production capacity was 4,600 tonnes/year.

South Africa

With the closure of EVRAZ Highveld Steel and Vanadium Ltd's operations during 2016, Bushveld Minerals Ltd's Vametco vanadium mine and Glencore plc's Rhovan facility were South Africa's only active primary vanadium producers in 2018. Bushveld announced that its Vametco vanadium mine and plant in Brits, North West Province, produced 2,560 tonnes of contained vanadium in the form of vanadium nitride and vanadium oxide in 2018 compared with 2,650 tonnes of contained vanadium in 2017.The company attributed the slight decrease to the 37.5 days of stoppages at its plant. Labor grievances accounted for 22.5 days of the stoppages. Bushveld announced that it would produce more vanadium at Vametco in 2019 because it was not anticipating any more plant stoppages. The company had commenced a multiphased expansion project to increase annual production at Vametco. Phase II of the expansion project was completed in June, increasing capacity to 3,750 tonnes/year of vanadium. Vametco used the standard salt roast and leach process to produce a trademark vanadium carbon nitride product called Nitrovan. Glencore plc

(Switzerland) announced that its Rhovan vanadium facility, 30 km northwest of Brits, produced 9,160 tonnes of V_2O_5 in 2018, a 3% decrease compared with 9,480 tonnes of V_2O_5 produced in 2017.

Kazakhstan

Ferro-Alloy Resources Ltd.(FAR) (United Kingdom) announced that it had completed a feasibility study to develop its Balasausqandiq vanadium project in Kyzylordinskaya Oblast, in the south of Kazakhstan, and was expected to build a new processing facility in two phases. Phase 1 was expected to treat 1 million metric tonnes per year of ore to produce 5,600 tonnes/ year of V_2O_5 . Phase 2 was expected to increase the ore treated to 4 million tonnes/ year, producing 22,400 tonnes/year of V_2O_5.In addition to developing the Balasausqandiq vanadium project, FAR continued to produce approximately 125 tonnes/year of V_2O_5 equivalent in the form of ammonium metavanadate (AMV) at its existing processing facility from purchased concentrates and other vanadium containing materials. The company was expected to install equipment to convert AMV to V_2O_5 and increase capacity to up to 1,500 tonnes/ year of V_2O_5

FOREIGN TRADE

Exports

The Exports of ferro-vanadium increased drastically by to 30%, 168 tonnes in 2021-22 as compared to 240 tonnes during the previous year. Exports were mainly to Oman(39%), Thailand (35%), Netherlands (12%),UAE(10%) , France (1%) (Table- 4) . The exports of vanadium ore and concentrates were reported at Nil in 2020-21 which was 10 tonnes during last year (Table5).

Table – 4: Export of Ferrovanadium

(By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**240**	**346840**	**168**	**353217**
Oman	32	49299	66	126260
Thailand	42	64449	58	118040
Netherlands	40	55916	20	53247
UAE	102	141985	18	38004
France	1	2162	2	6043
Turkey	1	1508	1	3017
Brazil	2	3803	1	2679
Fiji Is	-	-	1	1649
Bangladesh Pr	++	141	1	1067
Indonesia	++	507	++	1057
Other countries	20	27070	++	2154

Figures rounded off

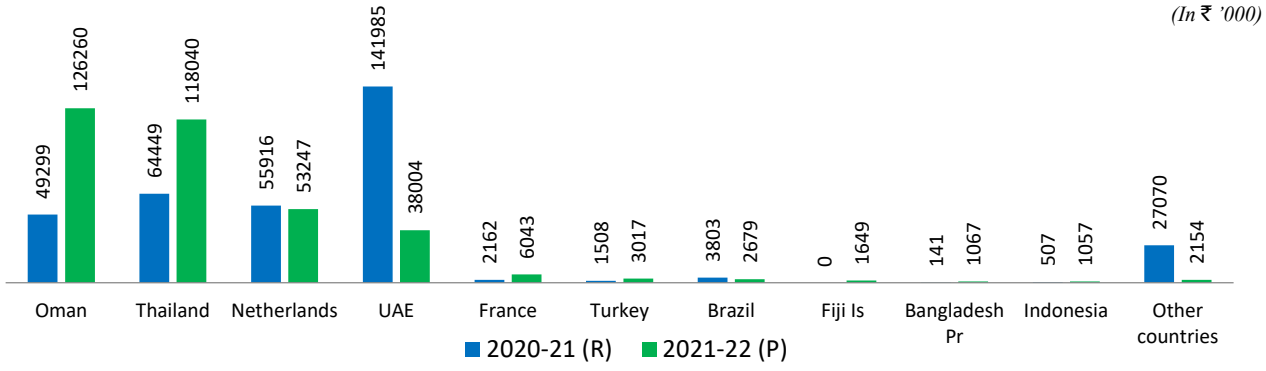


Fig 4: Countrywise Value of Export of Vanadium

Table – 5 : Exports of Vanadium Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**10**	**10801**	**-**	**-**
Latvia	10	10801	-	-

Figures rounded off

Imports

The Imports of ferro-vanadium were 900 tonnes during the year 2021-22 as compared to 480 tonnes during the previous year. The imports were mainly from Germany (32%), Republic of Korea (31%), Czech Republic (10%) and Japan(9%) (Table-6). The imports of vanadium ores and concentrates during 2021-22 increased by a massive 487% to 5,869 tonnes as compared to 999 tonnes in the previous year. The imports were mainly from Canada (71%), Kuwait (17%), Mexico (5%) and Republic of Korea (4%) (Table-6-7).

Table – 6 : Imports of Ferrovanadium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**480**	**613762**	**900**	**1806932**
Korea, Rep of	76	131424	280	658607
Germany	188	260094	287	555669
Japan	113	124205	81	192180
Czech Republic	30	29993	90	122774
UAE	48	26724	56	72657
South Africa	-	-	20	51635
Slovenia	-	-	16	42155
China	-	-	20	25003
Switzerland	20	32604	10	23724
Austria	-	-	10	23282
Other Countries	5	8718	30	39246

Figures rounded off

(In ₹ '000)

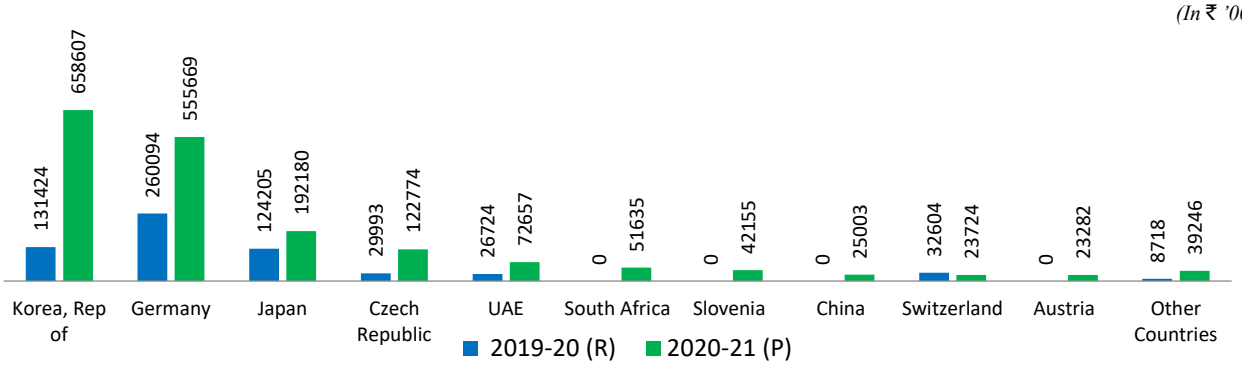


Fig 5: Countrywise Value of Import of Frrovanadium

Table – 7 : Imports of Vanadium Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**999**	**77967**	**5869**	**436744**
Canada	375	11608	4172	157517
Mexico	200	14406	277	104089
Kuwait	-	-	980	74117
Taiwan	54	8045	148	64896
Korea, Rep of	148	10560	253	19474
Russia	16	-	16	15593
Ukraine	-	-	23	1058
UAE	146	27377	-	-
Netherlands	74	5613	-	-
USA	2	358	-	-

Figures rounded off

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 segment, the consumption may 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.

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.

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