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VOLUME II

METALS & ALLOYS

INDIAN BUREAU OF MINES

Government of India
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Indian Bureau of Mines

INDIAN MINERALS YEARBOOK 2021

VOLUME - II
METALS & ALLOYS

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PREFACE

Indian Minerals Yearbook–2021 (IMYB–2021) is the 60th Edition in its series and comprises three Volumes. This book titled 'Metals & Alloys' is the second Volume and it contains 18 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 18 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–2021 pertains to the year 2020-21.

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 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–2021 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
14.09.2023

(Sanjay Lohiya)
IAS
Additional Secretary &
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Indian Bureau of Mines

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METALS & ALLOYS

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

b) Crude oil and natural gas

Coal Controller, Kolkata and the Coal Directory of India.

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.

Reserves/Resources	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	Transparency, 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

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.

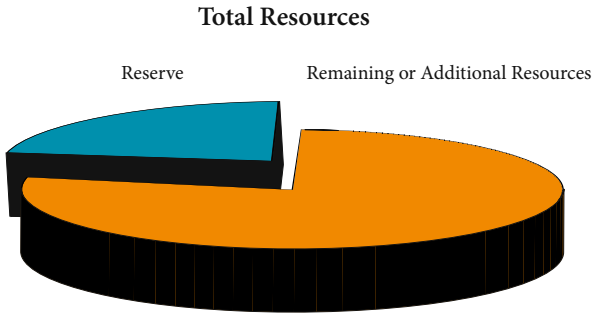
The UNFC consists of a three-dimensional system with the following three axes : Geological Assessment, Feasibility Assessment and Economic Viability. The process of geological assessment is generally conducted in stages of increasing details. The typical successive stages of geological investigation,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

41.65
(lakh tonnes) Total annual installed capacity of aluminium plants in the country in 2020-21

75.60
(lakh tonnes) Installed capacity of alumina plants in the country in 2020-21

3,619
(thousand tonnes) Production of aluminium in 2020-21

6,520
(thousand tonnes) Production of alumina in 2020-21

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 increased to 41.65 lakh tonnes from 41 lakh tonnes in previous year. The production of aluminium comes from the plants viz, Nalco, Hindalco, Balco & Vedanta whereas the Malco plant remained non-operational during the year 2020-21. Producer-wise capacity of aluminium is furnished in Table-1.

Table-1: Installed Capacity of Aluminium, 2020-21
(By Producers)

(In '000 tonnes)

Producer	Plant		Annual capacity
Total			4165
Public Sector			
National Aluminium Co. Ltd	Angul (Odisha)		460
Private Sector			
Bharat Aluminium Co. Ltd	Korba (CG) - I	245	570
	Korba (CG)- II	325	
Hindalco Industries Ltd	Aditya (Odisha)	360	1345
	Hirakud (Odisha)	215	
	Mahan (M.P)	360	
	Renukoot(U.P)	410	
Madras Aluminium Co. Ltd	Mettur (Tamil Nadu)		40#
Vedanta Aluminium Ltd	Jharsuguda-I (Odisha)	500	1750
	Jharsuguda-II (Odisha)	1250	

Source: Information received from the companies/Annual Reports.

MALCO has closed its smelter since December, 2008.

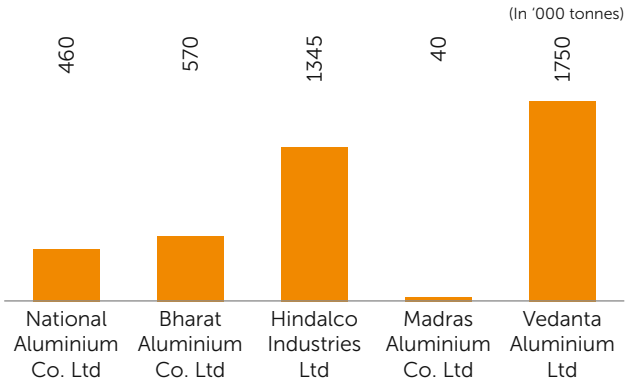


Fig 1: Company wise Installed Capacity of Aluminium 20-21

The installed capacity of alumina plants in the country was 75.60 lakh tpy. However, the operational capacity was 72.75 lakh tpy and plant capacity of 2.85 lakh tpy remained non-operational. Producer-wise capacity of alumina is furnished in Table-2.

Table-2: Installed Capacity of Alumina, 2020-21
(By Producers)

(In '000 tonnes)

Producer	Plant		Annual capacity
Total			7560
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	
Madras Aluminium Co. Ltd	Mettur (Tamil Nadu)		85#
Vedanta Aluminium Co. Ltd	Lanjigarh (Odisha)		2000

Source: Information received from the companies/Annual Reports.

Plants remained non-operational during the year.

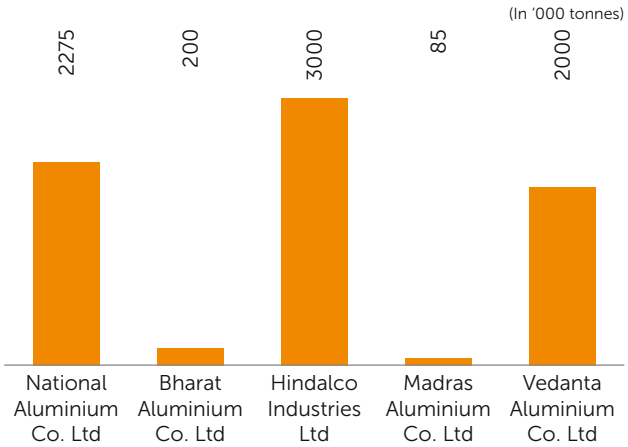


Fig 2: Company wise Installed Capacity of Aluminium 2020-21

PRODUCTION

Aluminium

The production of aluminium at 3,619 thousand tonnes in 2020-21 registered an decrease of 0.50% 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 2020-21

(Quantity in tonnes)

Year	Production	
	Quantity	Value
2018-19	3696181	528227924
2019-20	3635089	455960160
2020-21 (P)	3619237	415967702

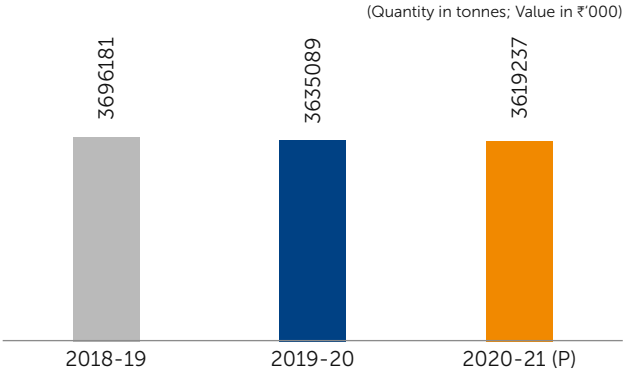


Fig 3: Production of Aluminium, 2019-20 to 2020-21

Table-4: Production of Aluminium, 2019-20 to 2020-21

(In tonnes)

Producer	Plant	Production	
		2019-20	2020-21 (P)
National Aluminium Co. Ltd	Angul	408410	418522
Hindalco Industries Ltd	Aditya	365733	355881
	Hirakud	171160	154126
	Mahan	363327	356354
	Renukoot	413752	362587
Bharat Aluminium Co. Ltd	Korba	565112	568496
Vedanta Aluminium Ltd	Jharsuguda	1347595	1403271

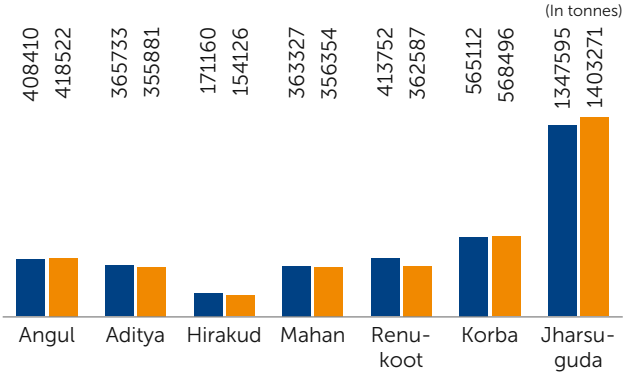


Fig 4: Plant wise Production of Aluminium

Alumina

The production of alumina at 6,520 thousand tonnes in 2020-21 decreased by about 2.24 % as compared to that in the previous year. NALCO continued to be the leading producer of alumina accounting for 33% of the total production during the year under review (Tables-5 & 6).

Table-5: Production of Alumina (including Calcined alumina) 2018-19 to 2020-21

(Quantity in tonnes; Value in ₹'000)

Year	Production	
	Quantity	Value
2018-19	6446370	153674440
2019-20	6670576	130410346
2020-21 (P)	6520852	118069838

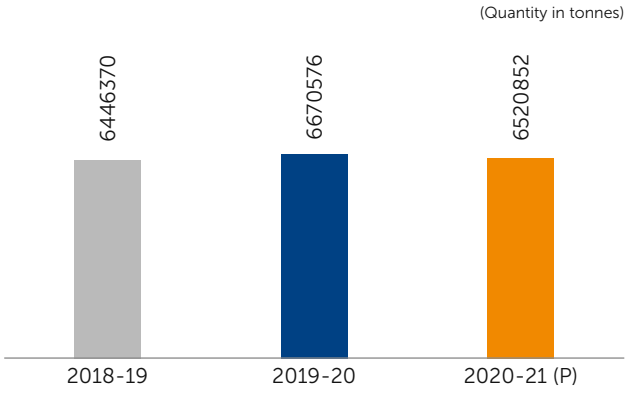


Fig 5: Production of Alumina (including Calcined alumina) 2018-19 to 2020-21

Table-6: Production of Alumina, 2019-20 to 2020-21

(By Plants)

(In tonnes)

Producer	Year	Production	
		2019-20	2020-21 (P)
National Aluminium Co. Ltd	Damanjodi	2103500	2202220
Hindalco Industries Ltd	Belagavi	285600	253000
	Muri	87663	222126
	Renukoot	690611	511831
Vedanta Aluminium Ltd	Lanjigarh	1810702	1688665

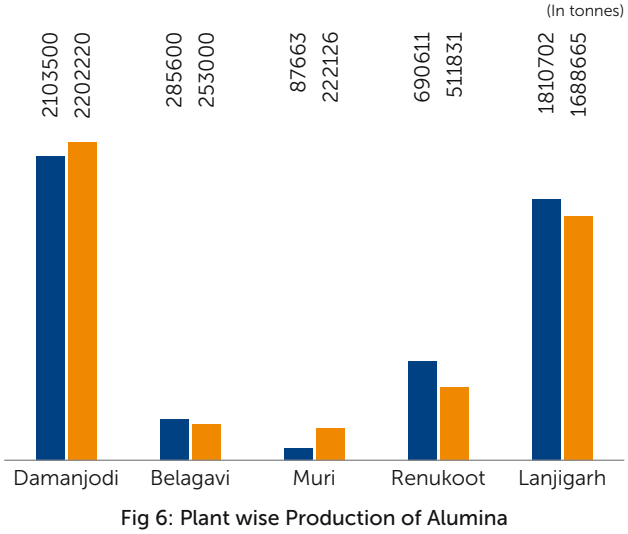


Fig 6: Plant wise Production of Alumina

INDUSTRY

Aluminium is the fastest growing non-ferrous metal in India and the same is evident by its growing and widespread use. Most of the Aluminium Smelter are located near their respective alumina refineries. Ten aluminium smelters are operated by four companies viz. NALCO, BALCO, HINDALCO & VEDANTA. NALCO is the only company in the Public Sector with installed capacity of 4,60,000 tpy. BALCO, earlier a Public Sector company, is now under Private Sector. The aluminium plants of NALCO and BALCO have their alumina-aluminium complexes at Damanjodi-Angul (Odisha) and Korba (Chhattisgarh), respectively.

NALCO is one of the largest integrated Bauxite-Alumina-Aluminium- Power Complex in the Country. The Company has 4,60, 000 tpy, Aluminium Smelter at Angul and 22,75,000 tpy Alumina Refinery located at Damanjodi in Koraput, Odisha.

Hindalco Aluminium smelting operations are located at Renukoot (Uttar Pradesh), Aditya Aluminium (Odisha), Mahan Aluminium (Madhya Pradesh) and Hirakud (Odisha). Newly installed smelters at Aditya Aluminium and Mahan Aluminium have state-of-the-art AP36 technology. The Hindalco's total primary aluminium (metal) capacity has enhanced to around 13,45,000 tpy from earlier capacity of 5,62, 000 tpy. This increase was primarily on account of production from Mahan and Aditya smelter commissioned during the year 2014-15. In addition to aluminium, Renukoot Integrated Aluminium Complex also produces semi-fabricated products viz. conductor redraw rods, sheet, extrusion, etc. The Alupuram (Kerala) smelter is closed but extrusion unit currently operates at a capacity of 8,000 tpy.

Hindalco's plants are equipped with sophisticated rolling mills and finishing equipment. The plants are located at Hirakud (Odisha), Belur (West Bengal), Mouda (Maharashtra), Renukoot (Uttar Pradesh) & Taloja (Maharashtra). Hindalco's finished products include, alumina, primary aluminium in the form of ingots, billets & wire rods, value-added products, such as, rolled products, extrusion and foils. Hindalco is the largest manufacturer of entire range of Flat Rolled Products. Flat Rolled Products facilities at Hirakud (Odisha) and Mouda (Maharashtra) are being modernised to produce world class Can Body stock and Ultra Thin Gauge Foils, respectively. The Hirakud plant produces Flat Rolled Products (FRP), rolled products, extrusions products and wire rods. Hindalco has a conductor redraw capacity of 56,400 tpy at Renukoot plant and sheet rolling capacity of 2,05,000 tpy spread over at Renukoot (80,000 tpy), Belur (45,000 tpy), Taloja (50,000 tpy) and Mouda (30,000 tpy) plants. The Company also has two plants for aluminium extrusion with capacity of 31,000 tpy comprising units at Renukoot with 23,000 tpy capacity and Alupuram (Kerala) with 8,000 tpy capacity.

Hindalco's foil unit located at Silvasa (Dadra & Nagar Haveli) has an installed capacity of 30,000 tpy and produces foils with thickness varying from 9 microns to 200 microns. Kollur plant in Medak district (Andhra

Pradesh) has capacity of 4,000 tpy and produces an array of high-quality foils, from cigarette and blister foil to lidding foil in thicknesses from 50 to 7 microns.

The overall BALCO's smelter capacity augmented to 5,70,000 tpy with the commissioning of Korba-II smelter with 3,25,000 tpy capacity, has capabilities to produce ingots, wire-rods billets, bushbars and rolled products. The Korba-I plant with 2,45,000 tpy capacity 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 underways. The mine is likely to be operational in the 4th quarter of financial year 2023-24.

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

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

NALCO and Odisha Industrial Infrastructure Development Corporation (IDCO) have formed a JV Company for establishment of Angul Aluminium Park

Pvt. Ltd (AAPPL) for promotion of downstream industries in the State of Odisha. The project is expected to be completed by financial year 2021-22.

HINDALCO: In the field of aluminium, Hindalco operates in primary aluminium and downstream aluminium segments and is one of the world 's largest integrated aluminium 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. We plan to invest around ₹8,000-10,000 crore in expanding flat rolling capacity at Hirakud, new extrusion plant at Silvassa and in a greenfield site at Mundra with a recycling facility. The Hirakud plant capacity for flat rolled products is estimated to be 340 KTPA. The planned capacity of the extrusion plant at Silvassa is 34 KTPA, which would have three extrusion presses to service premium customers in building and construction, automobile and transport, electrical, consumer and industrial good sectors. In addition, the new extrusion and recycling unit at Mundra is awaiting land acquisition process and would have a capacity of 93 KTPA.

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

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

USES

Aluminium is more environment-friendly than steel, plastic and other materials. The metal that made flying possible, is sustainable, light and energy efficiont. 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, thereby, saving energy and reducing greenhouse emissions. Aluminium recycling process is less capital intensive than primary metal production as the process requires only 5% of energy, i.e.,13–15 thousand units of power for producing one tonne of aluminium through primary route. Recycling of aluminium saves about 6 kg of bauxite/kg and 14 kWh of electrical energy /kg of primary aluminium. Besides, it keeps the emission levels of greenhouse gases as low as 5% from the actual emission experienced during primary production. Further, recycling facilitates reduced stress on the use of bauxite and thereby preserving about six lakh tonnes of bauxite resources every year.

India's metal recycling rate is about 25%. Altogether the rise in aluminium production from old scrap has grown from one million tonnes in 1980 to 20 million tonnes in 2019. All the activity related to aluminium scrap recovery are limited to the Unorganised sectors, catering mostly to the utensil and casting industries. The proportion of recycled aluminium has been increasing over the years. It is expected that in the years to come, it will reach a figure of about 35–40% of total aluminium consumption. Currently, there is only one recycling unit of Hindalco in the Organised Sector at Taloja with 25,000 tonnes annual capacity. Although the plant at Taloja was facing challenges due to less availability of scrap, the production from the unit has improved and the plant is now operating at 80% of the rated capacity as against earlier capacity of 60%. Hindalco is planning to set up greenfield recycling unit at mundra with a capacity of 93 KTPA.

Most recycling units in India operate on outdated, or primitive technology which leads to high levels of pollution and energy consumption. This is an area that needs to be addressed by the Indian Aluminium Industry. Due

recognition of recycling could encourage users of aluminium particularly in transport, housing, packaging and durable sectors to broaden the organised markets for the scrap generated.

WORLD REVIEW

World production of alumina was 134 million tonnes in 2020. China continued to be the leading producer with a share of about 55% which is followed by Australia (15%), Brazil (8%), India (5%) and Russia (2%) & Jamaica (1% each). World production of aluminium was at 65.40 million tonnes in 2020. China continued to be the leading producer with a share of about 57% which is followed by Russia, (6%) Canada (45%) and India (6%) & UAE (4%) (Tables-8 & 9).

Table-8: World Production of Alumina
(By Principal Countries)

(In '000 tonnes of Al_2O_3 content)

Country	2018	2019	2020
World: Total (rounded off)	1310000006	131200000	134700000
Australia	20061795	20239198	20836304
China	73607591	71474166	73131900
Brazil	8258000	9170800	10185000
India*[(d)]	6446370	6706500	6624500
Russia	2763000	2755000	2873000
UAE	-	1100000	1920000
Ireland	1818065	1860970	1822368
Saudi Arabia	1774000	1798340	1782041
Ukraine	1715000	1690000	1725000
Jamaica	2483572	2172977	1620943
Other countries	12074943	12271847	12149742

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	2018	2019	2020
World: Total (rounded off)	64100000	62900000	65400000
China	36447290	35043604	37080400
Russia	3627000	3637000	3638000
India*[(d)]	3696181	3635089	3619237
Canada	2923204	2853771	3154493
UAE	2640000	2600000	2520000
Australia	1574240	1569591	1585017
Bahrain	1011101	1365005	1548000
Norway	1295000	1312000	1330000
USA	898652	1126032	1026617
Argentina	437771	438200	309800
Other countries	9588255	9338829	9557603

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 thousand 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 shoused a marginal decline 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 capacity 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 impoundment after heavy rainfall. The Albras smelter, a joint venture between Norsk Hydro (51%) and Nippon Amazon Aluminium Co. Ltd (49%), would return 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 powerplants. 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 ram-pup 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 emissions of perfluorocarbons. Capacity of the smelter increased by 58,000 tpy.

FOREIGN TRADE

Exports

Export of alumina decreased marginally by 5% to 1,265 thousand tonnes in 2020-21 from 1,330 thousand tonnes in the previous year. Exports were mainly to UAE (56%), Malaysia (5%), China (5%) and Egypt (5%).

Export of aluminium and alloys including scrap increased by 15% to 2,735 thousand tonnes from 2,371 thousand tonnes. Exports in 2020-21 were mainly to Malaysia (24%), Republic of Korea (22%), USA (6%), Taiwan (5%) and Japan (Tables-10 to 12).

Table-10: Exports of Alumina

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1330038**	**30900409**	**1265941**	**28280781**
UAE	677614	15051302	706087	15048867
Oman	205	10849	183711	3891344
China	186328	4072835	69353	1658847
Qatar	32	23904	61208	1284659
Malaysia	214503	4578599	61330	1203104
Egypt	122738	2675711	61683	1182271
Taiwan	23151	976638	23266	921583
UK	515	28146	30935	734852
Netherlands	1	57	30640	717926
Korea, Rep. of	15021	629038	14037	564754
Other countries	89930	2853330	23691	1072574

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2371062**	**361046684**	**2735588**	**427759670**
Malaysia	686137	90572778	666017	90880481
Korea, Rep. of	495519	65253020	603703	79903721
USA	243638	45108317	160795	37510442
China	36780	4327045	219829	29862598
Taiwan	74517	9967245	123356	16079407
Singapore	30775	4136217	126652	16052945
Mexico	63110	9103078	77356	12689868
Bangladesh	41186	8268419	48564	11256437
Brazil	61579	8548411	72708	10976999
Greece	9337	1300372	66598	9596608
Other countries	628484	114461782	569983	112950164

Figures rounded off

Table-12: Exports of Aluminium

(By Items)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All items	**2371062**	**361046684**	**2735588**	**427759670**
Aluminium & Alloys : Unwrought	1961096	258975274	2324305	317093138
Aluminium Alloys Unwrought	289387	39904467	240867	36269198
Aluminium Ingots	1663948	217981548	2081831	280582856
Aluminium Unwrought Nes	7761	1089259	1607	241084
Aluminium & Alloys : Worked	212073	40300783	231811	45462208
Aluminium & Alloys :Worked (Bars, Rods, Plates)	121923	20021980	164374	28138974
Aluminium & Alloys :Worked (Bars, Rods, Profiles)	73783	16972515	47824	13330801
Aluminium Worked (Bars, Rods, Profiles etc.)	16367	3306288	19613	3992433
Aluminium & Alloys, Worked, Nes	188045	60229981	170757	63784997
Aluminium & Scrap	6108	655929	5428	598217
Aluminium Powders & Flakes	3740	884721	3287	821110

Imports

Import of alumina increased drastically by 27% to 2334 thousand tonnes in 2020-21 from 1,844 thousand tonnes in the previous year. Imports were mainly from Australia (57%), Vietnam (16%), Indonesia (21%), China (3%) and Netherlands (1%).

Imports of aluminium & alloys including scrap also decreased considerably like alumina by 4% to 2,060 thousand tonnes in 2020-21 from 2,152 thousand tonnes in the previous year. The imports were mainly from USA(16%), China (11%), Malaysia (6%), UAE (9%), UK (7%), Saudi Arabia (6%), Australia (4%) and Republic of Korea (2%) (Tables- 13 to 15).

Table-13: Imports of Alumina

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1844483**	**49829384**	**2334786**	**57491719**
Australia	854941	19241870	1323262	30057614
Indonesia	338352	22811269	490792	10803369
Vietnam	489849	8928324	378634	8817322
China	53408	12585192	62128	3706946
Netherlands	33338	3221286	19710	972577
Germany	7268	1859525	5686	752942
USA	3976	859060	3418	531390
Canada	2678	703558	3630	441073
France	10991	318780	8266	419867
Bahrain	5051	125935	28092	302334
Other countries	44631	1440442	11168	686285

Figures rounded off

Table-14: Imports of Aluminium Alloys Incl. Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2152419**	**310945506**	**2060227**	**299126164**
China	310132	67591927	228165	54307692
USA	334240	36470103	332610	36918693
UAE	156532	20499485	181587	25032890
Malaysia	178836	25776840	127515	19415186
UK	161092	18437476	147742	16647921
Saudi Arabia	115095	13509704	128621	16357314
Korea	73870	14482612	51085	11663612
Thailand	45390	9318099	40730	8824410
Germany	34833	7525113	50571	8730862
Australia	83211	9237109	77001	8605834
Other countries	659188	88097038	694600	92621750

Figures rounded off

Table-15: Imports of Aluminium

(By Items)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All items	2152419	310945506	2060227	299126164
Aluminium & Alloys:Unwrought	264667	37128024	265121	39500561
Aluminium Alloys Unwrought	38262	5847389	36521	5567424
Aluminium Ingots	223678	30671776	224566	33335909
Aluminium Unwrought Nes	4527	608859	4034	597228
Aluminium & Alloys:Worked	452255	95531395	369440	83394272
Aluminium & Alloys:Worked (Bars,Rods,Plates)	150383	30722227	134777	29387734
Aluminium & Alloys:Worked (Bars,Rods,Profiles)	232566	51178614	191905	45018990
Aluminium Worked(Bars,Rods,Profiles Etc)	72306	13630554	42758	8987548
Aluminium &Alloys,Worked,Nes	78624	37346586	52537	27206116
Aluminium & Scrap	1347920	140090406	1369546	148399920
Aluminium Powders & Flakes	4153	849095	3583	625295

FUTURE OUTLOOK

Aluminium plays a meaningful role when usages of aluminium are concerned. As per the industry sources, the primary aluminium demand in India is expected to reach 6 million tonnes by 2025, which is equivalent to 4.1 kg per capita aluminium consumption. The per capita aluminium consumption in India during 2020-21 was around 2.7 kg which is much below the global average of 11 kg. Thus, Indian market offers a huge potential for demand growth of Aluminium Industry. To reach the global average of 11 kg per capita, India will require an additional annual consumption of 16 million tonnes, and if achieved India would become the second largest consumer in the world.

Aluminium contributes to nearly 2% of manufacturing GDP and with projected consumption growth, the share (% of manufacturing GDP) may go higher. It is envisaged to expand the aluminium capacity from 4 MTPA to 12 MTPA by 2030. India is saving fuel to become a major global low-cost aluminium production hub and a major contributor to the Nation's GDP.

Aluminium consumption is most likely to increase as a result of Government's key flagship programmes like Make in India, National Capital Goods Policy, Development of 100 smart cities and Government's commitment to reach a 100 GW solar capacity by 2022 from 20 GW today. The Governments thrust in reinforcing the Power Sector, which a dominant consumer of aluminium in India, augers well for Aluminium Industry.

Aluminium has forward linkages with key sectors like aviation, defence, auto, electricity, construction, packaging, machinery, marine etc. and backward linkages with mining, chemical, power, machinery etc. By speeding up investment in sectors with high backward and forward multipliers, the industrialisation process can be speeded up which would in turn enable accelerating economic growth. The cumulative demand for aluminium is set to rise by several hundred thousand tonnes by 2030.

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

5,977
(tonnes) Imports of antimony ores and concentrates in 2020-21

Antimony is a strategic metal. The predominant 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, all in Inferred category located in Lahaul & Spiti district, Himachal Pradesh (Table-1) Fig 1(A). & Fig 1(B).

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

(By Grades/States)

Unit: '000 tonnes

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

Figures rounded off

Remaining Resources 60% Reserves 40%

Fig. 1(A) Reserves/resources of Antimony (Ore) as on 1.4.2020 (P)

Remaining Resources 71% Reserves 29%

Fig. 1(B) Reserves/resources of Antimony (Metal) as on 1.4.2020 (P)

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 its alloys find numerous applications in a wide range of high technology industries like electronic, space, defence, photographic materials, electroplating, besides cosmetic, paint, plastics and textile industries. Traditionally, it is used in type metal in Printing Industry and other alloys. It is now used extensively worldwide to harden and increase the mechanical strength of lead, particularly in Battery Industry. Antimony trioxide is the most important of the antimony compounds and is primarily used in flame-retardant applications, including such markets, as children's clothing, toys as well as in manufacturing aircraft and automobile seat covers. Antimony sulphide is one of the ingredients used in safety matches. It is used in solar panels to improve stability of the solar performance of the glass upon exposure to UV radiations or sunlight and also as a decolourising and refining agent in Glass Industry. Antimony compounds also find use in pharmaceutical applications. It is also used in semiconductors for making infrared detectors, diodes & acoustic devices, and in plastic production as a heat stabiliser in PVC.

INDUSTRY

The metal is obtained commonly as a by-product in lead-zinc-silver smelting. As part of its R & D programme, HZL successfully implemented antimony dust treatment flow sheet at Ancillary Industry. Antimony dust at Pantnagar Metal Plant (PMP) was leached in controlled conditions to recover antimony as Potassium Antimony Tartarate (PAT) reagent which is used in Zinc Hydro plants purification section and enriched lead silver residue. Presently, there is no production of antimony in India. The entire requirement of antimony in the country is met through imports of its ore and concentrates. HZL is currently operating metal plant having 1,400 TPA antimony concentrate (by-product). The antimony slag is recovered as antomony trioxide with more than 95% purity, which is commercially accepted with high demand as flame retardant.

SUBSTITUTES

Combination of tin, calcium, copper, selenium, cadmium, strontium and sulphur is among the substitutes used as hardeners for lead used in batteries. Low maintenance batteries have started using calcium as additive to substitute antimony. Antimony can be replaced by organic compounds or hydrated aluminium oxide in flame-retardants and by tellurium and selenium in rubber manufacturing. Compounds of titanium, zinc, chromium, tin and zirconium are substituted for antimony chemicals in paints, pigments and enamels.

TECHNICAL POSSIBILITIES

Antimony products can be used as 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 2.0 million tonnes in terms of metal content. Antimony reserves are located mainly in China, which contributes about 24% of the total reserves followed by Russia (18%), Bolivia (16%), Kyrgyzstan (13%), Australia (5%), Turkey (5%), Canada (4%), USA & Tajikistan(3% each) (Table-2).

Table-2: World Reserves of Antimony
(By Principal Countries)

(In tonnes of metal content)

Country	Reserves
World : Total (rounded off)	2000000
Australia	100000
Bolivia	310000
Myanmar	NA
Canada	78000
China	480000
Ecuador	NA
Guatemala	NA
Iran	NA
Kazakhstan	NA
Kyrgyzstan	260000
Laos	NA
Mexico	18000
Pakistan	26000
Russia (recoverable)	350000
Tajikistan	50000
Turkey	100000
USA	60000(a)
Vietnam	NA
Burma	140000

Source: USGS, Mineral Commodity Summaries, 2022

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 7% to 1,23,000 tonnes in 2020 as against 1,32,000 tonnes in the previous year. China with (52%) production was the main producer of antimony in the world followed by Tajikistan (18%), Russia (14%) and Iran (4%) (Table-3) Fig. 2.

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	2018	2019	2020
World: Total (rounded off)	174000	132000	123000
China	95286	60229	64530
Tajikistan	28881	29898	22500
Russia	30828	21671	17532
Myanmar[e]	5400	5000	-
Turkey	3500	3815	2570
Bolivia	3110	2747	2629
Iran[j]	2551	5264	5300
Australia[c]	2866	2170	3903
Vietnam	244	395	388
Other countries	6505	5543	3978

Source: BGS, World Mineral Production, 2016-20

(c) Years ended 30 June of that stated.

(j) Years ended 31 March following that stated

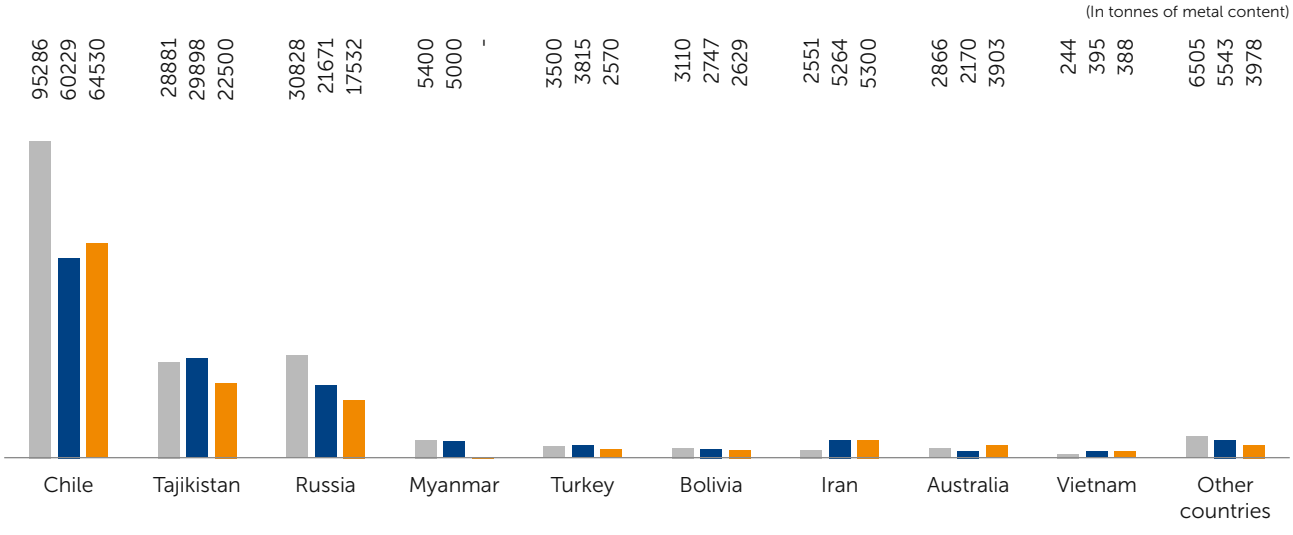


Fig 2: Country wise production of Antimony

FOREIGN TRADE

Exports

Exports of antimony ores & concentrates was nil for the years 2020-21 and 2019-20.

Exports of antimony alloys and scrap decreased slightly by 4 % to 2,134 tonnes in 2020-21 as against 2,217 tonnes in the previous year. Exports were mainly to USA (79%), Brazil (4%) and UAE, Netherlands & Canada (3%each). Exports of antimony (Unwrought) powders also decreased to 2,130 tonnes in 2020-21 as against 2,205 tonnes in 2019-20. Exports of antimonial lead were at 15,839 tonnes in 2020-21 as compared to 14,200 tonnes in 2019-20 (Tables-4 to 8).

Table-4: Exports of Antimony Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	-	-	-	-
Japan	-	-	-	-
Canada	-	-	-	-

* As per HS Code 26171000 (Antimony res & Conc.) for the year 2020-21,no data found.

Figures rounded off

Table-5: Exports of Antimony (Unwrought) Powders

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2205	919911	2130	930744
USA	1657	682716	1679	716907
Brazil	42	17589	84	46566
UAE	26	11765	73	34572
Netherlands	49	24526	69	32042
Canada	73	28925	71	28770
Thailand	-	-	50	22679
Italy	116	46154	23	11868
Egypt	20	8264	20	8405
Mexico	-	-	20	7976
Bangladesh	5	2100	17	7530
Other Countries	217	97872	24	13429

Figures rounded off

Table-6: Exports of Antimony & Articles, NES

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	12	7464	4	2178
Nepal	++	54	3	1267
Uganda	1	462	1	657
Sudan	-	-	++	225
UAE	-	-	++	15
Bhutan	++	5	++	8
Congo D. Rep.	-	-	++	4
Sweden	-	-	++	2
Sri Lanka	9	5482	-	-
Kenya	2	821	-	-
Germany	++	514	-	-
Other countries	++	126	-	-

Table-7: Exports of Antimony Alloys & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2217	927375	2134	932922
USA	1657	682716	1679	716907
Brazil	42	17589	84	46566
UAE	26	11765	73	34587
Netherlands	49	24526	69	32042
Canada	73	28925	71	28770
Thailand	-	-	50	22679
Italy	116	46154	23	11868
Egypt	20	8264	20	8405
Mexico	-	-	20	7976
Bangladesh	5	2100	17	7530
Other Countries	229	105336	28	15592

Figures rounded off

Table-8: Exports of Antimonial Lead

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	14200	2159294	15839	2395362
Bangladesh	3073	460895	6084	905373
UAE	3046	463801	4102	619059
Vietnam	2128	331542	1421	213221
Korea, Rep. of	1402	206320	1120	176475
Japan	1572	240298	842	126448
Oman	1487	219695	852	126136
USA	284	46523	548	90144
Nepal	415	64630	383	60365
Spain	157	23676	204	34462
Malaysia	75	11269	176	26993
Other countries	561	90645	107	16686

Figures rounded off

Imports

Imports of antimony ores and concentrates decreased by 22% to 5,977 tonnes in 2020-21 as compared to 7,656 tonnes in the previous year. Imports were mainly from Russia (56%), China & Canada (19% each), Tajikistan (4%) and remaining one per cent was contributed by other countries.

Imports of antimony alloys and scrap decreased sustantially by 10% to 1,319 tonnes in 2020-21 from 1,465 tonnes in the previous year. Imports of alloys and scrap were mainly from China (53%), Vietnam (12%, Netherlands (9%), Singapore (7%), Thailand (6%) and Oman (4%). Imports of antimony (Unwrought) powders decreased by 11% to 1,298 tonnes in 2020-21 as compared to 1,456 tonnes in the preceding year. Imports were mainly from China (53%), Vietnam & Netherlands (10% each), Singapore (7%), Thailand (6%) and Oman (4%) (Tables-9 to 13) Fig. 3.

Table-9: Imports of Antimony Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7656	1265983	5977	1072406
Russia	6273	1014285	3355	583767
Canada	57	10971	1133	207763
China	958	154931	1155	207247
Tajikistan	-	-	249	51502
Myanmar	50	10769	60	11181
Italy	49	23002	25	10941
Thailand	-	-	++	5
USA	269	52025	-	-

Figures rounded off

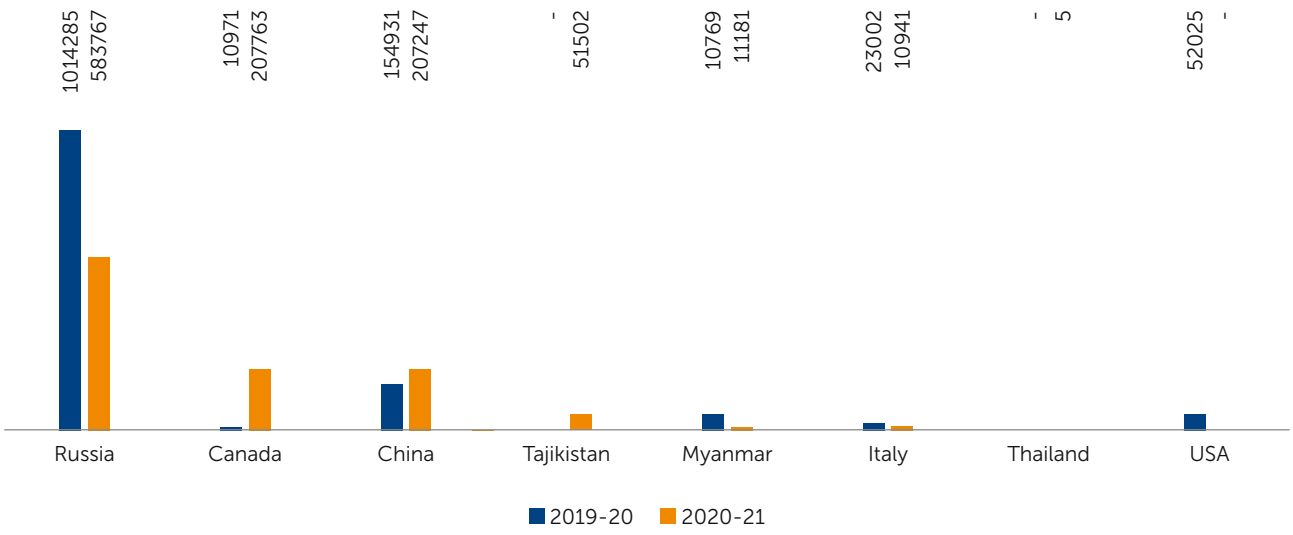


Fig: 3 Country wise Value of Import of Antimony

Table-10: Imports of Antimonial Lead

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	20150	2995867	30477	4523873
Malaysia	6204	897235	11878	1703491
Korea, Rep. of	6973	1086005	5553	848224
Singapore	945	139290	5194	770024
UAE	3008	434964	2459	368954
Saudi Arabia	296	42198	2002	306045
Belgium	-	-	596	105772
Thailand	-	-	499	78370
Mexico	-	-	471	74354
Lebanon	123	16301	364	52997
Nigeria	203	30467	222	34645
Other countries	2398	349407	1239	180997

Figures rounded off

Table-11: Imports of Antimony & Articles, NES

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	9	5482	21	10067
Vietnam	-	-	21	9368
USA	++	1065	++	414
UK	-	-	++	224
Germany	++	16	++	61
China	9	4401	-	-

Figures rounded off

Table-12: Imports of Antimony (Unwrought), Powders

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1456	654785	1298	581296
China	948	431246	693	320171
Vietnam	46	18606	134	62034
Netherlands	25	11134	124	55557
Singapore	123	51249	93	39818
Thailand	147	68820	77	33425
Oman	-	-	58	23937
Myanmar	-	-	24	10307
Japan	-	-	25	10303
Hong Kong	94	41148	25	10010
UK	48	21240	25	9953
Other countries	25	11342	20	5781

Figures rounded off

Table-13: Imports of Antimony Alloys & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1465	660699	1319	591363
China	957	435647	693	320171
Vietnam	46	18606	155	71402
Netherlands	25	11134	124	55557
Singapore	123	51249	93	39818
Thailand	147	68820	77	33425
Oman	-	-	58	23937
Myanmar	-	-	24	10307
Japan	-	-	25	10303
UK	48	21672	25	10177
Hong Kong	94	41148	25	10010
Other countries	25	12423	20	6256

Figures rounded off

FUTURE OUTLOOK

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.

3. Cadmium

913
(tonnes per year) Production capacity of cadmium ore in 2020-21

Nil
Production of cadmium in 2020-21

187
(tonnes) Exports of Cadmium in 2020-21

7,570
(tonnes) imports of cadmium in 2020-21

Cadmium is a soft, bluish-white metal of low melting point which is present generally in zinc ore deposits as greenockite (CdS). The principal source of cadmium is zinc ore, sphalerite. Other sulphides and sulphosalts may also carry small amounts of the metal.

In India, cadmium is recovered as a by-product during zinc smelting and refining. The concentration of cadmium in sphalerite, the principal ore of zinc, ranges from 0.03 to 9.0 wt%.

INDUSTRY

The total annual installed capacity for recovering cadmium was 913 tpy of which HZL accounted for 833 tpy capacity. Binani Zinc Ltd (Edayar Zinc Ltd) reported the remaining 80 tpy capacity (Table 1). HZL produces cadmium of high quality in its zinc smelters which is casted in the form of pencils weighing from 250 g to 500 g. The purity is 99.95% Cd (max.) at Debari; 99.97% Cd (max.) at Vizag and 99.99% Cd (min.) at Chanderiya plants. HZL has plans to conduct R&D for production of high purity cadmium. High purity cadmium is typically used for nuclear shielding applications.

Table-1: Installed Capacity for Recovery of Cadmium
(By Producers)

Unit	Location	Installed capacity (tpy)
Total		913
1. HZL, Debari Zinc Smelter	Debari, Dist. 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. 2019-20 & 2020-21 (Tables-2).The foreign market prices of cadmium are furnished in the General Review on "Prices".

Table-2: Production of Cadmium 2019-20 to 2020-21

(By Sector/States/Districts)

(Quantity in tonnes; Value in ₹'000)

State	Smelter	2019-20		2020-21 (P)	
		Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
India		0	0	0	0
Private Sector		0	0	0	0
Rajasthan		0	0	0	0
Chittorgarh	HZL	0	0	0	0
Rajsamand	Chanderia				
Udaipur					

RECYCLING

National Waste and Recycling Associations (NWRAs) have been created around the world to promote the collection and recycling of all batteries, both from the general public and industrial consumers. Nickel-cadmium batteries which account for about three-fourths of the cadmium consumed are virtually 100 per cent recyclable once they have been collected. The recovery of cadmium from cadmium products through recycing 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 procucing 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 24,500 tonnes in 2020. China (42%), Rep. of Korea (18%) and Japan (7%), Russia & Kazakhstan (6% each),and the remaining share was contributed by Netherlands, Mexico, Peru,Canada and 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. As per Mineral Commodity Summaries, 2020 of USGS Report, the world refinery production of cadmium was estimated at 24,000 tonnes for both of the year in 2020 & 2021, respectively.

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 2018 to 2020 by principal countries is furnished in Table-3 and Fig#1. 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-3 : World Production of Cadmium
(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
World: Total (rounded)	28100	26800	24500
China	10349	10300[e]	10300
Korea, Rep. of	4905	4500[e]	4500[e]
Japan	1980	2000[e]	1800
Canada[a]	1857	1803	140
Russia[e]	1700	1400	1400
Kazakhstan[e]	1500	1400	1500
Netherlands[e]	1100	1100	1100
Mexico	1307	952	978
Peru	765	772	687
Other countries	2642	2584	2126

Source: BGS World Mineral Production, 2016-20,

a) including cadmium sponge and/or secondary metal.

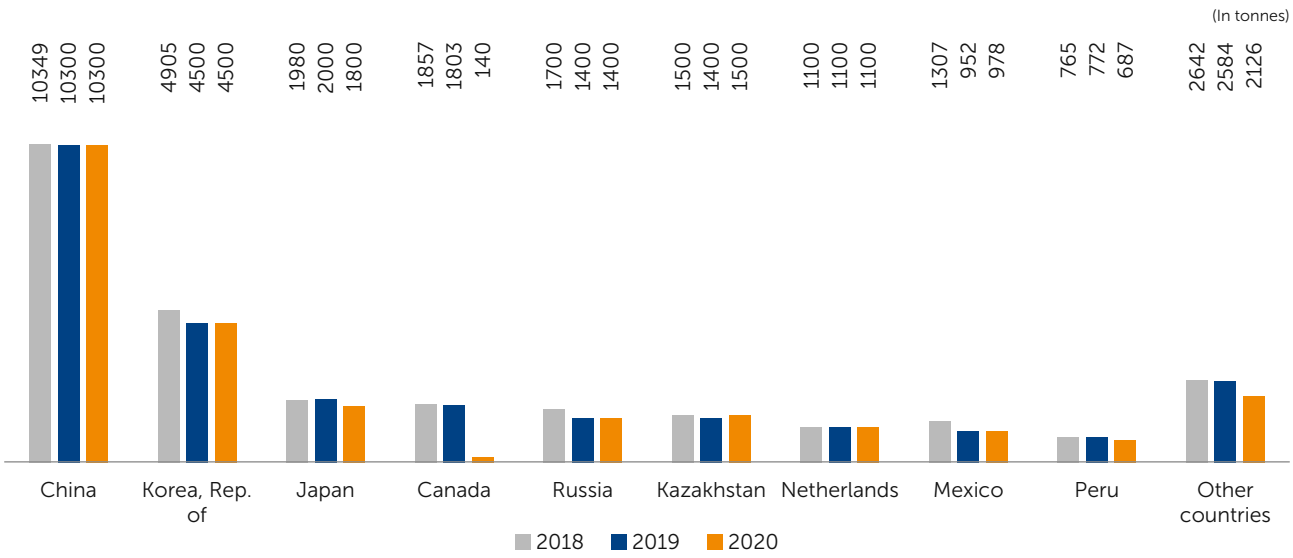


Fig 1: Country wise Value of Export of Cadmium

China

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

Korea, Republic of

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.s 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 drastically by 25% to 187 tonnes during 2020-21 from 250 tonnes in the previous year. Exports were mainly to Bangladesh (96%),UAE &Turkey (2% each). Similarly, exports of cadmium (including waste & scrap) also decreased by 22% to 208 tonnes during 2020-21 from that of 268 tonnes in the previous year.

On the other hand exports of cadmium & alloys increased substantially by 85% to 170 tonnes during 2020-21 as against 92 tonnes in the previous year, while exports of cadmium & scrap increased marginally by 17% to 21 tonnes in 2020-21 against 18 tonnes in 2019-20. Exports of cadmium unwrought and powders decreased by huge quantity to 17 tonnes during 2020-21 as compared to 156 tonnes in the previous year. Exports were mainly to Bangladesh (82%),Turkey(18%). (Tables-4 to 9).

Table-4: Exports of Cadmium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	250	33439	187	24202
Bangladesh	97	12815	180	22289
UAE	++	227	4	1008
Turkey	-	-	3	603
Kenya	-	-	++	204
Iraq	-	-	++	38
Qatar	-	-	++	31
USA	-	-	++	13
Jordan	-	-	++	8
Nepal	++	19	++	6
Fiji	-	-	++	2
Other countries	153	20378	-	-

Figures rounded off

Table-5: Exports of Cadmium

(Including Waste & Scrap)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	268	35680	208	24971
Bangladesh	115	15037	201	22756
UAE	++	243	4	1139
Turkey	-	-	++	204
Saudi Arabia	-	-	++	87
Iraq	-	-	++	38
Qatar	++	1	++	31
Oman	-	-	++	31
Yemenc	++	165	++	29
Egypt	-	-	++	24
Other countries	153	20234	++	29

Figures rounded off

Table-6: Exports of Cadmium & Alloys

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	92	13439	170	21746
Bangladesh	92	12214	166	20475
UAE	++	143	4	1008
Kenya	-	-	++	204
Iraq	-	-	++	38
USA	-	-	++	13
Nepal	-	-	++	6
Fiji	-	-	++	2
Australia	++	1037	-	-
Yemen	++	37	-	-
Sri Lanka	++	7	-	-
Other countries	++	1	-	-

Figures rounded off

Table-7: Exports of Cadmium Wrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2	225	-	-
Bangladesh	2	225	-	-

Figures rounded off

Table-8: Exports of Cadmium & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	18	2241	21	769
Bangladesh	18	2222	21	467
UAE	++	16	++	131
Saudi Arabia	-	-	++	87
Oman	-	-	++	31
Yemen	-	-	++	29
Egypt	-	-	++	24
Bhutan	++	2	-	-
Qatar	++	1	-	-
UK	++	++	-	-

Figures rounded off

Table-9: Exports of Cadmium: Unwrought, Powders

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	156	19775	17	2456
Bangladesh	3	376	14	1814
Turkey	-	-	3	603
Qatar	-	-	++	31
Jordan	-	-	++	8
China	143	16973	-	-
Pakistan	10	2195	-	-
Yemen	++	128	-	-
UAE	++	84	-	-
Nepal	++	19	-	-

Figures rounded off

Imports

The imports of cadmium also decreased by 5% to 7,570 tonnes in 2020-21 from 7,999 tonnes in the previous year. Imports of cadmium was mainly from China (27%), Japan(17%), Korea Rep of (12%), Belgium (6%), Uzbekistan (5%), Hong Kong, Peru & UAE (4% each). Imports of cadmium (including waste & scrap) decreased by 19% to 8,249 tonnes in 2020-21 from 9,640 tonnes in the year 2020-21. The imports also comprised 7,570 tonnes of unwrought & powders and 679 tonnes of cadmium & scrap besides less than one tonnes of cadmium & alloys in 2020-21 (Tables- 10 to 14) Fig 2.

Table-10: Imports of Cadmium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7999	1490921	7570	1224090
China	1988	375093	2025	348870
Japan	747	141736	1271	202576
Korea, Rep.of	909	177007	890	137018
Belgium	224	43857	473	66157
Hong Kong	592	109667	295	57388
Uzbekistan	71	12430	370	53051
Peru	615	112535	320	52128
UK	291	56250	252	47573
Bulgaria	197	36640	264	43187
UAE	955	164528	284	42027
Other countries	1410	261178	1126	174115

Figures rounded off

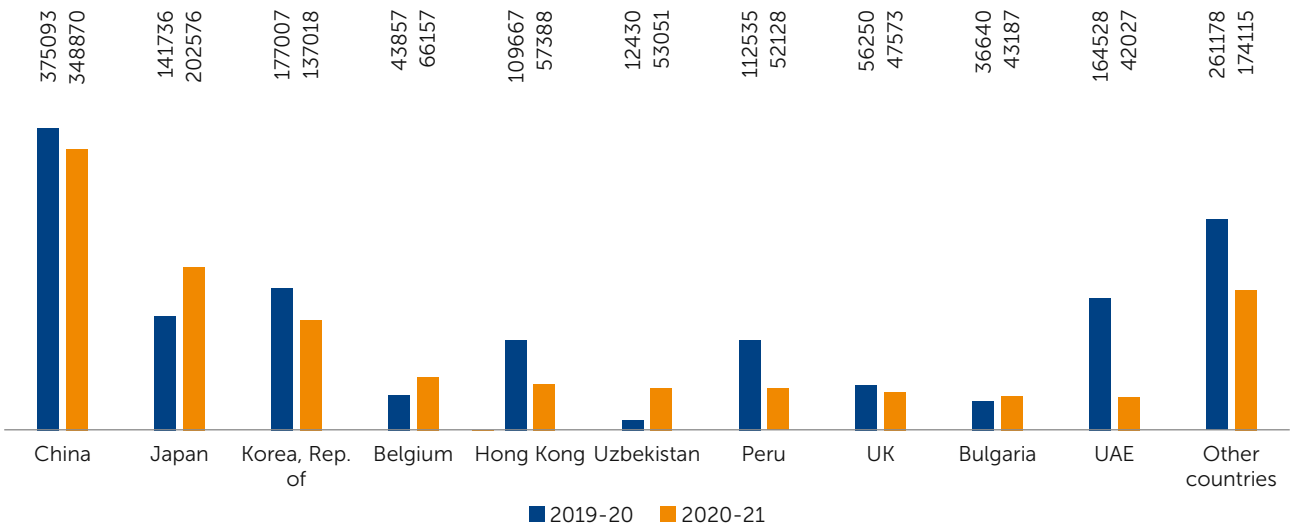


Fig 2: Country wise Value of Import of Cadmium

Table-11: Imports of Cadmium (Including Waste & Scrap)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**9640**	**1787948**	**8249**	**1338734**
China	2401	452323	2107	365126
Japan	1284	242994	1408	226999
Korea	1262	246354	1190	183652
Belgium	224	43857	473	66157
Hong Kong	654	117207	295	57388
Uzbekistan	71	12430	370	53051
Peru	675	124280	320	52128
UK	291	56250	252	47573
Bulgaria	197	36640	264	43187
UAE	955	164528	284	42027
Other countries	1626	291085	1286	201446

Figures rounded off

Table-12: Imports of Cadmium & Alloys

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4**	**1159**	**++**	**17**
Germany	++	50	++	17
China	4	642	-	-
Hong Kong	++	295	-	-
USA	++	170	-	-
UK	++	2	-	-

Figures rounded off

Table-13: Imports of Cadmium: Unwrought, Powders

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**7995**	**1489762**	**7570**	**1224073**
China	1984	374451	2025	348870
Japan	747	141736	1271	202576
Korea, Rep. of	909	177007	890	137018
Belgium	224	43857	473	66157
Hong Kong	592	109372	295	57388
Uzbekistan	71	12430	370	53051
Peru	615	112535	320	52128
UK	291	56248	252	47573
Bulgaria	197	36640	264	43187
UAE	955	164528	284	42027
Other countries	1410	260958	1126	174098

Figures rounded off

Table-14: Imports of Cadmium & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1641	297027	679	114644
Korea	353	69347	300	46634
Japan	537	101258	137	24423
Russia	-	-	102	17150
China	413	77230	82	16256
USA	20	4331	38	5524
Australia	-	-	20	3011
Canada	++	1882	++	1646
Brazil	147	13434	-	-
Peru	60	11745	-	-
Kazakhstan	49	10260	-	-
Other countries	62	7540	++	++

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.

Cadmium 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	Nil	>1
(million tonnes) Total reserves/ resources of cobalt in terms of ore as on 1st April 2020	Exports of cobalt ores & concentrates in 2020-21	(tonnes) Imports of cobalt ores and concentrate in 2020-21

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 0.08-0.15% Co along with 1.5-4% 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 remaing 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 Resources
	Total	Measured	Indicated	Inferred	Reconnaissance	Total	(A+B)
	(A)	STD331	STD332	STD333	STD334	(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 "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 cycle life 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, electric 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 hydroformylation catalysts.

RECYCLING

Recycling technologies for recovery of cobalt especially from waste Li-ion batteries have been an evolving process. The need for technologies which can recover valuable metals and the commercialisation of that technology by the industry is highly desirable. The technology related to "Recovery of cobalt from Li-ion batteries of mobile phones" developed by National Metallurgical Laboratory (NML), Jamshedpur, reportedly claims up to 95% recovery of pure cobalt from Li-ion batteries. Considering the need and significance of the problem related to energy materials like Ni and Co, CSIR-IMMT has developed suitable process flow sheets for the processing of secondary resources, such as, alloy scrap and spent catalyst to produce Ni/Co based precursor material that can be used for battery applications perticularly in preparing electrodes of Li-ion batteries. In addition to this CSIR-IMMT has taken up another project from MIDHANI to produce high purity cobalt metal from impure cobalt hydroxide.

The Mobility Mission held consultations with industry to develop battery recycling as a sustainable method for ensuring up to 95% recovery of critical minerals, such as, lithium, nickel, cobalt etc. from spent batteries, thereby ensuring regular supply of raw materials for battery maintenance.

TRADE POLICY

As per the Foreign Trade Policy 2015-2020, 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 are restricted.

WORLD REVIEW

The world cobalt reserves are estimated at 7.6 million tonnes of cobalt metal content. Cobalt reserves are mainly in the Congo (Kinshasa) which contributes (46%) to the total reserves followed by Australia (18%). Besides, major reserves are also located in Cuba (7%), Philippines , Russia and 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)	7600000
Australia	1400000[a]
Canada	220000
China	80000
Congo (Kinshasa)	3500000
Cuba	500000
Madagascar	100000
Morocco	13000
Papua New Guinea	47000
Philippines	260000
Russia	250000
Indonesia	600000
USA	69000
Other countries	610000

Source: USGS Mineral Commodity Summaries, 2022

[a]: For Australia, Joint Ore Reserves Committee-compliant reserves were 5,60,000 tonnes.

The world mine production of cobalt in terms of metal content increased by 2.4% to 126 thousand tonnes in 2020 as compared to 123 thousand tonnes in the preceding year. The Democratic People's Republic of Congo (DRC) was the principal producer contributing about (68%) which is followed by Russia (5%), Australia & Cuba (4% each), Philippines & Canada (3%). (Table-3) Fig1.

Table-3: World Mine Production of Cobalt

(By Principal Countries)

(In tonnes of metal content)

Country	2018	2019	2020
World:Total (rounded off)	154000	123000	126000
Congo, Dem. P.R.	109402	77964	85856
Philippines	5400	6700	3600
Australia[b]	5616	5693	5632
Russia	5450	5500	5700
Cuba	5000	5200	5500
Canada	5608	5132	4279
Madagascar	2890	2947	963
Papua New Guinea	3275	2915	2941
Morocco[c]	1806	2397	2416
Other countries	9846	8705	9489

Source: BGS, World Mineral Production, 2016-20

[b]:Years ended 30 June of that stated: ,

[c]:Metal and/refined

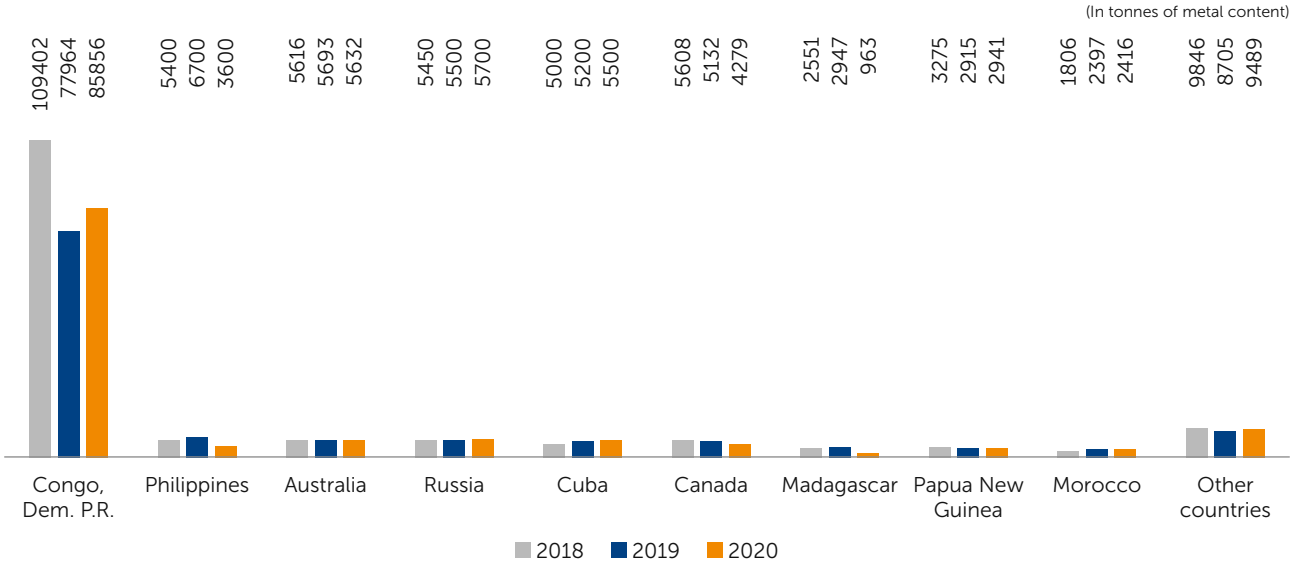


Fig 1: Country wise production of Cobalt

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 sulfates. 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 its 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-cobalt concentrate 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 sulfide 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

During 2020-21, nil cobalt ores & concentrates were exported as compared to 2 tonnes in the preceding year.

Exports of cobalt and alloys including waste and scrap increased exponentially by 224% to 340 tonnes in 2020-21 from 105 tonnes in the previous year. Exports were mainly to Korea (74%), USA (17%) and China (4% each). Out of the total exports in 2020-21, exports of cobalt and alloys were at 340 tonnes and those of cobalt & scrap were at negligible. Similarly, during 2020-21 exports of cobalt powder were at 137 tonnes and that of cobalt (other articles) were at 149 tonnes. (Tables- 4 to 10)

Table-4: Exports of Cobalt Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2	9478	-	-
UAE	2	9478	-	-

Figures rounded off

Table-5: Exports of Cobalt & Alloys (Including Waste and Scrap)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	105	220380	340	364327
USA	14	47850	59	202658
Korea	++	39	252	55551
China	++	1218	15	38392
UAE	24	59027	3	21129
Switzerland	++	6622	2	12084
UK	39	38847	2	8905
Finland	10	9237	2	8883
France	++	2437	1	4006
Belgium	++	996	1	2580
Germany	3	6355	1	2495
Other countries	15	47752	2	7644

Figures rounded off

Table-6: Exports of Cobalt & Alloys

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	87	199965	340	364006
USA	14	47325	59	202658
Korea	++	39	252	55551
China	++	1218	15	38392
UAE	24	59027	3	21129
Switzerland	++	6622	2	12084
Finland	10	9237	2	8883
UK	23	21409	2	8840
France	++	2437	1	4006
Belgium	++	996	1	2580
Germany	1	3903	1	2495
Other countries	15	47752	2	7388

Figures rounded off

Table-7: Exports of Cobalt & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	18	20415	++	321
Vietnam	-	-	++	256
UK	16	17438	++	65
Germany	2	2452	-	-
USA	++	525	-	-

Figures rounded off

Table-8: Exports of Cobalt Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2	12909	137	59805
Korea	-	-	134	41019
UAE	++	10	3	18340
UK	++	463	++	190
Saudi Arabia	-	-	++	179
Turkey	-	-	++	77
USA	2	12282	-	-
Egypt	++	87	-	-
Bhutan	++	57	-	-
Czech Republic	++	10	-	-

Figures rounded off

Table-9: Exports of Cobalt (Other Articles)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	61	128382	149	127944
USA	12	35043	19	63709
Korea	-	-	118	14532
Switzerland	++	6570	2	12084
Finland	10	9237	2	8883
UK	23	20946	2	8650
France	++	2437	1	4006
UAE	++	473	++	2789
Belgium	++	996	1	2580
Germany	1	3903	1	2495
Netherlands	10	19505	++	2082
Other countries	5	29272	3	6134

Figures rounded off

Table-10: Exports of Cobalt Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	24	58674	54	176257
USA	-	-	40	138949
China	-	-	14	37305
Morocco	-	-	++	3
UAE	24	58544	-	-
Switzerland	++	52	-	-
Botswana	++	39	-	-
Korea	++	39	-	-

Figures rounded off

Imports

During the period 2020-21, less than one tonnes of cobalt ores and concentrate were imported, while it was only two tonne in the previous year.

Imports of cobalt & alloys including waste and scrap decreased by 38% to 802 tonnes in 2020-21 from 1294 tonnes in the previous year. Imports in 2020-21 were mainly from Netherlands (21%), USA (13%), Japan & Belgium (12% each), China (11%) and UK (9%). Out of the total imports in 2020-21, imports of cobalt & alloys were at 802 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 237 tonnes, 343 tonnes and 222 tonnes, respectively (Tables - 11 to 17).

Table-11: Imports of Cobalt & Alloys (Including Waste & Scrap)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1294	4216990	802	2898721
USA	92	409471	106	563955
Netherlands	287	711267	171	421470
UK	78	638092	69	396203
Japan	155	413054	96	281460
Belgium	110	315099	100	277313
China	304	782718	85	241056
Germany	9	136035	9	178290
France	8	166835	8	100585
Norway	3	6751	26	67271
Bahamas	85	202878	25	60736
Other countries	163	434790	107	310382

Figures rounded off

Table-12: Imports of Cobalt Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	333	996721	237	722141
Belgium	55	178727	67	203912
Japan	28	108573	33	111860
China	38	109302	29	83490
Australia	56	134431	20	54981
UK	2	9463	15	53737
USA	28	105980	16	41581
Netherlands	43	113666	14	34252
Turkey	17	48250	12	33692
South Africa	9	24326	10	31128
Finland	42	104789	10	28304
Other countries	15	59214	11	45204

Figures rounded off

Table-13: Imports of Cobalt (Other Articles)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	284	1606752	343	1612473
USA	64	301987	81	495573
UK	72	617393	54	341609
Netherlands	1	3142	85	221054
Germany	5	114642	8	170462
China	37	140982	27	75267
France	4	148800	1	70393
Norway	-	-	26	67271
Japan	18	56731	22	65295
Brazil	-	-	15	33605
Belgium	55	134675	12	30399
Other countries	28	88400	12	41545

Figures rounded off

Table-14: Imports of Cobalt (Unwrought)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	677	1613517	222	564100
Netherlands	243	594459	72	166164
Japan	109	247750	41	104305
China	229	532434	29	82299
Bahamas	85	202878	25	60736
Belgium	++	1697	21	43002
UAE	-	-	13	41548
Singapore	-	-	10	28276
USA	++	1504	9	26794
France	++	1349	++	4966
Morocco	3	6449	2	4878
Other countries	8	24997	++	1132

Figures rounded off

Table-15: Imports of Cobalt & Alloys

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1294	4216990	802	2898714
USA	92	409471	106	563948
Netherlands	287	711267	171	421470
UK	78	638092	69	396203
Japan	155	413054	96	281460
Belgium	110	315099	100	277313
China	304	782718	85	241056
Germany	9	136035	9	178290
France	8	166835	8	100585
Norway	3	6751	26	67271
Bahamas	85	202878	25	60736
Other countries	163	434790	107	310382

Figures rounded off

Table-16: Imports of Cobalt & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	-	-	++	7
USA	-	-	++	7

Figures rounded off

Table-17: Imports of Cobalt ore & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2	9253	++	325
UK	2	9083	++	325
Canada	++	156	-	-
USA	++	14	-	-

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 in 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. Increases 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

3.38
(million tonnes) Production of copper ore in 2020-21

82,463
(tonnes) Exports of copper ores & concentrates in 2020-21

4,15,136
(tonnes) Imports of copper ores & concentrates in 2020-21

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 Jharkhand with 251 million tonnes (15.14%) and Madhya Pradesh with 387 million tonnes (23.28%). 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)

Unit: '000 tonnes

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	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
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

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
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
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 3.38 million tonnes in 2020-21 decreased by 14% as compared to that in the previous year.

The metal content in the ore produced in 2020-21 works out to 26,462 tonnes as against 29,502 tonnes in 2019-20. During the year under review, 3.44 million tonnes of ore were treated for obtaining copper concentrates as against 3.88 million tonnes in 2019-20 (Tables 2 to 4).

Table-2: Principal Producer of Copper Concentrates, 2020-21

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

Table-3: Production of Copper Ore, 2019-20 and 2020-21

(By States)

(In tonnes)

State	2019-20			2020-21 (p)		
	Ore Produced	Cu%	Metal Content	Ore Produced	Cu%	Metal Content
India	3952472	0.75	29502	3377850	0.78	26462
Jharkhand	288477	0.78	2247	41772	0.72	301
Madhya Pradesh	2544472	0.69	17526	2344087	0.76	17889
Rajasthan	1119523	0.87	9729	991991	0.83	8272

(p): Provisional

Table-4: Copper Ore Treated, 2019-20 and 2020-21

(By States)

(In tonnes)

State	2019-20			2020-21 (p)		
	Ore Produced	Cu%	Metal Content	Ore Produced	Cu%	Metal Content
India	3879453	0.75	29042	3439116	0.77	26413
Jharkhand	269568	0.78	2099	47291	0.61	287
Madhya Pradesh	2479185	0.69	17106	2384025	0.75	17810
Rajasthan	1130700	0.87	9837	1007800	0.83	8316

(p): Provisional

Production of copper concentrates at 1,08,719 tonnes in 2020-21 decreased by about 13% as compared to that in the previous year. Madhya Pradesh was the leading producer State of copper concentrates accounting for about 60% of the production during 2020-21, followed by Rajasthan with 39% and Jharkhand with 1 per cent. The number of reporting mines was five in both the years, i.e., 2019-20 and 2020-21 (Tables 5 & 6).

Table-5: Production of Copper Concentrates, 2018-19 to 2020-21

(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2018-19		2019-20		2020-21 (p)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	143668	8846151	124586	8448405	108719	8633968
Jharkhand	6594	529620	7660	604135	1209	23707
Madhya Pradesh	70999	4000290	65094	4750125	64920	5238309
Rajasthan	66075	4316241	51832	3094145	42590	3371952

(p): Provisional

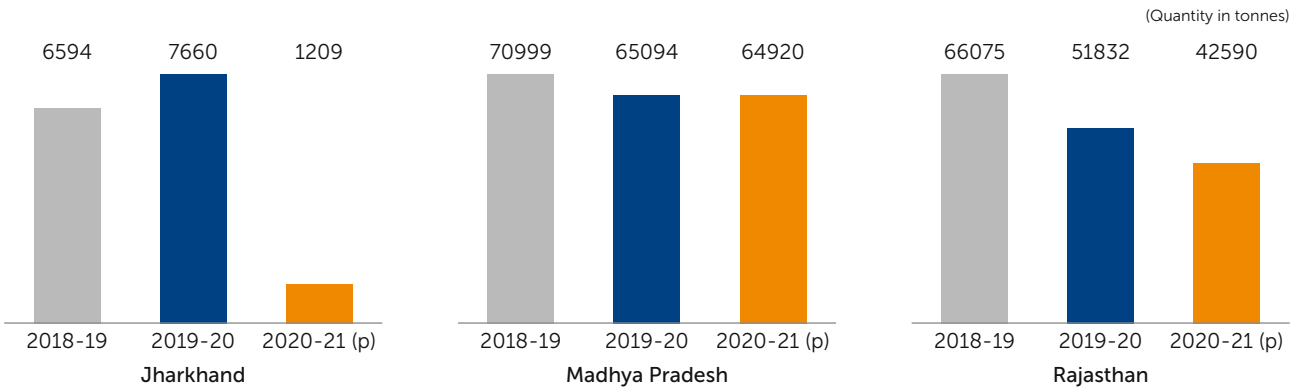


Fig 1: Production of Copper Concentrates, 2018-19 to 2020-21
(By States)

Table-6: Production of Copper Concentrates, 2019-20 and 2020-21

(By Sector/States/Districts)

(Quantity in tonnes; Value in ₹ '000)

State/District	No. of mines	2019-20		No. of mines	2020-21 (p)	
		Quantity	Value		Quantity	Value
India	5	124586	8448405	5	108719	8633968
Public Sector	5	124586	8448405	5	108719	8633968
Jharkhand	2	7660	604135	2	1209	23707
Singhbhum (East)	2	7660	604135	2	1209	23707
Madhya Pradesh	1	65094	4750125	1	64920	5238309
Balaghat	1	65094	4750125	1	64920	5238309
Rajasthan	2	51832	3094145	2	42590	3371952
Jhunjhunu	2	51832	3094145	2	42590	3371952

(p): Provisional

Grade Analysis

During the year 2020-21, the average copper content in the ore produced was 0.78% Cu as against 0.75% in the previous year. All India average metal content of ore treated during the year works out to 0.77% Cu and 0.75% Cu for 2020-21 and 2019-20, respectively. The copper content in the ore treated varies from State to State. The average metal content in the concentrate produced works out to 23.20% Cu in 2020-21 as against 22.87% Cu in the previous year.

The average daily employment of labour in copper mines in 2020-21 was 2,766 as against 3,928 in the preceding year.

Copper Metal

Hindustan Copper Ltd produces copper metal from the ore produced at their captive mines. Vedanta Limited formerly known as Sterlite Industries (India) Ltd and Hindalco Industries Ltd produce copper metal from imported copper concentrates (Table 7).

Table-7: Producers of Copper Metal, 2020-21

Name and address of the producer

Location	State	District
Hindustan Copper Ltd, Tamra Bhavan, II, 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
Vedanta Ltd,	Tamil Nadu	Thoothukudi
Sesa Ghor, 20 EDC Complex, Patto, Panaji - 403 001, Goa.	Dadra & Nagar Haveli	Chinchpada (Silvassa)

There is nil production of copper blister in 2020-21 and copper continuous cast wire rods registered a decrease of 2% only in 2020-21 as compared to the previous year. The production of copper cathodes decreased by 11%. Production of copper electrolytic wire bars was not reported for more than seven years (Tables-8 to 11). Prices of copper are furnished in the General Review on 'Prices'.

Table-8: Production of Copper Metal, 2018-19 to 2020-21

(In tonnes)

Year	Copper Blister	Copper Cathodes	Copper Electrolytic Wirebars	Copper CCWR
2018-19	13293	454337	--	354146
2019-20	3997	408003	--	349475
2020-21(p)	0	363609	--	341563

(p): Provisional

Table-9: Production of Copper (Blister), 2019-20 and 2020-21

(By State/Plant)

(Quantity in tonnes)

State	Plant	2019-20		2020-21(p)	
		Quantity	Value	Quantity	Value
India		3997	N.A.	0	N.A.
Jharkhand	Surda ICC	3997	N.A.	0	N.A.

(p): Provisional

Table-10: Production of Copper (CCWR), 2019-20 and 2020-21

(By States/Plants)

(Quantity in tonnes ;Value in ₹'000)

State	Plant	2019-20		2020-21(p)	
		Quantity	Value	Quantity	Value
India		349475	155090811	341563	188445400
Gujarat	Hindalco	245108	108804500	219171	122004100
Maharashtra	HCL Taloja	4153	1884911	0	0
Tamil Nadu	Vedanta Ltd	0	0	0	0
D & N Haveli	Vedanta Ltd	100214	44401400	122392	66441300

(p): Provisional

Table-11: Production of Copper (Cathodes), 2019-20 and 2020-21

(By States/Plants)

(Quantity in tonnes ;Value in ₹'000)

State	Plant	2019-20		2020-21(p)	
		Quantity	Value	Quantity	Value
India		408003	176011710	363609	190616200
Gujarat	Hindalco	325567	139788500	262174	136047000
Jharkhand	Surda ICC	4948	2225010	0	0
Tamil Nadu	Vedanta Ltd	0	0	0	0
D & N Haveli	Vedanta Ltd	77488	33998200	101435	54569200

(p): Provisional

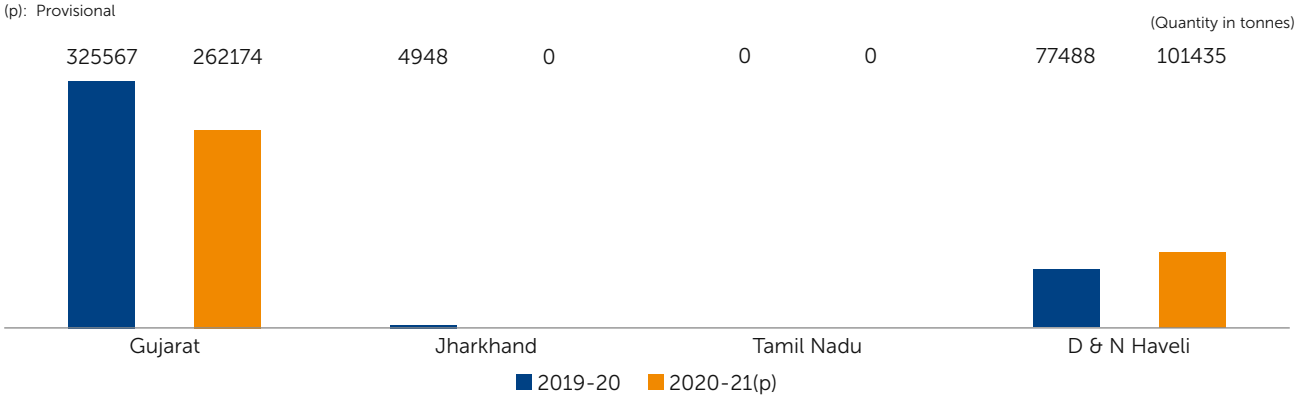


Fig 2: Production of Copper (Cathodes), 2019-20 and 2020-21

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.

Malanjkhand Copper Project (MCP) is the largest copper ore producing mine with 2.0 million tonnes production capacity per year. Khetri Copper Complex and Indian Copper Complex have production capacities 3.0 and 4.35 million tonnes per annum, respectively.

Hindustan Copper Ltd

Khetri Copper Complex (KCC), Khetrinagar, Jhunjhunu District, Rajasthan

The operation unit at Khetri Copper Complex (KCC) comprises two underground mines, namely, Khetri mine & Kolihan mine and one beneficiation plant. Earlier, KCC also had smelting and refining facility. But owing to economic consideration, the Company had to suspend this operation w.e.f. December 2008. Mining methods adopted in Khetri and Kolihan underground mines of HCL are sub-level open stoping and blasthole stoping. In sub-level open stoping, sub-levels are developed at vertical intervals of 20 to 25 m and a crown level is developed 15 m below upper main level. Sub-level open stoping method has two variations, namely, longitudinal stoping and transverse stoping. Longitudinal stoping is adopted where the thickness of the orebody is small to moderate. In this method, an extraction drive is developed from the main footwall drive at extraction level and a trough drive is developed in the orebody along the strike. Draw points at 9-m interval are also developed from extraction drive connecting the trough drive. A slot raise is made from the main level to top of the ore block to be extracted. Slot crosscuts are made in the sub-levels and extraction level. The slot crosscut exposes the orebody from hangwall to the footwall. Parallel holes are drilled (115 mm or 57 mm diameter depending on the orebody width) in the slot crosscut and are blasted against the pre-face of the slot raise. This provides an opening throughout the height of the ore covering the entire width of the orebody. Rings of holes, drilled in the trough drive and sub-levels are blasted against pre-face of the slot. The broken ore falls into the trough where it is loaded into the track mounted Gran-By Cars by loading equipment, such as, LHD and Loaders.

In transverse stoping, the basic design remains the same. But the development is done across the orebody and stoping advances from hangwall to the footwall. Slot drive is developed along the strike.

Another mining method used is blasthole stoping method, wherein, a drill level is prepared between two main levels leaving a crown pillar of 9 to 15 m. Slot raise, slot, stope and rib pillar are drilled by Cubex 165 mm diameter machine. Trough, sill and crown pillar drilling are done by drifter machine. Sequence of blasting remains the same as in the sub-level open stoping method.

The proposed expansion of Khetri and Kolihan mine and development of Banwas deposit will increase ore production from the existing 1.1 to 5.0 million tonnes per annum in two phases. Mine-wise status is described below:

At Kolihan mine, environmental clearance for shaft sinking & creation of ore handling facilities below 0 mRL (meter reduced level) to augment the production capacity to 1.5 MTPA was obtained on 2.2.2015. To establish the ore bodies at depth, 1,650 m of Diamond drilling work was undertaken. In 2019-20, a total of 308.4 m of drilling have been completed. Further drilling has been undertaken to establish mineralisation corresponding to (-) 120 mRL and 6,298 meter of surface exploratory drilling have been completed in 2019 -20. Further drilling is in progress. After proving of continuity of ore body in depth, proposal will be undertaken.

At Khetri mine, contract was awarded during 2011-12 to augment ore production capacity of Khetri mine from 0.5 MTPA to 1.5 MTPA under Phase II through deepening of existing shaft and other related activities. However, during execution of the contract, the work was badly affected at the initial stage due to extremely bad ground / fault zone encountered while making approach cross cut to reach below the existing Production Shaft area for setting up winding arrangement for sinking of shaft further. Despite many efforts made by the contractor the problem persisted and finally the contract was terminated in January, 2017 as per terms and conditions of the contract.

At Banwas Mine, mine construction work got completed in February, 2017. The Company has appointed contractual agency for ore production, the contractual agency has produced 2,43,942 tonnes of ore in FY 2019-20 and the target production ramp will be achieved by 2023-24.

Indian Copper Complex (ICC), Ghatsila, East Singhbhum District, Jharkhand

The Indian Copper Complex (ICC) comprises mines, beneficiation plant and smelting & refining facility. Surda is one of the several copper deposits which has been mined since ancient time and it lies along the shear zone. The orebody of the mine has a strike length of 2.2 km and is currently at a maximum depth of 450 m. The width of the orebody varies from a few metres up to 60 m in thickness as the copper mineralisation occurs in pinches and swells. Most of the mining is done by using horizontal cut-and-fill method. The extraction of ore, i.e., cut takes place by drilling and blasting which leaves void that needs to be filled with tailings to provide for platform so that mining activity could be taken up further to the next cut-up.

The Plan envisages increase in the depth of the mine and enhancement of production capacity from 0.4 million tonnes per annum to 1.0 million tonnes per annum. On 19-20 September 2016, Expert Appraisal Committee of Ministry of Environment, Forest and Climate Change (MoEFCC) has recommended the proposal for Environment Clearance subject to clarification regarding forest clearance for forest land involved in underground mining. Matter is under scrutiny at Forest Clearance Division of MoEFCC & Department of Mines & Geology, Government of Jharkhand.

The Company initiated action to re-open closed mines at Singhbhum Copper Belt of ICC, namely, Kendadih and Rakha mines to produce 0.21 million tonnes and 2.5 million tonnes of ore per annum, respectively. Mine-wise status is furnished as below:

Kendadih mine was re-opened in December, 2017 after all the mine-related equipping work including mine dewatering was completed. Mine development work is in progress. Equipment were mobilised in a phased manner and mine had production of 43,200 MT of ore during 2019-20 was to have been treated in Mosaboni Concentrator Plant.

At Rakha mine, considering the change in market scenario, the Company proposes to implement the project through an EPC route and has plans to augment production capacity to 1.5 MTPA of ore by reopening and expanding the closed Rakha mine. Environmental Clearance of Rakha mining lease was obtained on 1.8.2014 and Stage-II Forest Clearance for the project has been obtained on 15.9.2016.

Chapri-Sideshwar mine falls within the Rakha and Kedadih mining lease area. All mine plans and schedules were updated. The EC and Stage II FC for Kendadih was obtained in the year 2015 and 2017, respectively. Tender floated by the Company for mine development and production from Chapri mine was discharged despite several attempts due to high price quoted by bidders and poor response. In view of this, the Company is exploring to engage contractor through MDO (Mine Developer-cum-Operator) route for re-opening and expansion of Rakha Copper Mine. Development of a new underground mine at Chapri-Sideshwar and erection & commissioning of a new Concentrator Plant at ICC is in progress and the process of floating tender for engagement of MDO agency is underway. Meanwhile, surface exploratory drilling has been undertaken at Chapri Block of Rakha Mining Lease and 5,243.5 m of drilling has been done during the year 2019-20. The Company envisages augmentation of ore production capacity in 1st phase to 12.2 MTPA by 2028-29 in stages. The Company will take up enhancement of ore production capacity to 20.2 MTPA in 2nd phase after successful completion of 12.2 million tonnes per annum capacity plan.

Malanjkhand Copper Project (MCP), Malanjkhand, Balaghat District, Madhya Pradesh

MCP has the largest copper ore producing open-pit mechanised mine in the country with an annual capacity to produce 2 million tonnes ore along with a matching concentrator plant. Prominent deposits in MCP are Malanjkhand, Shitalpani, Gidhri Dhorli, Jatta and Garhi Dongri. Currently, this mine contributes to around 64% of HCL's copper production. The deposit is estimated at average grade of 1.31% Cu with 0.45% cut-off grade. The strike length of the deposit is 2.6 km in North-South direction with a dip of 650 to 750 towards the East and the average width is 70/75 m. Mining is carried out by deployment of large capacity electric rope shovels having 10 m3 bucket capacity and hydraulic excavators having 5/10 m3 bucket capacity in combination with 60, 85 and 100 tonnes capacity dumpers. The bench height and diameter of blastholes are 12 m and 165 mm, respectively. Site Mixed Slurry explosives are used for primary blasting and Cartridge explosives are used for secondary/pre-split blasting.

At Malanjkhand Copper Project, work is under progress to expand the production capacity of Malanjkhand mine from present 2 million tonnes per annum to 5 million tonnes per annum (2nd phase to 8 million tonnes per annum by FY 23-24) by developing an underground mine below the existing open-cast mine at an estimated cost of ₹1,856.74 crore (up to ₹2,900 crore in 2nd phase). All the approval are in place, Environment Clearance and approval of National Board for Wild Life have been obtained in 2014-15 and EPC contractor for implementation of the project has been appointed and a contract for ore production from developing underground mine through decline has been awarded in July, 2019 and it is expected that production will commence in 2020-21. Sinking of Service Shaft (665.5 m) and Production Shaft (693.6 m) have been completed during May, 2018 and October, 2018, respectively. The development work of North Decline and South Decline has been completed up to 2,975 m and 2,103 m respectively. The development work of North and South Ventilation shaft has been completed up to 372 m and 475 m respectively.

Extraction of Minerals from Copper Ore Tails (MP):

The Company is in advance stage of erection of Copper Ore Tailing (COT) recovery facility of capacity 3.3 million tonnes per annum that which would enable to recover the valuable metals and minerals from the tailing and reduce the mass in the existing tailing storage facility (TSF) so as to extend active life of TSF and unlock the value in the waste / Tailing at Malanjkhand Copper Project (MCP). The project besides generating additional revenue to the Company will also help to mitigate the risk to the environment. It is expected that the plant will be commissioned during the FY 2019-20.

SMELTING

HCL has two primary smelting & refining plants at KCC and ICC with installed capacity of cathode 31,000 tonnes and 20,500 tonnes per annum, respectively. However, due to economic considerations the Company suspended KCC's smelting and refinery operation from December 2008. HCL has one secondary copper smelter in Bharuc district, Gujarat is capable of producing 50,000 tonnes per annum of copper cathode conforming to LME-A grade. 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.

Apart from HCL, two other major players dominate the Indian Copper Industry, namely, Hindalco and Sterlite Industries which are under the Private Sector. Hindalco at Dahej in Gujarat and Sterlite Industries in Thoothukudi in Tamil Nadu 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 with annual production capacity of 500 thousand tonnes and 400 thousand tonnes, respectively. Besides, there are a few small companies which produce Electrowon copper but their capacities are very low and production is inconsistent.

The total installed capacity of copper smelter in the country is one million tonne per annum. Details regarding capacity of copper smelter are reflected in Table-12. Company-wise details of copper smelters and refineries are given below:

Table-12: Capacity of Copper Smelters

(Quantity in '000 tonnes)

	Smelter/Location		Annual Capacity
	Total		1001.5
1	Hindustan Copper Ltd		51.5
	Khetri Copper Complex, Distt. Jhunjhunu, Rajasthan.	31	
	Indian Copper Complex, Distt. East Singhbhum, Jharkhand.	20.5	
2	Sterlite Industries (India) Ltd, Thoothukudi, Tamil Nadu.		400
3	Hindalco Industries Ltd Dahej, Distt. Bharuch, Gujarat.		500
4	Hindustan copper Ltd (Formerly Jhagadia Copper Ltd), Distt. Bharuch, Gujarat.		50

1. Hindustan Copper Ltd

a) Khetri Copper Complex (KCC)

The KCC smelter, located at Khetri in Jhunjhunu district, Rajasthan, had a capacity of 31,000 tonnes refined copper per annum. In addition, KCC has sulphuric acid and phosphatic fertilizer plant facilities. KCC's smelter halted its operations due to economic considerations since December, 2008.

Operations of Khetri concentrator plant during the year was affected due to acute water shortage. Action to ensure supply of water from Kumbharam project of Government of Rajasthan has been taken in addition to ensuring intake of water from extra bore well.

b) Indian Copper Complex (ICC)

ICC has the smelting & refining facility of 20,500 tonnes per annum capacity. Smelter is located at Ghatsila, East Singhbhum district, Jharkhand. In addition, the Complex consists of 8,400 tonnes per annum wire bar casting plant, 54,000 tonnes per annum sulphuric acid plant and a brass rolling mill. There is also a precious metal recovery plant for recovery of gold, silver, selenium, tellurium, nickel sulphate, copper sulphate, etc. A pilot plant with a capacity to produce one tonne nickel cathodes per month was also set up at ICC. The plant is currently being scaled up to a production capacity of 5 tonnes per month of nickel cathodes. In 2019-20, copper cathode production at ICC was 4,948 tonnes. which is less by 64% as compared to 13,782 tonnes in the preceding year.

c) Gujarat Copper Project (GCP)/ Jhagadia Copper Ltd (formerly SWIL Ltd)

HCL has acquired the assets of Jhagadia Copper Ltd (renamed as GCP) situated at 747, Jhagadia Industrial Estate, Bharuch, Gujarat through Asset Reconstruction Company (India) Ltd (ARCIL) during April 2015. The plant is designed to produce 50,000 tonnes LME A-grade cathode through secondary route based on Outokumpu Technology AB (formerly Bolidewn Contech AB), Sweden.

Gujarat Copper Project of the Company consists of three units, namely, Anode Furnace (Smelter), Refinery and Kaldo Furnace valuing ₹27,214.50 lakh as on March 31, 2019. The Anode Furnace and Refinery unit has been commissioned in October 2016 while Kaldo unit is yet to be commissioned. Since commissioning, the Anode Furnace and Refinery units are being operated at a sub-optimal level for want of feedstock. GCP being a secondary smelter, the feedstock are copper scrap, copper blister, liberator cathode etc. The Company has not been able to source these materials in the required quantity resulting in sub-optimal operations.

d) Taloja Copper Project (TCP)

The plant with a capacity of 60,000 tonnes per annum continuous cast wire rods (CCWR) is located at Taloja in Maharashtra. It uses the SCR 2000 system of the world renowned South Wire Co., USA. It produces rods of 8 mm, 11 mm, 12.5 mm, 16 mm and 19.6 mm diameters and meets most precise standards conforming to ASTM B 49/2010 &/ or IS 12444/1988. The plant commenced commercial production in April 1991. The installed capacity could further be increased to 80,000 tonnes per annum in the future. The unit also undertakes tolling of cathodes.

e) Joint Venture with Chhattisgarh Copper Limited (CCL)

CCL was established on 21.05.2018 as a Joint Venture Company between Hindustan Copper Ltd and Chhattisgarh Mineral Development Corporation Ltd for exploration, mining and beneficiation of copper and its CCMDC associated minerals in the State of Chhattisgarh. The shareholding of HCL and CMDC is in the ratio of 74:26. CCL is a subsidiary company of HCL. After incorporation and examining the geological information available, the Company has identified two blocks, i.e. Bodal Block (21.7559 km) and Hiddar Block (about 28 sq. km located at District Rajnandgaon.The Company has submitted application for area reservation for above blocks in the month of July, 2018 to the Ministry of Mines & Govt. of Chhattisgarh.

During the year, HCL has not made any additional investment in its subsidiary viz. Chhattisgarh Copper Ltd (CCL). The total paid up capital of CCL as on 31.3.2020 is ₹0.25 lakh out of which 74% equity is held by HCL and remaining 26% is held by Chhattisgarh Mineral Development Corporation Ltd.

f) New Development

The Company has plans to set up a plant of capacity 1.0 lakh tonnes per annum to manufacture copper cathode

through cost-effective hydrometallurgy technology. The site of the project has been finalised and investment in the project is ₹3,025 crore. The investment proposal after approval of the Board has been sent to the Ministry of Mines to obtain CCEA approval. The proposal is under scrutiny of the Ministry.

The Company is in advance stage of erection of Copper Ore Tailing (COT) recovery facility of capacity 3.3 million tonnes per annum to recover the valuable metals and minerals from the tailing and reduce the mass in the existing tailing storage facility (TSF) so as to extend active life of TSF and unlock the value in the waste/Tailing at Malajkhand Copper Project(MCP). A contract has been awarded for the construction of the plant on EPC mode at a cost of ₹200 crore. It was expected that the plant would be commissioned by June, 2018.

Information in respect of Subsidiary, Associate and Joint Venture

During the year, HCL has invested ₹75 lakh in the equity shares of Khanij Bidesh India Ltd (KABIL), a JV company between NALCO, HCL and MECL incorporated on 8.8.2019 with the objective to identify, acquire, develop, process and make commercial use of strategic and other minerals in overseas locations for supply in India and boost "Make in India" campaign. The shareholding of NALCO, HCL and MECL in the JV Company is in the ratio of 40:30:30.

2. Sterlite Industries (India) Ltd

The Sterlite Industries (India) Ltd, a prominent Private Sector plant, has an installed smelter capacity of 4,00,000 tonnes per annum copper anodes and is located at Thoothukudi in coastal Tamil Nadu. It is based on 'Isasmelt' technology using imported concentrates. The Company is investing ₹3,300 crore for expansion to double its copper production capacity at the plant. After expansion the plant will be Asia's largest copper manufacturing facility in a single location. Sterlite copper has two units in Silvassa in the Union Territory of Dadra & Nagar Haveli where it operates two copper rods plants (one in Chinchpada and another in Piparia). Anodes from Thoothukudi are refined at Silvassa for domestic market. Besides copper, the Company also manufactures sulphuric acid, phosphoric acid, gold and silver as by-products. Sterlite Copper Plant at Thoothukudi has been closed since May, 2018 on State Govt. order.

3. Hindalco Industries Ltd (Birla Copper)

The Company with smelter facility located at Dahej, Bharuch district, Gujarat, has a capacity of 5,00,000 tpy. The smelter is based on Outokumpu technology. The cathodes produced are mostly used for production of continuous cast wire rods. In the process of extraction of copper metal, sulphuric acid, phosphoric acid, gold and silver are also recovered as by-products. The entire requirement of copper concentrates was met through imports from many countries, namely, Chile, Australia, Indonesia, Papua New Guinea, Peru, Canada, Saudi Arabia, etc.

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

The per capita consumption of copper in India during the year 2019-20 is at 0.5 kg which is very low in comparison to countries like Russia 3.3 kg, China 5.4 kg, USA 5.5 kg, Italy 8.9 kg and Germany 13.6 kg. The average per capita consumption of copper in developed nation works out to be 10 kg. India's per capita consumption is likely to be moderate and has many strides to cover so as to match that of China. 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 2020 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 2019-20, the imports of refined copper were more than the exports. The availability of refined copper increased from 4,98,710 tonnes in 2018-19 to 5,23,008 tonnes in 2019-20 (Table-13).

Table-13: Apparent Availability of Copper for Domestic Consumption

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

(Quantity in tonnes)

Item		2019-20
I)	Total Production* (Cathodes)	408003
II)	Total Imports (copper refined)	151964
III)	Total Exports (copper refined)	36959
IV)	Apparent Availability	523008

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 880 million tonnes of copper content. Chile has the largest share, accounting for about 23% of world reserves, followed by Peru (9%), Australia (11%) Russia (7%), Mexico & USA (6% each), Poland (4%) and China (3%), Congo (Kinshasa), Kazakhstan & Zambia (2% each). Remaining about 29% 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)	880000
Australia	93000
Canada	9800
China	26000
Chile	200000
Congo (Kinshasa)	31000
Germany	–
Indonesia	24000
Japan	–
Kazakhstan	20,000
Korea	–
Mexico	53000
Peru	77000
Poland	31000
Russia	62000
USA	48000
Zambia	21000
Other countries	180000

Source: USGS, Mineral Commodity Summaries, 2022,

(a): For Australia, Joint Ore Reserves Committee Compliant reserves were about 22 million tonnes.

The world mine production of copper remains same at 20.6 million tonnes of metal content in 2020 as compared to previous year. Chile continued to be the largest single producer of copper in 2020 with 28% share followed by Peru (10%), China (8%), Dem. Rep. of Congo (7%) and USA (6%) (Table-15).

Table-15: World Mine production of Copper

(By Principal Countries)

(In tonnes of metal content)

Country	2018	2019	2020
World Total	20600000	20600000	20600000
(rounded off)			
Chile	5831600	5787400	5733100
Peru	2437035	2455440	2150126
China	1615234	1683700	1723100
Congo, Dem. Rep. of	1225227	1420386	1587459
USA	1220000	1260000	1200000
Russia	870500	812400	924100
Australia	910896	925157	879522
Zambia	851089	797518	869061
Mexico	696580	713704	732863
Canada	548011	560781	584608
Other countries	4383048	4153202	4251834

Source: BGS, World Mineral Production, 2016-20.

As per BGS world refined copper production was 24.1 million tonnes in the year 2018 which showed an increase of 1.26% from 23.80 million tonnes in the previous year. China was the largest producer of refined copper with 9.78 million tonnes in the year 2019 (41% of world production) followed by Chile (9%), Japan 1.49 million tonnes (6%), Dem. Rep. of Congo 1.16 million tonnes (5%) and USA & Russia (4% each), etc.

In 2018, China accounted for 51% of world apparent consumption, which rose by 3% to a recoord high 24.4 million tonnes from 23.7 million tonnes in 2017 as per International copper Study Group (ICHG).

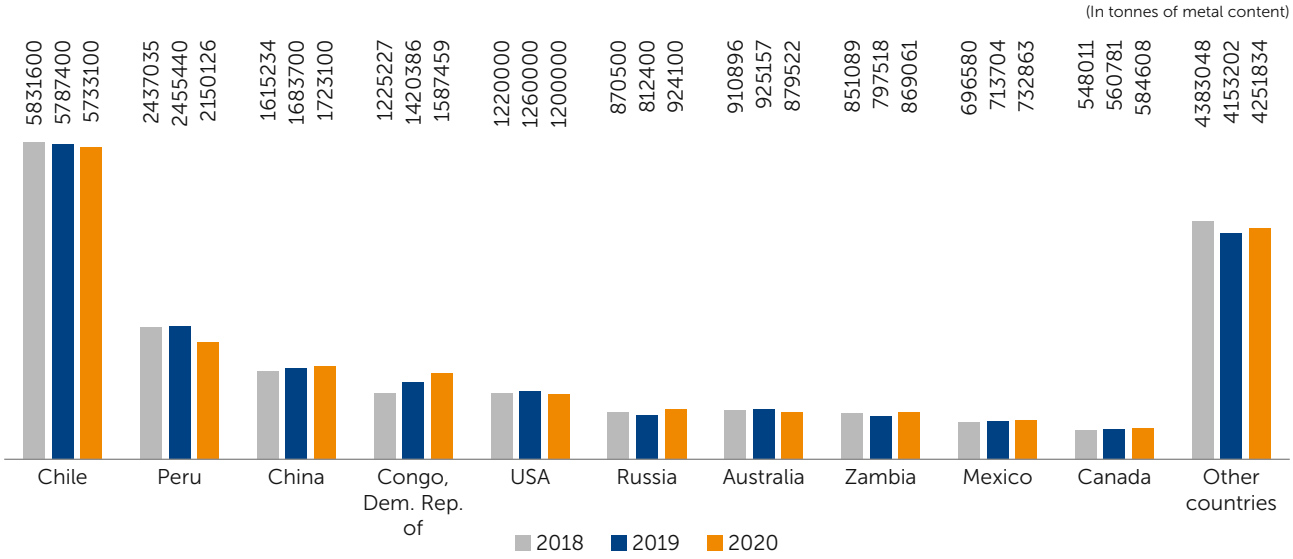


Fig 3: World Mine Production of Copper

Australia

Mineral copper production in Australia increased by 7% to 920000 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 months. 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 decreased 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 543,000 tonnes of copper from 595,000 tonne in 2017.The largest declines in production took place at the Sudbury complex (owned by Vale S.A.), where output decreas by 26,000 tonnes; at the Voisey's Bay Mine (Vale), by 7,800 tonne; and at the Gibraltar Mine, by 7,260 tonnes. Vale attributed the decreases at the Sudbury complex and the Voisey's Bay Mine to a strategic decision to deprioritize 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 tonnnes from 903,000 tonnes in 2017. At the Collahuasi Mine production was 559,000 tonnes in 2018, up by 7% from 524,000 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 Cobe de Chile (Codelco) operated 7 mines in the country, 3 of which were ranked among the 20 leadingglobal 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 400,000 tonnes, and Guangxi Nanguo Copper Co. completed a 300,000 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 12% to 1.23 million tonnes in 2018 from 1.09 million tonnes in 2017, and refined copper production rose by 15% to 953,000 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 a 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 150,000 tonnes in 2018 and was expected to increase by roughly 135,000 tonnes in 2019.

Indonesia

In December 2018, Freeport reached an agreement with the Government of Indonesia for an extension of the mining license at the Grasberg Mine (third-ranked) through 2031, which had been set to expire in 2021. The license 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 526,000 tonnes in 2018 from 446,000 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 300,000 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 446,000 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 956,000 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 426,000 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 854,000 tonnes from 794,000 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 39% to 82,463 tonnes during 2020-21 from 2,12,659 tonnes in 2019-20. The export were mainly to China (98%) followed by Rep. of Korea (2%). Exports of refined copper increased substantially by 23% to 88,359 tonnes in 2020-21 from 36,957 tonnes in 2019-20. Exports of refined copper were mainly to China (99%) and Bangladesh (1%). The total exports of copper & alloys (including brass & bronze) were at 2,09,332 tonnes in 2020-21 as against 1,41,010 tonnes in 2019-20. Export of copper (scrap) were at 7,290 tonnes in 2020-21 as against 7,736 tonnes in 2019-20 (Tables-16 to 32).

Table-16: Exports of Copper Ores & Conc.

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	212659	20450948	82463	7689376
China	159572	13723814	81060	7590259
Korea, Rep. of	3181	215992	1403	99117
Canada	--	--	++	++
Malaysia	28733	3792338	--	--
Taiwan	21046	2713968	--	--
Vietnam	109	3536	--	--
Thailand	18	1295	--	--
UK	++	2	--	--
USA	++	2	--	--
Australia	++	1	--	--

Table-17: Exports of Refined Copper

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	36957	15257396	88359	43312924
China	35516	14629645	87429	42824386
Bangladesh	1042	436308	509	281143
France	201	104079	123	73934
Hong Kong	24	9678	94	46837
Germany	--	--	98	40333
Thailand	++	50	45	21291
Malaysia	++	5	26	10795
Finland	--	--	9	4995
Nepal	14	5378	21	3738
Bhutan	++	343	1	977
Other Countries	160	71910	4	4495

Table-18: Exports of Copper & Alloys (Incl. Brass & Bronze) : Total

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	140857	60527102	209332	102064524
China	52403	18935979	138740	57637004
USA	19370	11091382	14536	12160651
UAE	6332	3270705	4664	2680903
Saudi Arabia	5143	1855274	3301	2232114
Korea, Rep. of	5197	886479	9679	2185298
UK	4884	2040595	2081	1887684
Germany	4192	1806984	1885	1608456
Qatar	3147	1386327	2690	1459572
Malaysia	1206	565288	2715	1366837
Nepal	3092	1382266	2710	1301752
Other Countries	35891	17305823	26331	17544253

Table-19: Exports of Copper (Scrap)

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7736	2777611	7290	2977834
China	2257	911846	2252	1172553
Korea, Rep. of	1048	281557	2953	938544
Japan	894	291003	634	246012
Malaysia	41	17819	432	223770
Spain	76	29876	555	217431
Germany	402	125086	95	40957
Taiwan	88	32275	109	40392
UAE	521	220712	88	34568
Italy	--	--	62	24104
Russia	--	--	50	17497
Other Countries	2409	867437	60	22006

Table-20: Exports of Copper & Alloys

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	81388	35989492	139540	67619065
China	40791	15168684	100047	44731757
USA	7930	5704049	7848	6306411
UAE	3770	1618762	2787	1546711
Qatar	2889	1275618	2501	1309383
Korea, Rep. of	3681	451579	6401	1128242
Nepal	2666	1169871	2025	1010269
Sri Lanka	971	430700	1709	942990
UK	1116	747377	945	820074
Saudi Arabia	1969	714286	1221	817185
Thailand	882	473273	1445	791623
Other Countries	14723	8235293	12611	8214420

Table 21: Exports of Brass & Bronze

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	50669	21447989	61018	30956169
China	9355	2855449	36171	11652944
USA	11421	5377055	6685	5853235
Saudi Arabia	3153	1132083	2080	1414865
UAE	2041	1431066	1739	1087478
UK	3718	1273734	1136	1067610
Indonesia	1359	870288	1316	914448
Germany	2352	957536	933	904192
Canada	326	262848	516	473011
Italy	1197	388198	528	417890
Netherlands	841	424746	464	396470
Other Countries	14906	6474986	9450	6774026

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

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty	Value	Qty	Value
	(t)	(₹'000)	(t)	(₹'000)
All Countries	**1064**	**312010**	**1484**	**511456**
Malaysia	439	121784	504	180003
Korea, Rep. of	348	97361	294	98250
China	--	--	270	79750
Spain	--	--	189	69627
Hong Kong	--	--	83	32957
Germany	175	58817	77	30869
UAE	++	165	50	12146
Taiwan	--	--	9	3413
Japan	2	682	6	2921
Nepal	1	360	1	380
Other Countries	99	32841	1	1140

Table 23: Exports of Copper & Alloys : Worked (Bars,Rods,Plates,etc)

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty	Value	Qty	Value
	(t)	(₹'000)	(t)	(₹'000)
All Countries	**8812**	**5462095**	**8547**	**5638560**
USA	1596	1116202	1541	1286505
UAE	1718	894988	1549	859494
Korea, Rep. of	94	75810	685	385456
Canada	245	204815	445	314201
Thailand	481	231686	373	216899
Oman	402	237263	353	213009
Nigeria	295	169169	297	155844
Saudi Arabia	166	109614	213	131814
Malaysia	257	144594	210	130081
Nepal	339	160677	211	120316
Other Countries	3219	2117277	2670	1824941

Table 24: Exports of Copper Mattes

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty	Value	Qty	Value
	(t)	(₹'000)	(t)	(₹'000)
All Countries	**7728**	**670705**	**16307**	**1572663**
China	4029	299829	10721	986780
Korea, Rep. of	3569	361526	5341	574265
Thailand	54	583	244	11281
Kenya	--	--	1	245
Sri Lanka	++	28	++	70
Nepal	++	5	++	14
Germany	--	--	++	8
Spain	76	8701	--	--
Bangladesh	++	30	--	--
Canada	++	3	--	--
Other Countries	++	++	--	--

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

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	18172	10325520	14934	11103826
USA	6129	4452655	6176	4943763
Saudi Arabia	1715	548039	938	637328
UK	800	553689	659	623998
Thailand	338	234990	771	534777
Peru	1847	884606	997	457824
Germany	917	454224	461	455155
UAE	1400	407411	712	432449
Australia	169	134356	314	223086
Colombia	48	24230	328	185839
Canada	174	146705	196	182351
Other Countries	4635	2484615	3382	2427256

Table-26: Exports of Copper Powder & Flakes

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1156	197213	353	211413
Brazil	303	174468	290	195963
Thailand	5	2877	10	6154
UAE	++	5	49	5733
Bangladesh	2	742	3	708
South Africa	++	3	1	488
USA	++	159	++	444
Japan	++	747	++	427
Malaysia	++	271	++	298
Australia	--	--	++	236
Egypt	++	315	++	173
Other Countries	846	17626	++	789

Table-27: Exports of Blister & Other Unrefined Copper

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	5	1027	491605
China	--	--	1027	491605
Oman	++	4	--	--
UK	++	1	--	--

Table-28: Exports of Brass & Bronze : Bronze Powder

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	226	1	351
Bangladesh	--	--	1	220
Austria	--	--	++	131
Indonesia	++	164	--	--
Singapore	++	62	--	--

Table-29: Exports of Copper Alloys : Unwrought Excl. Brass & Bronze

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	387	154727	937	391076
China	139	51183	608	239809
Sri Lanka	107	46721	114	58548
Taiwan	14	5863	75	31144
Malaysia	26	10454	42	18095
Italy	1	1553	26	10797
Spain	--	--	24	10458
Jordan	--	--	20	7292
Nepal	++	276	14	5279
Japan	++	748	1	2476
Togo	--	--	3	2051
Other Countries	100	37929	10	5127

Table-30: Exports of Brass & Bronze Unwrought

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	9831	2958841	36524	11593935
China	9073	2628033	35669	11237540
Taiwan	117	43245	275	93528
Thailand	338	140234	177	64265
USA	103	43986	82	38153
Nepal	11	5141	87	32014
Japan	--	--	40	15931
UAE	25	12862	24	13864
UK	1	1109	5	12675
Italy	++	1255	28	12174
Mexico	41	18468	25	11892
Other Countries	122	64508	112	61899

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

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	367	4	1066
Korea, Rep. of	--	--	4	948
Nigeria	--	--	++	50
South Africa	--	--	++	39
Kazakhstan	--	--	++	17
Australia	--	--	++	12
Qatar	++	367	--	--

Table-32: Exports of Copper & Alloys

(Excluding Brass & Bronze and Scrap)

(By Items)

Item	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All items	81388	35989492	139540	67619065
Blister & Other Unrefined Copper	++	5	1027	491605
Copper & Alloys: Worked (Bars, Rods, Plates, etc.)	8812	5462095	8547	5638560
Copper & Alloys: Worked, Nes	18172	10325520	14934	11103826
Copper Alloys: Unwrought Excl. Brass & Bronze	387	154727	937	391076
Copper Mattes	7728	670705	16307	1572663
Copper Powder & Flakes	1156	197213	353	211413
Copper Refined Copper Worked	7361	3523722	8687	4705513
Electroplated Anode of Nickel	5	3185	64	31638
Master Alloys of Copper	810	394924	325	159847
Refined Copper	36957	15257396	88359	43312924

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 2020-21, imports of copper ores & concentrates decreased by very narrow margin to 4,15,136 tonnes as compared to 8,21,555 tonnes in 2019-20. Chile with a share of 59% was the leading supplier followed by Indonesia (29%), Malaysia and Canada (5% each) and Saudi Arabia (2%). While imports of refined copper increased drastically by 65% to 1,55,038 tonnes in 2020-21 from 1,51,964 tonnes in 2019-20. Japan was the leading supplier of refined copper with share of 82% followed by UAE (10%) and Tanzania (3%). Out of the total imports in 2020-21, copper & alloys comprised 4,96,358 tonnes and copper (scrap) 90,604 tonnes (Tables - 33 to 42).

Table-33: Imports of Copper Ores & Conc.

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty	Value	Qty	Value
	(t)	(₹'000)	(t)	(₹'000)
All Countries	**821555**	**86675247**	**415136**	**59071579**
Chile	520728	56127386	245238	29065049
Indonesia	30150	4932740	119609	21391418
Malaysia	--	--	19821	3974697
Canada	20398	2590179	20386	2969661
Saudi Arabia	31389	3142310	10046	1667131
UK	--	--	24	1969
USA	++	14	10	869
Bosnia-Herzegovina	--	--	2	785
Peru	97175	8748942	--	--
Australia	71973	6170829	--	--
Other Countries	49742	4962847	--	--

Table-34: Imports of Refined Copper

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty	Value	Qty	Value
	(t)	(₹'000)	(t)	(₹'000)
All Countries	**151963**	**67289144**	**155038**	**78258449**
Japan	116158	51690905	127811	64345604
UAE	21868	9604118	15051	7771508
Tanzania	695	301693	4736	2451911
Indonesia	1266	545875	2444	1240156
Thailand	1628	671491	1471	700847
South Africa	104	42459	1147	603482
Malaysia	3618	1531001	968	439346
Germany	722	330898	381	198253
Vietnam	72	31568	303	140540
Luxembourg	674	280966	249	106039
Other Countries	5158	2258170	477	260763

Table-35: Imports of Copper & Alloys (Incl. Brass & Bronze) : Total

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty	Value	Qty	Value
	(t)	(₹'000)	(t)	(₹'000)
All Countries	**896848**	**361304774**	**744819**	**341717156**
Japan	131396	59756787	143670	73323543
South Africa	11881	4558381	71269	37370877
UAE	111440	46828568	66135	32035807
Tanzania	5994	2564223	58541	30001251
Vietnam	67460	31632493	36163	20580074
Thailand	42411	19537106	31124	16491527
Malaysia	86879	38375543	26219	13755862
China	28857	12599647	25903	12376742
Germany	32906	10027517	34242	11519130
USA	58553	17873331	35088	11430483
Other Countries	319071	117551178	216465	82831860

Table-36: Imports of Copper & Alloys

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**616456**	**280500278**	**496358**	**261483027**
Japan	127093	57661706	140585	71641305
South Africa	8570	3686974	70647	37179074
Tanzania	5956	2553419	58289	29931494
UAE	94407	41655987	51803	26747022
Vietnam	67398	31594109	36077	20525043
Thailand	40459	18691840	29056	15512568
Malaysia	79345	35698690	20433	11444563
China	25164	10609734	22019	10023048
Mozambique	3439	1450519	13646	6308248
Zambia	116786	51117159	12304	5265397
Other Countries	47839	25780141	41499	26905265

Table-37: Imports of Copper (Scrap)

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**112714**	**29265171**	**90604**	**28462247**
Saudi Arabia	10929	4342309	12315	5966405
USA	17635	4588537	12540	3452407
UAE	8490	2801587	7388	3194766
Kuwait	5541	2325013	6191	2755410
UK	15509	2386811	12402	2329223
Australia	8465	1651500	5706	1498850
Germany	14222	2255962	8419	1476016
Netherlands	3382	815990	4306	1001698
Canada	3401	1058148	1976	715362
Malaysia	1390	540926	1321	640121
Other Countries	23750	6498388	18040	5431989

Table-38: Imports of Brass & Bronze

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**23552**	**12369100**	**19468**	**11486251**
China	3667	1980711	3847	2339606
Korea, Rep. of	3005	1402274	3693	1828557
Malaysia	4728	1726446	3173	1265470
Japan	2501	1644253	1650	1232034
Germany	1286	976411	1290	1083767
Thailand	1799	792446	1547	759946
USA	374	748805	520	432978
Italy	404	284006	362	373538
Nepal	1172	470317	546	247350
Taiwan	673	302310	442	243415
Other countries	3943	2041121	2398	1679590

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

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**144126**	**39170225**	**138189**	**40285631**
USA	39543	11080135	20949	6210740
Germany	12890	3455378	21183	6114950
Saudi Arabia	11752	3177036	12329	3670926
UK	6646	1724629	12427	3667903
Netherlands	4446	1209506	8779	2540524
UAE	8479	2338901	6920	2080389
Belgium	2077	547791	4889	1382706
Sweden	6115	1468727	4866	1296978
Poland	5551	1483319	4210	1170937
Denmark	3395	905930	3516	985599
Other countries	43232	11778873	38321	11163979

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

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**763**	**39**	**5489**
Australia	--	--	39	5471
China	--	--	++	18
Germany	--	--	++	++
France	++	670	--	--
USA	++	80	--	--
UK	++	13	--	--

Table-41: Imports of Copper & Alloys

(Excluding Brass & Bronze and Scrap)

By Items

Item	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All items	**616456**	**280500278**	**496358**	**261483027**
Blister & Other Unrefined Copper	103618	45396612	77702	39937454
Copper & Alloys: Workered (Bars, Rods, Plates, etc.)	100361	49227407	83438	44695904
Copper & Alloys: Worked, Nes	10200	7044868	6334	6448830
Copper Alloys: Unwrought Excl.Brass & Bronze	1277	662652	993	587326
Copper Mattes	++	9	3	1159
Copper Powder & Flakes	645	447429	702	563996
Copper Refined Copper Worked	217031	96866798	93319	50376605
Electroplated Anode of Nickel	31222	13449229	78724	40534144
Master Alloys of Copper	139	116130	105	79160
Refined Copper	151963	67289144	155038	78258449

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

By Countries

Country	2019-20(R)		2020-21(P)	
	Qty	Value	Qty	Value
	(t)	(₹'000)	(t)	(₹'000)
All Countries	100361	49227407	83438	44695904
Vietnam	41305	20228333	35758	20342324
China	18242	7159227	19324	7628556
Malaysia	19350	9817651	11231	6363215
Thailand	7209	3584499	4773	2485366
Germany	2800	1987953	2142	1541451
Korea, Rep. of	2761	1246925	2743	1307888
Hong Kong	1823	785658	1616	921410
Taiwan	2274	819269	2035	751076
Japan	881	725463	702	688367
USA	402	789016	379	642923
Other Countries	3314	2083413	2735	2023328

FUTURE OUTLOOK

HCL, Public Sector company, undertook expansion projects in its mines, namely, Malanjkhand, Khetri, Kolihan, etc. to increase production. HCL has chalked out an expansion plan to increase mine production from 3.95 to 20.2 million tonnes per annum in next six years with a capital layout of ₹5,500 crore. The company targets to complete the first phase of the plan, which will take its capacity to 12.2 mtpa by 2028-29. 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 by 2022, 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 from the current level of 0.5 kg to 1 kg by 2025. The per capita copper consumption of China is 6 kg and world average is 3.2 kg.

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 in 2020-21

50,000
(tonnes) Total installed capacity of noble ferroalloys in 2020-21

4,21,980
(tonnes) Imports of ferroalloys in 2020-21

18,43,322
(tonnes) Exports of ferroalloys in 2020-21

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 are chromium, manganese and silicon. 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 is 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 produced is exported. Ferromanganese, silicomanganese, ferrosilicon, high carbon ferrochrome and chargechrome 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, 2020 & 2021 issues 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, 2018-19 to 2020-21

(In tonnes)

Ferroalloys	2018-19	2019-20	2020-21
A) Bulk Ferroalloys			
Ferromanganese	518000	NA	NA
Silicomanganese	342591	320594	329295
Ferrosilicon	90000	NA	NA
Ferrochrome	944000	944000	868000
Charge-chrome	NA	NA	NA
B) Noble Ferroalloys			
Ferromolybdenum	1003	527	428
Ferrovanadium	1013	665	664
Ferrotungsten	NA	NA	NA
Magnesium-ferro-silicon	19180	13930	13930
Ferroaluminium	2752	1461	1119
Ferro-silicon-zirconium	NA	NA	NA
Ferrotitanium	118	121	249
Ferroboron	NA	NA	NA
Ferroniobium	NA	NA	NA

Source: Monthly Statistics of Mineral Production (MSMP), IBM, March, 2021 Issues.

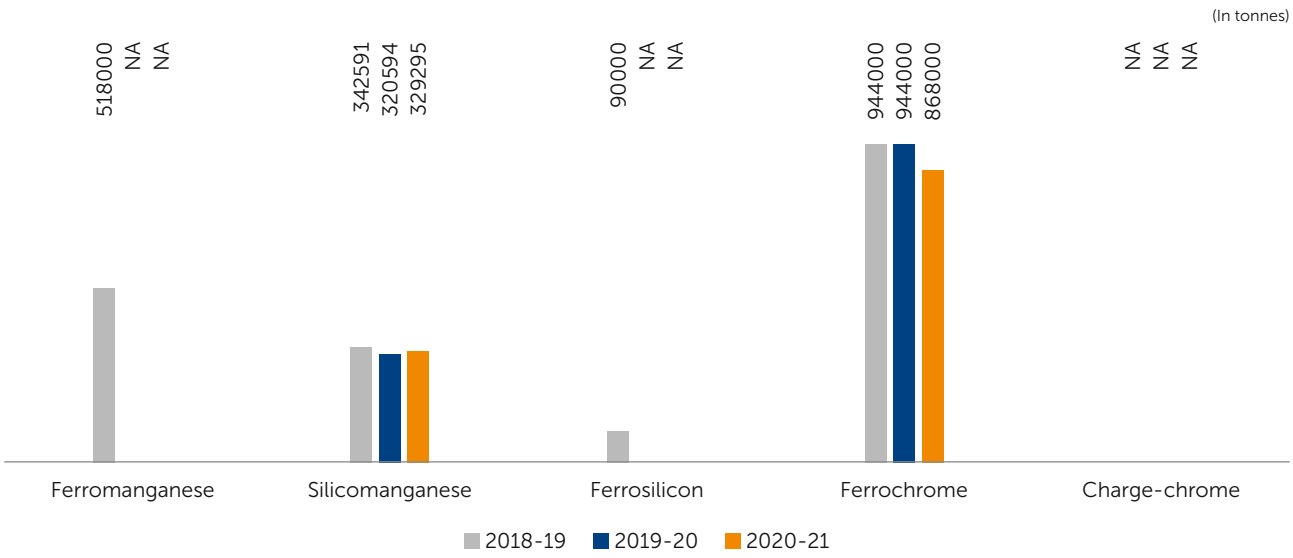


Fig 1: Production of Bulk Ferro-Alloys

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, 0.1-0.7% 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 year, has emerged as a leading producer of silicomanganese. Silicomanganese was also produced by a number of small-scale ferroalloy producers. The total production of ferromanganese in 2018-19 was about 5,18,000 tonnes. As per the annual return submitted to IBM in form 'O', the production of ferromanganese was 47,406 tonnes in 2019-20. The estimated consumption of ferromanganese was 50,800 tonnes in 2017-18. The production of silicomanganese (including medium-carbon & low-carbon silicomanganese) which was about 3,42,591 tonnes in 2018-19 decreased to 3,20,594 tonnes in 2019-20. In 2017-18, the total consumption of silicomanganese by all industries has been estimated at 1,22,600 tonnes.

Ferrrochrome/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), there is 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 (1.5-3%), 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 2019-20 was about 9,21,000 tonnes which decreased to 8,68,000 in 2020-21.

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 is 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 2019-20 and 2020-21 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.

These high temperature alloys impart strength, resistance and stability within a temperature range from 260 to 1,200 oC. These alloys are used generally in turbine engines, power plants, furnaces and all pollution control equipment. Noble ferroalloys include ferrovanadium, ferrotitanium, ferronickel, ferromolybdenum, ferrotungsten and ferroniobium. In India, noble ferro alloys 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. The all India production decreased to 428 tonnes in 2020-21 as compared 527 tonnes in 2019-20.

Ferrotungsten

The consumption and production of ferrotungsten in 2020-21 were not reported in the Organised Sector.

Ferrovanadium

Production of ferrovanadium in 2019-20 was 1013 tonnes which decreased to 664 tonnes in 2020-21.

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 2018-19 to 2020-21 are furnished in Table- 2 & Fig1.

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& Fig2.

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, Srinivasanagar, Distt Vizianagaram	HC ferrochrome	Cr: 60-65% max. Si: 2-4% max. C: 6-8% max. P: 0.040% max. S: 0.040% max.	
	Silicomanganese	Mn: 60% min. C: 2.5% max. Si: 14% min. P: 0.3 % max. S: 0.035% max.	20,000
FACOR Alloys Ltd, Shreeramnagar, Garividi, Distt Vizianagaram	HC ferromanganese	Mn: 70-80%, C:6-8%, Si: 1-5 % max. P: 0.35% max. S: 0.05% max.	72,500 (For all ferroalloys)

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
		Size: 25-150 mm +/- 10%, Corresponding ISI specification: IS 1171-2011.	
	HC Ferrochrome	Cr: 60-63%, Si: 3-4%, C: 6-8%, P: 0.03-0.05% (max.), S: 0.03-0.05% (max.)	90,345
	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, Chintalapalem (PO), Pendurthi (SO), Vizianagaram	Silicomanganese	NA	30,000
Jindal Stainless Ltd, (Ferro Alloys Division) Jindal Nagar, Kothavalasa, Distt Vizianagaram.	HC ferrochrome	Cr: 62%, Si: 2.5%, C: 7-8%, P: 0.040%,	40,000
Sree Sarda Alloys Ltd, Ravivalsa, Tekkali Mandal, Distt Srikakulam.	Ferrochrome	NA	6,000
Metkore Alloys and Industries Ltd, Srikakulam.	H C ferrochrome	NA	25000
Siri Smetters & Energy Pvt. Ltd, Distt Vizianagaram.	Silicomanganese	NA	8,500
Maithan Alloys Ltd, Visakhapatnam.	Ferroalloy	NA	1,20,000 (Total)
MDA Mineral Dhatu AP Pvt. Ltd, Distt Vizianagaram.	Ferro Mn	NA	9,000
	Silico Mn	NA	11,000

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Rhodium Ferro-alloys Pvt. Ltd, Gollapuram, Distt Anantapur	Ferrosilicon	NA	8,000
Ushodaya Electrodes Pvt. Ltd, Visakhapatnam	Ferromanganese	NA	4
Srinivasa Ferro Alloys Ltd, Visakhapatnam	Silicomanganese	NA	26000
Sri Raghvendra Ferro Alloys Pvt. Ltd, Nalgonda	Silicomanganese	NA	18000
Sri Balaji Electro Smelters Ltd, Hyderabad	Silicomanganese	NA	4650
Sri Mahalakshmi Smelters Pvt. Ltd, Vizianagaram	Ferrosilicon	NA	7,200
Nav Bharat Ventures Ltd, Distt Khammam	Silico Mn	NA	1,25,000
Anjaney Alloys Ltd, Atchutapuram, Distt Visakhapatnam	Ferroalloys	NA	1,20,000
M.B. SMELTERS Pvt. Ltd,	MC ferromanganese	NA	7,500
Hindupur, Distt Anantapur	HC ferromanganese	NA	50,000
Chhattisgarh			
(i) Hira Ferro Alloys Ltd, Urla, Distt Raipur.	HC ferromanganese	Mn: 70-75%, Si: 1.50% max. 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, Raipur.	Ferroalloys	NA	18,000
INDSIL Energy & Electrochemical Ltd, Raipur, Chhattisgarh	Silicomanganese	NA	19,200
Sarda Energy & Minerals Ltd	Ferromanganese	Mn: 70% (min.), Si: 1.5% (max.), C: 6-8%, P: 0.35% (max.), S: 0.050% (max.)	45 MVA (Total)
	Silicomanganese	Mn: 60% (min.), Si: 15-20%, C: 2.50% (max.), P: 0.35% (max.), S: 0.050% (max.)	
Chhattisgarh Electricity Co. Ltd, Siltara, Raipur.	HC ferromanganese	Mn: 70-75%, Si: 1.5-2.0%, C: 6.0-8.0%, P: 0.35-0.40%, S: 0.05% (max.)	36,000
	Silicomanganese	Mn: 60-65% , Si: 15-20%, C: 2.0-2.5%, P : 0.3-0.35 %, S: 0.05% (max.)	NA
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

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Orion Ferro alloys, Gharghoda,	Silicomanganese	NA	8,000
Raigarh	Silico-slag (as by-product)	NA	12,000
Vandana Global Ltd, Raipur	Silicomanganese	NA	36,000
Jindal Steel & Power Ltd,	HC Ferrochrome	Cr: 60-66%,	36,000
		Si: 4% (max.),	
Kharsia, Distt Raigarh.		C: 6 to 8%,	
		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.		Sio2:14-15% (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.	Ferrosilico-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)			

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Castron Technologies Ltd,	Ferromanganese	NA	14,400
Bokaro Industrial Area,	Silicomanganese	NA	
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$\pm$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%	

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
Meghnagar, Distt Jhabua.			
Crescent Alloys Pvt. Ltd,	Ferrosilicon	N.A.	4,500
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),	Charge-chrome	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),	Charge-chrome	Cr: 60% (min.), Si: 4% (max.) ,	55,000
Bamnipal, Distt Keonjhar.		C: 8% (max.), P: 0.03% (max.),	

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
		S: 0.03% (max.)	
	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)	Charge-chrome		
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)
	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	–	
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%	1,800
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, Verka, Amritsar.	Ferromolybdenum Ferrovanadium Ferrotitanium Ferrotungsten Ferroboron	NA	300
Sikkim			
Akshay Ispat & Ferro Alloys Ltd, Mamring, Namchi, Distt South Sikkim.	Ferrosilicon	NA	6,000
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 Pvt. Ltd, Nalgonda	Silicomanganese	NA	15000
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 Ferrochrome Ferroboron Chromium metal LC ferromanganese Ferrovanadium		(Total)
Hindustan Ferro-Alloys, Hamirpur.	Ferrosilicon	NA	3,200
West Bengal			
Bhaskar Shrachi Alloys Ltd, Durgapur	Silicomanganese	Si: 15%	24,000
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
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

Name and location of the plant	Product	Specifications	Installed capacity (tpy)
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, and paucity of data, hence consumption may not be complete

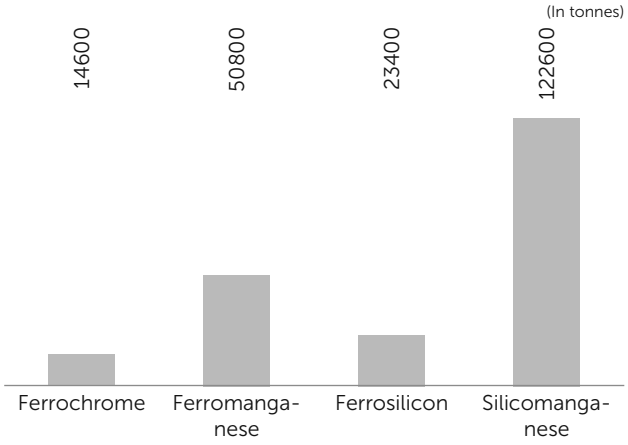


Fig 2: Consumption of Principal Ferro Alloys 2017-18

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 CO2 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 CO2 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 2020 was 36,000 thousand tonnes, while production of ferroalloys in South Africa during 2020 was 2984 thousand tonnes. Kazakhstan reported production of 1847 thousand tonnes of ferrochrome during 2020. 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, 2018 to 2020

(By Principal Countries)

(In tonnes)

Country	Ferroalloys	2018	2019	2020
China	Fe-Alloys	31234000	36577000	36000000
	Si-Metal	2404500	2400000	2400000
South Africa	Fe-Alloys	4081452	3806766	2984105
Kazakhstan	FeCr	1772508	1858130	1841309
	FeSiCr	110500	110500	110500
	FeSiMn	137710	123528	122743
	FeSi	65405	79930	80000
India[b]	FeAl	2752	1461	1119
	FeCr	944000	921000	868000
	FeMn	518000	0	0
	FeMo	1003	527	428
	FeSiMg	19180	14173	9700
	FeSiMn	342591	320594	329295
	FeSi	90000	0	0

Country	Ferroalloys	2018	2019	2020
	FeTi	118	121	249
	FeV	1013	665	634
Ukraine	FeMn	155869	172508	117215
	FeNi	79537	79334	73700
	FeSiMn	912300	858708	850000
	FeSi	97084	97000	97000
	Other Fe-Alloys	100764	100000	100000
Russia	FeCr	332261	384089	390000
	FeMn	281000	273000	240000
	FeMo	4700	4700	4700
	FeNi	20000	20000	20000
	FeSiCr	4200	4200	4200
	FeSiMn	43334	51774	50000
	FeSi	928797	846579	830000
	FeV	11383	10894	12000
	Other Fe-Alloys [e]	34000	34000	34000
	Si-Metal [e]	48000	48000	48000
	Spiegeleisen [e]	7000	7000	7000
Finland	FeCr	497000	505000	498000
Japan	FeMn	456518	462740	400331
	FeNi	339844	337790	234505
	Other Fe-Alloys	73094	74015	49544
Korea, Rep. of	FeMn [e]	355000	355000	355000
	FeSiMn [e]	196000	196000	196000
	Other Fe-Alloys [e]	4200	4200	4200
Brazil	FeCr [d]	175061	136780	254346
	FeMn	168000	151000	150000
	FeNi [y]	42310	45543	46000
	FeNb	60000	60000	60000
	FeSiMg [e]	20000	20000	20000
	FeSi [e][y]	100000	100000	100000
	Other Fe-Alloys [e]	40000	40000	40000
	Si-Metal	190000	340000	340000
Other countries	FeCr	540821	519995	497543
	FeSiMn	758956	683117	571383
	FeSi	910538	645172	594287
	FeMo	25779	26212	24218
	FeMn&FeSiMn	1445432	1260537	1165627
	Si-Metal	439558	428106	402234
	FeNi	654547	648213	640518
	FeV	14400	14900	13800
	FeAlloys	565210	435026	400841
	FeNi	7500	7500	7500
	FeSiCr	3000	3000	3000

Source: BGS, World Mineral Production, 2016-2020 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 2020-21, exports of ferroalloys (total) increased by 7% to 18,43,322 tonnes in 2020-21 from 17,15,919 tonnes in the previous year. In terms of value, ferroalloys exports also increased to ₹12,773 crore in 2020-21 from ₹11,810 crore in 2019-20.

Out of total export, in terms of quantity, majority were exports of ferrochrome (39%) followed by ferro-silico-manganese (41%), ferromanganese (18%) and ferrosilicon (1%). The other ferroalloys together accounted for the remaining 1% of exports in 2020-21. Exports were mainly to China (19%), UAE (11%), Republic of Korea (9%) and Japan (7%), (Tables-6 to 26).

Table-6: Exports of Ferroalloys : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1715919	118100709	1843322	127735114
China	331317	22028834	365306	25279096
UAE	218678	16890628	210748	15800630
Korea, Rep. of	204280	13597764	175560	12094753
Japan	171239	11785134	144689	10340378
Taiwan	123436	7974907	133816	8647484
Italy	53556	3065405	119785	7649075
Indonesia	18540	1306989	59316	4451852
Egypt	48076	3289428	65616	4396277
Thailand	44891	2986138	53086	3680146
Turkey	21104	1380315	48615	3311803
Other countries	480802	33795167	466785	32083620

Figures rounded off

Table-7: Exports of Ferroboron

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	51	11143	39	9728
South Africa	40	8928	31	7527
Turkey	1	361	2	524
Ukraine	-	-	2	381
Oman	10	1844	2	306
Egypt	-	-	1	303
Brazil	++	++	1	73
Malaysia	-	-	++	31
Saudi Arabia	-	-	++	5
Canada	-	-	++	3
Other countries	++	10	++	2

Figures rounded off

Table-8: Exports of Ferrochrome

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**732431**	**48794984**	**720539**	**49939983**
China	329483	21572846	362570	24871853
Korea, Rep. of	182087	12051454	160428	11043385
Indonesia	809	67186	45272	3456230
Taiwan	58349	3938225	49667	3334406
Japan	69265	4818220	35780	2639979
Thailand	9845	672213	13532	1049023
Italy	10249	717701	11882	814645
Canada	4469	321526	8921	616025
Mexico	11520	791894	6533	434927
Netherlands	11131	558689	7601	364171
Other countries	45224	3285030	18353	1315339

Figures rounded off

Table-9: Exports of Ferromanganese

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**262265**	**19769179**	**335229**	**23997006**
UAE	117268	9730668	105006	8680752
Italy	2786	171809	25342	1691665
Taiwan	11204	673610	19999	1207025
Netherlands	1641	129632	16932	1185968
USA	3247	232268	16110	1183401
Canada	14550	924740	17642	1177511
Brazil	5851	430846	16958	1165667
Oman	19831	1425975	16102	1038465
Egypt	13583	907178	13001	823569
Turkey	7546	500773	12826	822519
Other countries	64758	4668680	75311	5020464

Figures rounded off

Table-10: Exports of Ferromolybdenum

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**129**	**146529**	**279**	**324540**
Oman	98	103025	220	240963
South Africa	-	-	25	34174
Philippines	4	4208	6	10964
Thailand	13	15517	6	6459
UAE	6	7419	4	5669
Indonesia	1	2951	3	5515
Argentina	-	-	4	4931
Taiwan	5	4907	5	4703
Saudi Arabia	++	697	4	4029
Peru	1	2382	1	2063
Other countries	1	5423	1	5070

Figures rounded off

Table-11: Exports of Ferronickel

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	197	77	65052
China	-	-	76	63882
Kyrghyzstan	++	197	1	1170

Figures rounded off

Table-12: Exports of Ferro-niobium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	26	52730	14	25114
UAE	26	49886	14	23884
Malaysia	++	1137	++	640
Egypt	++	602	++	534
France	-	-	++	36
Canada	-	-	++	20
Indonesia	++	563	-	-
Pakistan	++	386	-	-
Saudi Arabia	++	122	-	-
Chile	++	34	-	-

Figures rounded off

Table-13: Exports of Ferro-phosphorus

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	80	10878	77	11038
Sweden	80	10724	76	10909
Saudi Arabia	-	-	1	129
China	++	149	-	-
Tanzania	++	5	-	-

Figures rounded off

Table-14: Exports of Ferrosilico-chrome

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3	638	32	12095
Turkey	-	-	12	10152
Nepal	-	-	16	1287
Jordan	-	-	2	436
Saudi Arabia	3	553	2	216
Japan	-	-	++	4
Tanzania	++	85	-	-

Figures rounded off

Table-15 : Exports of Ferro-silico-magnesium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**7153**	**770985**	**4192**	**483234**
Mexico	3248	347590	1051	112845
UAE	440	49859	489	60077
USA	610	63087	540	60061
Turkey	948	94163	488	54045
Italy	54	5711	273	31379
Sri Lanka	221	33946	157	24779
South Africa	235	22704	178	18309
Oman	206	23661	140	17898
Saudi Arabia	276	30921	148	17520
Taiwan	10	1101	105	12460
Other countries	905	98242	623	73861

Figures rounded off

Table-16: Exports of Ferro-silico-Manganese

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**682846**	**44374533**	**764747**	**50326047**
Japan	94743	6469404	99815	7081430
UAE	94271	6122804	100922	6409352
Italy	37978	2033422	80714	4977728
Taiwan	53252	3311030	63878	4068495
Egypt	33180	2273351	52366	3552108
Malaysia	58630	4041654	42338	2868163
Turkey	10018	600495	33880	2296815
Bangladesh	46520	2886269	36256	2208861
Thailand	26108	1675513	30156	1956520
Saudi Arabia	24765	1580837	20194	1304853
Other countries	203381	13379754	204228	13601722

Figures rounded off

Table-17: Exports of Ferro silicon

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**18754**	**1601611**	**11236**	**1194260**
UAE	724	65533	2012	196679
Brazil	1713	177352	766	87456
Slovenia	603	70337	687	82827
USA	519	67566	512	77741
Bangladesh	2927	213965	872	72541
Mexico	301	43213	457	62460
Oman	1030	80563	616	61957
Saudi Arabia	789	65558	548	53001
Italy	1596	78205	379	48893
Malaysia	284	20757	499	42796
Other countries	8268	718562	3888	407909

Figures rounded off

Table-18: Exports of Ferro-titanium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3227**	**678896**	**2553**	**567131**
China	1615	359401	1049	190297
Korea, Rep. of	59	12257	279	73593
UAE	170	42790	240	67047
Japan	120	26317	220	57155
Spain	-	-	120	31706
UK	235	54364	99	26611
Netherlands	65	12482	100	24288
Malaysia	2	565	99	18119
Bulgaria	5	1227	64	14949
USA	19	2671	50	14655
Other countries	937	166822	233	48711

Figures rounded off

Table-19 : Exports of Ferro-tungsten

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**1223**	**++**	**1150**
South Africa	-	-	++	740
Brazil	++	++	++	234
Qatar	-	-	++	148
Venezuela	-	-	++	13
Kenya	-	-	++	12
Spain	-	-	++	3
Pakistan	++	1130	-	-
Turkey	++	120	-	-

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	**531**	**883571**	**240**	**346840**
UAE	103	140008	102	141985
Thailand	16	29814	42	64449
Netherlands	82	121635	40	55916
Oman	8	12390	32	49299
Belgium	225	398727	20	26199
Brazil	2	5191	2	3803
France	-	-	1	2162
Turkey	1	1832	1	1508
Indonesia	++	617	++	507
Malaysia	++	317	++	386
Other countries	94	173040	++	626

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	1	2901	++	1522
UAE	-	-	++	849
UK	++	260	++	648
Qatar	-	-	++	25
Peru	1	2303	-	-
Pakistan	++	338	-	-

Figures rounded off

Table-22: Exports of Ferrozirconium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5	2914	3	1644
Brazil	4	2491	3	1644
Israel	1	375	-	-
Saudi Arabia	++	48	-	-

Figures rounded off

Table-23: Exports of Ferroselenium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	1365	++	979
Malaysia	++	1365	++	979

Figures rounded off

Table-24: Exports of Ferroalloys (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	8417	969357	4065	427722
UAE	4971	570010	989	112902
Italy	893	58557	1195	84723
Saudi Arabia	908	159374	301	52652
South Africa	438	66109	260	41345
Oman	51	5581	228	28886
Bangladesh	130	13103	228	27861
Turkey	42	3912	143	26042
Japan	360	15153	264	11048
Nepal	20	1595	154	10445
Bahrain	246	32691	37	4951
Other countries	358	43272	266	26867

Figures rounded off

Table-25: Exports of Ferrocobalt

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	75	++	29
Germany	++	44	++	15
USA	++	15	++	14
Philippines	++	16	-	-

Figures rounded off

Table-26: Imports of Ferroalloys : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	483127	63432050	421980	55319083
Indonesia	69185	13259249	62209	12174907
Bhutan	131540	9056395	105907	8388867
Singapore	13994	5460830	10508	5161202
China	62726	5937287	48375	5045760
Korea, Rep. of	12163	3778102	16970	4414616
Malaysia	66873	4484822	51284	3293125
Brazil	5106	2297825	7416	2660712
South Africa	38817	2928910	32104	2270907
Russia	9194	1090807	20599	1965356
Japan	9890	3936189	5505	1258262
Other countries	63639	11201634	61103	8685369

Figures rounded off

Imports

Imports of ferroalloys (total) decreased marginally by 13% to ₹4,21,980 tonnes in 2020-21 from ₹4,83,127 tonnes in the previous year. In terms of value, the ferroalloys imports also decreased to ₹5,531 crore in 2020-21 from ₹6,343 crore in 2019-20. Out of total imports in terms of quantity, imports of ferrosilicon accounted for about 46% followed by ferromanganese (15%), ferronickel (18%), ferrochrome (9%) and chargechrome (3%). Other ferroalloys together accounted for the remaining 9% of the imports in 2020-21. Imports were mainly from Bhutan (25%) followed by Indonesia (14.1%), Malaysia (12%), China (11%) and South Africa (7%). (Tables-27 to 44).

Table-27: Imports of Ferroboron

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1166	190257	1238	197093
China	1141	186545	1224	196384
UK	-	-	14	625
USA	++	16	++	84
Hong Kong	24	3421	-	-
Germany	1	275	-	-

Figures rounded off

Table-28: Imports of Ferrochrome

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	29999	3893862	39002	4897369
China	19661	2496163	19525	2513774
Russia	2409	393701	6249	819171
Brazil	748	123472	2528	366851
Turkey	1959	237426	2770	322344
Kazakhstan	933	115119	2195	232759
Netherlands	301	86003	800	119875
Switzerland	270	38580	844	112104
USA	254	42378	600	86659
Sweden	3	649	825	75307
Albania	909	113385	562	68139
Other countries	2552	246986	2104	180386

Table-29: Imports of Charge-chrome

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**5654**	**328099**	**14004**	**741433**
South Africa	5505	315048	12018	636251
Switzerland	-	-	987	54623
Mozambique	-	-	999	50559
UAE	149	13051	-	-

Figures rounded off

Table-30: Imports of Ferromanganese

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**95706**	**6607464**	**66089**	**4785976**
Malaysia	45134	2906642	29550	1808754
Korea, Rep. of	10376	1069697	13807	1305274
South Africa	29125	2006120	16662	1118462
Norway	411	22745	2489	219991
Japan	576	69333	1170	132227
Vietnam	76	10280	540	65473
UAE	1556	92927	794	45248
Netherlands	286	7870	500	44368
China	1007	42955	115	18140
Sri Lanka	-	-	189	13706
Other countries	7159	378895	273	14333

Table-31: Imports of Ferromolybdenum

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2531**	**3120808**	**2883**	**3115738**
Korea, Rep. of	1678	2527510	2697	2928669
Switzerland	59	67694	100	100055
UAE	40	49808	3	78222
Germany	20	19395	3	4439
Canada	-	-	++	33
USA	++	18	-	-
Austria	507	216941	-	-
Hong Kong	86	103779	-	-
Singapore	40	48664	-	-
Japan	40	27676	-	-
Other countries	61	59323	-	-

Figures rounded off

Table-32: Imports of Ferro-nickel

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**113151**	**25036565**	**79737**	**16875880**
Indonesia	69185	13259249	62174	12168876
Singapore	10670	2109365	7757	1630801
Japan	9095	3590022	3331	704757
Dominican Rep.	358	364044	765	616318
Brazil	334	274275	1057	524809
Albania	16628	3143486	1903	467983
Canada	100	15472	1591	267660
UAE	103	99497	175	178249
USA	41	11929	463	118709
Switzerland	1911	410875	302	101890
Other countries	4726	1758351	219	95828

Table-33: Imports of Ferro-niobium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2778**	**5483410**	**3026**	**5857814**
Singapore	1582	3203128	1681	3397956
Brazil	765	1532168	879	1480909
Canada	171	414428	275	653843
UAE	17	32526	40	94965
Hong Kong	60	88767	68	70128
Netherlands	45	89805	27	62304
Swizerland	-	-	30	47403
Senegal	-	-	20	36901
Malaysia	104	28538	4	9651
Belgium	-	-	2	3223
Other countries	34	94050	++	531

Table-34: Imports of Ferrophosphorus

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2577**	**71363**	**2006**	**55172**
Vietnam	1152	26187	989	24022
China	1306	40231	619	22162
Kazakhstan	54	1155	216	4895
Germany	8	2083	125	2429
Sweden	-	-	3	1250
Russia	-	-	27	618
Hong Kong	57	1707	27	603
Italy	-	-	++	173
USA	-	-	++	20

Figures rounded off

Table-35: Imports of Ferro-silico-Chrome

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	37	14448	-	-
Norway	9	9957	-	-
Kazakhstan	27	3660	-	-
Netherlands	1	831	-	-

Figures rounded off

Table-36: Imports of Ferro-silico-Manganese

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	6172	344396	10497	546336
Bhutan	-	-	2964	236017
Malaysia	5784	317586	5673	234668
Australia	-	-	1620	63433
Singapore	-	-	200	7172
China	11	1635	10	1462
Slovak Rep.	10	1183	10	1240
France	20	2154	10	1222
Netherlands	-	-	10	1122
Saudi Arabia	300	16637	-	-
Sweden	20	4011	-	-
Other countries	27	1190	-	-

Figures rounded off

Table-37: Imports of Ferro-Silico-Magnesium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3128	294705	2765	289625
Bhutan	2212	208660	1720	186911
China	697	62755	946	93015
Taiwan	81	7111	54	5210
Marshall Island	-	-	38	3420
Belgium	10	1396	7	1069
Hong Kong	61	6436	-	-
Norway	42	5218	-	-
South Africa	25	3129	-	-

Figures rounded off

Table-38: Imports of Ferro-silicon

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	215181	16171706	194439	16370102
Bhutan	129152	8839190	101183	7963507
China	36025	2598422	23053	1869232
Malaysia	15322	1153154	15976	1234247
Russia	6656	513847	14265	1133643
Netherlands	2310	261593	9149	958416
Norway	3604	535691	4332	645226
UAE	1383	105024	8287	596568
France	4991	700107	3190	508442
South Africa	4044	570727	3256	499144
Brazil	3238	353666	2952	288143
Other countries	8456	540285	8796	673534

Figures rounded off

Table-39: Imports of Ferro-titanium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1157	299792	462	109565
UK	441	115789	255	59672
Netherlands	74	20230	69	20561
Canada	583	148565	70	15641
Russia	26	6474	58	11924
Taiwan	-	-	10	1725
USA	14	4390	++	42
Korea, Rep. of	19	4198	-	-
UAE	++	146	-	-

Table-40: Imports of Ferrovanadium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	595	1143397	480	613762
Germany	216	342960	188	260094
Korea	56	151770	76	131424
Japan	124	224188	113	124205
Switzerland	10	13218	20	32604
Czech Republic	10	12928	30	29993
UAE	-	-	48	26724
Netherlands	33	107490	5	8711
UK	++	15	++	7
Russia	92	174162	-	-
China	14	78472	-	-
Other countries	40	38194	-	-

Figures rounded off

Table-41: Imports of Ferrotungsten

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4	9250	13	23282
China	4	7519	9	15511
Belgium	-	-	4	7448
USA	++	292	++	171
Turkey	-	-	++	152
UK	++	1439	-	-

Figures rounded off

Table-42: Imports of Ferrozirconium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	342	41178	374	51237
China	342	41178	346	46248
Hong Kong	-	-	15	3395
UAE	-	-	8	1371
UK	-	-	5	223

Figures rounded off

Table-43: Imports of Ferroalloys (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2149	379604	4965	787297
Japan	39	21395	890	296556
China	2470	280353	2528	269832
Singapore	1	1978	713	103277
Canada	4	2789	395	44132
UAE	4	576	45	22985
USA	17	9782	40	15746
Argentina	288	37461	144	14356
Indonesia	-	-	35	6031
Malaysia	-	-	81	5805
Turkey	68	10917	54	4922
Other countries	58	14353	40	3655

Figures rounded off

Table-44: Imports of Ferrocobalt

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	1746	++	1402
Germany	++	935	++	1402
USA	++	811	-	-

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.

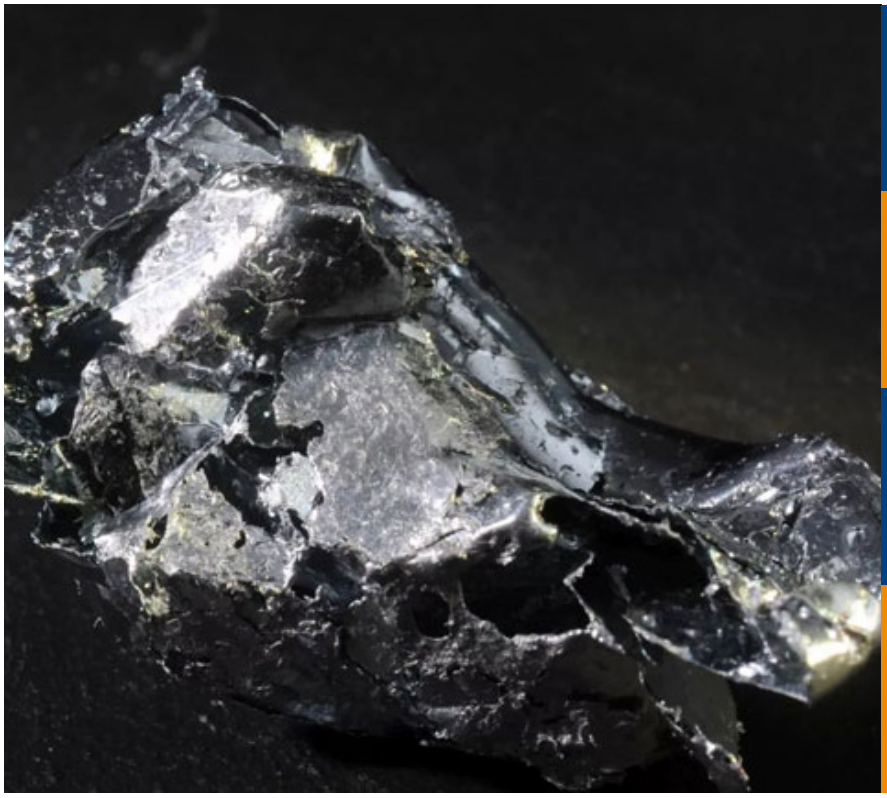
Indian Ferroalloys Industry has immense potential and capability to compete in the international market. On the positive side, India produces some of the finest ferroalloys in the world. Indian ferroalloys are extensively preferred in Europe. India exports potential is indeed bright with very high growth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

As per the steelworld report, ferroalloys Industry is estimated to grow at a CAGR of 5.9% between 2017 to 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 ferro-alloys 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 2018

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-shape-memory alloy" Ni-Mn-Ga". Gallium gadolinium garnet (GGG) is used as substrate for a bubble memory device. Gallium is used in some high temperature thermometers and an eutectic alloy of gallium, indium and tin is widely utilised in fever thermometers, replacing mercury. It is also used as a component in low melting alloys and in creating brilliant mirrors.

PRODUCTION

Gallium is recovered as a by-product while producing alumina. Two plants, namely, Hindalco Industries Ltd, at Renukoot, Uttar Pradesh and National Aluminium Co. Ltd at Damanjodi alumina refinery, Odisha, had recovered gallium in the past.

NALCO

NALCO was reportedly in the process of sourcing environment-friendly technology for establishing a gallium extraction plant. Nalco has plans to set up 10 tpy gallium extraction plant at its Alumina Refinery in Damanjodi (Odisha). NALCO has targets to produce gallium metal with a purity of 99.99%. In December 2015, NALCO has signed R & D agreement with Chalieco, China for separation of iron concentrate from Red Mud and extraction of gallium from Bayer's Liquor.

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 highpurity 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 2020, 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	2018	2019	2020
China	404	357	350
Russia[e]	13	13	13
Ukraine[e]	4	8	4
Japan	3	3	3[e]
Korea, Rep. of [ae]	3	3	2[e]

a-Primary production only
e-estimated

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 by- product 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 establishment of gallium recovery units.

Smartphones are a fundamental structural shift in mobile communications, offering services not available on standard cellular telephones, such as, internet access, video streaming, computer programme applications ("apps"), and global positioning systems. Smartphones, which use up to 10 times the amount of GaAs-rich RF content than 2G cellular telephones, are expected to account for 87% of all worldwide handset sales by 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 Développement 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 April 2020

451
(thousand tonnes) Production of gold ore in 2020-21

Nil
Exports of gold ore in 2020-21

10,742
(kg) Imports of gold ore concentrate in 2020-21

Gold in its purest form is a bright, slightly reddish yellow, dense, soft malleable and ductile metal. It is one of the least reactive chemical elements and is solid under standard conditions. Gold often occurs in free elemental (native) form, as nuggets or grains, in rocks, in vein and in alluvial deposits. Gold dissolves in alkaline solution of cyanide, which are used in mining and electroplating. It also dissolves in mercury, forming amalgam alloys, but this is not a chemical reaction. Gold is resistant to corrosion and to most acid and has unique properties distinct from other metals.

Gold is a relatively scarce metal in the world and a scarce commodity in India. The domestic demand is mainly met through imports.

RESERVES/RESOURCES

As per NMI data, based on UNFC system, as on 1.4.2020, the total reserves/resources of gold ore in the country have been estimated at 518.23 million tonnes. Out of these, 23.72 million tonnes were placed under Reserves category and the remaining 494.50 million tonnes under Remaining Resources category. The total reserves/resources of gold (primary), in terms of metal stood at 607.26 tonnes. Out of these, 92.76 tonnes were placed under Reserves category and 514.50 tonnes under Remaining Resources category. The resources include placer-type gold ore in Kerala estimated at 26.12 million tonnes containing 5.86 tonnes gold metal.

By States, largest resources in terms of gold ore (primary) are located in Bihar (43%) followed by Rajasthan (24.92%), Karnataka (20%),West Bengal (2.47%) & Andhra Pradesh (3.03%) and Jharkhand (2%). The remaining 5.22% resources of ore are located in Chhattisgarh, Madhya Pradesh, Kerala, Maharashtra and Tamil Nadu.Although, Bihar is the leading State in India as far as resources of gold ore are concerned. However, the resource estimate 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)/Fig. 1A & Fig. 1B.

Table-1: Reserves/Resources of Gold as on 1.04.2020 (P)

(By Grades/States)

(In tonnes)

States/Grades	Reserves				Remaining Resources								
	Proved	Probable		Total	Feasibility		Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+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
Madhya Pradesh													
Ore (Primary)	-	-	-	-	-	-	-	-	5745934	1947000	-	7692934	7692934
Metal (Primary)	-	-	-	-	-	-	-	-	6.03	2.22	-	8.25	8.25
Maharashtra													
Ore (Primary)	-	-	-	-	-	-	-	-	-	1627000	-	1627000	1627000

(In tonnes)

States/Grades	Reserves				Remaining Resources								
	Proved	Probable		Total	Feasibility		Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
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

Figure rounded off.

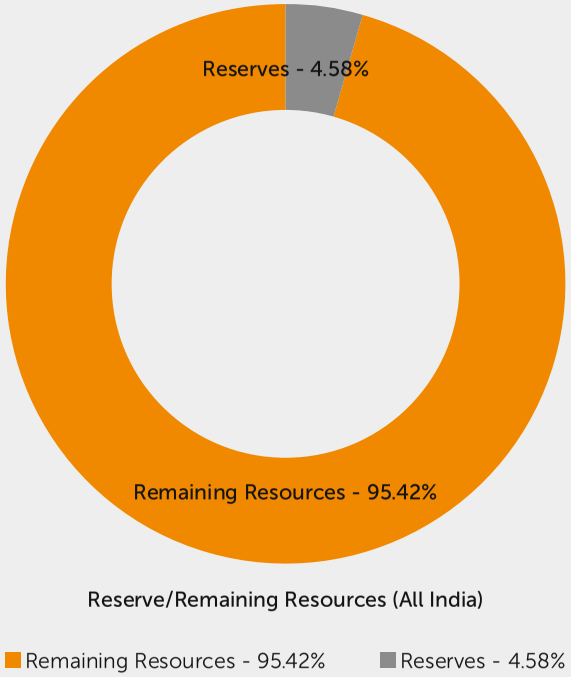


Fig. 1A

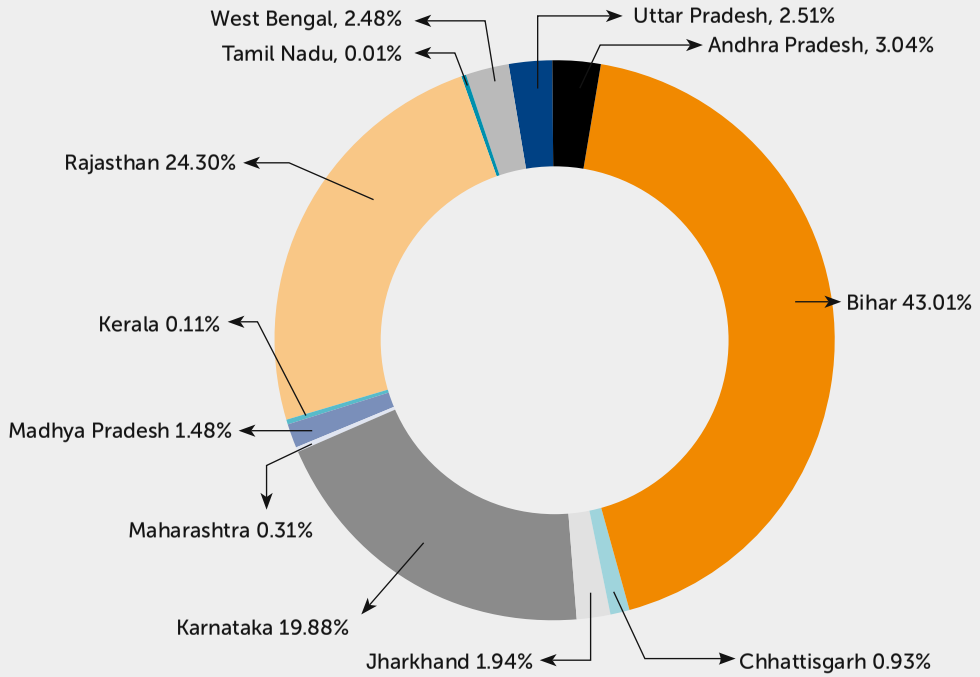


Fig. 1B: (By States)

EXPLORATION & DEVELOPMENT

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

PRODUCTION

The production of gold ore at 451 thousand tonnes during 2020-21 decreased by 24% as compared to 595.51 thousand tonnes in the previous year. Similarly, the quantity of ore treated also decreased by 29.10% from 643.48 thousand tonnes during the year 2019-20 to 456.21 thousand tonnes in the year 2020-21. There were six reporting mines of gold ore in 2020-21.

The average grade of gold ore produced in India during 2020-21 was 3.14 g/t as against 3.78 g/t in 2019-20 whereas, that of gold ore treated was 2.76 g/t in 2020-21 as compared to 3.21 g/t in 2019-20.

Production of primary gold in 2020-21 at 1,126 kg decreased by 35% as compared to 1642 kg in the previous year.

Karnataka was the leading producer of primary gold accounting for 99% production in 2020-21 (Fig.2) (Tables-2 to 6).

Table-2: Principal Producers of Gold, 2020-21

(By Producers)

Name and address of the producer	Location of the mine	
	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	Saraikela - Kharaswan

Table-3: Production of Gold Ore 2019-20 and 2020-21

(By States)

(In tonnes)

State	2019-20		2020-21 (P)	
	Ore Produced	Avg. Grade (g/t)	Ore Produced	Avg. Grade (g/t)
India	595511	3.78	450611	3.14
Jharkhand	4807	2.57	2859	4.19
Karnataka	590704	3.79	447752	3.14

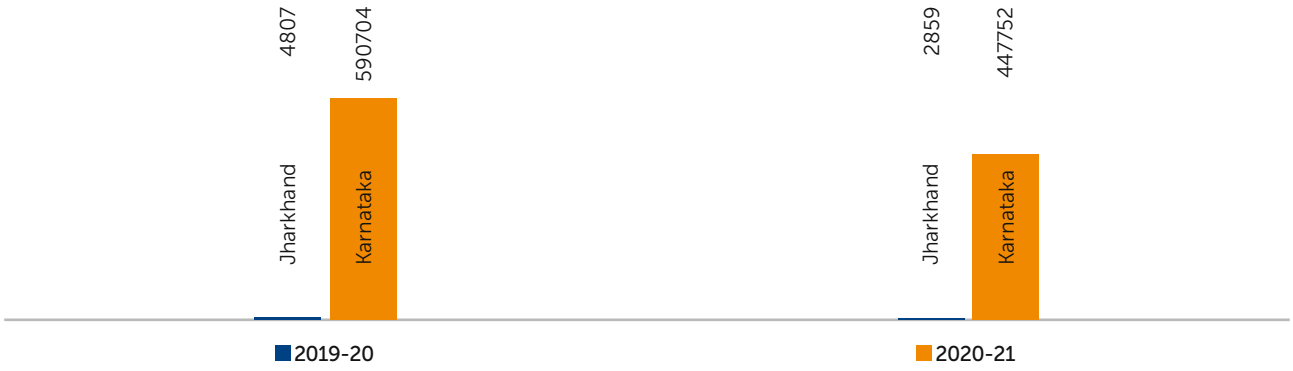


Fig.2: State wise Production of Gold ore

Table-4: Gold Ore Treated 2019-20 and 2020-21

(By States)

(In tonnes)

State	2019-20		2020-21 (P)	
	Ore Treated	Avg. Grade (g/t)	Ore Treated	Avg. Grade (g/t)
India	643489	3.21	456217	2.76
Jharkhand	4787	5.05	2880	4.2
Karnataka	638702	3.19	453337	2.75

Table-5: Production of Gold, 2019-20 to 2020-21
(By States)

(Quantity in kg; Value in ₹ 000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	1672	5267696	1742	6495723	1126	5475950
Primary Gold	1672	5267696	1742	6495723	1126	5475950
Jharkhand	11	33888	18	64689	11	53790
Karnataka	1661	5233808	1724	6431034	1115	5422160

Table-6: Production of Primary Gold, 2019-20 and 2020-21
(By Sectors/States/Districts)

((Quantity in kg; Value in ₹ 000)

State/District	No. of mines	2019-20		No. of mines	2020-21 (P)	
		Quantity	Value		Quantity	Value
India	6	1742	6495723	6	1126	5475950
Public Sector	4	1724	6431034	4	1115	5422160
Private Sector	2	18	64689	2	11	53790
Primary Gold	6	1742	6495723	6	1126	5475950
Andhra Pradesh	1*	-	-	1*	-	-
Kurnool	1*	-	-	1*	-	-
Jharkhand	1	18	64689	1	11	53790
Saraikela kharasawan	1	18	64689	1	11	53790
Karnataka	4	1724	6431034	4	1115	5422160
Raichur	4	1724	6431034	4	1115	5422160

* Only Labour reported.

The average daily employment of labour in 2020-21 was 2,788 as against 3,261 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.

Gold Bullion

Production of gold bullion in India is reported both in primary and secondary forms and also includes gold recovered from imported copper concentrates. Total production of gold bullion during 2020-21 at 7,387 kg decreased by 12% as compared to 8,382 kg in the previous year (Table -7) (Fig.3).

Table-7: Production of Gold Bullion 2018-19 to 2020-21

(Quantity in kg; Value in ₹ 000)

	Quantity	Value
2018-19	12623	39663595
2019-20	8382	31283423
2020-21 (P)	7387	35814249

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

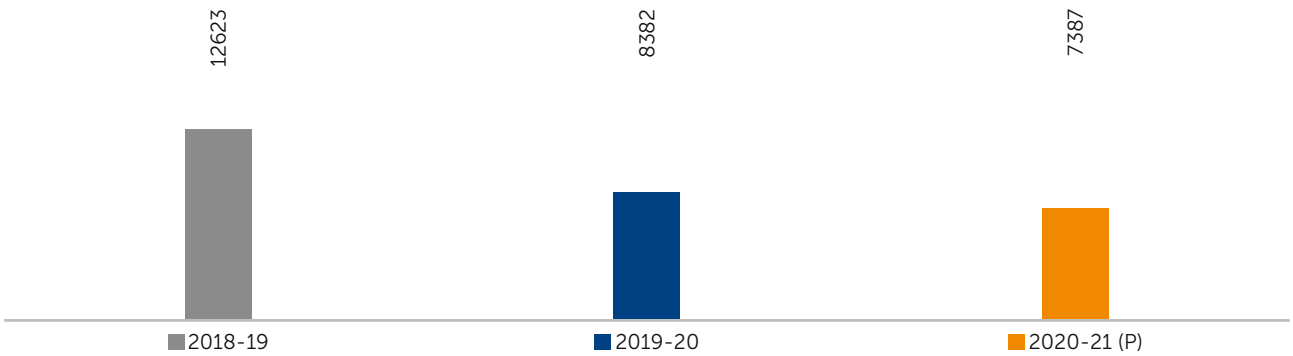


Fig.3: Production of Gold Bullion

MINING & MILLING

Presently, HGML is the only Public Sector Company producing gold in the country. While in the Private Sector, Manmohan Mineral Industries Pvt. Ltd is engaged in mine production of gold at Kunderkocha in Singhbhum East district, Jharkhand by underground method of mining. Geomysore Services (India) Pvt. Ltd has been granted a mining lease over an area of 597.82 ha for gold mining in Village Jonnagiri in Kurnool district of Andhra Pradesh. HGML operates mines at Hutti and Hira-Buddini in Raichur district, Karnataka. Sub-level and LDBH stoping methods are adopted in exploitation of gold ore. In the Uti mine, mining was carried out by opencast method till the year 2006 and thereafter by underground method. The ore from this mine is transported to Hutti mine by road for processing at the mills. Underground exploratory mining too is in progress. Several operations at Hira-Buddini old unit, such as, exploratory mine development and deepening and re-equipping of main shaft are in progress. Exploratory mine development using compressed air jackhammer drilling and electrical hoist in the shaft is presently underway. Based on the developmental work and feasibility, the locomotive loaders, wagon drills and other required machinery are likely to be used to increase the ROM.

The new ore processing plant based on modern technology (SAG and Ball Mill) with a capacity of 2,000 TPD has been operational at Hutti underground gold mine since 2010. At the Hutti Mineral Treatment Plant, the r.o.m. of -8" size is crushed. The final product from crushing plant, i.e. -10 mm size is stored in a 1,500 tonnes capacity fine ore bin for subsequent treatment, i.e., grinding. The Milling/ Grinding process of gold ore employs two distinct grinding techniques. The first technique involves grinding done in two stages, i.e., primary grinding followed by secondary grinding for adequate comminution. The processes involve one primary mill and three tube mills which constitute one stream of grinding in which pebbles and smaller size balls are used as composite grinding media.

There are two such streams and strake tables for collection of coarse gold as concentrate for this circuit. In the second technique, grinding is done by four ball mills of different sizes and each of them is an independent circuit in which large size balls are used as grinding media. In these circuits, Knelson concentrator is used to collect coarse gold as concentrate. In all the milling techniques, cyclones are in closed circuit with the mills so as to get the required sizes (80% passing 75 micron) for the subsequent treatment process.

The concentrate collected from both the techniques is upgraded on James Table. The upgraded concentrates are roasted, magneted and finally smelted into bullion buttons.

All the cyclone overflow, i.e., finely-ground ore in the form of slurry from the two streams of first technique and 4 streams of second technique join together in a distributor box from which finely-ground ore slurry is fed to High Rate Thickener for thickening purpose. The thickened pulp (60% solid w/w) thus obtained from thickeners is subjected to cyanidation process in which cyanide accessible gold in slurry makes complexes with cyanide in presence of oxygen and dissolves in solution at high pH. To increase the oxygen potential of slurry, H_2O_2 is added in addition to compressed air. The cyanidation or leaching process is carried out in a series of mechanically agitated agitators of different sizes.

The cyanide leached pulp is then fed to two Carbon-in Pulp (CIP) plants. The CIP plants are of 1,000 tpd size each and are parallel in circuit. The objective of CIP plant is to absorb the dissolved gold in activated carbon from the solution.

The gold-loaded carbon is removed from the CIP plant periodically, subjected to acid and alkaline wash and then eluted in four elution columns with 1.0% NaOH and 0.1% NaCN solution at 95 ^{0}C for a period of 60 hours. The solution is then passed through four electrowinning cells in which gold is deposited on steel wool cathodes. The gold loaded steel wool cathodes are manually removed periodically and subsequently subjected to acid digestion, drying and smelting to obtain bullion buttons. The bullion buttons thus obtained from table concentrate and steel wool are cast into bullion bars weighing 4 to 11 kg and then despatched for sales.

In the past, gold was produced by the Central Government undertaking, namely, BGML. BGML earlier mined and processed the ore from Chigargunta reef in Chittoor district, Andhra Pradesh; Mysore Mines of Kolar Gold Fields in Karnataka; and Yeppamana mine in Anantapur district, Andhra Pradesh. All activities of BGML were stopped and BGML was closed w.e.f. 1.3.2001 under Section 25 (O) of the Industrial Disputes Act, 1947 in terms of Ministry of Labour, Government of India's Order dated 29.1.2001.

Gold is sometimes recovered from the pregnant (Simple gold-bearing solution) solutions by adding zinc to form soluble zinc cyanide and precipitate of gold & silver. The pregnant solution can also be passed through activated carbon which absorbs dissolved gold. Gold from either process is cast into bars, bullion and dore (when it contains silver), which must be further refined to remove impurities, 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 reported production since 2007-08.

NMDC has secured a Bulyang / 'Ombe gold prospect in Tanzania. The gold prospect has a total area of 38.83 sq.km. Initial studies of NMDC revealed that Bulyang'Ombe I had a prospect for good concentration where gold values have shown a maximum of 7.2 gram per tonne, which is close to the top quality standard of 8 to 10 gram per tonne set by the World Gold Council.The Company is in process of setting up of a pilot-scale processing plant for gold in Tanzania.

NMDC has submitted the proposal for Bhukia Gold block to DMG, Govt. of Rajasthan, for over an area of 24 sq. km in Dist. Banswara. The Company has been allocated 3 Gold blocks, 2 in Karnataka and 1 in Madhya Pradesh.

Legacy Iron Ore Ltd (NMDC holding 90.05% equity stake) based in Perth, Australia is concentrating in exploration of gold in Mount Ceila where good occurrence of gold is observed. Mount Celia gold project has identified two gold occurrences, namely, Kangaroo Bore and Blue Peter deposit. Currently exploration drilling and mining study is being carried out to get the confidence & complete the feasibility study.

In Jharkhand, NMDC has submitted application to DMG, Jharkhand, for proposal to reserve 24.80 sq. km area in Kuchai Tehsil, District - Saraikela - Kaswan, Jharkhand under Section 17A (2A) of MM(D&R) Amendment Act, 2015 for prospecting and mining operation of gold & associated minerals. The matter is being pursued by NMDC with Govt. of Jharkhand for reservation.

NMDC has applied for Peravali-Betapalli Block for gold. NMDC has requested the Government of Andhra Pradesh to reserve the block in favour of NMDC under 17A (2A) of MM (D&R) Amendement Act, 2015 for prospecting & mining.

NMDC has been allotted 3 gold blocks (2 in Karnataka & 1 in Madhya Pradesh) by Ministry of Mines, for G4 level exploration under NMET. NMDC has completed exploration of 5 blocks and submitted Geological Report to NMDC.

NMDC has applied for prospecting of various minerals (diamond, gold, PGE, nickel, etc.) in Jabalpur, Katni Block (563 sq. km). Tripartite MoU among GoMP (MRD, through DGM) MPSMCL & NMDC was signed for geological and geophysical exploration for various districts of Madhya Pradesh.

A committee on Transforming India's Gold Market was constituted by NITI Aayog to recommend measures for Transforming the Gold Market Ecosystem in the country. The major recommendations of the committee are structured into five key areas. These are Make in India Gold, finalisation of Gold, Tax and duty structure, Regulatory Infrastructure and Skill Development & Technology Upgradation.

The Recommendations of the Committee are summarised as follows:

Gold Mining

1. Make gold mining viable and attractive to investors by promoting ease of doing business with single window clearances.
2. Government may consider making available the risk capital for long-term capital-intensive mining projects to attract investments.
3. The mining policy should consider availability of suitable exit option. Aspects related to brownfield exploration may also be considered.
4. Improve the quality and availability of digital data, covering geological database (which includes quality and scale of maps and ease of access to informations).
5. A comprehensive taxation policy should be formulated to align India's taxation framework with the strategic needs of the gold mining sector.

POLICY

Foreign Direct Investment (FDI) up to 100% in Mining Sector has been allowed.

In the revised Export-Import Policy, comprised in the Foreign Trade Policy (FTP), 2015-20, gold ores and concentrates are under freely importable category. Under Heading No.7108, the import of non-monetary gold metal also falls under Free category subject to RBI regulations, while import of gold metal in monetary form is restricted.

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 54,000 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)	54,000
Argentina	1600
Australia	1011000
Brazil	2400
Burkina Faso	NA
Canada	2200
China	2000
Colombia	NA
Ghana	1000
Indonesia	2600
Kazakhstan	1000
Mexico	1400
Papua New Guinea	1100
Peru	2000
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 3,188 tonnes in 2020 as compared to the 3,330 tonnes in the preceding year. China contributed about 11% to the world's total mine production of gold followed by Australia (10%), Russia (9%), USA (6%), Canada (5%), Ghana & Kazakhstan (4% each) and Mexico & Uzbekistan (3% each) (Table-9) (Fig.4).

Table-9: World Mine Production of Gold

(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
World:Total (rounded off)	3399	3330	3188
China(d)	401	380	365
Australia	313	326	327
Russia	280	305	308
USA	226	200	190
Canada	194	183	182
Ghana	149	142	125
Kazakhstan	100	106	116
Mexico	141	133	110
Uzbekistan	92	93	100
Other countries	1502	1459	1361

Source: BGS, World Mineral Production, 2016-2020.

(d):-Metal production

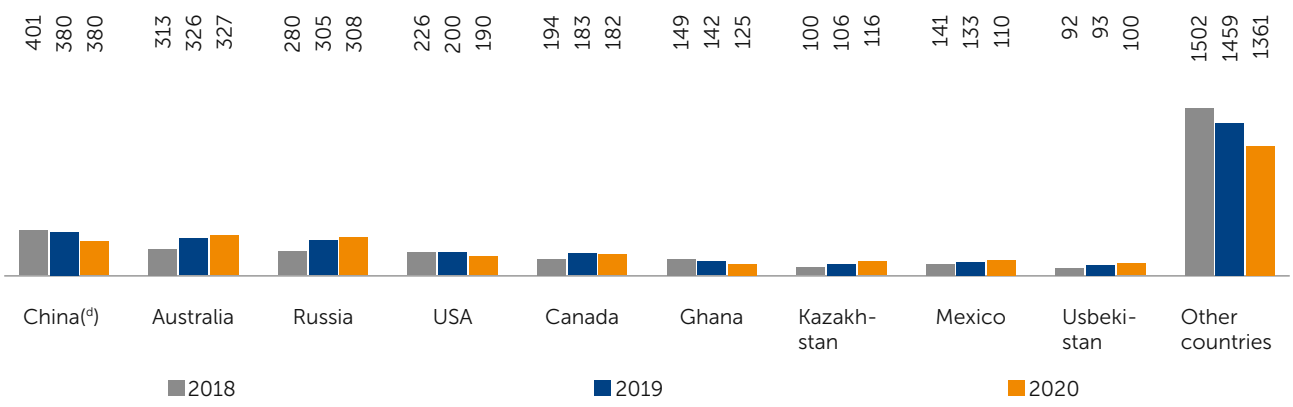


Fig.4: World Mine production of Gold

PRICES

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

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 315,100 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 183,047 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 401,119 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 135,000 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 311,000 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 117,200 kg, 15% less than output 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 2020-21, there was nigligible exports of gold ores & conc. as against Nil in the preceding year. Export of gold-clad metals/base metals, NES was negligible during the years i.e 2020-21 & 2019-20. 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) increased by more than three fold to 4191 kg in 2020-21 from 1730 kg in 2019-20. The exports in 2020-21 were to Switzerland (74%) followed by Turkey (25%) and negligible quantities to Guinea, UAE and Hong Kong. (Tables- 10 to 17).

Table-10: Exports of Gold: Total

(Non-monetary & Monetary)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	1730	5742699	4191	18895717
Switzerland	1150	3973862	3124	14175874
Turkey	-	-	1048	4637250
Guinea	-	-	9	37872
UAE	155	442324	7	31523
Hong Kong	++	664	3	11939
Netherlands	-	-	++	946
USA	++	24	++	233
UK	++	72	++	24
Australia	-	-	++	22
Mauritius	-	-	++	18
Other countries	425	1325753	++	16

Figures rounded off

Table-11: Exports of Gold (Non-monetary)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	**1730**	**5742699**	**4191**	**18895692**
Switzerland	1150	3973862	3124	14175874
Turkey	-	-	1048	4637250
Guinea	-	-	9	37872
UAE	155	442324	7	31523
Hong Kong	++	664	3	11939
Netherlands	-	-	++	946
USA	++	24	++	208
UK	++	72	++	24
Australia	-	-	++	22
Mauritius	-	-	++	18
Other countries	425	1325753	++	16

Figures rounded off

Table-12: Exports of Gold, (Non-monetary): Other Unwrought Forms
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	**1575**	**5300969**	**4191**	**18894458**
Switzerland	1150	3973862	3124	14175874
Turkey	-	-	1048	4637250
Guinea	-	-	9	37872
UAE	++	1403	7	31523
Hong Kong	-	-	3	11939
South Africa	425	1325608	-	-
UK	++	72	-	-
USA	++	24	-	-

Figures rounded off

Table-13: Exports of Gold - Monetary
(By Countries)

Country	2019-20 (R)		2020-21 (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	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	**++**	**19**	**++**	**306**
Sudan	-	-	++	263
Zambia	-	-	++	43
Kenya	++	10	-	-
Mauritius	++	9	--	-

Table-15: Exports of Gold Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (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	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	-	-	++	16
Nigeria	-	-	++	16

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	155	441730	++	1218
Netherlands	-	-	++	946
USA	-	-	++	208
UK	-	-	++	24
Australia	-	-	++	22
Mauritius	-	-	++	18
UAE	155	440921	-	-
Hong Kong	++	664	-	-
Fiji	++	65	-	-
Indonesia	++	65	-	-
Korea	++	15	-	-

Figures rounded off

Imports

Imports of gold ores & concentrates increased manifolds to 10,742 kg during 2020-21 from 273 kg in the preceding year. On the other hand imports of gold (Non-monetary), powder was negligible levels in 2020-21. Negligible imports of gold-clad metal in the year 2020-21 were reported. Imports of total gold (Monetary and Non-monetary) decreased substantially by 27% to 6,51,238 kg in 2020-21 from 7,19,905 kg in 2019-20. 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 6,49,374 kg. Imports of gold (Non-monetary & Monetary: total) were mainly from Switzerland (42%), UAE (10%), South Africa (6%), Peru (5%) and Guinea (4%) (Tables-18 to 24).

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	719905	1992494952	651238	2542884698
Switzerland	328413	1020172363	275265	1193849372
UAE	58665	190761632	70583	309169370
South Africa	29602	96497096	43020	187099143
Peru	41221	100648829	31429	110557375
Guinea	5561	16732510	26173	105177080
Singapore	1415	4874954	21364	92859048
USA	43173	96487145	20918	87412294
Bolivia	19667	59778150	20626	85098064
Ghana	31407	91530580	16018	66154120
Hong Kong	4166	13378535	9833	45586522
Other countries	156615	301633158	116009	259922310

Figures rounded off

Table-19: Imports of Gold, Non-monetary

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	**719905**	**19924952**	**651238**	**2542884698**
Switzerland	328413	1020172363	275265	1193849372
UAE	58665	190761632	70583	309169370
South Africa	29602	96497096	43020	187099143
Peru	41221	100648829	31429	110557375
Guinea	5561	16732510	26173	105177080
Singapore	1415	4874954	21364	92859048
USA	43173	96487145	20918	87412294
Bolivia	19667	59778150	20626	85098064
Ghana	31407	91530580	16018	66154120
Hong Kong	4166	13378535	9833	45586522
Other countries	156615	301633158	116009	259922310

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	**1981**	**6047059**	**1864**	**7902576**
USA	1115	3502953	1003	4070158
UAE	121	428114	429	2015678
U K	++	1342	150	727309
Singapore	48	174168	88	408927
Hong Kong	137	437041	69	292488
Germany	160	283667	72	164976
Spain	82	283717	21	94382
Italy	12	42125	21	88835
Japan	1	4054	3	12677
Colombia	-	-	3	11198
Other countries	305	889878	5	15948

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	**717924**	**1986447422**	**649374**	**2534982071**
Switzerland	328413	1020172363	275265	1193849372
UAE	58544	190333518	70154	307153692
South Africa	29602	96497096	43020	187099143
Peru	41221	100648829	31429	110557375
Guinea	5561	16732510	26173	105177080
Singapore	1367	4700786	21276	92450121
Bolivia	19667	59778150	20626	85098064
USA	42058	92984172	19915	83342130
Ghana	31407	91530580	16018	66154120
Hong Kong	4029	12941494	9764	45294034
Other countries	156055	300127924	115734	258806940

Figures rounded off

Table-22: Imports of Gold Ores & Conc

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	273	736	10742	48481
Columbia	-	-	10546	26319
Peru	6	713	196	22162
Australia	267	23	-	-

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	++	471	++	51
UK	-	-	++	45
USA	++	20	++	6
Germany	++	451	-	-

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹ 000)	Qty (kg)	Value (₹ 000)
All Countries	++	270	++	1694
UK	++	270	++	1694

Figures rounded off

FUTURE OUTLOOK

Historically, purchase of gold was consider to be a safe haven, hedge against economic failures, portfolio diversifier and store of wealth.

India is a traditional and stable market for gold consumption. The present production of gold is insufficient and does not meet the ever increasing demand. Therefore, efforts will be required to reduce the gap between production and demand.

The recommendations of the Committee on Transforming India's Gold Market (Constituted by NITI Aayog) contributes for fulfilling the transformational vision for India's gold market seeking to double its contribution in GDP 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 co-operation between the States and the Centre.

9. Iron Steel & Scrap and Slag

103.545
(million tonnes) India's crude steel production in 2020-21

1,22,510
(Rs crores) Exports of iron & steel in 2020-21

82,638
(Rs crores) Imports of iron & steel in 2020-21

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 96.204 million tonnes (Crude Steel Equivalent) in 2020-21. Out of this, 48.725 million tonnes was Non-Flat steel and the remaining 47.479 million tonnes was Flat steel. The contribution of non-alloy finished steel, alloy finished steel and stainless steel segment is 90.608 million tonnes, 3.326 million tonnes and 2.27 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 86% (82.438 million tonnes) in 2020-21.

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 stood at 10.78 million tonnes in 2020-21, a growth of 29% over 2019-20 while imports stood at 4.75 million tonnes, a decrease by 29.81% in 2020-21 over 2019-20. Such trends implied that India emerged as a net exporter of total finished steel in 2020-21 in contrast to its status as net importer in 2019-20.

Liberalisation of the Indian Steel Sector

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

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

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 Enterprise (MSME) Sector, improve raw material security, enhance R&D activities, reduce import dependency and cost of production, and thus develop a technologically advanced and globally competitive Steel Industry that which would promote economic growth eyeing self-sufficiency in production, developing globally economical steel manufacturing capabilities by facilitating investments and cost efficient productions with adequate availability of raw materials.

With focus on R&D through establishment 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 efficient steel 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 and Production (by 2030-31)

(All values in million tonnes 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

A resilient show by the domestic Steel Industry during 2021 ensured that India not only maintained its global ranks intact [as per rankings released by the World Steel Association (worldsteel], but it also became the 2nd largest producer of crude steel and the largest sponge iron producer in the world but breaking past records: India

emerged as the 2nd largest consumer of total finished steel in the world with its steel consumption edging past the historic 118 million tonnes mark in 2019.

Affecting millions across continents, COVID-19 adversely impacted the major markets around the world in the year of 2020-21. Besides the irreparable loss of human lives, the massive spread of COVID-19 went on to wreak havoc on the global economy through complete shutting down of all economic activities. The world grappled to control the calamitous spreading of the virus ¬— the economic topsy-turvy cavsed has led to meltdowns that may take years to overcome.

The following is a status report on the performance of Indian Steel Industry during April-March 2020-21, based on data published by Joint Plant Committee (JPC). It is to be noted that total finished steel includes both non-alloy and alloy (including stainless steel) and all comparisons are made with regard to same period of last year.

- Production of crude steel was at 103.54 million tonnes, a decline of 5.12 % . At 143.914 million tonnes, crude steel capacity indicated a utilisation of 72 % compared to 77% of last year.
- Hot metal production was 69.26 million tonnes, a decrease of 5.1%.
- Pig iron production was 4.88 million tonnes, down by 10 %.
- Sponge iron production was 34.38 million tonnes, up by 7.3%.
- Total finished steel equivalent production was 96.20 million tonnes, a decrease of 6.3 %.
- Export of total finished steel reached 10.78 million tonnes, an increase of 29 %.
- Import of total finished steel was 4.75 million tonnes, a decrease of 29.8 %.
- India was a net exporter of total finished steel.
- Consumption of total finished steel equivalent was 94.89 million tonnes, a decrease of 6.3 %.

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 important iron & steel units in India are Steel Authority of India, Rashtriya Ispat Nigam, 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 structure of the Indian Steel Industry in 2020-21 along with the production for 2019-20 to 2020-21 is furnished in Table-1. Production of iron & steel, crude steel, pig iron and finished steel (alloy + non-alloy) by SAIL, TSL Group , RINL, AM/NS (erstwhile Essar Steel), JSWL, JSPL and other producers along with production of crude steel from oxygen route, electric arc furnace route and induction furnace route during the year 2016-17 to 2020-21 reflected in Table-2 along with the production of sponge iron through gas-based & coal-based units during the year 2016-17 to 2020-21. The production of iron & steel by Public and Private Sectors during 2015-16 to 2019-20 is furnished in Table-3. The details on plant-wise capacity and production of hot metal and crude/liquid steel are listed out in Table-4. Table-5 elucidates the production of crude/liquid steel by BOF and Electric route (EAF/IF) routes. Crude Steel Scenario Region / State -wise covering No. of Units, Annual Capacity and Production in respect of 2020-21 is shown in Table 6. Prices of steel are provided in Table-7.

Table-1: Structure of the Indian Steel Industry, 2019-20 & 2020-21

(Capacity/Production: In million tonnes)

Sector	Total Annual Capacity	2019-20 Production	2020-21 Production	% Capacity Utilisation
Crude Steel	143.914	109.14	103.54	72%
(A) Producer-wisew				
SAIL, TSL GROUP, RINL, AM/NS, JSWL, JSPL	81.932	68.382	65.053	79%
Other Producers	61.982	40.755	38.491	62%
(B) Sector-wise				
Public Sector	25.932	20.905	19.575	75%
Private Sector	117.982	88.232	84.032	71%
Hot Metal	79.351#	73.011	69.266	93%
Pig iron	NA	5.421	4.877	
Sponge Iron	48.079	37.102	34.376	71%
Total Finished Steel (Non alloy + Alloy + stainless)	NA	102.621	96.204	

Sector	Total Annual Capacity	2019-20 Production	2020-21 Production	% Capacity Utilisation
1) Finished Steel (Non-alloy)	NA	97.5	90.608	
A) Non-Flat Products	NA	49.625	45.157	
Bars & Rods		40.327	37.171	
Structural		7.485	6.494	
Rly Material		1.813	1.493	
B) Flat Products	NA	47.876	45.457	
PM Plates		4.681	4.246	
HR Coil/Strip		43.194	41.204	
2) Finished Steel (Alloy)	NA	2.841	3.326	
A) Non-Flat Products	NA	2.596	2.99	
B) Flat Products	NA	0.245	0.336	
3) Finished Steel (Stainless)	NA	2.28	2.269	
A) Non-Flat Products	NA	0.526	0.577	
B) Flat Products	NA		1.754	1.692

Source: Annual Statistics, 2020-21 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, 2016-17 to 2020-21

(In '000 tonnes)

Item/producers	2016-17	2017-18	2018-19	2019-20	2020-21(P)
I. Pig Iron : Total	10342	5728	6414	5421	4877
SAIL,TSL GROUP , RINL, AM/NS, JSWL, JSPL	905	726	1663	1193	1413
Other Producers	9437	5002	4751	4227	3464
II. Sponge Iron : Total	28762	30511	34705	37102	34376
Gas based	4854	6458	6899	6564	6175
Coal based	23908	24053	27806	30539	28201
III. Crude Steel : Total	97936	103131	110921	109137	103545
Integrated steel Plants (SAIL, TSL GROUP, RINL, AM/NS, JSWL and JSPL)					
Oxygen Route	39603	41747	47412	46735	43947
EAF Units	15883	17639	21295	21647	21106
Other Producers					
Oxygen Route	2291	5645	2043	1838	1138
EAF Route	13187	8879	7181	6719	8301
IF Route	26972	29221	32990	32198	29052
IV. Total Finished Steel (Non alloy +Alloy + Stainless)	120140	126855	101287	102621	96204
SAIL,TSL GROUP , RINL, AM/NS, JSWL, JSPL	61927	69143	61283	61286	55322
Other Producers	58213	57712	40004	41336	40882

Source: Annual Statistics, 2020-21 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.

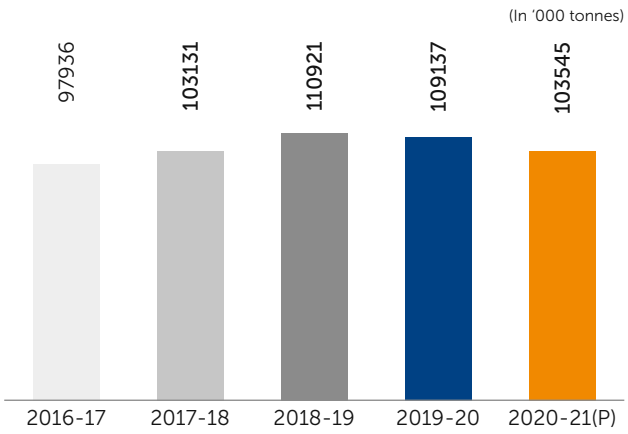


Fig 1: Production of Crude Steel 2016-17 to 2020-21

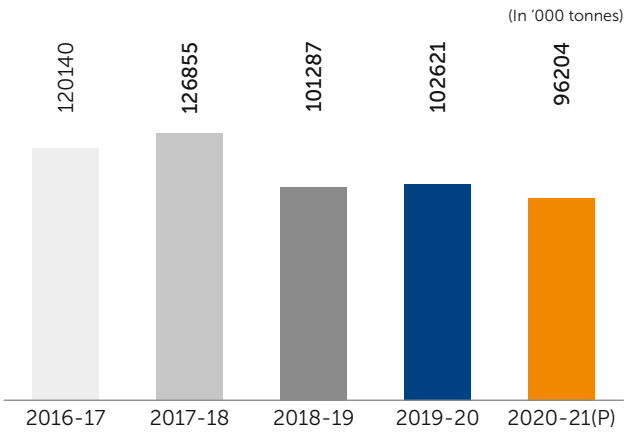


Fig 2: Production of Finished Steel 2016-17 to 2020-21

Table-3: Production of Iron and Steel, 2016-17 to 2020-21

(By Sectors)

(In '000 tonnes)

Item/producers	2016-17	2017-18	2018-19	2019-20	2020-21(P)
I. Pig iron : Total	10342	5728	6414	5421	4877
Public sector (SAIL+RINL)	573	364	588	614	669
Private sector (JSWL+JSPL+TSL Group Other Blast Furnace / Corex Unit)	9769	5364	5826	4807	4208
II. Crude steel /SEMIS: Total	97936	103131	110921	109137	103545
Public sector	18456	19753	21496	20905	19515
Private sector	79480	83378	89425	88232	84030
III. Finished steel (Non-Alloy+Alloy+ Stainless): Total	120140	126855	101287	102621	96203
Public sector (SAIL+RINL)	16571	17944	16933	16029	13783
Private sector {TSL + AM/NS (ESL) +JSWL+JSPL+Other Producers}	103569	108911	84353	86593	82420

Source: Annual Statistics, 2020-21 of JPC;

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

Table-4: Capacity and Production of Hot Metal and Crude/Liquid Steel, 2019-20 and 2020-21

(By Principal Producers)

Unit	Annual installed capacity		Production			
	Hot metal	Crude/ Liquid steel	Hot metal		Crude steel	
			2019-20	2020-21	2019-20	2020-21
Public Sector						
SAIL	17105	19632	17437	16581	16156	15213
Rashtriya Ispat Nigam Ltd (Andhra Pradesh)	6300	6300	5161	4681	4749	4302
Private Sector						
JSW Steel Ltd	16500	18000	15220	14389	16156	14780
TSL Group	17169	19400	19019	17775	18525	17204
AM/NS (Essar Steel Ltd)	3490	10000	3632	3331	7121	6696
Jindal Steel & Power Ltd	5325	8600	5262	5862	5861	6859
Others	13680	60367	7281	6647	40755	38491
Other BOF	-	4077	-	-	1838	1786
Other EAF	-	11794	-	-	6719	7653
IF Units	-	44496	-	-	32198	29052

Source: Annual Statistics, 2020-21 of JPC

Table-5: Production of Crude/Liquid Steel, 2016-17 to 2020-21
(By Sectors)

(In '000 tonnes)

Route/plant	2016-17	2017-18	2018-19	2019-20	2020-21(P)
All Routes: (A+B) Total	97936	103131	110921	109137	103545
A. Oxygen Route : Total	41894	47392	49455	48573	45085
SAIL	14298	14829	16045	15946	15054
RINL	3962	4731	5233	4749	4302
Tata Steel Ltd	11688	12459	-	-	-
TSL Group	-	-	16038	16399	15811
JSW Steel Ltd	9655	9728	10096	9641	8780
Bhushan Steel Ltd	-	3167	-	-	-
Other Oxygen Route	2291	2478	2043	1838	1138
B. Electric Route: Total	56042	55739	61466	60564	58460
Electric Arc Furnace	29070	26518	28476	28366	29407
SAIL	196	193	218	210	158
TSL Group	-	-	2363	2126	1392
AM/NS (Essar Steel Ltd)	5391	6753	6813	7121	6696
JSW Steel Ltd	6851	6679	6647	6329	6080
Jindal Steel & Power Ltd	3445	4014	5254	5861	6859
Lloyds Steel Ltd	575	560	518	495	452
Jindal Stainless Ltd	1391	1497	1554	1418	1458
Bhushan Steel Ltd	5601	87	-	-	-
Bhushan Power & Steel Ltd	3324	2018	2778	2901	3754
Other Electric Arc Furnace	2296	4717	2331	1905	2638
Electric Induction Furnace	26972	29221	32990	32198	29052

Source :- Annual statistics 2020-21 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: 2020-21

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	17	38	823	878	57295	40354	46266	143915	45085	29407	29052	103544
Eastern Region	9	12	133	154	32577	12463	11247	56287	26854	10655	7116	44625
Arunachal Pradesh	-	-	3	3	-	-	125	125	-	-	-	-
Assam	-	-	6	6	-	-	131	131	-	-	59	59
Bihar	-	-	13	13	-	-	830	830	-	-	465	465
Jharkhand	3	1	27	31	16477	1000	2011	19488	13603	648	1298	15549
Meghalaya	-	-	5	5	-	-	181	181	-	-	37	37
Odisha	4	7	42	53	11400	10882	3048	25330	9319	9774	2339	21432
Tripura	-	-	1	1	-	-	30	30	-	-	7	7
West Bengal	2	4	36	42	4700	581	4892	10173	3932	233	2911	7076
Western Region	1	17	220	238	6000	24102	15883	45985	4244	15600	10621	30465
Chhattisgarh	1	6	74	81	6000	6323	6868	19191	4244	3810	5129	13183
Dadra and Nagar haveli	-	-	10	10	-	-	168	168	-	-	145	145
Daman and Diu	-	-	3	3	-	-	46	46	-	-	40	40
Goa	-	-	10	10	-	-	405	405	-	-	400	400
Gujarat	-	2	69	71	-	10150	3538	13688	-	6718	1685	8403
Madhya Pradesh	-	-	9	9	-	-	457	457	-	-	369	369
Maharashtra	-	9	45	93	-	7630	4401	12031	-	5072	2853	7925

State	No. of Units				Annual Capacity ('000 tonnes)				Annual Production ('000 tonnes)			
	BOF	EAF	IF	TOTAL	BOF	EAF	IF	TOTAL	BOF	EAF	IF	TOTAL
Northern Region	0	7	272	279	0	1609	9987	11596	0	993	6092	7085
Delhi	0	0	2	2	0	0	16	16	0	0	10	10
Haryana	0	3	11	14	0	847	190	1037	0	607	123	730
Himachal Pradesh	0	0	25	25	0	0	1144	1144	0	0	766	766
Jammu & Kashmir*	0	0	8	8	0	0	189	189	0	0	118	118
Punjab	0	4	110	114	0	762	4302	5064	0	386	2531	2917
Rajasthan	0	0	31	31	0	0	1005	1005	0	0	589	589
Uttar Pradesh	0	0	46	46	0	0	1617	1617	0	0	1005	1005
Uttarakhand	0	0	39	39	0	0	1524	1524	0	0	950	950
Southern Region	7	2	198	207	18718	2180	9148	30046	15292	2159	5224	21368
Andhra Pradesh	2	0	23	25	6600	0	2014	8614	5001	-	1333	5897
Karnataka	4	1	20	24	11118	2000	2143	15261	9656	2059	806	11688
Kerala	0	0	29	29	0	0	480	480	0	0	253	253
Puducherry (UT)	0	0	10	10	0	0	364	364	0	0	179	179
Tamil Nadu	1	1	98	91	1000	180	2542	3722	635	100	1461	2159
Telangana	0	0	27	27	0	0	1605	1605	0	0	1192	1192

* Jammu & Kashmir,vide enactment of Jammu & Kashmir Reorganisation Act,2019, is a Union Territory.

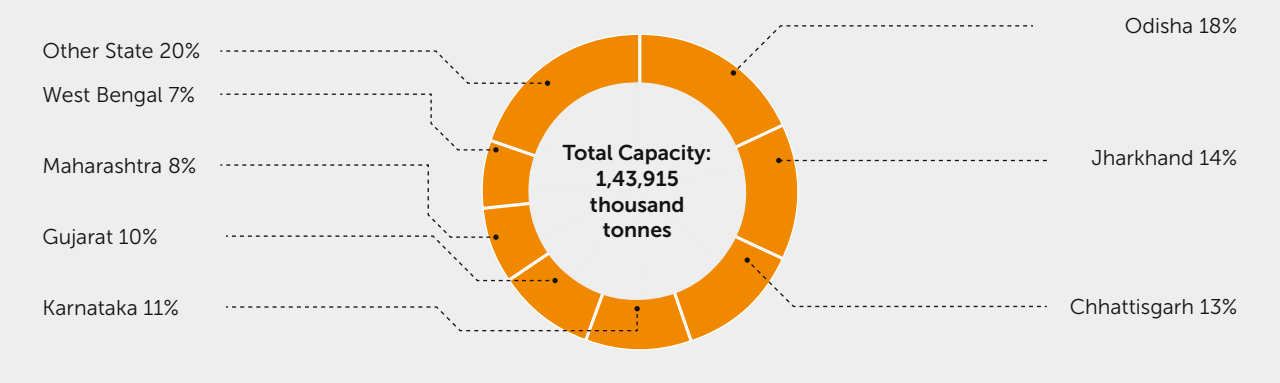


Fig 3: Crude Steel Working Capacity in states 2020-21

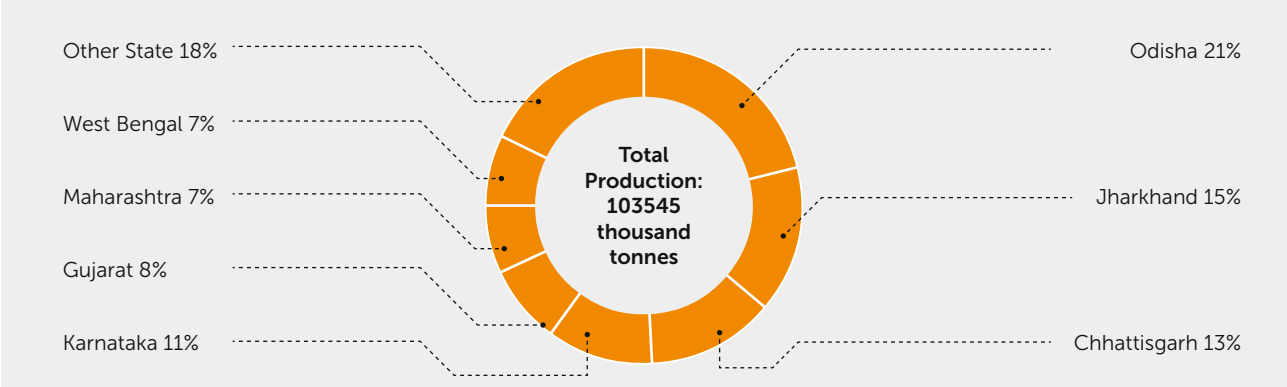


Fig 4: Crude Steel Production in states 2020-21

Table-7: Prices of Steel, 2018-19 to March 2022

(Domestic Markets)

(In ₹ per tonne)

Grade	Market	2018-19	2019-20	Mar-22
TMT Bars (ISI, 8 mm)	Delhi	46180	45044	53075
MS Squares (8 mm)	"	45044	50525	60650
MS Angles (25 x 3 mm)	"	45135	50265	62250
Channels (75 x 40 mm)	"	44827	49560	62813
Joists (150 x 75 mm)	"	44546	51325	63875
Melting Scrap	"	26217	39775	50500
Induction Ingots	"	35698	33517	64700
TMT Bars (local 8 mm)	Mumbai	44998	43838	62550
MS Rounds (8 mm)	"	43658	42258	60650
MS Angles (40 x 6 mm)	"	46071	44619	62250
Joists (150 x 75 mm)	"	44538	42977	62813
Melting Scrap (Foundry G.)	"	-	-	55000
Melting Scrap (Steel G.)		-	-	49000
Melting Scrap (CRCA)		-	-	54000
Induction ingots	"	36119	33170	64700
Arc Ingots	"	36238	33835	64950
Concast Billet ingots	"	36529	34148	59800
TMT Bars (ISI, 8 mm)	Kolkata	46447	45398	63510
MS Squares (8 mm)	"	45726	44944	62110
MS Angles (25 x 3 mm)	"	45242	44773	62750
Channels (75 x 40 mm)	"	47124	44898	62100
Joists (150 x 75 mm)	"	44633	43079	61538
Induction Ingots	"	36190	33982	61900
Arc Ingots	"	36329	34257	64275
Concast Billet Ingots	"	36433	34444	58550
Induction ingots (round)	Gobind	35970	31693	58550
Blooms (SAIL, 150 mm)	"	36016	31660	59750
Old Ship Breaking Scrap	"	29510	29126	48425
Melting Scrap (rolling)	"	33271	28166	51075
MS Rounds (10 mm)	"	45075	43367	66775
MS Squares (8 mm)	"	47033	46018	69575
MS Angles (25 x 3 mm)	"	45313	44051	69475
MS Sponge Iron	"	26529	24566	39425
MS Flat (3 x 20 mm)	"	45300	43339	69075
Pig Iron (Foundry Grade) –A*	Mumbai	-	-	62500
Pig Iron (Foundry Grade) –B*	Punjab	-	-	62625
Pig Iron Steel Grade	"	-	-	60625

Source: Minerals & Metals Review - August 2022

A* : Low Sulphur/Phosphorus, i.e., 0.09% max. which is used in Critical automotive engine components & specialised 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 Foundary 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 103.545 million tonnes (mt) in 2020-21, India's crude steel production declined by 5.1% as compared to 109.14 million tonnes in 2019-20. Given the above production for 2020-21 and with capacity at 143.91 million tonnes, crude steel capacity utilisation stood at 72% during 2020-21 as compared to 77% of last year. The Crude Steel working Capacity and Capacity Utilisation during the last five years are furnished below in Table- 8

Tabe- 8: Production and Working Capacity Crude Steel (2016-17 to 2020-21)

(Quantity in million tonnes)

Year	Working capacity	Production	% Utilisation
2016-17	128.277	97.936	76%
2017-18	137.975	103.131	75%
2018-19	110.921	110.921	78%.
2019-20	142.299	109.137	77%
2020-21	143.914	103.545	72%

Figures rounded off.

With 81 % share, the Private Sector (84.032 million tonne, led the crude steel production in 2020-21. In fact, India's crude steel production has been consistently led by the Private Sector in the last five years ending 2020-21, with average share of the Sector standing at 81% during this period.

With a 63% share, SAIL, RINL. TSL Group, AM/NS (Essar Steel), JSWL, JSPL together produced 65.053 million tonnes of crude steel in 2020-21 while the rest 37% was the share of the other producers during this period. In fact, the trend of last five years ending 2020-21 indicate that India's crude steel production is driven by these six producers.

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 17 Basic Oxygen Furnace units which are available in the Indian Iron & Steel Sector with a total capacity of 57.295 million tonnes and produced 45.085 million tonnes of crude steel through BOF route in 2020-21 at 79 % 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 38 working units with total capacity of 40.354 million tonnes including the SAIL (ASP), AM/NS, JSWL (Dolvi, Vijaynagar) & JSPL and produced 29.407 million tonnes crude steel through EAF route in the year 2020-21 at 73 % 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 823 IF working units with total capacity of 46.266 million tonnes which produced 29.052 million tonnes crude steel through IF route in 2020-21 at 63 % 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)

(In '000 tonnes)

Process Route	2016-17	2017-18	2018-19	2019-20	2020-21(P)
Oxygen	41.894	47.392	49.455	48.573	45.085
EAF	29.07	26.518	28.476	28.366	29.407
IF	26.972	29.221	32.99	32.198	29.052
Total	**97.936**	**103.131**	**110.921**	**109.137**	**103.545**

Source : Performance Review Iron & Steel 2020-21, JPC

On further analysis of the relative shares of the various routes in total production of crude steel, electric furnace route is dominated by the Induction Furnace route, which has emerged as a key driver of crude steel production in the country (Table- 10).

Table-10: Process Route Share in total Production (%age)

(In '000 tonnes)

Process Route	2016-17	2017-18	2018-19	2019-20	2020-21(P)
Oxygen	43	46	44	45	44
EAF	29	26	26	26	28
IF	28	28	30	29	28

Source : Performance Review Iron & Steel 2020-21, JPC

B. Hot Metal

At 69.266 million tonnes in 2020-21, domestic hot metal production declined by 5.12% over 2019-20.

With 81% share, the Private Sector (84.032 million tonnes, led hot metal production in 2020-21.

In 2020-21 , with a 90 % share, SAIL, RINL, TSL Group, AM/NS (Essar Steel), JSWL and JSPL together produced 62.619 million tonnes, a decline of 4.8 % as compared to that in 2019.20. Whereas the other producers produced 6.64 million tonnes which too showed a decline of 8.8% during the year 2020-21.

C. Total Finished Steel (Crude Steel Equivalent)

1. Trend in Production of Total Finished Steel

In the year 2020-21, the production of finished steel, measured in terms of crude steel equivalent, stood at 96.204 million tonnes. The figures of production of finished steel related to the year 2019-20 and 2020-21 are not comparable to other FYs, as they are reported in terms of Crude Steel Equivalent and this is different in concept from those reported for past FYs due to change in reporting system of JPC as approved by Ministry of Steel and Industry Experts.

With a 86% share, the Private Sector produced 82.420 million tonnes finished steel equivalent in 2020-21 while 14 % (13.783 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 58% share, SAIL, RINL, TSL Group, AM/NS (Essar Steel), JSWL, JSPL taken together produced 55.322 million tonnes of finished steel in 2020-21 while the rest 42% (40.882 million tonnes) was the share of the Other producers during this period. In fact, the trend of last five years ending 2020-21 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 90.608 million tonnes, while 3.326 million tonnes and 2.269 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 45.16 million tonnes.
- While that of the Non-alloy Finished Steel flat Segment stood at 45.46 million tonnes.
- Contribution of the Alloy Steel Non-flat Segment stood at 2.99 million tonnes.
- While that of the Alloy Steel Flat Segment stood at 0.34 million tonnes.
- Contribution of the Stainless Steel Non-flat Segment stood at 0.58 million tonnes.
- While that of the Stainless Steel Flat Segment stood at 1.69 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 37.17 million tonnes while production of Structural and Rly. Materials 6.49 million tonnes and 1.49 million tonnes respectively.
- For the Flat Non-alloy Segment, the production of Plate Mill Plates stood at 4.25 million tonnes while production of HR Coil/Strip stood at 41.20 million tonnes.
- In the Non-flat, Alloy Steel Segments, the overall production of all items stood at 2.99 million tonnes.
- Flat alloy Steel production stood at 0.34 million tonnes.
- In the Non-flat, Stainless Steel Segment, the overall production of all items stood at 1.75 million tonnes.
- Flat Stainless Steel production stood at 1.69 million tonnes.

2. Trends in Consumption of Total Finished Steel

Finished Steel consumption stood at 94.891 million tonnes in 2020-21 as compared to 100.17 million tonnes during 2019-20, notching down a growth of 5.3 %. Data on overall consumption of total finished steel (non-alloy + alloy + stainless) during the last five years is provided in Table-11and is illustrated in and these indicate a steady growth in domestic steel consumtion during the said period. However, reflecting on the year-on-year (yoy) rate of growth it could be said that such a trend, impacted and shaped largely by macroeconomic factors and prevailing steel market conditions, has followed a zig-zag track, with growth rates peaking in 2019-20 (1.5%) but falling thereafter to a significantly low 5.3% in 2020-21 (Table-12).

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

(Crude Steel Equivalent) (2016-17 to 2020-21)

(In '000 tonnes)

Year	Total Finished Steel Consumption	% yoy change
2016-17	84042	3.1
2017-18	90708	7.9
2018-19	98708	8.8
2019-20	100171	1.5
2020-21	94891	-5.3

Figures rounded off.

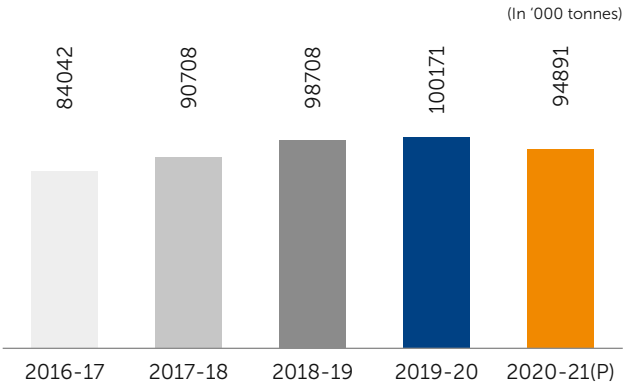


Fig 5: Production of Crude Steel 2016-17 to 2020-21

Table-12: Total Finished Steel Consumption - Non-alloy / alloy / stainless steel wise

Crude Steel Equivalent (2019-20 to 2020-21)

(In '000 tonnes)

ITEM	2019-20		2020-21 %		% yoy Change
	Qty	% share	Qty	% share	
Total Finished Steel (Non alloy+ alloy + stainless)	100171	-	94891	-	5.3
Non-alloy Finished Steel	93477	93.3	88667	93.4	5.1
Alloy Finished Steel	3988	4	3833	4	-3.9
Stainless steel	2706	2.7	2392	2.6	-11.6

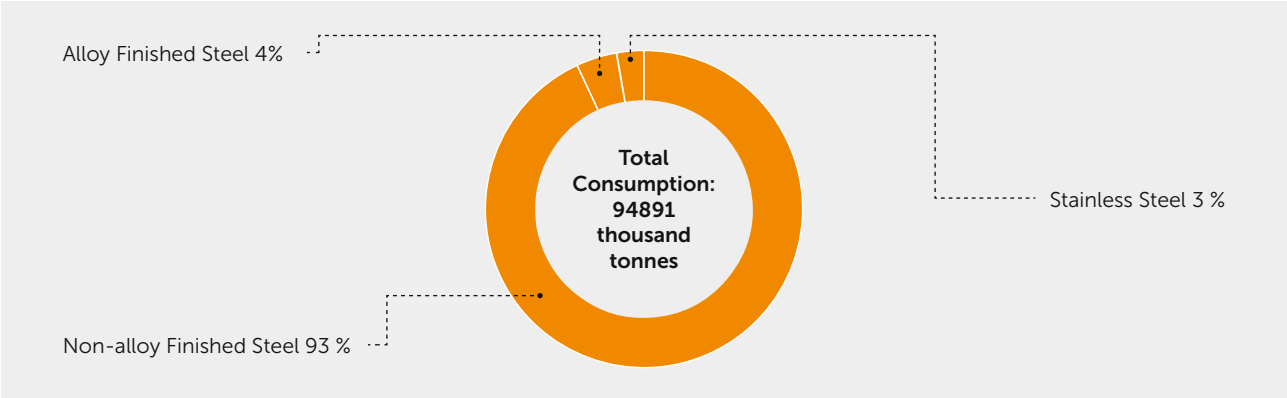


Fig 6: Total Finished Steel Consumption –Non alloy 2020-21

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 2019-20 and 2020-21. 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 (2019-20 to 2020-21)

(include non-alloy + alloy + stainless)

(In '000 tonnes)

ITEM	2019-20		2020-21 %		% yoy Change
	Qty	% share	Qty	% share	
Total Finished Steel (Non Flat+ Flat)	100171	-	94891	-	5.3
Non-Flat Finished Steel	51720	51.6	51354	54.1	0.7
Flat Finished Steel	48451	48.4	43537	45.9	-10.1

Source : Annual Statistics 2020-21; JPC

Table-14 shows detailed consumption data for major categories of finished steel in 2020-21 over 2019-20 in terms of crude steel equivalent of finished steel as per the present reporting system. The data reveals that in the non-alloy, non-flat segment, the major contributor to consumption was bars & rods (39.67 million tonnes — up by 0.9 %) whereas for the flat segment, consumption was led by HRC (36.64 million tonnes, down by 9.4 %). Consumption of alloy and stainless steel recorded a declined by 3.9 % and 11.6 % respectively and non-alloy steel also decline by 5% during the year 2020-21.

Table-14: Detailed Consumption for Major Categories of Total Finished Steel in 2020-21 over 2019-20

(Crude Steel Equivalent)

(In '000 tonnes)

ITEM	2019-20	2020-21	% yoy Change
Total Finished Steel (Non-alloy + Alloy + stainless)	100171	94891	-5.3
1. Finished Steel (Non-alloy)	93478	88667	-5.1
a) Non-Flat Products	48345	47789	-1.2
Bars & Rods	39329	39679	0.9
Structural	7167	6562	-8.4
Rly Material	1849	1548	-16.3
b) Flat Products	45133	40878	-9.4
PM Plates	4684	4242	-9.4
HR Coil/Strip	40449	36635	-9.4
2. Finished Steel (Alloy)	3988	3833	-3.9
a Non-flat Products	2960	3099	4.7
b) Flat Products	1028	734	-28.6
3. Finished Steel (Stainless)	2706	2392	-11.6
a) Non-flat Products	416	466	12
b) Flat Products	2290	1925	-15.9

D. Pig Iron

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

The working capacity of hot metal & pig iron during 2020-21 was reported as 77.94 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 4.88 million tonnes in 2020-21, a decline of 10 % as compared to the production of 5.421 million tonnes 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

Sl.No.	Plants/unit	Location	Capacity
9	Bhushan Power and Steel Ltd, Odisha	Odisha	2500
10	Electro Steels Ltd, Jharkhand	Jharkhand	1450
11	Electrosteel Castings Limited, Khardah	West Bengal	250
12	Electrotherm (India) Ltd	Gujarat	277
13	Ispat Damodar Ltd	West Bengal	15
14	J S W Steel Ltd, Salem (Siscol)	Tamil Nadu	1000
15	J S W Steel Ltd, Vijaynagar	Karnataka	12000
16	Jai Balaji Industries Ltd West Bengal Unit-3	West Bengal	429
17	Jai Balaji Industries Ltd West Bengal Unit-4	West Bengal	81
18	Jai Balaji Industries Ltd - I	West Bengal	30
19	Jayaswals Neco Inds Ltd	Chhattisgarh	650
20	Jindal Steel and Power Ltd, Chhattisgarh	Chhattisgarh	2125
21	Jindal Steel and Power Ltd, Odisha	Odisha	3200
22	Jsw Ispat Special Products Ltd, Raigarh	Chhattisgarh	613
23	Jsw Steel Ltd, Dolvi	Maharashtra	3500
24	K I C Metaliks Ltd	West Bengal	165
25	Kalyani Steels Ltd	Karnataka	480
26	Kirloskar Ferrous Inds Ltd	Karnataka	385
27	Kohinoor Steels Ltd	Jharkhand	48
28	Makers Casting India Pvt Ltd	Jharkhand	2
29	Mideast Integrated Steels Ltd	Odisha	460
30	Narsingh Ispat Ltd	Jharkhand	83
31	Neelachal Ispat Nigam Ltd	Odisha	1099
32	Neo Metaliks Ltd	West Bengal	188
33	Niranjan Hi- Tech Ltd.	Jharkhand	15
34	Rashmi Metaliks Limited	West Bengal	170
35	SAIL–Bhilai Steel Plant	Chhattisgarh	3925
36	SAIL–Bokaro Steel Plant	Jharkhand	4360
37	SAIL– Durgapur Steel Plant	West Bengal	1802
38	SAIL– Iisco Steel Plant	West Bengal	2500
39	SAIL–Rourkela Steel Plant	Odisha	4400
40	SAIL–Visveswaraya Iron And Steel Ltd, Bhadrabati	Karnataka	118
41	Sathavahana Ispat Ltd	Andhra Pradesh	240
42	Satyam Ferro Tech Ltd	Jharkhand	30
43	Shyam SEL and Power Ltd, Jamuria	West Bengal	60
44	SLR Metaliks Ltd	Karnataka	240
45	Sree Metaliks Ltd	Odisha	36
46	Sri Kalahasthi Pipes Limited (Lanco)	Andhra Pradesh	300
47	Suraj Products Ltd	Odisha	24
48	Swati Concast and Power Pvt Ltd	Jharkhand	43
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 (2019-20)

(Crude Steel Equivalent)

(In '000 tonnes)

State	No.of working Units	Working Capacity	Annual installed capacity	
			Hot metal	Pig Iron
Jharkhand	9	16828	15630	506
Odisha	12	19053	15915	497
West Bengal	13	6302	5209	1351
Chhattisgarh	4	7313	7487	586
Goa	1	625	593	593
Gujarat	2	3767	3178	11
Maharashtra	2	4100	3347	6
Andhra Pradesh	4	7140	5242	329
Karnataka	5	13223	11435	905
Tamil Nadu	1	1000	930	34
Total	**53**	**779351**	**69266**	**4877**

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 86 % share, the Private Sector (4.208 million tonnes, down by 12.4 % over 2019-20) led pig iron production in 2020-21, with the average share of the Sector at 91% in the last five years ending 2020-21.The share of Public Sector in 2020-21was about 9 % (0.67 million tonnes, up by 9 % over previous year).

With a 71 % share, the Other Producers (3.464 million tonnes, down by 18% over 2019-20) led pig iron production in 2020-21 while the rest 29 % was the share contributed by SAIL, RINL, TSL Group, AM/NS(Essar Steel), JSWL, JSPL taken together. In fact, the trend of last five years ending 2020-21 has been similar in this regard.

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 47.85 million tonnes in 2020-21.The total number of working units is 285 out of which 281 are coal-based units and 4 are gas-based units. The DRI operating capacity got increasingly built up during 2015-16 to 2020-21. At 34.376 million tonnes in 2020-21, India's sponge iron production declined by 7.3% over that of 2019-20.

Over the years, the coal-based route has emerged as a key contributor to overall production and its share increased from 63% in 2004-05 to about 82% (28.2 million tonnes, decline by 7.7%) of total sponge iron production in the country in 2020-21, with the average share of the Route at 81% in the last five years ending 2020-21. State-wise capacity and production of sponge iron are reflected in Table- 17.

Table-17: State-wise Capacity and Production of Sponge Iron (2020-21)

(In '000 tonnes)

State	No.of working Units	Working Capacity	Annual Production
Total	**285**	**48079**	**34376**
Western Region	**89**	**21185**	**15074**
Chhattisgarh	69	9474	7587
Goa	3	186	180
Gujarat	10	8115	5428
Maharashtra	7	3410	1879
Eastern Region	**136**	**20224**	**14477**
Jharkhand	24	3372	2399
Odisha	76	12826	8297
West Bengal	36	4026	3782

State	No.of working Units	Working Capacity	Annual Production
Northern Region	4	537	389
Uttar Pradesh	4	537	389
Southern Region	56	6133	4435
Andhra Pradesh	6	911	403
Karnataka	35	4267	3346
Tamil Nadu	6	528	336
Telangana	9	427	350

Source : Annual Statistics 2021; JPC

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 during 2020-21

Sl. No.	Type of Industry	No. of Working Units	Working Capacity ('000 tonnes)	Production ('000 tonnes)
I	Pellets	38	82726	69626
II	Sponge Iron	285	48079	34376
III	Blast Furnace	53	79351	69266
1	BOF	17	57295	45085
2	Electric Arc Furnace	38	40354	29407
3	Induction Furnace	823	46266	29052
IV	Crude Steel (1-3)	878	143914	103545
V	Finished Steel (Crude Steel Equivalent)			
4	Re-rolling	1029	83792	51223
5	HR Product	24	54900	44552
VI	Value - added steel	66	27030	15481
6	CR Product	28	9576	6727
7	GP/GC Sheets	16	2727	2064
8	Colour Coated	5	849	481
9	Tin plate	81	10100	3531
10	Pipes	-	-	-

Source : Annual Statistics 2020-21; 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 these get generated in large quantities and form substantial reserves of scrap that could be efficiently put to use. Iron scrap is available in the country in the form of pressed bundles, a mixture of used steel components (called as a commercial scrap), turnings & borings and heavy melting scrap. These are generated by industries of all sectors like automobiles, railways and engineering workshops.

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

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

Ship Breaking

Ship breaking has been a major source of scrap generation. Ship breaking activities are carried out at various places on the Indian coast, the largest concentration being in the West coast. Private entrepreneurs handle the task of ship breaking in India. It is a labour-intensive job, and in India, it is a cost-efficient activity. Locations of present ship breaking activities are:

(i) Alang and Sosiya yards in Bhavnagar district, Gujarat,

(ii) Sachana district, Gujarat

(iii) Mumbai and

(iv) Kolkata

Alang & Sosiya yards account for 98% concentration of the Ship Breaking Industry in India.The yard has capacity to recycle about 450 ships per year generating re-rollable steel of > 4.5 million tonnes per annum. There are a total of 167 plots available for ship recycling spread over 10 km stretch along the coast of Alang.

The NGO Shipbreaking Platform is a global coalition of environmental, human and labour rights organisations working to promote safe and environmentally sound ship recycling practices. The coalition quickly evolved from being a European Platform to a global one, including NGOs based in the major shipbreaking countries, such as, India, Bangladesh, Pakistan and Turkey. It now has 18 member organisations and six partners in 12 countries. The Platform is recognised by United Nations agencies, the European Union and leading media outlets as the preeminent international civil society advocacy organisation on ship recycling.

Today, Alang possibly represents the single largest concentration of Ship-breaking Industry in the world. The average life of an ocean-going ship is about 25–30 years. About 40% of the ships broken are dry cargo ships, while the remaining 60% of the ships broken are wet cargo, tanker – specialised ships etc. These recyclable steels mainly as steel scrap provide feed to Steel and Foundry Industry in India. The steel generated from ship recycling contributes to around 1% to 2% of the domestic steel demand.

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 Safeand 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 canalising agency for import of carbon steel melting scrap, sponge iron, hot briquetted iron and re-rollable scrap till February 1992.

Presently, the Company has diversified mainly into providing e-auction /e-procurement services. Under this segment, the Company undertakes disposal of ferrous and non-ferrous scrap arisings, surplus stores, condemned plants, minerals, Agri & forest produce etc. from Public Sector Undertakings and Government Departments including private companies. The Trading Division is engaged in import as well as domestic sourcing of bulk industrial raw material for actual users as well as traders. This Division looks after sourcing, purchase and sale of industrial raw materials like low ash metallurgical coke, HR coil, naphtha, crude oil, coking coal, steam coal, line pipes etc. on behalf of customers across steel, oil & gas, power sectors under Private and Public Sector. It also undertakes trading of items within the country in competition with any other private trader.

Ferro Scrap Nigam Ltd (FSNL)

FSNL is a wholly owned subsidiary of MSTC Ltd under the Ministry of Steel. The Company undertakes the recovery and processing of scrap from slag and refuse dumps in the nine steel plants at Bhilai, Bokaro, Burnpur, Durgapur, Rourkela, Visakhapatnam, Dolvi, Duburi and Haridwar and also at Rail Wheel factory Bengaluru. The scrap so recovered is returned to the steel plants for recycling disposal and the Company pays processing charges on the quantity recovered at varying rates depending on the category of scrap. Scrap is generated during iron & steel making and also in the rolling mills. In addition, the Company provides steel mill services, such as, scarfing of slabs, handling of BOF slag, etc.

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.

Production of Slag

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, Bhadravati, 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.

Consumption of Slag

The Steel Industry in India is producing about 24 million tonnes of blast furnace slag and 12 million tonnes of steel slag annually. It is expected that the BF slag generation may reach around 45 to 50 million tonnes and BOF slag around 15– 20 million tonnes per year by 2030. Besides, EAF and IF slag generation will also increase to more

than 10 million tonnes per year from the present level of around 5 million tonnes per year by 2030. The BF slag in India is used mainly in the cement manufacture and in other unorganised work, such as, landfills and railway ballast. A small quantity is also used by the Glass Industry for making slag wool fibres. Cement plants in the country producing slag cement require BF slag in granulated form.

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 2020 was about 1,400 million tonnes which increased marginally by 2.6 % as against 1,382 million tonnes in 2019. China (63%), India (7%), Japan & Russia (4% each), Republic of Korea (3%) and Iran, Brazil & Germany (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	2018-19	2019-20	2020-21
World	**1358000000**	**1382000000**	**1418000000**
China	779876300	809365000	893100000
India*	106823000	111574000	101400000
Japan	77327888	74907006	61600469
Russia	51800000	51200000	52000000
Korea, Rep of	47124000	47521000	45359000
Iran	28100000	31000000	32700000
Brazil	32765000	30901000	29655000
Germany	27271000	25400000e	23000000
Ukraine	20531200	20055900	20238000
USA	24058000	22301000e	18300000
Other countries	162087325	157906862	140216553

Figures rounded off ;

Source: BGS, World Mineral Production, 2016-2020

* India's production of Pig Iron during 2018-19, 2019-20 and 2020-21 was 64,14,000 tonnes, 54,21,000 and 48,77,000 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 2020 marginally increased by 0.1% to 1,857 million tonnes from 1,855 million tonnes in 2019. China was the top producer accounting for 57% of world's crude steel production, followed by India (5%), Japan , USA & Republic of Korea (4% each), and Germany, Turkey & Brazil (2% each) (Table-21).

Table-21: World Production of Steel Crude
(By Principal Countries)

(In tonnes)

Country	2018-19	2019-20	2020-21
World Total	**1834000000**	**1855000000**	**1857000000**
China	929038400	996342000	1064732000
India[(d)]	110920000	102058000	95122000
Japan	104318836	99284114	83186485
Russia	74144495	73740141	7460000
USA	86607400	87761000e	72690000
Korea, Rep. of	72464000	71411000	67082000
Turkey	37311700	33700000	35763000
Germany	42435000	39667000	35658000
Brazil	35407000	32569000	31415000
Other countries	320940216	318575128	297117677

Figures rounded off;

Source: BGS, World Mineral Production, 2016-2020,

* India's production of crude steel during 2018-19, 2019-20 and 2020-21 was 1,10,921,000 tonnes, 1,09,137,000 and 1,03,545,000 tonnes, respectively.

(d) Years ended 31st March following that stated.

FOREIGN TRADE

Exports

In terms of value, exports of iron & steel (total) increased slightly by 20 % to ₹1,22,510 crore in the year 2020-21 from ₹1,01,996 crore in the previous year. Iron & Steel exports in 2020-21 comprised mainly of Semi-finished Steel (including Steel Ingots) with ₹48,095 crore (39%) and Finished Steel Including Cold Rolled Sheet with ₹35,843 crore (29%). and Other Finished Steel, NES with ₹34,059 crore (28%). Other items together accounted for the remaining 4 % exports. In terms of value, exports of iron & steel in the year 2020-21 were mainly to USA (12%), Vietnam (10%), Nepal, UAE & Italy (6% each), Germany (4%) and Belgium & Bangladesh (3% each) (Tables- 22 to 32).

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**	**1019955563**	**	**1225105321**
USA	**	16236652	**	152007711
Vietnam	**	121911905	**	119370682
Nepal		78635322		77714158
UAE	**	77685549	**	76806887
Italy	**	63074307	**	75130322
Belgium	**	67564368	**	36799755
Germany	**	38867032	**	48319029
Bangladesh	**	36280244	**	32998105
UK	**	22677140	**	27071331
Canada	**	26560508	**	27046766
Other countries	**	470462536	**	524840575

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4631222**	**309262120**	**6108963**	**358432755**
Nepal	1119805	33710113	1077289	36877715
China	160490	6686255	1206831	35099422
USA	231106	31814834	129635	24633704
Belgium	248973	50518714	294746	22484302
Italy	217252	17019826	159829	15666462
UAE	253650	18890300	187626	14960010
Oman	61292	6203570	155069	14753277
Canada	166106	16277447	115643	12268008
Thailand	179137	6268369	289316	9391071
Indonesia	266523	12813664	226448	9358946
Other countries	1726888	139059028	2266531	162939838

Figures rounded off

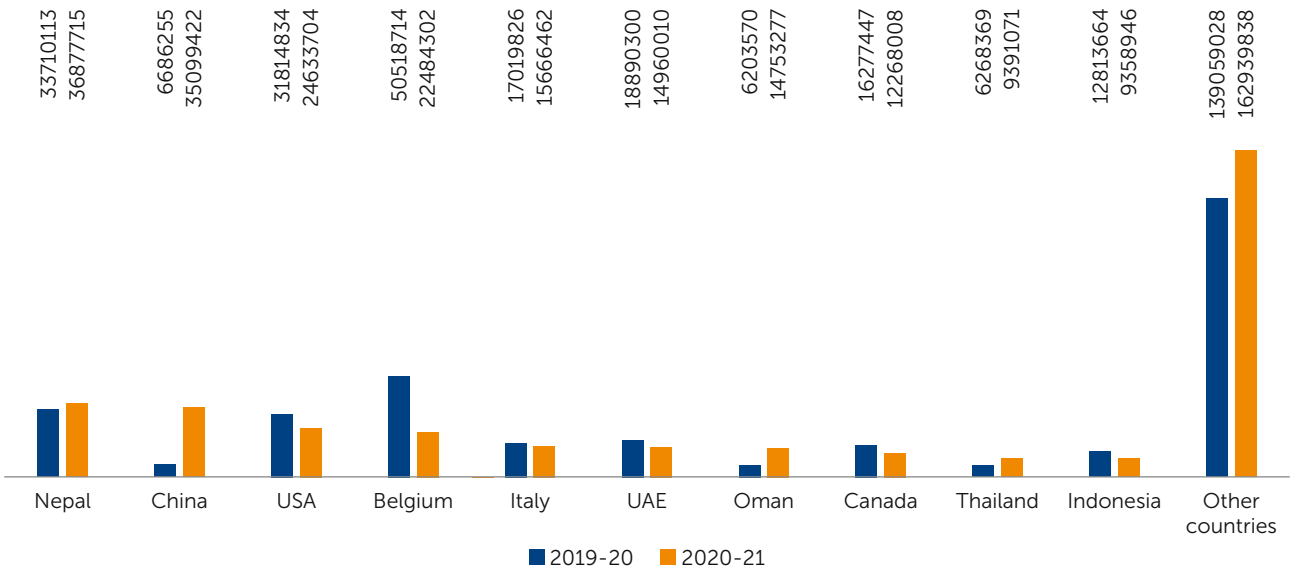


Fig 7: Country wise Value of Export of Iron & Steel

Table-24: Exports of Iron & Steel

(Steel wire)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**159597**	**23911264**	**169631**	**25750975**
USA	19002	3757083	21538	4032087
Netherlands	16630	2719757	16695	2861241
Turkey	8419	1433262	10125	1672341
France	7500	1254420	8978	1650759
Russia	7684	1457079	7986	1551073
Germany	3951	809174	6419	1369530
Italy	4208	841871	5479	1089365
UAE	8506	919735	8516	986881
Nepal	15639	717916	16231	768269
UK	3721	634568	3792	715614
Other countries	64337	9366399	63872	9053815

Figures rounded off

Table-25: Exports of Iron & Steel

(Other Finished Steel, NES)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	******	**339926285**	******	**340587784**
USA	**	80606408	**	85605428
Germany	**	23399614	**	20652426
UK	**	17271517	**	16687853
UAE	**	18881064	**	15912729
Saudi Arabia	**	7663138	**	9595069
Netherlands	**	9839791	**	9508219
Italy	**	9362606	**	9220254
Canada	**	8786260	**	8511984
Bangladesh	**	8896368	**	7434064
Australia	**	6903716	**	7362939
Other countries	**	148315803	**	150096819

Figures rounded off

Table-26: Exports of Iron & Steel

(Semi-finished Steel Including Steel Ingot)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**7957507**	**320684584**	**12577510**	**480956813**
China	203221	5964786	3973874	113751925
Vietnam	2356856	75596961	2244954	73639866
Italy	911046	35517209	1109787	49058758
UAE	742929	28015351	781766	31056671
Nepal	928223	32742555	762992	28207151
Belgium	250701	12220301	386942	20451813
Spain	179275	7433837	311947	13671849
Indonesia	78345	3016429	340693	12207779
Hong Kong	129007	4494438	331957	11557452
Thailand	129873	4600137	276828	10719669
Other countries	2048031	111082580	2055770	116627880

Figures rounded off

Table-27: Exports of Iron & Steel : Alloy Steel

(Granules)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	484	29004	422	29056
USA	48	7079	23	7579
UAE	126	5568	121	5349
Taiwan	75	2849	99	4152
Kenya	--	--	51	2667
Portugal	14	2287	14	2384
Bangladesh	23	1316	33	2359
Nigeria	57	2857	27	1641
Malaysia	--	--	27	1221
Saudi Arabia	120	5743	15	830
Nepal	10	539	11	693
Other countries	11	766	1	181

Figures rounded off

Table-28: Exports of Iron & Steel: Alloy Steel

(Powder)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	68	9067	4	1760
Turkey	1	969	1	839
Indonesia	1	262	2	544
Taiwan	--	--	1	163
China	11	1070	++	140
Austria	++	29	++	27
Germany	--	--	++	25
Czech Republic	++	2	++	22
Iran	10	3722	--	--
Sweden	19	1972	--	--
Tanzania	24	642	--	--
Other countries	2	399	--	--

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	11876	688320	25613	649151
Bhutan	5663	139377	20609	244302
Sweden	2301	355841	1368	208921
UAE	60	22904	189	72586
Brazil	384	39738	413	42620
Malaysia	414	11820	987	22423
Singapore	575	19101	1217	14997
Thailand	57	3299	182	7965
France	21	8436	16	6133
Korea	335	4676	94	5807
Nepal	81	4510	114	5421
Other countries	1985	78618	424	17976

Figures rounded off

While in terms of quantity, the exports of Pig and Cast Iron including Spiegeleisen increased substantially by155 % to 1,123 thousand tonnes in 2020-21 from 440 thousand tonnes in the previous year. Exports were mainly to China (57 %), USA (19 %), followed by Bangladesh & Oman (8% each) (Table-30 to 33)

Table-30: Exports of Iron & Steel

(Sponge iron)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	898475	17286760	524566	11248671
Bangladesh	433009	8494481	278459	5983287
Nepal	181061	3217577	161972	3556579
Bhutan	193604	3585642	68390	1268552
Malaysia	56498	1205773	4674	114303
Kenya	4353	89611	2271	67416
USA	482	75013	274	44545
Thailand	1020	20727	2002	41929
Madagascar	3144	69212	1761	41479
Sri Lanka	2855	58096	1376	33098
Sudan	15954	314529	1481	27430
Other countries	6495	156099	1906	70053

Figures rounded off

Table-31: Exports of Iron & Steel

(Stainless Steel)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	8181	3679488	12889	3197360
France	174	812883	350	657506
Bangladesh	155	133341	4025	370124
Nigeria	704	205757	2239	344675
USA	1332	357089	1250	285639
UAE	715	241575	545	189237
Saudi Arabia	569	213211	289	115661
Russia	1	270	312	99950
Italy	417	162272	223	95339
Qatar	185	50569	222	80280
Malaysia	61	24431	108	76826
Other countries	3868	1478090	3326	882113

Figures rounded off

Table-32: Exports of Iron & Steel Material

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	84891	4478671	70062	4250996
UAE	11897	587418	11471	612288
Brazil	12743	635548	11306	535792
USA	12127	709804	6147	450033
Turkey	8969	459192	9020	414925
Belgium	3222	234084	3143	395078
Puerto Rico	4380	212365	6688	362413
Qatar	3580	143142	4118	174490
Bangladesh	296	15404	2990	150040
Trinidad	1879	89983	2515	136363
Slovenia	--	--	2221	114196
Other countries	25798	1391731	10443	905378

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	440432	10737676	1123792	30155194
China	181910	3957345	637214	15383161
USA	1443	169468	215373	6803201
Bangladesh	180832	4257535	88895	2468097
Oman	14	2343	85799	1897118
Turkey	233	25364	36498	1322513
UAE	1174	55296	16498	641140
Nepal	10305	258802	13791	357175
Taiwan	1619	40127	7539	291501
Japan	7348	296504	5775	262072
Thailand	22850	580597	7451	229210
Other countries	32704	1094295	8959	500006

Figures rounded off

However, in terms of quantity, the exports of slag (dross, etc.) in 2020-21 increased by 16 % to about 152 thousand tonnes from 132 thousand tonnes in the previous year. Exports were mainly to Philippines (58%), Malaysia (16%), Vietnam (15%) and Nepal (8 %) (Table-34).

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	131880	702416	152818	951045
Philippines	115500	638112	88000	655043
Vietnam	--	--	23600	153353
Malaysia	--	--	23858	81107
Nepal	14654	54536	12672	30075
Bhutan	1111	5481	1818	10712
China	--	--	1166	6747
South Africa	102	708	750	6129
Qatar	140	849	465	2941
Angola	347	2328	362	2750
Br Virgin Is	--	--	22	1609
Other countries	26	402	105	579

Figures rounded off

Imports

Like exports in terms of value, imports of iron & steel (total) in 2020-21 decreased marginally by 18% to ₹82,638 crore from ₹1,01,387 crore in the previous year. Iron & steel imports in 2020-21 comprised mainly of finished Steel Including Cold Rolled Sheet with ₹28,136 crore (34%), Scrap with ₹21,340 crore (26%), Other Finished Steel, NES with ₹18,715 crore (23%) and Semi-finished Steel including Ingots with ₹9,734 crore (12%). Other items together accounted for the remaining 5% imports. In terms of value, the imports in 2020-21 were mainly from China (19%) followed by Republic of Korea (17%), Japan (8%), USA (5%) and UAE (4%) (Tables- 35 to 45) .

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**	**1013874204**	**	**826381853**
China	**	180714157	**	153661953
Korea, Rep. of	**	180437240	**	140136092
Japan	**	94345436	**	67911395
USA	**	53373825	**	43110658
UAE	**	43942879	**	36377761
Germany	**	35006576	**	32042498
Singapore	**	33720103	**	27885974
Vietnam	**	23468621	**	26444970
Malaysia	**	25045558	**	24673252
UK	**	29015568	**	22291777
Other countries	**	314804241	**	251845523

Figures rounded off

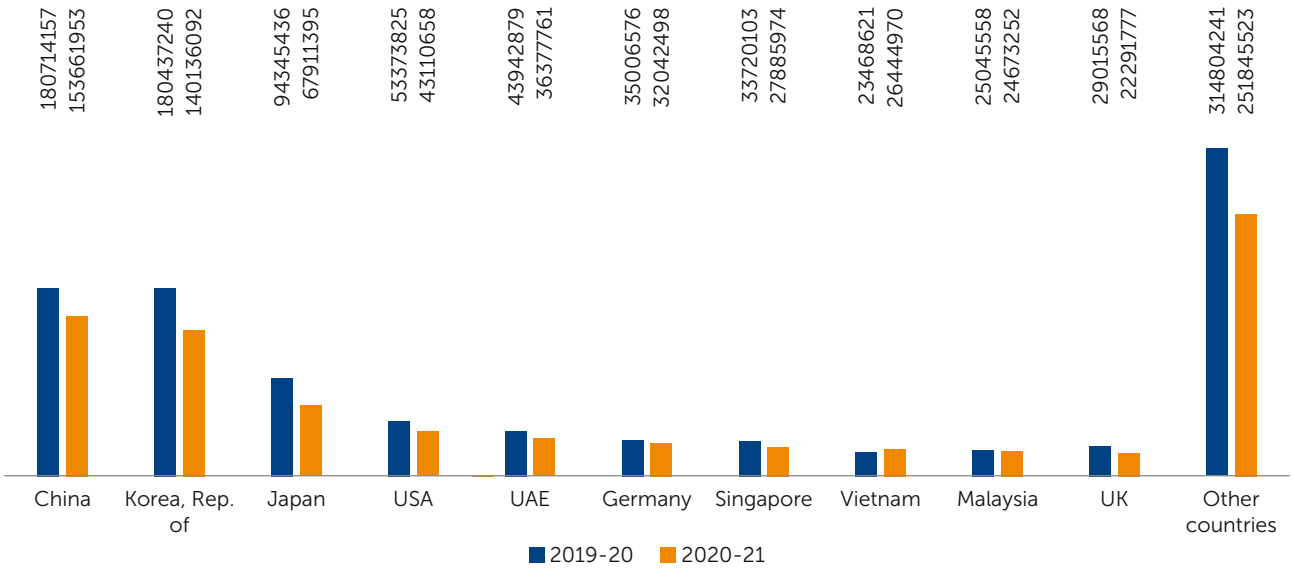


Fig 8: Country wise Value of Export of Iron & Steel

Table-36: Imports of Iron & Steel

(Finished Steel Including CR Sheet)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4024286**	**358688033**	**3123084**	**281364644**
China	1150799	93590513	908307	76871110
Korea, Rep. of	891675	69791425	722938	56701936
Japan	608521	53468349	485725	44102605
Belgium	147367	11054117	83643	9597484
Vietnam	70292	6089714	113528	9260800
Germany	61764	8654395	40058	8009947
Indonesia	284372	35301903	52344	6555312
Malaysia	60206	5490376	52982	6489554
USA	67338	7766618	54558	6017647
France	20954	4826890	69332	5514598
Other countries	660998	62653733	539669	52243651

Figures rounded off

Table-37: Imports of Iron & Steel

(Steel Wire)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**185193**	**17301064**	**151105**	**15473255**
China	62778	5454971	58769	5436942
Korea, Rep. of	25191	2257897	22503	2150814
Malaysia	33802	2493739	22717	1780729
Japan	6834	1886421	5316	1727262
Vietnam	8355	646043	8655	649393
Thailand	7568	576181	6459	539811
Germany	1076	565553	973	464100
France	2497	307319	3041	337048
Indonesia	4019	3992142	2998	311196
Italy	2874	353167	2507	305448
Other countries	30199	2367631	17167	1770512

Figures rounded off

Table-38: Imports of Iron & Steel

(Other Finished Steel, NES)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (**)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	****	**202485997**	****	**187149323**
China	**	62995142	**	60848505
Korea, Rep. of	**	17240483	**	15497795
Germany	**	15105225	**	14015783
Japan	**	13631680	**	13033669
USA	**	12114076	**	10867738
Thailand	**	7925917	**	8001613
Singapore	**	7175304	**	7585258
Italy	**	7745663	**	7273790
Vietnam	**	5212404	**	6720669
UK	**	5021329	**	4980939
Other countries	**	48318774	**	38323564

Figures rounded off

Table-39: Imports of Iron & Steel

(Semi-finished Steel Including Steel Ingots)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3008429**	**146062138**	**1848059**	**97340310**
Korea, Rep. of	1687140	76803491	1179765	55092241
China	214067	11095010	114215	6814712
Japan	465235	20727127	89374	5702327
Belgium	21986	1178189	80463	5001515
France	13857	1359330	50000	3841671
Italy	41812	3412477	25706	2017162
Sweden	12297	2822220	7071	1852028
Ukraine	107096	3919953	44641	1645577
Singapore	129842	5174025	35331	1614181
Thailand	38341	1572976	31540	1582648
Other countries	276756	17997340	189953	12176248

Figures rounded off

Table-40: Imports of Iron & Steel: Alloy Steel

(Granules)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	20530	1083770	17284	1015659
France	4927	265210	5870	317289
China	5359	245998	3044	168417
Germany	1400	94234	1414	110734
Thailand	1483	74508	1968	101633
Spain	1911	105858	1728	99971
Taiwan	682	44720	960	53109
Netherlands	220	14409	492	38994
South Africa	3082	146526	789	38600
Japan	36	15041	104	22244
USA	1	2575	220	19738
Other countries	1429	74691	695	44930

Figures rounded off

Table-41: Imports of Iron & Steel: Alloy Steel

(Powder)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3661	579712	2596	590464
UK	233	156206	233	146086
China	337	73529	600	102983
Japan	18	59672	67	90538
Germany	587	63044	747	87770
Netherlands	39	14990	58	45837
Canada	2133	109851	528	45771
USA	119	45003	95	35846
Sweden	106	11800	147	17250
Singalpore	8	29873	3	6396
Belgium	26	12237	28	6119
Other countries	55	3507	90	5868

Figures rounded off

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

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	6776675	241791670	5393385	213404783
UAE	1039544	32190631	874594	29380968
USA	847122	31637831	621408	24833165
UK	776918	20853101	544678	14918210
Singapore	439295	15847842	377204	14622849
Malaysia	164640	9021681	186401	11925230
Netherlands	213093	11641595	110936	8339788
Canada	178286	8625581	180010	7329732
Australia	217643	6804969	241890	7235280
Thailand	87130	6447507	84608	7068178
Germany	141929	6877874	96537	6264725
Other countries	2671075	91843058	2075119	81486658

Figures rounded off

Table-43: Imports of Iron & Steel

(Sponge Iron)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**65244**	**1263296**	**68343**	**1315159**
South Africa	18089	325247	30222	604310
Egypt	12458	185372	23281	350321
UAE	27208	634131	9509	245709
Bhutan	55	349	2723	53161
Iran	972	17015	1505	38991
Singapore	--	--	780	16346
Saudi Arabia	--	--	128	2660
Oman	--	--	77	1670
Bahrain	4492	58188	97	1355
Canada	--	--	21	466
Other countries	1970	42994	++	170

Figures rounded off

Table-44: Imports of Iron & Steel

(Stainless Steel)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**71949**	**13132633**	**39876**	**7480309**
China	37367	4916346	15264	2313116
Vietnam	12642	2154381	11757	2241642
Italy	4440	717147	4123	1055086
Belgium	79	198553	342	414539
Singapore	925	128478	700	255655
Malaysia	696	81154	2087	203046
USA	1494	269203	934	173251
Japan	2486	1401791	628	136155
Germany	219	81187	150	109746
Netherlands	97	33962	506	99141
Other countries	11504	3150431	3385	478932

Figures rounded off

Table–45: Imports of Iron & Steel Material

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**527392**	**31485891**	**385727**	**21247947**
Taiwan	126065	5238718	149993	6129693
Korea Rep.	192199	9128182	115886	5824150
Vietnam	95309	5777244	55950	3797203
Germany	26831	1768503	19262	1498319
China	27673	2318581	15967	1062758
Netherlands	17	6523	1453	693298
Singapore	5651	412454	4579	367983
Russia	6696	326804	7263	352938
Japan	2552	531901	1924	302698
France	7467	606577	2114	210221
Other countries	36932	5370404	11336	1008686

Figures rounded off

Similarly, in terms of quantity, the imports of Pig and Cast Iron (including Spiegeleisen) decreased substantially by 23% to 37 thousand tonnes in 2020-21 from 48 thousand tonnes in the previous year. Imports were mainly from China (17%), South Africa (12%), Germany & Taiwan (10% each) and Thailand (8%) (Table-46).

Table-46: Imports of Pig & Cast Iron

(Incl. Speigeliesen)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	47749	3618533	36920	3368526
China	9827	748263	6399	679636
Germany	4394	458268	3777	347360
USA	1592	236180	1642	271021
Japan	278	174946	421	262244
UK	305	223456	529	197121
Italy	1629	210876	1236	184092
South Africa	7185	197976	4597	159502
Thailand	1806	109904	2884	158436
Taiwan	2365	96590	3577	153425
Belgium	940	132508	897	130412
Other countries	17428	1029566	10961	825277

Figures rounded off

In terms of quantity, the imports of slag increased by 31 % to 85 thousand tonnes in 2020-21 from 65 thousand tonnes in the previous year. Imports were mainly from Japan (63%) , Rep. of Korea (36%) and Bhutan (1%) (Table-47).

Table-47: Imports of Slag

(Dross etc. from Iron and Steel exc. Granulated)
(Steel Wire)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	64674	527863	84962	592855
Japan	30235	195155	53102	405024
Korea, Rep. of	33193	320320	30579	174241
Bhutan	1242	11917	996	12373
Spain	4	471	4	467
Nepal	--	--	281	461
Singapore	--	--	++	272
USA	--	--	++	17

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. The Indian Steel Industry has entered into a new development stage, post de-regulation, riding high on the resurgent economy and rising demand for steel. Besides being the 2nd largest global Crude Steel producer in 2020, India has also made a mark globally in the production of Sponge Iron/Direct Reduced Iron (DRI). The growth of coal-based sponge iron units in key mineral-rich pockets of the country resulted in rapid increase of domestic Sponge Iron production, enabling the country to achieve and maintain the number one position in the global market. With several expansion projects at different stages of implementation, the future of the Indian Steel Industry is optimistic. Steel consumption shows a strong correlation with GDP and is indicative of and environmentally sustainable economic development of any Nation. In India,in particular the Steel Industry can play an important role to make India one of the largest economies in the world.

The Government has released the National Steel Policy 2017, which has laid down the broad roadmap for encouraging long-term growth for the Indian Steel Industry, both on demand and supply sides, by 2030-31. At the policy level, in addition to the NSP-2017, the policy for providing preference to domestically manufactured Iron & Steel products in Government procurement was unveiled, the object of which was to accomplish the Hon'ble Prime Minister's vision of 'Make in India' that aims at nation building and of that of encouraging domestic manufacturing.

Globally, India made noticeable strides — the country remained the second largest producer of crude steel, the 3rd largest consumer of total finished steel and the largest DRI producer during the year, as per ranking released by World Steel Association.

As per World Steel Association, construction is one of the most important steel-using industries, accounting for more than 50% of world steel demand. Buildings, from houses to car-parks to schools and skyscrapers, rely on steel for their strength. Steel is also used on roofs and as cladding for exterior walls. The world's population is expected to increase by 2 billion persons in the next 30 years, from 7.7 billion currently to 9.7 billion in 2050, according to United Nations report launched in 2019. Commensurately, the demand and consumption of Steel are expected to soar of multiclimensional levels.

10. Lead & Zinc

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

15.46
(million tonnes) Production of lead and zinc ore in 2020-21

9
(tonnes) Exports of lead ores and concentrates in 2020-21

5,473
(tonnes) Imports of lead ores & concentrates in 2020-21

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 2020-21 due to shut down of the operation of Edayar Zinc Limited (EZL).

RESERVES/ RESOURCES

The total resreves/resources of lead and zinc ore as on 1.4.2020 as per NMI database based on UNFC system have been estimated at 766.49 million tonnes. of these, 103.27 million tonnes (13.47%) fall under 'Reserves' category while the balance 663.22 million tonnes (86.53%) are 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/ 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)

(Unit: '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+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
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

(Unit: '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
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	31266.02
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
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

EXPLORATION & DEVELOPMENT

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

PRODUCTION & PRICES

Lead & Zinc Ores and Concentrates

The entire output of lead & zinc ore and concentrates in 2019-20 and 2020-21 was reported by mines owned by Hindustan Zinc Ltd, a Private Sector company.

The production of lead and zinc ore at 15.46 million tonnes in 2020-21 increased by 7% as compared to previous year. The metal content of lead and zinc in the ore produced in 2020-21 works out to 2,74,933 tonnes and 8,42,470 tonnes respectively as against the corresponding figures 2,57,268 and 8,24,820 tonnes in the preceding year (Tables-2 & 3) (Fig 1).

Table - 2 : Producers of Lead & Zinc Ore, Concentrates, 2020-21

Name and address of the producer	Location of mine	
	State	District
Hindusthan Zinc Ltd, Yashad Bhavan, Udaipur - 313 004, Rajasthan.	Rajasthan	Ajmer Bhilwara Rajsamand Udaipur

Table – 3 : Production of Lead and Zinc Ore, 2019-20 and 2020-21
(By States)

(In tonnes)

State	2019-20			2020-21 (P)		
	Ore Produced	Metal Content		Ore Produced	Metal Content	
		Lead (Pb)	Zinc (Zn)		Lead (Pb)	Zinc (Zn)
India	14479032	257268	824820	15455343	274933	842470
Rajasthan	14479032	257268	824820	15455343	274933	842470

(In tonnes)

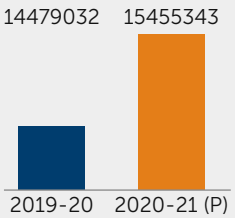


Fig 1: Production of Lead and Zinc Ore

During the year 2020-21, 15.46 million tonnes of lead & zinc ore was treated as against 14.40 million tonnes in 19-20 (Table-4).

Table – 4 : Lead and Zinc Ore Treated, 2019-20 and 2020-21
(By States)

(In tonnes)

State	2019-20			2020-21 (P)		
	Ore Treated	Metal Content		Ore Treated	Metal Content	
		Lead (Pb)	Zinc (Zn)		Lead (Pb)	Zinc (Zn)
India	14401132	254580	813115	15458066	274977	842273
Rajasthan	14401132	254580	813115	15458066	274977	842273

The production of lead concentrates in 2020-21 at 3,76,924 tonnes increased by 7% as compared to the previous year. Entire production of lead concentrates was reported from Rajasthan (Tables-5 & 6).

Table – 5 : Production of Lead Concentrates, 2018-19 to 2020-21
(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	358369	16316914	351746	18260832	376924	20416324
Rajasthan	358369	16316914	351746	18260832	376924	20416324

Table-6: Production of Lead Concentrates, 2019-20 and 2020-21

(By Sector/States/Districts)

(Quantity in tonnes; Value in ₹ '000)

State/District	No. of mines	2019-20			No. of mines	2020-21 (p)		
		Quantity	Pb%	Value		Quantity	Pb%	Value
India	10	351746	56.03	18260832	10	376924	57.38	20416324
Public Sector	2	-	-	-	2	-	-	-
Private Sector	8	351746	56.03	18260832	8	376924	57.38	20416324
Rajasthan	10	351746	56.03	18260832	10	376924	57.38	20416324
Ajmer*	1	-	-	-	1	-	-	-
Bhilwara	1	73839	54.93	2929685	1	79537	56.97	3147437
Rajsamand	3	185895	55.27	8319263	3	194850	55.78	8768404
Sirohi	1	-	-	-	1	-	-	-
Udaipur	4	92012	58.43	7011884	4	102537	60.75	8500483

*: 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.

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 to 15,13,996 tonnes in 2020-21 from 14,46,824 tonnes in 2019-20. The entire production of zinc concentrates was reported from Rajasthan (Tables - 7 & 8).

Table – 7 : Production of Zinc Concentrates, 2018-19 to 2020-21

(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2018-19		2019-20		2020-21 (p)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	1456804	56083827	1446824	60438504	1513996	66668989
Rajasthan	1456804	56083827	1446824	60438504	1513996	66668989

(p): Provisional

Table – 8 : Production of Zinc Concentrates, 2019-20 & 2020-21

(By Sector/States/Districts)

(Quantity in tonnes; Value in ₹ '000)

State/District	No. of mines	2019-20			No. of mines	2020-21 (p)		
		Quantity	Zn%	Value		Quantity	Zn%	Value
India	@	1446824	49.71	60438504	@	1513996	49.94	66668989
Private Sector	@	1446824	49.71	60438504	@	1513996	49.94	66668989
Rajasthan	@	1446824	49.71	60438504	@	1513996	49.94	66668989
Bhilwara	@	904023	49.79	33291114	@	943093	49.98	34787718
Rajsamand	@	403559	48.91	16992620	@	400197	48.99	16801729
Sirohi	@	-	-	-	@	-	-	-
Udaipur	@	139242	51.47	10154770	@	170706	52	15079542

*: 34RAJ01001 - Reported production of lead and zinc ore only and processing is done along with ore produced from Rampura Agucha mine at Bhilwara.

Grade Analysis

All India average metal content of ore treated during 2020-21 worked out to be 7.23% (1.78% Pb and 5.45% Zn) as against 7.42% (1.77% Pb and 5.65% Zn) in 2019-20. The metal content of ore treated at Rampura Agucha mine in Bhilwara district of Rajasthan was the highest at 11.08% (1.43% Pb & 9.65% Zn). The lead concentrates produced during 2020-21 was of grade 57.38% Pb as against 56.03% Pb in 2019-20. Metal content of zinc concentrates produced in Rajasthan worked out to 49.94% Zn in 2020-21 as against 49.71% Zn in the previous year.

Stock

Mine-head closing stocks of lead concentrates in 2020-21 were 2447 tonnes as against 17,735 tonnes in 2019-20. The entire quantity of the stocks at the end of the year was held in Rajasthan (Table-9).

Table – 9 : Mine-head Closing Stocks of Lead Concentrates, 2019-20 and 2020-21

(By State)

(in tonnes)

State	2019-20	2020-21(p)
India	17735	2447
Rajasthan	17735	2447

Mine-head closing stocks of zinc concentrates in 2020-

21 were 28,926 tonnes as against 25,929 tonnes in 2019-20. The entire quantity of the stocks was held in Rajasthan (Table-10).

Table – 10 : Mine-head Closing Stocks of Zinc Concentrates, 2019-20 and 2020-21
(By State)

(in tonnes)

State	2019-20	2020-21(p)
India	25929	28926
Rajasthan	25929	28926

Employment

The average daily labour employed in lead and zinc mines during the year 2020-21 was 9,557 as against 10,396 in 2019-20.

Lead and Zinc Metals

The production of primary lead during 2020-21 increased to 2,14,399 tonnes from 1,81,365 tonnes during 2019-20. The entire output of primary lead was from Chanderiya and Dariba smelters of Hindustan Zinc Ltd.

The production of zinc ingot metal at 7,15,445 tonnes in 2020-21 increased by 4% from 6,88,282 tonnes in the previous year. Hindustan Zinc Ltd, contributed 100% of the total output. (Tables - 11 to 14).

Table – 11 : Production of Lead Metal, 2018-19 to 2020-21

(Quantity in tonnes; Value in `'000)

Year	Lead Primary	
	Quantity	Value
2018-19	197839	33814419
2019-20	181365	29111241
2020-21 (P)	214399	34531700

Table – 12 : Production of Zinc Metal, 2018-19 to 2020-21

(Quantity in tonnes; Value in `'000)

Year	Zinc Ingots	
	Quantity	Value
2018-19	696283	153894301
2019-20	688282	137840297
2020-21 (P)	715445	147976396

Table – 13 : Production of Lead (Primary), 2019-20 and 2020-21
(By States/Plant)

(Quantity in tonnes; Value in ₹ '000)

State	Plant	2019-20		2020-21 (P)	
		Quantity	Value	Quantity	Value
India		181365	29111241	214399	34531700
Rajasthan	HZL Chanderiya/Dariba	181365	29111241	214399	34531700

Table – 14 : Production of Zinc (Ingots), 2019-20 and 2020-21
(By States/Plant)

(Quantity in tonnes; Value in ₹ '000)

State	Plant	2019-20		2020-21 (P)	
		Quantity	Value	Quantity	Value
India		688282	137840297	715445	147976396
Rajasthan	HZL HZL Chanderiya/ Debari/Dariba	688282	137840297	715445	147976396

MINING & MILLING

HZL is the only integrated lead and zinc metal producer in the country. Its operations can be classified into mining and smelting. At present, HZL's eight mines and all mining operations are located in Rajasthan. The eight mines are Rampura Agucha mine (Bhilwara district), Kayad mine (Ajmer district), Rajpura Dariba mine, Sindesar Khurd mine (both in Rajsamand district) and Zawar group of mines (4 mines in Udaipur district i.e. Mochia, Balaria, Zawarmala and Baroi), Rajasthan. All the mines of HZL undertake underground mining operations. Rampura Agucha mine was completely turned to underground mine with an annual production capacity of 5 million tonnes of lead & zinc ore. Sindesar Khurd mine is highly mechanised and the largest ore producing underground mine with annual production capacity of 6 million tonnes. The other six mines viz, Rajpura Dariba, Zawar group of mines (Mochia, Balaria, Zawarmala and Baroi) and Kayad mine are underground mines with an annual production capacity of 1.08 million tonnes, 4.0 million tonnes and 1.2 million tonnes of lead & zinc ore respectively (Table-15).

Table – 15 : Ore Production Capacity of HZL Mines

Mine	Ore	Capacity (million tpy)
Total		17.28
Zawar Mines, Distt Udaipur, Rajasthan.	Zinc-lead	4
Rajpura Dariba, Distt Rajsamand, Rajasthan.	Zinc-lead	1.08
Sindesar Khurd Mine, Distt Rajsamand, Rajasthan.	Zinc-lead	6
Rampura Agucha, Distt Bhilwara, Rajasthan.	Zinc-lead	5
Kayad Distt Ajmer Rajasthan.	Zinc-lead	1.2

Source : HZL Annual Report 2020-21

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 2020-21, the Zawar group of mines produced 3.9 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 2020-21, Rajpura Dariba Mine produced 1.2 million tonnes ore. 1.18% 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. 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 2019-20, the production of ore was carried out by underground mining at 4.3 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 7% with its silver-rich lead-zinc deposit. The mine lies on the same geological belt as the Rajpura Dariba mine. During the year 2020-21, Sindesar Khurd mine produced 4.8 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 6.3% 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 2020-21, the Kayad mine produced 1.2 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 tpy	Production		Zinc capacity tpy	Production	
		2018-19	2019-20 (P)		2018-19	2019-20 (P)
Hindustan Zinc Ltd	210000	197839	132316	913000	696283	516316
Edayar Zinc Ltd	-	-	-	38000	-	-
Total	210000	197839	132316	951000	696283	516316

The smelting capacity of HZL for zinc is distributed between three smelters at Debari (88,000 tonnes), Chanderiya (5,85,000 tonnes) and Dariba (2,40,000 tonnes). Edayar Zinc Ltd's plant at Binanipuram (Aluva), Kerala, has capacity of 38,000 tonnes per annum. Thus, the smelting capacity for zinc in the country is 9,51,000 tonnes per annum. EZL produced zinc from imported concentrates but since the Company has been declared as sick unit, it did not operate its plant. Besides lead & zinc capacities, HZL has capacities to produce 800 tonnes per annum of silver. HZL is India's largest manufacturer of sulphuric acid which is by-product of its smelting operations. 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 per annum of zinc. The present capacity has now reached 88,000 tonnes per annum of zinc. It is located at about 13 km north of Udaipur, Rajasthan. Zinc smelter Debari employs Roast-leach Electro-winning Technology at its Hydro-metallurgical zinc smelter. The plant has three roasting facilities, leaching & purification section, electrolysis, melting and casting sections. It produced surplus calcine, an intermediate product, which is supplied to the rest of the Hydro-metallurgical zinc smelter. In the year 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 is utilised to backfill the underground mined stopes and the remaining tailings is 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), SO2, NOX 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 SOX. The small-scale units generally do not control process parameters, such as, smelting temperature, charge to fuel ratio, leakages in the body, etc. As per the National Ambient Air Quality standards, the permissible concentration of lead in ambient air is 0.50 µg/m3 while the permissible limit for SOX is 50 µg/m3.

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 2019-20 and 2020-21 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 1,62,274 tonnes in 2019-20 (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	2019-20	2020-21
Total Production Lead (Primary)	181365	214399
Total Imports*	103602	89777
Total Exports*	122693	125041
Apparent Consumption (Primary)	162274	179135

* DGCI & S, Kolkata

Zinc

Owing to its corrosion resistance in varied types of environment, zinc is used for protecting steel by way of galvanising. The Galvanising Industry alone consumes about 57% of zinc, followed by coatings (16%), die-casting alloys (14%), oxides & chemicals (7%) and extruded products (6%). The apparent consumption of zinc during the year 2019-20 and 2020-21 was calculated on the basis of production of zinc, import & export of zinc (not alloyed). The apparent consumption, thus arrived at was 5,96,571 tonnes in 2019-20 and 5,19,008 tonnes in 2020-21 (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	2019-20	2020-21
Total Production Zinc	688282	715445
Total Imports*	107453	84980
Total Exports*	199164	281417
Apparent Consumption	596571	519008

* 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.

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) (Fig 2).

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.

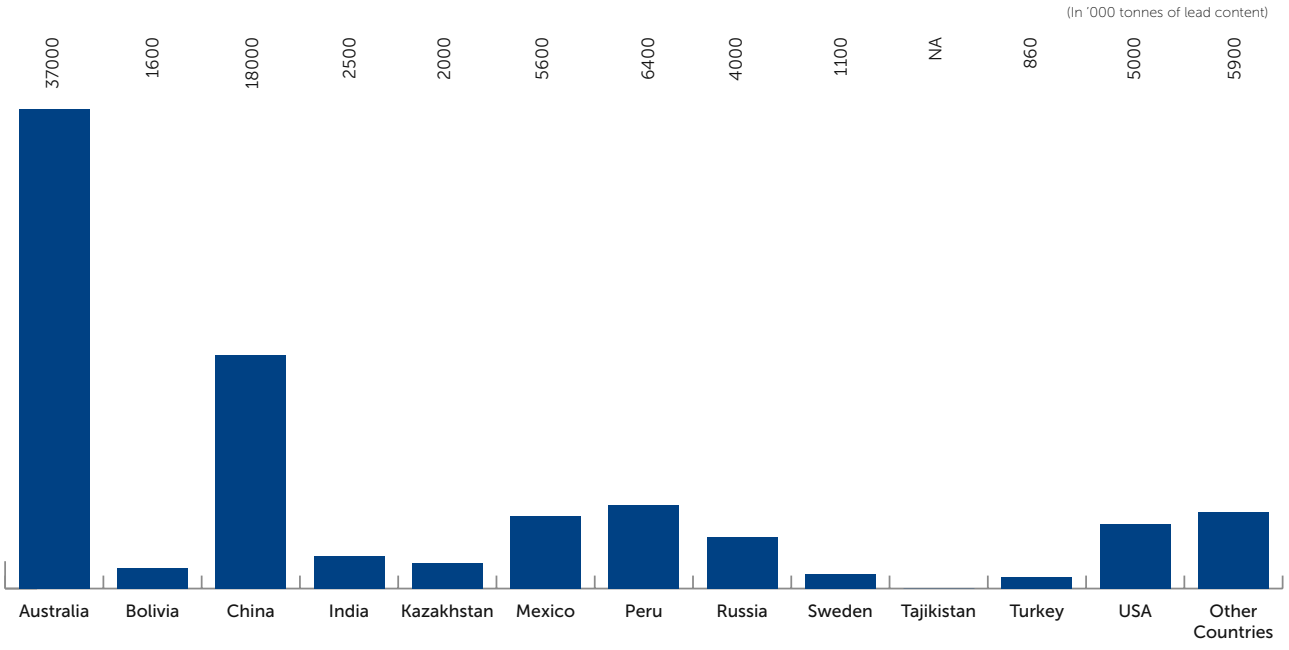


Fig 2: Country wise Reserves of Lead

Zinc

The world's reserves of zinc were estimated at 250 million tonnes of zinc content. Australia accounts for 27% of world's zinc reserves, followed by China (18%), Russia (9%), Kazakhstan (5%), USA (4%), etc. (Table-20) (Fig 3).

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
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.

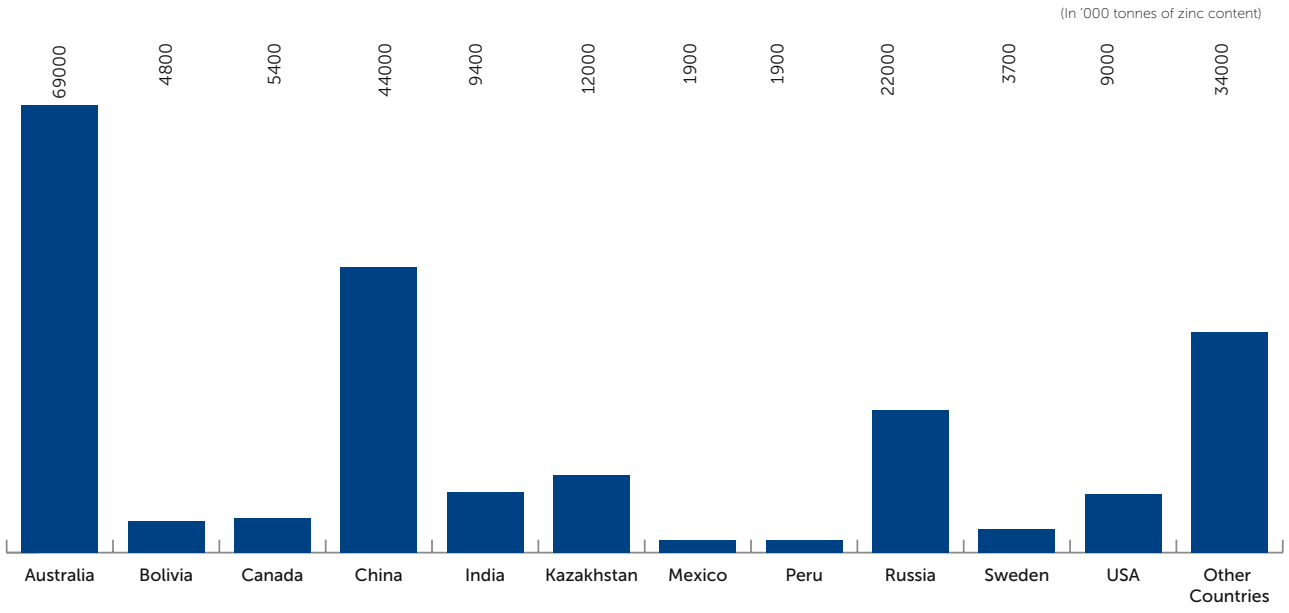


Fig 3: Country wise Reserves of Zinc

PRODUCTION

Lead

World mine production of lead in terms of metal content was about 4.54 million tonnes in the year 2020 which is 6% more as compared to 4.81 million tonnes in the previous year. China is foremost amongst producing countries with about 1.97 million tonnes (43%) followed by Australia (11%), USA & Mexico (6% each), and Peru (5%). (Table-21) (Fig 4).

Table-21: World Mine Production of Lead

(By Principal Countries)

(In tonnes of metal content)

Country	2018	2019	2020
World: Total (rounded off)	4471639	4818746	4543981
China	1892173	2006000	1970000
Australia	446571	500985	494271
USA	271000	266000	297000
Mexico	230869	372106	260390
Peru	289123	308116	241548
India*[(c)]	207067[(c)]	202964[(c)]	217787
Russia	206100	207900*	200000
Turkey	76000*	71500*	81500
Iran	49600	72500*	70000
Poland	70340	69860	65660
Other countries	732796	740815	645825

Source: BGS, World Mineral Production, 2016-20

* India's production of primary lead in 2018-19, 2019-20 and 2020-21 was 181 thousand tonnes and 214 thousand tonnes respectively.

(c) Year ended 31st March following that stated

(d) Metal content of ore

(e):Estimated

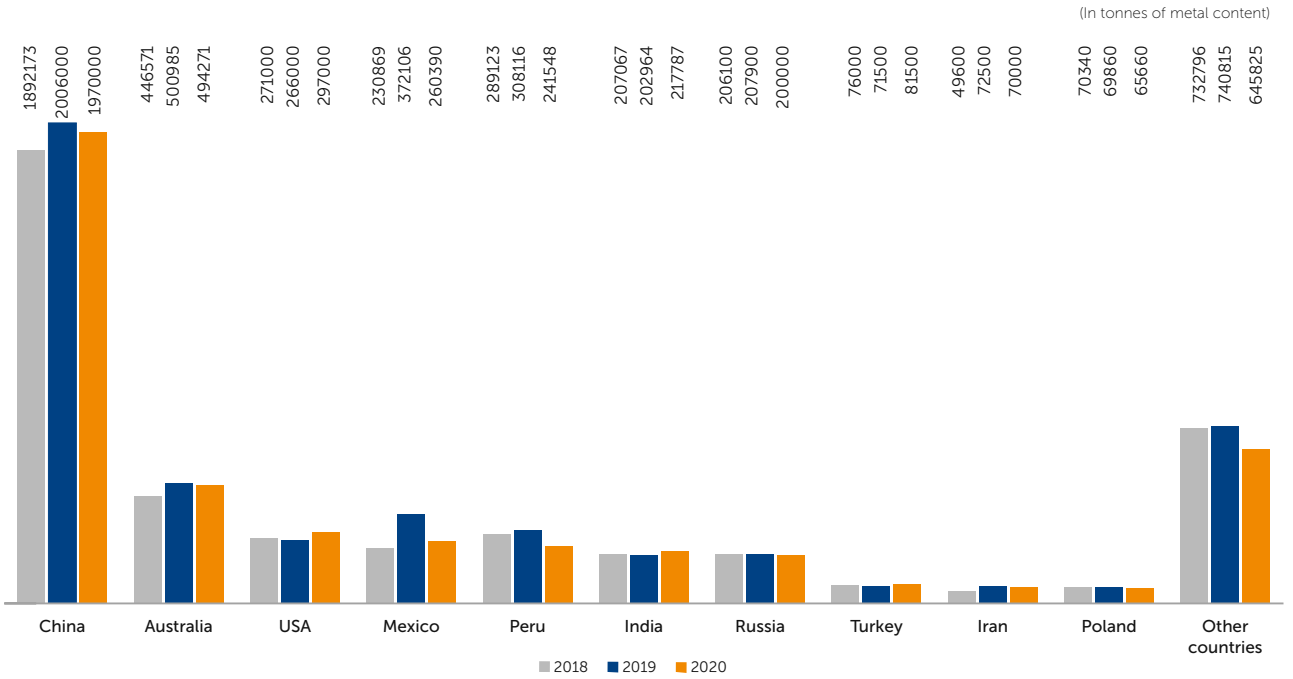


Fig 4: Country wise Production of Lead

Zinc

World mine production of zinc ore was at 11.53 million tonnes in terms of zinc content in the year 2020 which was slightly decreased by 7% from 12.48 million tonnes in the year 2019. China is at top position with 3.20 million tonnes (27%) followed by Peru & Australia (11% each), USA, India & Mexico (6% each), Canada (4%), etc. (Table- 22) (Fig 5).

Table-22: World Mine Production of Zinc

(By Principal Countries)

(In tonnes of metal content)

Country	2018	2019	2020
World: Total (rounded off)	12227675	12483251	11530291
China	3721100*	3700000*	3200000
Peru	1474383	1404382	1334570
Australia	1146781	1337321	1314910
India*[(b)]	728402[(b)]	723412[(b)]	756998
USA	824000	753000	718000
Mexico	662355	859194	688461
Canada	304964	323019	371491
Bolivia	519630	527521	358411
Kazakhstan	346000	321900	335400
Russia	288000	275400*	280000
Other countries	2212060	2258102	2172050

Source : BGS, World Mineral Production, 2016-20

* India's production of primary zinc in 2018-19, 2019-20 and 2020-21 was 696 thousand tonnes, 688 thousand tonnes and 715 thousand tonnes respectively.

(b) Year ended 31st March following that stated

(e): Estimated

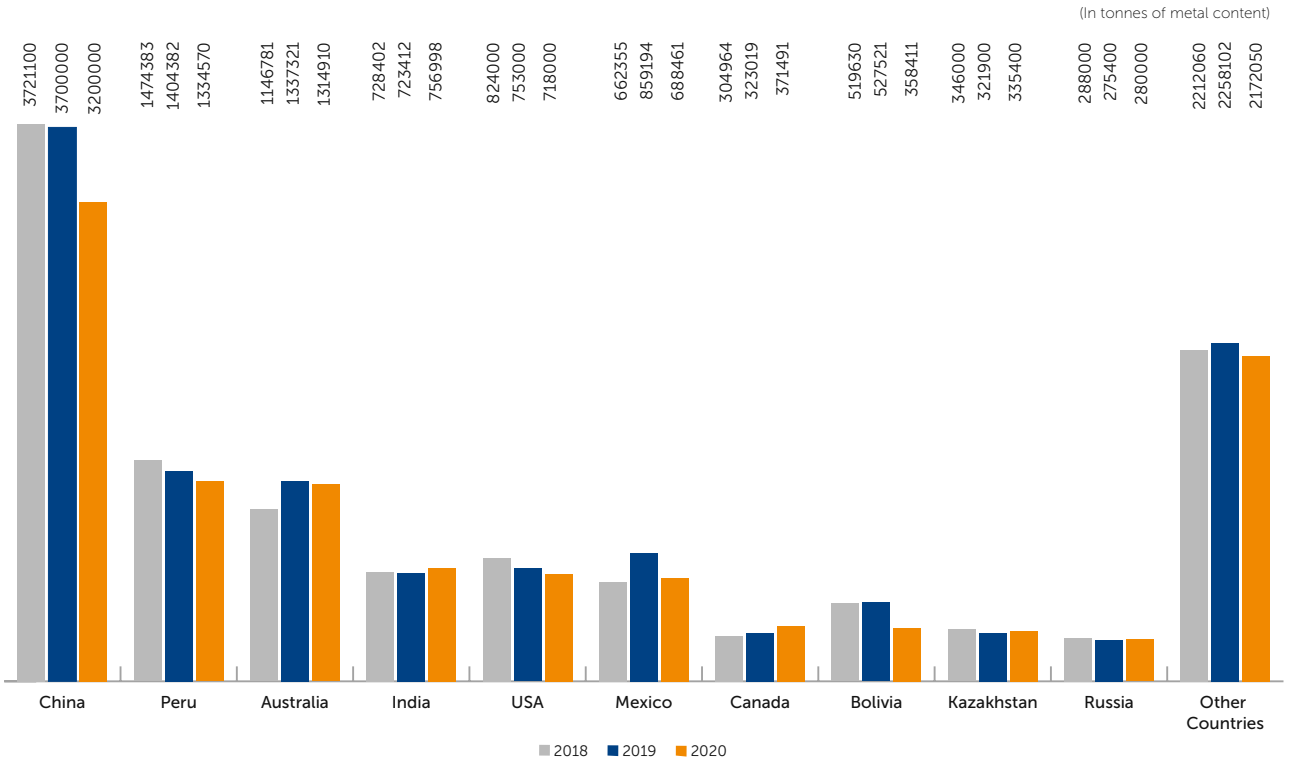


Fig 5: Country wise Production of Zinc

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 reopened after the processing plant was refurbished. Minerals and Metals

Group opened Dugald River zinc mine in Northe western Queensland and commercial production 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 Salaberry-de-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 3 tonnes in 2019-20 increased to 9 tonnes in 2020-21. Bangladesh is the sole country which imports lead ores & concentrates from India.

Exports of lead & alloys including scrap increased slightly by 1% to 1,76,601 tonnes during 2020-21 as compared to 1,74,939 tonnes in the preceding year. Similarly, export of lead and alloys also increased by 1% to 1,76,569 tonnes in 2020-21 as compared to 174936 tonnes in the previous year. Exports of refined lead unwrought also increased by 2% to 1,25,041 tonnes in 2020-21 as compared to 1,22,693 tonnes in the previous year. (Tables-23 to 29) (Fig 6).

Table – 23 : Exports of Lead and Alloys

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	174936	26421811	176569	25841849
Korea, Rep. of	53405	7940557	69336	9803170
Thailand	25498	3821467	17440	2645595
Vietnam	28491	4310715	16591	2430259
Taiwan	10465	1608589	14250	2031656
Bangladesh	11744	1737394	13326	1988441
U A E	11892	1798359	11540	1819996
Malaysia	1218	196121	10544	1497810
Singapore	254	55151	6202	851671
Oman	5840	917069	4584	692525
Japan	2286	355846	3066	520185
Other countries	23843	3680543	9690	1560541

Figures rounded off

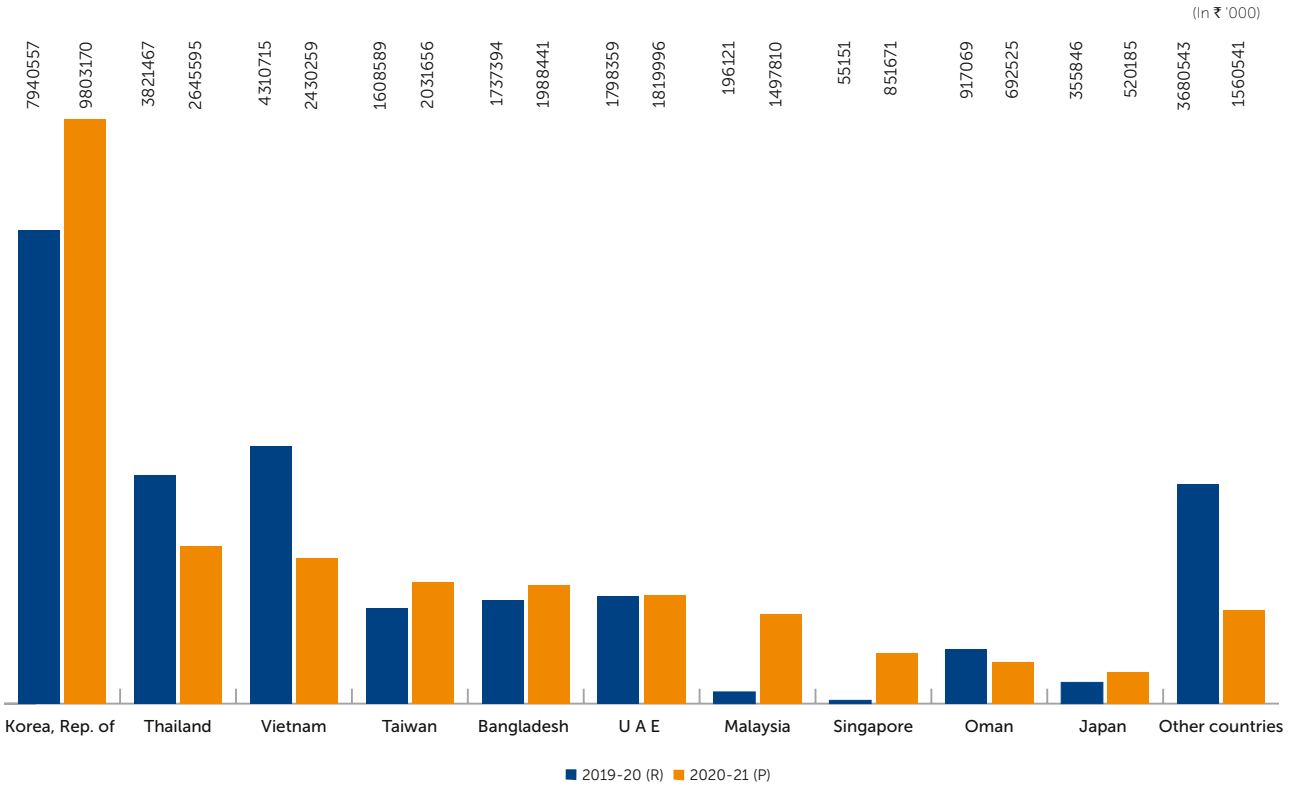


Fig 6: Country wise Value of Export of Lead and Alloys

Table – 24 : Exports of Lead Ores & Concentrates

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3	202	9	1076
Bangladesh	3	178	9	700
Sri Lanka	-	-	++	176
Canada	-	-	++	110
Iraq	-	-	++	59
South Africa	-	-	++	24
U S A	-		++	7
Nepal	++	24	-	-

Figures rounded off

Table – 25 : Exports of Lead & Alloys Including scrap

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	174939	26422498	176601	25845466
Korea, Rep. of	53405	7940557	69336	9803170
Thailand	25498	3821467	17440	2645595
Vietnam	28491	4310715	16591	2430259
Taiwan	10465	1608589	14250	2031656
Bangladesh	11744	1737394	13326	1988441
UAE	11892	1798366	11540	1820001
Malaysia	1218	196121	10544	1497810
Singapore	254	55151	6202	851671
Oman	5840	917069	4584	692525
Japan	2286	355846	3066	520185
Other Countries	23846	3681223	9722	1564153

Figures rounded off

Table – 26 : Exports of Lead and Waste & Scrap

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3	687	32	3617
U K	-	-	27	2491
Nepal	3	680	4	913
Uganda	-	-	++	118
Bhutan	-	-	1	90
U A E	++	7	++	5
Mozambique	++	++	-	-

Figures rounded off

Table – 27 : Exports of Refined Lead Unwrought

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	122693	18128632	125041	17711659
Korea, Rep. of	37909	5561918	57095	8010251
Taiwan	10457	1599104	14249	2031320
Vietnam	22932	3438337	11555	1646508
Thailand	19434	2824753	10384	1480455
Malaysia	999	145578	10127	1409221
Singapore	++	53	6032	810675
Bangladesh	7416	1085177	4725	692814
UAE	4073	593575	4206	627828
Turkey	5847	849106	1711	249713
Qatar	644	95136	1550	235663
Other countries	12982	1935895	3407	517211

Figures rounded off

Table – 28 : Exports of Lead & Alloys Unwrought, NES

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	34926	5603892	31878	5105512
Korea, Rep. of	13057	2026225	9163	1348577
Thailand	5783	947651	6923	1141307
Oman	3673	599639	3615	548344
U A E	4403	667661	2982	521682
Vietnam	2988	476240	3220	512255
Bangladesh	1249	191108	2517	390239
Japan	371	66441	1174	225339
Indonesia	1413	225604	903	145148
Belgium	183	47054	744	144470
Australia	219	36288	152	24936
Other countries	1587	319981	485	103218

Figures rounded off

Table – 29 : Exports of Lead (Pig Lead)

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1	88	-	-
Nepal	1	80	-	-
Bhutan	++	8	-	-

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 increased to 5,473 tonnes in 2020-21 as compared to 3283 tonnes in 2019-20. Imports were mainly from UAE (40%), Turkey (28%), Sudan (6%) and Morocco (5%). The total imports of lead & alloys including scrap decreased marginally by 10% in 2020-21 with 3,14,954 tonnes as compared to 3,48,747 tonnes during 2019-20, of the total imports of lead and alloys including scrap. Imports of lead and alloys during 2020-21 were 2,45,841 tonnes as compared to 2,56,132 tonnes in 2019-20. (Tables- 30 to 36) (Fig 7).

Table – 30 : Imports of Lead Ores & Conc.

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3283	166725	5473	325104
Turkey	25	1107	1574	146234
U A E	1192	56676	2196	101447
Morocco	380	23721	276	19963
Mozambique	686	41725	274	16161
Sudan	98	4330	316	12421
Argentina	-	-	212	8710
Ghana	-	-	322	7141
Kuwait	50	2029	152	6343
Jordan	64	3111	101	4385
Yemen, Rep. of	23	923	50	2284
Other countries	765	33103	++	15

Figures rounded off

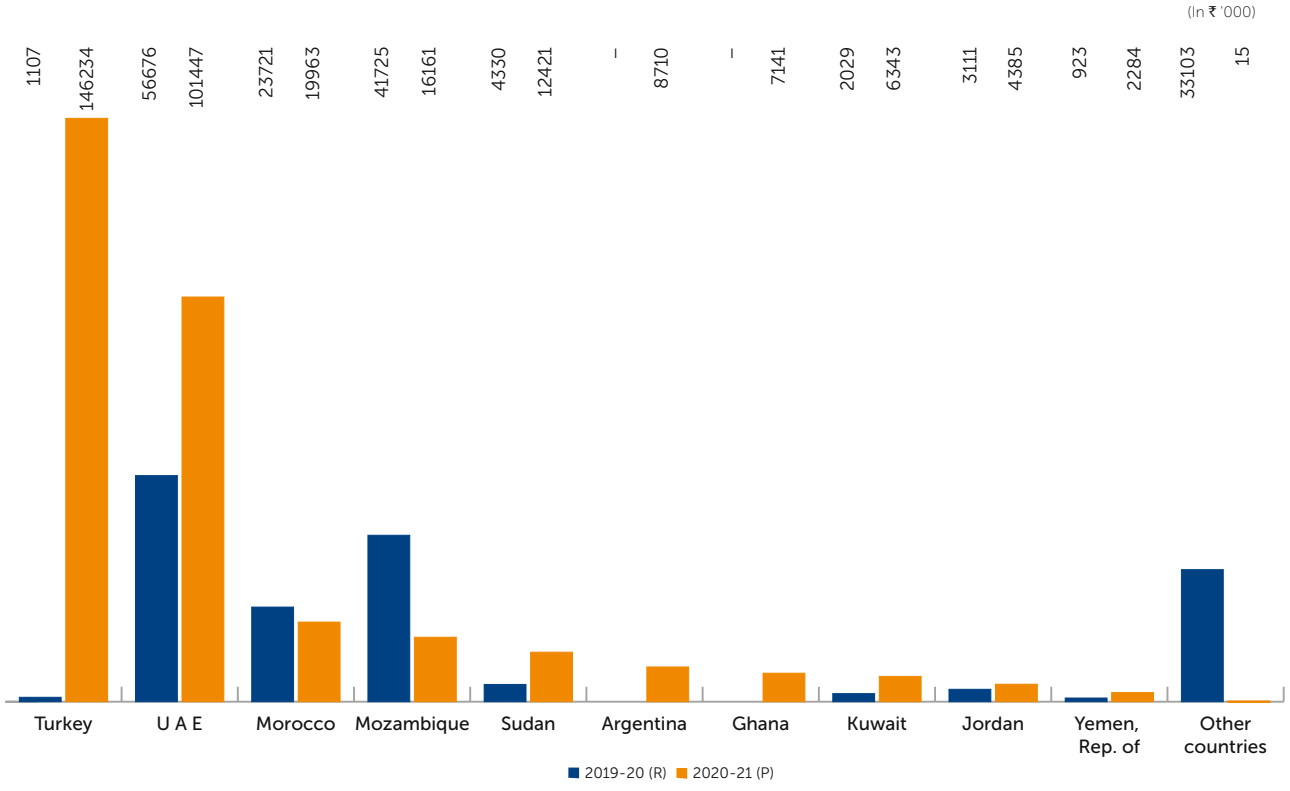


Fig 7: Country wise Value of Import of Lead and Alloys

Table – 31 : Imports of Lead and Alloys Including Scrap : Total

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**348747**	**49923441**	**314954**	**45882809**
Korea, Rep.of	68876	10913957	64132	10047758
U S A	31192	4246560	29942	4125992
U A E	27657	3884470	27109	3952987
Australia	15330	2215733	24631	3597602
Malaysia	32955	4673445	20411	2925282
Vietnam	23196	3299440	20436	2915131
U K	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	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**256132**	**37990315**	**245841**	**36498550**
Korea, Rep. of	68780	10902383	64132	10047758
U A E	23788	3405218	25190	3689200
Australia	11258	1667801	21298	3154063
Vietnam	23196	3299440	20436	2915131
Malaysia	30824	4413631	19727	2835078
Singapore	8049	1199770	14944	2222329
Japan	5294	806262	7399	1153717
Philippines	7467	1069360	6295	904353
Tanzania	6892	973831	5471	768310
Mozambique	5374	740356	5333	725802
Other countries	65210	9512263	55616	8082809

Figures rounded off

Table – 33 : Imports of Lead and Waste &Scrap

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**92615**	**11933126**	**69113**	**9384259**
USA	29818	4050544	29111	4008027
UK	22765	2902236	14957	2034671
Australia	4072	547932	3333	443539
Venezuela	606	126345	1326	296140
U A E	3869	479252	1919	263787
Canada	1693	223558	1758	232161
Spain	1688	224209	1707	226882
Belgium	424	54148	1807	212306
Saudi Arabia	332	45268	1245	168766
Netherlands	2708	341659	1113	139473
Other countries	24640	2937975	10837	1358507

Figures rounded off

Table – 34 : Imports of Lead (Pig Lead)

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3049	435541	3091	446955
UAE	2224	318017	2393	347242
South Africa	450	63870	384	55459
Nepal	-	22218	169	23913
Turkey	-	-	94	12990
Oman	-	-	51	7351
Taiwan	99	13755	-	-
Myanmar	50	7824	-	-
Singapore	49	7006	-	-
U S A	20	2851	-	-

Figures rounded off

Table – 35 : Imports of Lead Unrefined, NES

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	52369	7459331	76691	1883029
Vietnam	16992	2428886	17825	2549515
UAE	6818	977842	13370	1925738
Singapore	5002	738455	6375	923452
Philippines	2286	324116	4781	687182
Tanzania	831	117121	4635	647258
Mozambique	852	118358	4075	553340
Malaysia	5282	325287	3036	433410
Sanegal	1052	146258	2604	347763
Saudi Arabia	1058	147573	2289	342534
Japan	496	70187	2027	287490
Other countries	14700	2065248	15602	2185347

Figures rounded off

Table – 36 : Imports of Refined Lead Unwrought

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	103602	15394884	89777	13415047
Korea, Rep. of	45756	6956160	44988	6773388
Australia	6707	975249	15764	2302577
Japan	2418	384525	4663	718114
U A E	7397	1047041	4216	615859
Malaysia	12827	1825824	3707	541480
Singapore	1777	272555	2623	407586
U K	3648	952326	2378	370189
Sri Lanka	3400	489024	2225	318846
Russia	2179	298878	1770	278778
Myanmar	3500	520040	1550	228847
Other countries	11294	1673262	5893	859383

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 399 tonnes in 2020-21 as against 317 tonnes in the previous year. China is the main export destination of zinc ores & concentrates and accounted for 63% of all the exports of zinc ores & concentrates followed by Cuba (37%).

Exports of zinc & alloys including scrap during 2020-21 were 3,00,018 tonnes as against 2,12,702 tonnes in the preceding year. Almost entire exports during 2020-21 were of zinc & alloys while those of scraps were nominal. Malaysia (32%), Singapore (25%), Republic of Korea (6%), Taiwan (10%), China (15%) and Thailand (5%) were the main export destinations for zinc alloys & scrap. Exports of zinc (scrap) were at 82 tonnes in 2020-21 as compared to 119 tonnes in the preceding year (Tables- 37 to 40).

Table – 37 : Exports of Zinc Ores & Concentrates

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	317	15828	399	20716
Cuba	100	10896	150	17276
China	199	4078	249	3440
UAE	4	636	-	-
South Africa	13	196	-	-
Japan	1	14	-	-
Finland	++	6	-	-
Nepal	++	2	-	-

Figures rounded off

Table – 38 : Exports of Zinc & Alloys Including Scrap : Total

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	212702	40372945	300018	55103971
Malaysia	10189	1893547	95207	15880500
Singapore	26607	4807449	72651	13296034
Taiwan	33646	6381708	30349	5684418
Korea, Rep. of	35929	6670090	19462	3619387
Thailand	12331	2393846	14109	2832734
UAE	10707	2234539	13401	2594864
Nepal	17062	3184485	12622	2457205
Kenya	4587	882776	8137	1575005
Indonesia	7478	1441091	7749	1469272
China	32318	5869960	6044	1122759
Other countries	21848	4613454	20287	4571793

Figures rounded off

Table – 39 : Exports of Zinc & Alloys

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	212592	40361623	299936	55094321
Malaysia	10189	1893547	95207	15880500
Singapore	26607	4807449	72651	13296034
Taiwan	33646	6381708	30349	5684418
Korea, Rep. of	35929	6670090	19462	3619387
Thailand	12331	2393846	14109	2832734
U A E	10707	2234539	13401	2594864
Nepal	17062	3184428	12618	2456700
Kenya	4587	882776	8137	1575005
Indonesia	7478	1441091	7749	1469272
China	32318	5869960	6018	1119820
Other countries	21738	4602189	20235	4565587

Figures rounded off

Table – 40 : Exports of Zinc (Scrap)

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	119	11322	82	9650
Hong Kong	-	-	52	6206
China	-	-	26	2939
Nepal	++	57	4	505
U S A	40	3948	-	-
Italy	25	3769	-	-
Belgium	27	2675	-	-
Bangladesh	10	621	-	-
Bhutan	8	172	-	-
Saudi Arabia	++	74	-	-
Canada	++	4	-	-
Other countries	++	2	-	-

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 2020-21 were at 804 tonnes as against 101 tonnes import during the previous year. Imports were mainly from Belgium (59%), Imports of zinc & alloys during 2020-21 were at 1,39,679 tonnes as compared to 1,73,997 tonnes in 2019-20. Imports of zinc (scrap) were 49,428 tonnes during 2020-21 as compared to 75,505 tonnes in 2019-20. Imports of zinc or spelter were at 1,18,333 tonnes in 2020-21 as compared to 1,45,138 tonnes during the previous year. The major suppliers of zinc & alloys including scrap during 2020-21 were Republic of Korea (47%), Japan (17%), USA (5%) and UAE (5%) (Tables- 41 to 45).

Table – 41 : Imports of Zinc Ores & Conc

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	101	2667	804	9530
Belgium	-	-	804	9513
U S A	++	++	++	17
Ethiopia	60	1630	-	-
U A E	21	610	-	-
U K	20	424	-	-
China	++	3	-	-

Figures rounded off

Table – 42 : Imports of Zinc and Alloys Including Scrap: Total

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	249502	46153989	189197	34313169
Korea, Rep. of	111254	21809467	88877	16988711
Japan	25287	4907877	31867	6297778
USA	18918	3040874	9544	1472753
UAE	15287	2546126	9788	1463781
Australia	5642	1087263	3936	772291
Italy	6870	1168592	3999	693321
Malaysia	4511	778874	3341	539389
Saudi Arabia	4107	622820	3273	471652
Netherlands	1964	321859	3048	465791
Germany	2713	510349	2637	437731
Other countries	52949	9359888	28887	4709971

Figures rounded off

Table – 43 : Imports of Zinc & Alloys

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	173997	34384910	139769	27338160
Korea, Rep. of	111118	21787036	88866	16987074
Japan	25164	4889761	31643	6267634
Australia	5190	1013880	3848	760630
U A E	6827	1244854	3411	602970
China	1403	576739	909	419540
Switzerland	780	156479	1879	385274
U S A	1526	300448	1091	229504
Italy	119	86692	606	199346
Belgium	2764	597158	816	191588
Myanmar	4306	832663	998	189027
Other countries	14800	2899200	5702	1105573

Figures rounded off

Table – 44 : Imports of Zinc (Spelter)

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	145138	27974586	118333	22644454
Korea, Rep. of	93379	18155565	73744	13989990
Japan	24881	4809588	31372	6189217
Australia	4721	921055	3844	759038
U A E	6077	1134815	2325	433102
Switzerland	248	50332	1829	374946
Myanmar	4306	832663	998	189027
Italy	49	9103	553	112908
Kenya	200	30333	672	107305
Russia	688	141126	590	103276
U S A	1150	192728	484	71918
Other countries	9439	1697228	1922	313727

Figures rounded off

Table – 45 : Imports of Zinc (Scrap)

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	75505	11769079	49428	6975009
USA	17392	2740426	8453	1243249
UAE	8460	1301272	6377	860811
Italy	6751	1081900	3393	493975
Saudi Arabia	3941	593340	3269	470225
Netherlands	1515	227533	2808	426371
Malaysia	2476	368805	2503	364714
Germany	1955	309729	2397	346003
Indonesia	2113	318293	1996	261024
U K	3615	559797	1782	243296
Mexico	2460	389926	1638	223535
Other countries	24827	3878058	14812	2041806

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 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 5 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. Molybdenum

27.20
(million tones) Total reserves/ resources of molybdenum ore in 2020-21

428
(tonnes) Production of ferromolybdenum in 2020-21

45
(tonnes) Exports of molybdenum ores & concentrates in 2020-21

9,177
(tonnes) Imports of molybdenum ores & concentrates in 2020-21

Molybdenum (Mo) is a refractory metal used principally as an alloying agent in steel, cast iron & superalloys to enhance strength and resistivity to wear & corrosion. It does not occur in nature in free state. Usually, it is found in chemically combined form with other elements. Molybdenite (MoS2) 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 UNFC System, the resources of molybdenum ore in the country have been estimated at 27.20 million tonnes containing about 16,891 tonnes MoS_2. The above resources of ore are located in Tamil Nadu (17.88 million tonnes), Madhya Pradesh (8 million tonnes) and Karnataka (1.32 million tonnes) (Table-1).

Table-1: Reserves/Resources of Molybdenum as on 1.4.2020 (P)

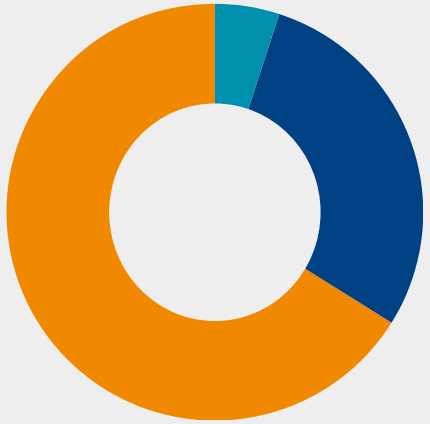
(By Grades/States)

(In tonnes)

Grade/State	Reserves	Remaining Resources						Total Resources (A+B)
	Total	Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	(A)	STD221	STD331	STD332	STD333	STD334	(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.

Reserves/resources of Molybdenum (Ore)



State wise Resources of Molybdenum in India

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 decreased from 527 tonnes in 2019-20 to 428 tonnes in 2020-21 (Table-2) and Fig 1.

Table-2: Production of Ferromolybdenum 2016-17 to 2020-21

(In tonnes)

Year	Production
2016-17	1603
2017-18	1205
2018-19	1003
2019-20(R)	527
2020-21(P)	428

Source: Monthly Statistics of Mineral Production, March, 2021, IBM

Non-ferrous Technology Development Centreat the Defence Metallurgical Research Laboratory, Hyderabad, has a pilot plant for producing molybdenum powder. Institute of Minerals and Materials Technology (formerlyRRL), Bhubaneswar, has been undertaking basic research on recovery of molybdenum from spent catalysts.

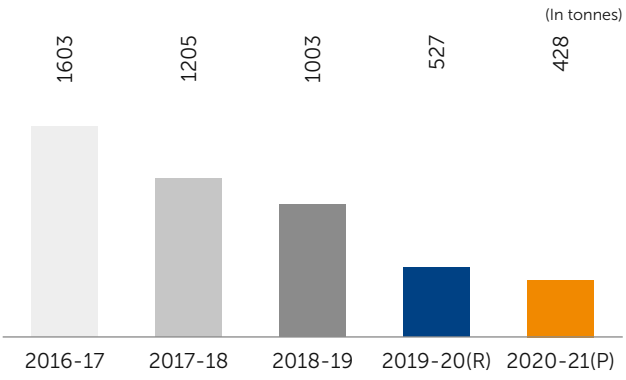


Fig 1: Production of Ferromolybdenum

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 U.T. 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 18 million tonnes, located mainly in China (52%), USA (17%), Peru (14%), Chile (9%) and Russia (3%) (Table-3).

The world mine production of molybdenum in terms of metal content increased marginally by 4% to 2.97 lakh tonnes in 2020 from 2.85 lakh tonnes in 2019. China with 35% production was the main producer of molybdenum in the world followed by Chile (20%), USA (17%), Peru (11%) and Mexico (6%) (Table-4) & Fig 2.

Table-3: World Reserves of Molybdenum
(By Principal Countries)

(In '000 tonnes of molybdenum content)

Country	Reserves
World: Total (rounded off)	16000
Argentina[e]	100
Armenia[e]	150
Canada	96
Chile	1400
China[e]	8300
Iran[e]	43
Mexico	130
Mongolia	NA
Peru	2300
Russia[e]	430
Turkey[e]	360
USA	2700
Uzbekistan[e]	60

Source: USGS, Mineral Commodity Summaries, 2022.

Table-4: World Mine Production of Molybdenum

(By Principal Countries)

(In tonnes of metal content)

Country	2018-19	2019-20	2020-21
World:Total (rounded off)	289000	285000	297000
China	113308	104435	105000
Chile	60248	53541	59319
USA	41400	48000	51100
Peru	28034	30441	32185
Mexico	20265	21694	18562
Iran(a)	7662	8711(e)	8700
Armenia	5666	7360	12691
Canada	5036	3955	2671
Mongolia	2579	2492	2889
Other countries	5227	4345	4244

Source: BGS World Mineral Production, 2016-20,

(a) years ended 20th March following that stated.

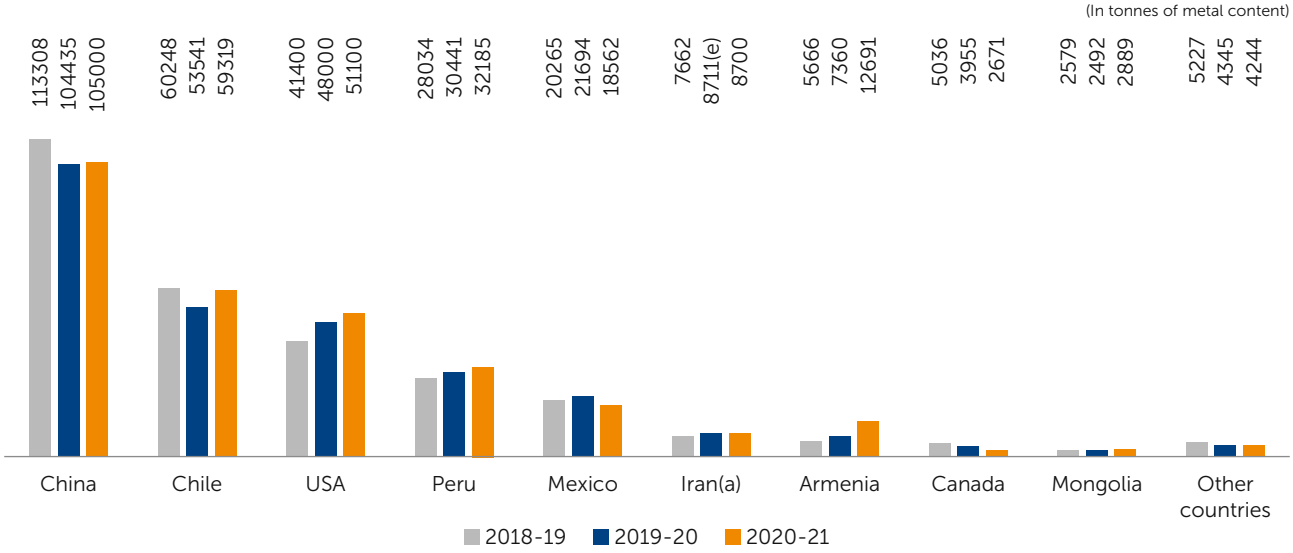


Fig 2: Country wise production of Molybdenum

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 molyblenum 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 increased drastically to 45 tonnes in 2020-21 from 3 tonnes in 2019-20. Exports were solely to Korea, Rep of (89%) & Kenya (11%). Exports of molybdenum and scrap also increased sharply 45 % to 119 tonnes in 2020-21 from 82 tonnes in 2019-20. Exports were mainly to Germany (53%), Netherlands (19%), and Philippines (12%) (Tables-5 to 8).

Table-5: Exports of Molybdenum Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3	3023	45	43181
Korea,Rep of	-	-	40	41622
Kenya	-	-	5	1559
UAE	3	3023	-	-

Figures rounded off

Table-6: Exports of Molybdenum & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	82	122342	119	182537
Austria	3	40669	6	72646
Germany	10	11088	63	31197
China	1	12744	1	20820
USA	++	7658	2	11987
Malaysia	++	20	3	8698
Poland	1	4721	1	5219
Netherlands	60	14723	23	4400
Belgium	++	7067	++	4347
Egypt	++	1682	1	3978
Philippines	-	-	14	3081
Other countries	7	21970	5	16164

Figures rounded off

Table-7: Exports of Molybdenum Powders.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	399	3	8907
Malaysia	++	20	3	8698
UAE	-	-	++	169
France	-	-	++	31
Egypt	-	-	++	9
Kazakhstan	++	++	++	++
UK	++	355	-	-
USA	++	24	-	-

Figures rounded off

Table-8: Exports of Molybdenum: Worked

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	82	122342	119	182537
Austria	3	40669	6	72646
Germany	10	11088	63	31197
China	1	12744	1	20820
USA	++	7658	2	11987
Malaysia	++	20	3	8698
Poland	1	4721	1	5219
Netherlands	60	14723	23	4400
Belgium	++	7067	++	4347
Egypt	++	1682	1	3978
Philippines	-	-	14	3081
Other countries	7	21970	5	16164

Figures rounded off

Imports

Like exports, imports of molybdenum ores & concentrates increased by 16% to 9,177 tonnes in 2020-21 from 7,901 tonnes in 2019-20. Imports were mainly from Chile (39%) , Thailand (22%), USA (14%) UAE (8%), Netherlands (7%). Imports of molybdenum and scrap decreased to 430 tonnes in 2020-21 from 429 tonnes in the 2019-20. Imports were mainly from China (75%), Austria (10%) and USA (5%) (Tables-9 to 13) and Fig 3.

Table-9: Imports of Molybdenum Ores and Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7901	9809780	9177	8848441
Chile	3328	3793869	3567	3190606
Thailand	2302	3230436	1977	2082011
USA	288	279469	1300	1302431
UAE	502	604464	756	748294
Netherlands	200	308666	622	597959
Korea	188	153457	274	317728
China	215	235472	150	146839
Switzerland	137	227884	95	137817
Belgium	104	110323	234	104372
Turkey	376	619472	62	85472
Other countries	261	246268	140	134912

Figures rounded off

(In tonnes of metal content)

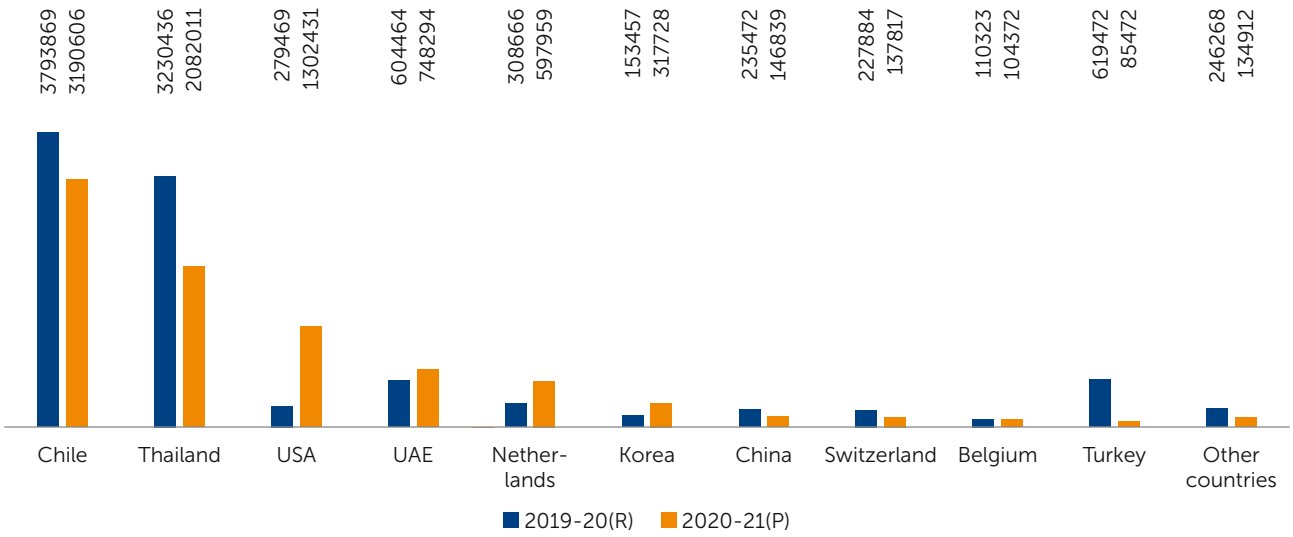


Fig 3: Country wise Value of Import of Molybdenum ore

Table-10: Imports of Molybdenum & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	429	1545908	430	1540722
China	340	1021928	323	964917
Austria	49	293674	45	293841
USA	19	123114	20	81188
Germany	9	36913	19	56291
Singapore	3	23532	4	38224
UK	7	20741	11	33882
Russia	++	1442	++	31267
France	++	6335	++	11125
Hong Kong	1	5486	2	10747
Japan	++	6495	++	6617
Other countries	1	6248	6	12623

Figures rounded off

Table-11: Imports of Molybdenum Powders

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	15	79969	12	62407
USA	11	44841	8	32025
Singapore	3	22772	2	17840
Japan	++	5222	++	5539
Hong Kong	++	2364	++	2344
China	1	3062	1	1889
Belgium	++	1302	++	1538
Italy	-	-	1	947
Germany	++	41	++	241
Canada	-	-	++	44
UK	++	365	-	-

Figures rounded off

Table-12: Imports of Molybdenum :Worked

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	284	1109940	231	1047016
China	218	716313	140	540752
Austria	42	248529	45	293841
Germany	9	36484	19	56050
USA	8	78270	12	49146
UK	5	13793	11	33871
Russia	++	1442	++	31267
Singapore	++	760	2	20384
France	++	6335	++	11125
Hong Kong	1	2419	++	4522
Canada	++	2353	2	2950
Other countries	1	3242	++	3108

Figures rounded off

Table-13: Imports of Molybdenum & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	130	355999	187	431299
China	121	302553	182	422276
Netherlands	-	-	2	4130
Hong Kong	++	703	2	3881
UAE	-	-	1	454
Belgium	-	-	++	420
Italy	-	-	++	110
USA	++	3	++	17
UK	2	6583	++	11
Austria	7	45145	-	-
Japan	++	624	-	-
Other countries	++	388	-	-

Figures rounded off

FUTURE OUTLOOK

The principal uses for molybdenum are expected to continue to be as catalysts and 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 lowers 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) Containig 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.

12. Nickel

189
(million tonnes) Total reserves/ resources of nickel have been established as on 1st April 2020

2,937
(tonnes) Exports of nickel and alloys including scrap decreased drastically in 2020-21

56,536
(tonnes) Imports of nickel & alloys including scrap in 2020-21

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)

Grade/State	Total Reserves (A)	Remaining Resources						Resources
		Feasibility		Measured	Indicated	Inferred	Total	
		STD221	STD222	STD331	STD332	STD333	(B)	(A+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, and that which is an eco-friendly technology 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.

An Indian delegation led by Dr V.K. Saraswat, Member, NITI Aayog visited Chile, Argentina and Bolivia to explore opportunities for sourcing lithium for manufacture of advanced chemistry batteries in India. Discussions were held with Western Australian Premier and the delegation on strategic partnerships for sourcing raw materials, such as, lithium, cobalt and nickel to support manufacturing of battery. The mobility mission held consultations with industry to develop battery recycling as a sustainable method for ensuring up to 95% recovery of critical minerals, such as, lithium, nickel, cobalt etc.

Considering the need and significance of the problem related to energy materials, CSRI-IMMT has developed suitable process flow sheets for the processing of resources, such as, alloy scrap and spent catalyst to produce percusor materials that can be used for battery application particularly in preparing electrodes of Li-ion batteries.

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 (ITC-HS Code no. 2604) and Nickel waste & scrap (ITC-HS Code 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 95 million tonnes of metal content. Indonesia & Australia (22% each), Brazil (17%), Russia (8%) and Philippines (5%) 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	Reserves
World: Total (rounded off)	95000000
Australia	21000000
Brazil	16000000
Canada	2000000
China	2800000
Indonesia	21000000
New Caledonia[b]	NA
Philippines	4800000
Russia	7500000
USA	340000
Other countries	20000000

Source: USGS, Mineral Commodity Summaries,2022

(a) for Australia, Joint Ore Reserve Committee - compliant reserves were 8.3 million tonnes.

(b) Overseas territory of France.

NA- Not Available

In 2020, world mine production of nickel decreased to 2.51 million tonnes as compared to 2.67 million tonnes of metal content in the previous year (Table-3). The chief producers of nickel in the world in 2020 were Indonesia (33%), Philippines (13%), Russia(9%), New Caledonia (8%), Canada & Australia (7% each), China (4%), etc. (Table-3) Fig 1.

Table – 3: World Mine Production of Nickel

(By Principal Countries)

(In tonnes of metal content)

Country	2018	2019	2020
World: Total	2384000	2674000	2510000
Indonesia*	651600	1036200	816700
Philippines	344966	323325	328372
Russia	218000	223200	237300
New Caledonia	216225	208185	199485
Canada	185962	180904	167243
Australia	160022	158751	169344
China	108200	104674	105000
Brazil	65300	55700	77100
Guatemala	65710	36300	68363
Other countries	367880	346151	341224

Source: BGS,World Mineral Production, 2016-20

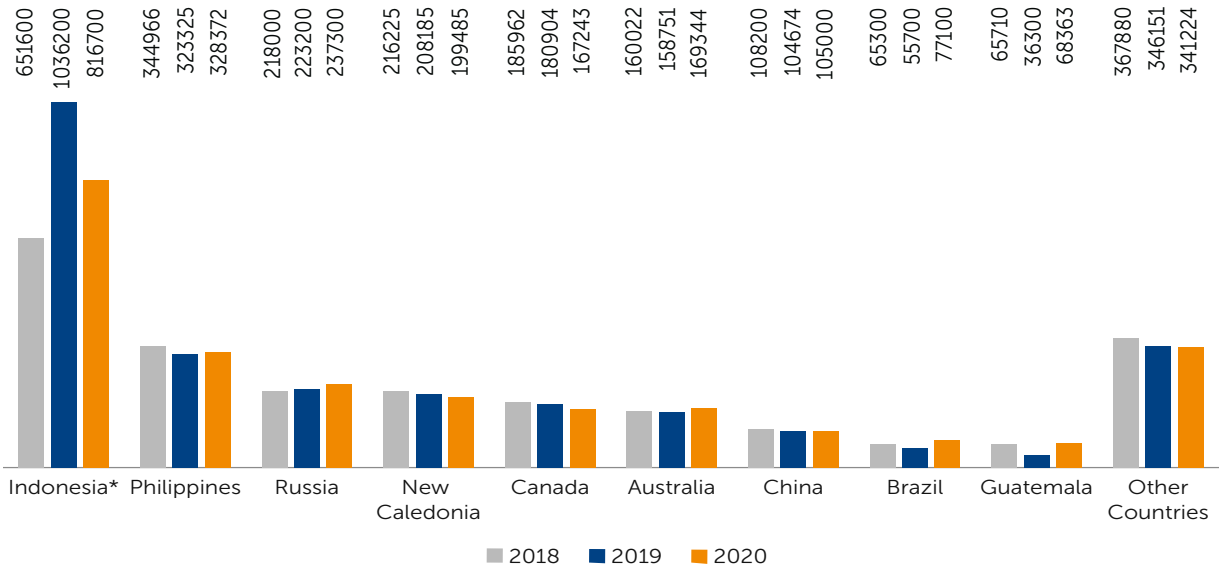


Fig 1: World Mine Production of Nickel

FOREIGN TRADE

Exports

Exports of nickel ores and concentrates were nil 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 decreased drastically by 83% to 2,937 tonnes in 2020-21 from 16,890 tonnes in the previous year. Out of the total alloys and scrap exported in 2020-21, nickel & alloys were 2,269 tonnes, while nickel waste & scrap were 668 tonnes. Exports of nickel and alloys including scrap were mainly to China (21%), UK (11%), Mexico & Netherlands (7%),Turkey (6%), USA (5%), Korea. Rep of (4%), UAE & Brazil (3% each)(Tables-4 to 18).

Table – 4: Exports of Nickel Ores and Conc.

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	++	-	-
UK	++	++	-	-

Figures rounded off

Table – 5: Exports of Nickel and Alloys Including Scrap

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16890	6532327	2937	4147078
China	13866	2731462	603	732297
USA	277	389530	161	382978
Mexico	173	264841	193	330936
Turkey	82	113712	187	308047
Netherlands	185	194938	215	272943
UK	566	414230	332	263743
UAE	72	127494	96	182322
Korea, Rep. of	168	213243	127	179750
Brazil	63	82499	98	152797
Saudi Arabia	109	339971	45	134758
Other countries	1329	1660407	880	1206507

Figures rounded off

Table – 6: Exports of Nickel & Alloys

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	15634	5830642	2269	3763280
China	13866	2731460	603	732297
USA	182	321089	159	381353
Mexico	171	258688	193	330936
Turkey	82	113712	187	308047
Netherlands	108	172915	160	248001
UAE	72	127492	96	182322
Korea, Rep. of	168	213243	127	179750
Brazil	57	81041	98	152797
Saudi Arabia	109	339971	45	134758
Thailand	93	130143	77	114149
Other countries	726	1340888	524	998870

Figures rounded off

Table – 7: Exports of Nickel Waste & Scrap

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1256	701685	668	383798
UK	509	318515	297	181612
Sweden	134	64106	177	104595
Malaysia	-	-	60	34127
Netherlands	77	22023	55	24942
Japan	145	84267	41	24241
Germany	130	44474	17	5456
Belgium	11	646	15	4931
USA	95	68441	2	1625
Nepal	6	1878	4	1387
Jordan	-	-	++	872
Other countries	149	97335	++	10

Figures rounded off

Table – 8 : Exports of Electroplated Anode of Nickel

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5	3185	64	31638
China	-	-	52	24164
Saudi Arabia	++	27	7	4558
Nepal	4	1943	4	1983
UAE	1	835	1	648
Hong Kong	-	-	++	112
Israel	-	-	++	79
Tanzania	-	-	++	77
Nigeria	-	-	++	12
Mauritius	++	++	++	2
Bangladesh	-	-	++	2
Other countries	++	380	++	1

Figures rounded off

Table – 9 : Exports of Nickel Oxide Sinters & Otr Intermediate

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	13375	2129664	++	127
Czech Republic	-	-	++	99
USA	-	-	++	28
China	13375	2129664	-	-

Figures rounded off

Table – 10 : Exports of Nickel Mattes

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	-	-	++	142
Turkey	-	-	++	142

Figures rounded off

Table – 11 : Exports Nickel Except Electroplated Anode

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	31	33070	39	45191
Singapore	-	-	24	23358
UAE	24	23913	6	7313
Saudi Arabia	3	4138	4	4904
Nigeria	1	1193	2	3857
Nepal	2	2146	2	2004
Ghansa	-	-	1	919
Sri Lanka	1	964	++	664
Taiwan	-	-	++	550
China	-	-	++	531
Indonesia	-	-	++	477
Other countries	++	716	++	614

Figures rounded off

Table – 12 : Exports of Nickel: Worked

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	212	303820	253	370849
Netherlands	76	113744	124	180585
Brazil	20	27649	39	58637
Turkey	14	19721	21	31273
Philippines	29	41573	21	31264
Germany	-	-	10	13343
Saudi Arabia	8	12311	7	10519
Colombia	20	26340	6	9132
USA	15	21038	6	8306
Malaysia	2	3272	4	6605
Thailand	4	4950	5	6253
Other countries	24	33222	10	14932

Figures rounded off

Table – 13 : Exports Nickel & Alloys: Unwrought

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2	8414	3	6481
Turkey	++	375	++	2466
Sri Lanka	++	121	1	984
Uganda	-	-	1	733
Nepal	++	564	++	626
Thailand	-	-	++	531
Kuwait	++	94	1	242
Brazil	++	70	++	214
Egypt	-	-	++	182
USA	++	328	++	156
Kenya	++	64	++	136
Other countries	2	6798	++	211

Figures rounded off

Table – 14 : Exports of Nickel & Alloys: Worked, Nes

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	195	473544	157	608831
Turkey	2	9932	27	113355
Hungary	17	52989	20	64008
Germany	13	46929	17	58865
USA	11	40692	15	58571
Indonesia	7	21393	7	33893
Korea, Rep of	82	87358	25	28772
Mexico	1	13421	4	25692
U K	9	15965	4	20163
Thailand	7	31536	4	20008
Singapore	6	19198	5	19388
Other countries	40	134131	29	166116

Figures rounded off

Table – 15 : Exports Nickel & Alloys: Worked

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	141	196522	186	253186
Turkey	22	21746	52	61574
Saudi Arabia	18	43421	10	32091
Netherlands	17	22390	20	21047
Italy	++	610	10	15676
South Africa	2	1612	12	15273
Colombia	19	20208	10	15091
Philippines	1	937	13	14136
USA	17	19117	10	11639
Thailand	2	2206	11	10069
Malaysia	5	5007	7	7547
Other countries	38	59268	31	49043

Figures rounded off

Table – 16 : Exports of Bars, Rods, Plates, Sheets, Foils of Nickel Alloys

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1403	2154307	1310	2001393
China	490	595593	602	725058
Mexico	158	231683	182	294890
USA	98	193453	98	250041
UAE	25	51146	72	137860
Korea	42	62361	46	62748
Saudi Arabia	56	151653	21	58502
Thailand	65	70816	42	54655
U K	42	66299	26	52247
Brazil	14	20740	21	38716
Netherlands	13	23594	12	27304
Other countries	400	686969	188	299372

Figures rounded off

Table – 17 : Exports of Bars, Rods, Plates, Sheets, Foils of Nickel

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	274	527509	321	473082
Korea	37	53521	56	88230
Turkey	33	45604	76	82100
USA	41	45989	30	52351
Brazil	18	28154	32	48231
Thailand	15	20635	15	22633
France	8	11273	13	22500
UAE	8	18551	13	22170
Japan	26	32896	11	20454
South Africa	3	17605	1	14792
Russia	++	2583	1	12201
Other countries	85	250698	73	87420

Figures rounded off

Table – 18 : Exports Nickel Electroplated Anode

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1	3792	++	3998
Kenya	-	-	++	1445
UK	++	1514	++	1294
Nepal	-	-	++	600
Bulgaria	-	-	++	398
USA	++	472	++	261
Netherlands	++	728	-	-
Bangladesh	1	704	-	-
Qatar	++	318	-	-
Bahrain	++	46	-	-
UAE	++	10	-	-
Other countries	++	++	++	++

Figures rounded off

Imports

Imports of nickel ores & concentrates were 37 tonnes in the year 2020-21. Imports of nickel & alloys including scrap were at 56,536 tonnes in 2020-21 which increased drastically by 17% from that of 48,425 tonnes in the previous year. Out of the total alloys and scrap imported in 2020-21, nickel & alloys were at 53,248 tonnes as compared to 45,294 tonnes in the previous year, while nickel waste & scrap were 3,288 tonnes as compared to 3,131 tonnes in the previous year. Imports of nickel and alloys including scrap in 2020-21 were mainly from Papua N Guinea (24%), Japan & Norway (10% each), Canada (6%), USA, China & South Africa (5% each) and UK & Netherland (3% each). (Tables-19 to 33).

Table –19: Imports of Nickel Ores & Conc.

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	204	37	6404
Japan	-	-	14	3504
UAE	-	-	3	1634
Indonesia	-	-	20	1266
Cote D' Ivoire	++	126	-	-
Austria	++	78	-	-

Figures rounded off

Table – 20: Imports of Nickel and Alloys Including Scrap

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	48425	55491356	56536	55125443
Japan	5116	6660013	5715	7387333
Norway	5901	6031943	5885	6935479
USA	2796	4964094	2927	4302850
China	4566	5597300	2775	3850114
Canada	1656	1680013	3242	3510354
South Africa	4040	3972545	2923	3450761
UK	1994	3169554	1599	2718478
Germany	1250	2065249	1192	2248424
Papua N Guinea	-	-	13788	2054289
Netherlands	3750	3481245	1704	2032483
Other countries	17356	17869400	14786	16634878

Figures rounded off

Table – 21: Imports of Nickel & Alloys

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	45294	53854179	53248	53022663
Japan	5116	6660013	5514	7224603
Norway	5901	6031943	5861	6905374
USA	2429	4758928	2349	3944331
China	4566	5597300	2775	3850114
South Africa	4034	3966489	2923	3450761
Canada	1437	1434077	2934	3198755
UK	1909	3120781	1558	2692889
Germany	1101	2006987	1115	2215537
Papua N Guinea	-	-	13788	2054289
Netherlands	3678	3453208	1620	1982477
Other countries	15123	16824453	12811	15503533

Figures rounded off

Table – 22: Imports of Electroplated Anode of Nickel

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	31222	13449229	78724	40534144
South Africa	2437	987073	46821	24112578
Mozambique	1971	832380	12601	5774332
Tanzania	1223	511543	11439	5562294
Philippines	1054	680608	7284	4764104
Malaysia	211	101269	255	144449
USA	186	92595	212	121052
Japan	79	39836	47	29282
China	14	7514	58	18465
UK	3	6763	1	3166
Singapore	764	149934	3	1937
Other countries	23280	10039714	3	2485

Figures rounded off

Table –23: Imports of Nickel Oxide Sinters & Otr Intermediate

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	55	22097	14098	2122865
Papua N Guinea	-	-	13788	2054289
Indonesia	-	-	78	16402
Saudi Arabia	-	-	78	16318
Japan	-	-	14	13330
USA	++	192	51	12063
UAE	-	-	20	4059
Egypt	-	-	36	3849
Malaysia	-	-	25	1555
Germany	3	1633	8	993
China	-	-	++	7
Other countries	52	20272	-	-

Figures rounded off

Table –24: Import of Nickel Mattes

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	72	++	407
UK	-	-	++	396
USA	++	72	++	11

Figures rounded off

Table –25: Imports of Nickel Except Elecroplated Anode

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**33613**	**33643137**	**27586**	**31317895**
Norway	5901	6031716	5861	6905365
Japan	3058	3215831	3933	4546886
South Africa	3882	3822088	2879	3406237
Canada	1418	1388317	2895	3149912
Netherland	3530	3202404	1326	1534814
China	3447	3527072	1421	1513648
Russia	1829	1645054	1239	1368013
Korea	1705	1766456	1255	1367722
Singapore	1569	1575062	1247	1363383
Australia	1158	1190371	1207	1325415
Other countries	6116	6278766	4323	4836500

Figures rounded off

Table – 26: Imports of Nickel: Worked

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**41**	**71892**	**13**	**23174**
China	17	21519	7	11917
Germany	++	1569	1	4006
UK	10	17716	3	3525
Colombia	-	-	2	2170
France	-	-	++	1316
USA	4	11314	++	175
Hong Kong	++	121	++	65
Taiwan	5	9013	-	-
Brazil	2	2926	-	-
Austria	1	2761	-	-
Other countries	2	4953	-	

Figures rounded off

Table – 27: Imports of Nickel & Alloys: Unwrought

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**364**	**357810**	**1027**	**896439**
UK	210	226565	101	189316
Brazil	-	-	153	166255
USA	139	83563	327	157541
Korea	-	-	100	115549
Netherlands	-	-	71	80939
Belgium	1	1642	62	66339
UAE	-	-	175	59528
Canada	-	-	20	21435
China	3	12025	5	14930
Slovenia	7	21440	3	11352
Other countries	4	12575	10	13255

Figures rounded off

Table – 28: Imports of Nickel & Alloys: Worked, Nes

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	380	1767793	368	2324709
Hong Kong	9	608701	2	858714
Singapore	2	17599	4	296963
USA	26	275197	29	270431
China	42	156612	120	214536
Germany	15	76069	17	158720
Korea	14	21915	69	136597
Japan	24	89580	28	114782
UK	9	63244	24	73537
South Africa	152	144401	44	44524
Italy	14	48871	6	26238
Other countries	73	265604	25	129667

Figures rounded off

Table – 29: Imports of Nickel & Alloys: Worked

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3813	5631578	3634	5138634
China	526	860292	844	1353439
Sweden	911	641451	1109	807595
UK	635	1294508	260	592537
Japan	179	302712	327	553483
USA	319	738179	169	419682
Brazil	243	369210	210	343829
Germany	383	566153	210	336399
Taiwan	92	147983	121	223227
Italy	112	130144	79	112395
Singapore	90	138511	47	74395
Other countries	323	442435	258	321653

Figures rounded off

Table – 30: Imports of Bars, Rods, Plates, Sheets, Foils of Nickel

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	521	1110499	531	1118988
UK	149	280942	182	363272
Netherlands	73	96487	94	130554
USA	61	215867	55	124592
China	44	85751	45	101769
Germany	25	62770	47	92479
Italy	46	139992	21	76051
France	8	15145	21	50484
Belgium	7	16643	12	37921
Hong Kong	12	17790	25	37696
Singapore	8	62318	4	37672
Other countries	88	116794	25	66498

Figures rounded off

Table –31: Imports of Bars, Rods, Plates, Sheets, Foils of Nickel Alloys

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	6506	11246333	5971	10049732
USA	1775	3318212	1695	2931058
Japan	1850	3040689	1196	1978821
Germany	669	1289556	830	1615107
China	487	934025	333	639491
UK	140	390582	188	491300
France	186	362567	186	443015
Belgium	113	171574	254	430810
Italy	247	587227	161	318947
UAE	216	194760	203	232136
Netherlands	68	128336	121	216685
Other countries	755	828805	804	752362

Figures rounded off

Table – 32: Imports of Nickel Electroplated Anode

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1	2968	20	29820
Italy	-	-	20	21009
Germany	++	71	++	4709
USA	++	1332	++	2046
Singapore	++	246	++	1484
China	++	4	++	377
France	++	127	++	153
Canada	-	-	++	42
Czech Republic	1	1154	-	-
UAE	++	34	-	-

Figures rounded off

Table – 33: Imports of Nickel Waste & Scrap

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3131	1637177	3288	2102780
USA	367	205166	578	358519
Canada	219	245936	308	311599
UAE	492	251979	557	239582
Japan	-	-	201	162730
Saudi Arabia	326	139357	278	141539
Belgium	-	-	100	115569
Bangladesh	296	153825	113	93487
Bulgaria	++	376	81	84203
Qatar	258	105813	206	79725
Malaysia	188	90350	103	71658
Other countries	985	444375	763	444169

Figures rounded off

FUTURE OUTLOOK

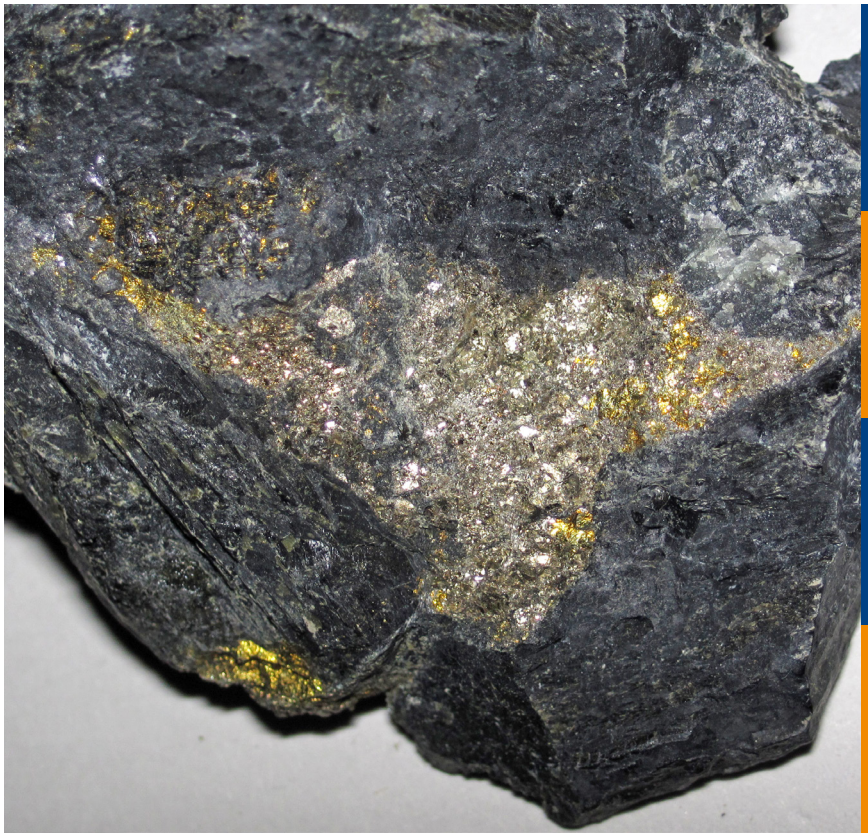
Primarily World nickel demand is for the production of stainless steel where about 65% nickel is consumed. Nickel accounts for 10 to 20% input cost in stainless steel production depending on the nickel content. The future outlook for nickel depends mainly on the production of stainless steel which is 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 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.

13. Platinum & Palladium



20.92
(tonnes) Metal content as per NMI Database, based on UNFC System

430
(tonnes) World mine production of PGMs in 2020

10,719
(kg) Imports of platinum alloys and related metals in 2020-21

616
(kg) Exports of platinum alloys and related metals in 2020-21

Platinum Group of Metals (PGM) is a family of 6 metals–platinum, palladium, rhodium, iridium, osmium and ruthenium. They have similar physical and chemical properties and tend to occur together in the same mineral deposits. These six elements are classified into two groups with reference to the specific gravity of gold (19.2). The elements, Ru, Rh, Pd (sp. gr. 12–12.4) are lighter, while the other three specific gravity elements, Os, Ir and Pt are heavier than gold but within the range of 21.0–21.5. Platinum is an extremely rare metal occurring at a concentration of only 0.005 ppm in earth's crust. Major applications of platinum and palladium are in Automotive Sector for emission control and in chemical and petroleum refining.

RESERVES/RESOURCES

Reserves/Resources of PGM in the country as on 1.4.2020 as per NMI Database, based on UNFC System, are placed at 20.92 tonnes of metal content. By State, Odisha alone accounts for 67% of country's resources of PGE followed by Uttar Pradesh (13%) and Tamil Nadu (8%) with negligible amount (Table-1)(Fig 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 to 0.15 ppm Pd. In recent past, occurrences of PGE mineralisation were reported in mafic-ultramafic complex of Shivamogga schist belt in Davanagere district of Karnataka. Three zones having 10 to 830 ppb of platinum and 50 to 1500 ppb of palladium were established (Table-1).

Table-1: Reserves/Resources of PGM as on 1.4.2020(P)

(In tonnes of metal content)

State	Reserves	Remaining Resources				Total Resources (A+B)
	Total	Indicated	Inferred	Reconnaissance	Total	
	(A)	STD 332	STD333	STD 334	(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

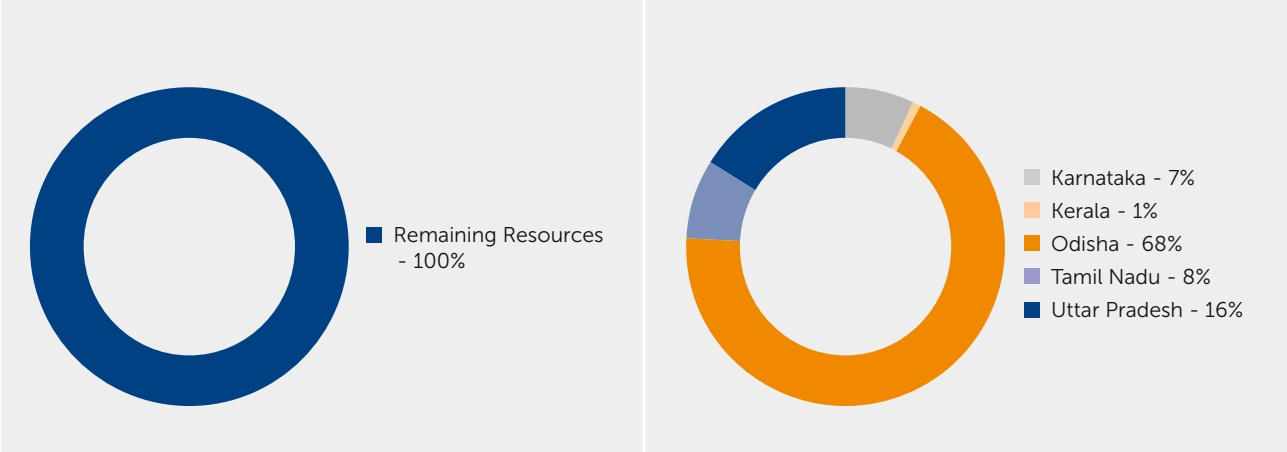


Fig 1: Resources of PGM in India

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 8 g 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 envolve 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 (6%), Zimbabwe (2%) and USA (1%) (Table - 2)Fig.

Table-2: World Reserves of Platinum Group Metals

(By Principal Countries)

(In kilograms of PGM content)

Country	Reserves
World: Total (rounded off)	7,00,00,000
Canada	3,10,000
Russia	45,00,000
South Africa	6,30,00,000
USA	9,00,000
Zimbabwe	12,00,000
Other countries	NA

Source: USGS.Mineral Commodity Summaries, 2022,

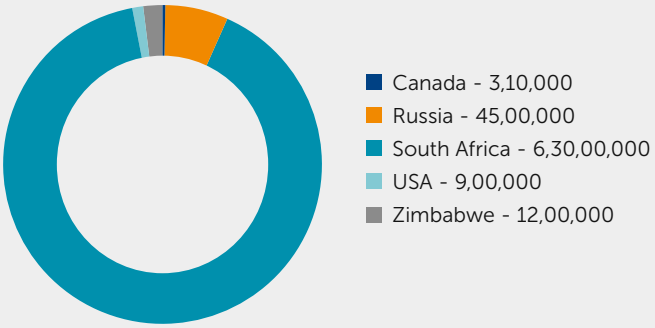


Fig:2 Country wise Reserves of PGM

World mine production of PGMs decreased slightly by 7% to 430 tonnes of metal content in 2020 from 461 tonnes of metal content in 2019 (Table-3).

South Africa, which accounted for 52% of the total PGM mine production in 2020 was followed by Russia (27%), Zimbabwe & Canada (7% each), USA (4%) while other countries contributed the remaining 3 percent.

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	2018-19	2019-20	2020-21
World:Total (rounded off)	469000	461000	430000
South Africa			
Platinum	137053	132989	111993
Palladium	80629	80684	66264
Other platinum metals	52964	54395	46835
Russia			
Platinum[a]	23800	22100	23500
Palladium[a]	85300	86600	92300
Other platinum metals[a]	2100	2100	2000
Zimbabwe			
Platinum	14703	13857	15004
Palladium	12094	11639	12890
Other platinum metals	3076	2800	3230
Canada[e]			
Platinum[e]	11000	10300	10700
Palladium[e]	19200	17900	18600
Other platinum metals[e]	1300	1200	1200
USA			
Platinum	4160	4150	4200
Palladium	14300	14300	14600
Other platinum metals	100	100	100
China			
Platinum	2500	2500	2500
Palladium	1300	1300	1300
Other countries			
Platinum	1593	973	1306
Palladium	1760	1289	1487
Other platinum metals	-	-	-
Grand Total	469202	461352	430419

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 metric 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

On September 12, 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 metric tonnes per year (t/yr) and threefold, respectively (Heraeus Precious Metals GmbH & Co. KG, 2018).

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 exported platinum concentrates beginning in 2019 to encourage domestic refining.

FOREIGN TRADE

Exports

Exports of platinum alloys and related metals increased by about 26% to 616 kg valued at ₹353.50 crore in 2020-21 from 604 kg valued at ₹168.16 crore in the previous year. Exports were mainly to UK (61%) and USA (10% each). Exports in 2020-21 comprised of platinum (unwrought) at 498 kg and platinum (others) at 46 kg. During 2020-21, exports of other metals of platinum group were 109 kg as compared to 345 kg during the preceding year while that of platinum-powder were 9 kg as compared to nil in the previous year (Tables- 4 to 9) (Fig 3).

Table-4: Exports of Platinum Alloys & Related Metals: Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	604	1681684	616	3535012
UK	297	801007	381	2798842
USA	31	60069	65	246419
Singapore	16	96301	14	240561
Japan	48	223676	8	195961
Italy	31	95619	16	35268
Germany	20	74142	1	15435
Cote D'Ivoire	-	-	++	1211
Bahrain	++	35	++	638
Israel	++	592	1	358
Liberia	-	-	++	100
Other countries	161	330243	130	219

Figures rounded off

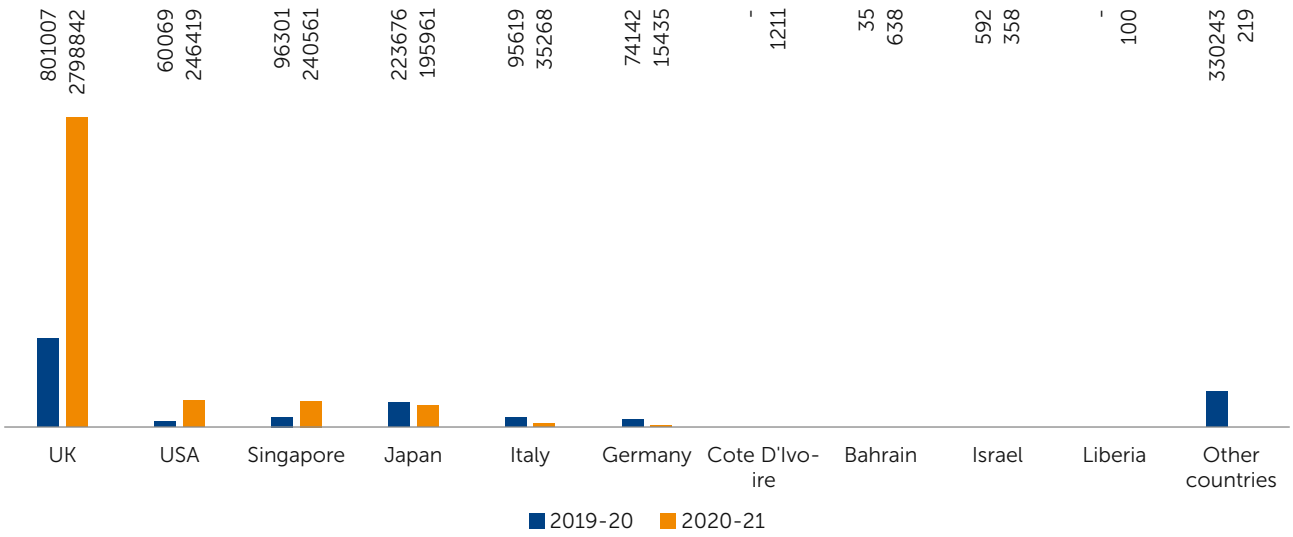


Fig 3: Country wise Exports of Platinum alloys & Related Metals

Table-5: Exports of Platinum (Unwrought)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	259	524194	498	401315
UK	64	62668	307	255329
USA	31	60069	60	143589
Cote D'Ivoire	-	-	++	1211
Bahrain	++	35	++	638
Israel	++	592	1	318
Liberia	-	-	++	100
Bangladesh	-	-	130	93
Egypt	-	-	++	37
Switzerland	151	327648	-	-
Singapore	5	56760	-	-
Other countries	8	16422	-	-

Figures rounded off

Table-6: Exports of Platinum (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	197	641515	46	343359
UK	141	426554	38	206137
Japan	8	52456	6	125985
Italy	23	79220	2	11235
UAE	-	-	++	2
Germany	20	62281	-	-
Singapore	5	21004	-	

Figures rounded off

Table-7: Exports of Platinum (Powder)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	-	-	9	151107
Singapore	-	-	9	151107

Figures rounded off

Table-8: Exports of Other Metals of Platinum Group

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	345	1157490	109	2982590
UK	233	738339	74	2543513
Japan	48	223676	8	195961
USA	-	-	5	102830
Singapore	11	39541	5	89454
Italy	23	79220	16	35268
Germany	20	74142	1	15435
Sweden	-	-	++	87
Israel	-	-	++	40
UAE	-	-	++	2
Hong Kong	10	2532	-	-
Other countries	++	40	-	-

Figures rounded off

Table-9: Exports of Platinum-Clad Base/Precious Metal

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	-	-	700	50
Bangladesh	-	-	700	50

Figures rounded off

Imports

Imports of platinum alloys and related metal increased slightly by 15% to 10,719 kg valued at ₹3833 crore during 2020-21 as compared to 9,299 kg valued at ₹2580 crore in the previous year. Imports were mainly from UK (40%), Germany (15%), South Africa (14%) and USA (15%). Imports in 2020-21 comprised of platinum (powder, unwrought & others) at 5,148 kg, platinum (others) 3,676 kg and other metals of platinum group 1,859 kg. Imports of other metals of platinum group were mainly from UK (32%), USA & South Africa (15% each), Germany & Hong Kong (13% each) and Italy (6%). During 2020-21, imports of platinum-clad base (precious metals) increased by manifold to 73 kg as compared to 6 kg in the previous year. Imports were mainly from Italy (79%) and USA (13%). During 2020-21, imports of platinum powder were at 786 kg as compared to 666 kg in the preceding year. Imports were mainly from USA (68%) and Germany (19%) (Tables-10 to 18) (Fig 4).

Table-10: Imports of Platinum Alloys and Related Metals : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	9299	25809821	10719	38332024
UK	3686	11602641	4307	15000141
Germany	968	3013894	1678	7732200
USA	1055	1650931	1632	7047110
South Africa	2082	6376221	1527	6584804
Italy	557	878768	486	862554
Russia	214	1086623	60	386469
Hong Kong	157	143135	745	343291
UAE	24	49410	62	161208
Japan	190	328280	39	98298
Czech Republic	14	49000	17	71696
Other countries	352	630918	166	44253

Figures rounded off

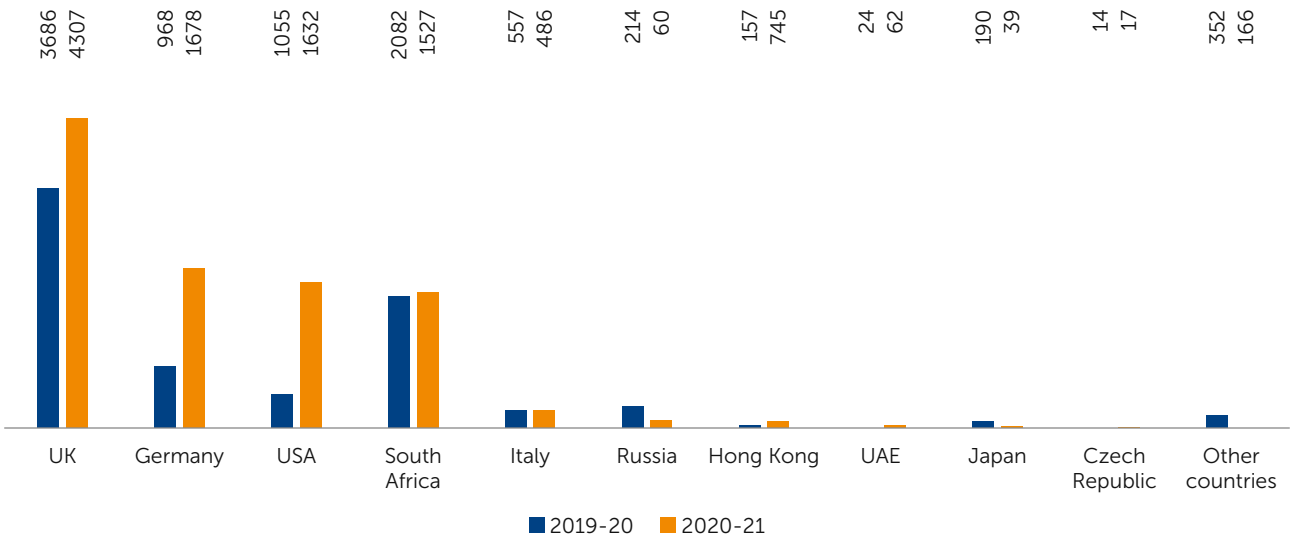


Fig :4 Country wise Imports of Platinum alloys & Related Metals

Table-11: Imports of Platinum (Powder, Unwrought & Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	4705	10157862	5184	11561645
UK	2057	4602109	2488	5415404
Germany	608	1262679	927	2114544
USA	245	515011	807	1742403
South Africa	1424	2992174	655	1493557
Italy	154	309459	144	374638
UAE	24	49410	62	161208
Japan	72	137296	37	86679
Czech Republic	14	49000	17	71696
Hong Kong	31	65198	22	49906
Russia	69	156165	19	41440
Other countries	7	19361	6	10170

Figures rounded off

Table-12: Imports of Other Metals of Platinum Group

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**4594**	**15651959**	**5535**	**26770379**
UK	1629	7000532	1819	9584737
Germany	360	1751215	751	5617656
USA	810	1135920	825	5304707
South Africa	658	3384047	872	5091247
Italy	403	569309	342	487916
Russia	145	930458	41	345029
Hong Kong	126	77937	723	293385
Singapore	158	99086	40	29768
Japan	118	190984	2	11619
France	-	-	++	1942
Other countries	187	512471	120	2373

Figures rounded off

Table-13: Imports of Platinum (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**3025**	**9724169**	**3676**	**19444680**
UK	929	3642359	1323	7413686
Germany	1	519	692	4715147
USA	686	660810	605	3481428
South Africa	608	3303033	543	2991103
Italy	403	569309	341	480220
Russia	145	930458	41	345029
Singapore	60	32359	10	8067
Japan	16	73624	1	5655
France	-	-	++	1942
China	160	1698	120	1880
Other countries	17	510000	++	523

Figures rounded off

Table-14 : Imports of Platinum - Clad Base / Precious Metal

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	**6**	**14483**	**73**	**42046**
USA	5	12444	10	33322
Spain	-	-	4	4014
Italy	-	-	58	2151
UK	1	2039	++	1552
Netherlands	-	-	1	795
Germany	-	-	++	212

Figures rounded off

Table-15: Imports of Other Metals of Platinum Group

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	1569	5927790	1859	7325699
UK	700	3358173	496	2171051
South Africa	50	81014	329	2100144
USA	124	475110	220	1823279
Germany	359	1750696	59	902509
Hong Kong	126	77937	723	293355
Singapore	98	66727	30	21701
Italy	-	-	1	7696
Japan	102	117360	1	5964
China	10	773	-	-

Figures rounded off

Table-16: Imports of Platinum–Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	4039	8706425	4398	9874821
UK	2057	4602015	2463	5355270
Germany	327	663692	772	1759798
South Africa	1161	2404616	606	1385586
USA	197	415505	269	619870
Italy	154	309459	144	374638
UAE	24	49410	62	161208
Japan	67	128169	37	86679
Czech Republic	14	49000	17	71696
Hong Kong	31	65198	22	49906
Singapore	3	5746	3	5868
Other countries	4	13615	3	4302

Figures rounded off

Table-17: Imports of Platinum – Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	666	1451437	786	1686824
USA	48	99506	538	1122533
Germany	281	598987	155	354746
South Africa	263	587558	49	107971
UK	++	94	25	60134
Russia	69	156165	19	41440
Japan	5	9127	-	-

Figures rounded off

Table-18: Imports of Platinum-Clad Base/Precious Metal

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	6	14483	73	42046
USA	5	12444	10	33322
Spain	-	-	4	4014
Italy	-	-	58	2151
UK	1	2039	++	1552
Netherlands	-	-	1	795
Germany	-	-	++	212

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 issue which adversely affected 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.

14. Selenium & Tellurium

20.92
(tonnes) Metal content as per NMI Database, based on UNFC System

China was the leading global producer of selenium and tellurium and accounted for 33% and 61% of world production, respectively

40
(tonnes) Exports of selenium in 2020-21

701
(tonnes) Imports of selenium in 2020-21

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 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. Presently, the plant is not operational. A tellurium recovery plant has also been developed by R & D Wing. Hindalco Industries Ltd reported 73,870 kg production of selenium from imported copper concentrates at its Dahej Smelter in Gujarat during 2010-11 and thereafter no production data is available.

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, resistant to light and chemical attack and hence are used in ceramics, plastics, paints, inks and enamels. Selenium is used in catalysts to enhance selective oxidation and in plating solutions to improve appearance and durability. It is also used in blasting caps and gun bluing.

The use of selenium in glass has increased due to higher colourless glass production. The use of selenium in fertilizer and supplements in the plant-animal human chain and as human vitamin supplements increased as its health benefits were documented. The use of selenium in copper-indium-gallium-diselenide (CIGD) solar cell has increased.

Selenium is recovered from used electronic and photocopier components and recycled.The estimated global use of selenium was in metallurgy (40%); glass (25%); agriculture/ chemicals/ pigments/ electronic (10% each); and other industries (5%).

Tellurium

Tellurium (Te) demonstrates properties similar to those of elements known to be toxic to humans and has application in industrial processes, which is rapidly growing in importance and scale. Tellurium is used principally as an alloying element in the production of free-machining low carbon steel, where additions up to 0.1% tellurium greatly improves machinability. It is also used as a minor additive in copper alloys to improve machinability without reducing conductivity. Tellurium catalysts are used chiefly for the oxidation of organic compounds and also in hydrogenation and halogenation reactions. Tellurium chemicals are used as vulcanising and accelerating agents in processing of rubber compounds. It finds use as a component of catalysts for synthetic fibre production that is increasingly used in cadmium-tellurium-based solar cells. In plain paper copiers and in thermoelectric and photoelectric devices, tellurium is used along with selenium. Mercury-cadmium telluride is used as a sensing material for thermal imaging devices. Tellurium is also used as an ingredient in blasting caps and as a pigment to produce colours in glass and ceramics. High purity tellurium is used in alloys for electronic applications.

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 1,00,000 tonnes or 0.1 million tonnes only cover the estimated contents of economic copper deposits. Selenium was obtained as a by-product with copper. Substantial resources also exist in association with other metals and in uneconomic copper deposits.Selenium reserves are mainly found in China (26%), Russia (20%), Peru (13%), USA (10%) and Canada (6%) (Table-1).

Table-1: World Reserves of selenium
(By Principal Countries)

(In tonnes of Selenium content)

Country	Reserves
World: Total (Rounded off)	100000
Belgium	-
Canada	6000
China	26000
Finland	-
Germany	-
Japan	-
Peru	13000
Poland	3000
Russia	20000
Sweden	-
Turkey	-
United States	10000
Other countries	22000

Source: USGS, Mineral Commodity Summaries, 2022.

The world production of refined selenium is furnished in Table-2 Fig 1. The chief producers of selenium in the world in 2020 were China, Germany, Japan and Belgium. In addition to the countries listed, Australia, Iran, the 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	2018-19	2019-20	2020-21
China	1150	1358	1400
Germany[e]	300	300	300
Japan	768	740	750
Belgium[e]	200	200	200
Russia	176	184	190
USA[e]	152	144	66
Kazakhstan[e]	130	130	130
Mexico	107	127	106
Finland	109	115	84
Other countries	515	389	458

Source: BGS, World Mineral Production, 2016-2020

(e): Includes selenium produced from imported material

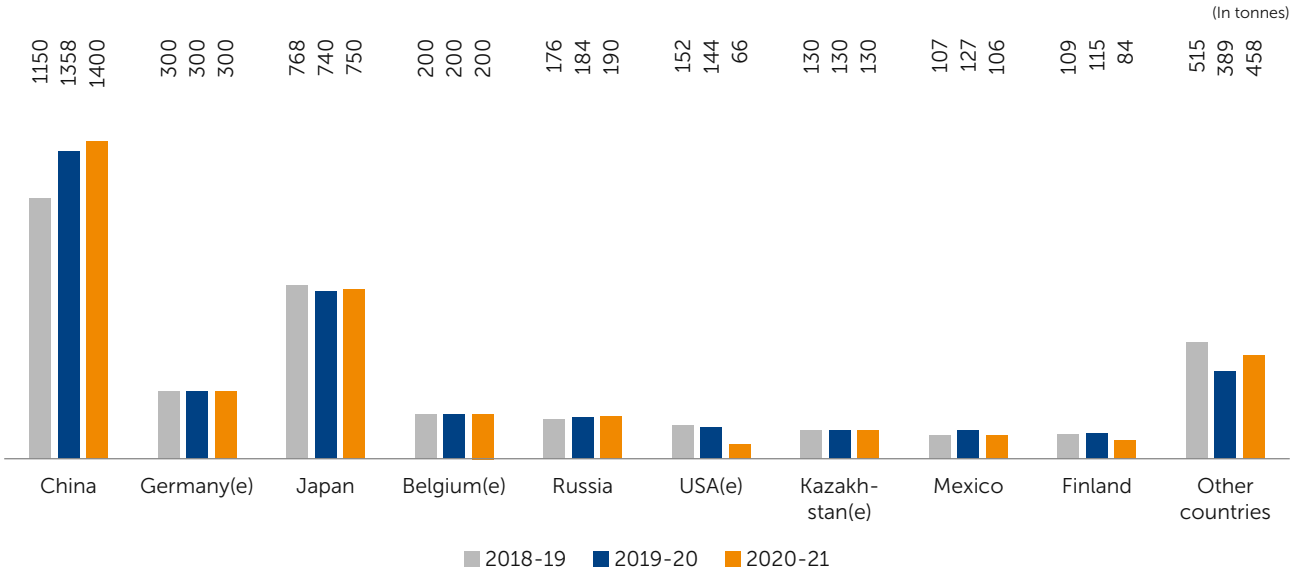


Fig 1: Country wise production of Selenium

Tellurium

The world reserves of tellurium were at 31,000 tonnes contained in copper resources. Tellurium reserves are mainly located in China (21%), USA (11%), Canada (3%) and Sweden (2%). In addition to the countries listed, Australia, Belgium, Chile, Colombia, Germany, Kazakhstan, Mexico, Philippines and Poland 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).

Table-3: World Reserves of Tellurium

(By Principal Countries)

(In tonnes of Selenium content)

Country	Reserves
World: Total (rounded off)	31000
Bulgaria	-
Canada	800
China	6600
Japan	-
Russia	-
South Africa	-
Sweden	670
USA	3500
Other countries	19000

Source: USGS, Mineral Commodity Summaries, 2022.

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 ores. The anode slimes of copper and lead refineries normally contain about 3% tellurium. The chief producers of refined tellurium in the world in 2020 were China, Japan, USA, Russia, Sweden, Canada and Bulgaria (Fig 2).These countries together contributed as an estimated 633 tonnes to the world production in 2020 as compared to 620 tonnes produced in 2019. In addtion to the countries listed, Germany and Belgium are also believed to produce refined tellurium (Table-4).

Table-4: World Production of Tellurium, Refined

(By Principal Countries)

(In tonnes)

Country	2018-19	2019-20	2020-21
China	357	461	460
Japan	58	50(e)	50
Russia	46	50	55
Sweden	45	41	42
Canada	17(e)	15	23
Bulgaria	4	3	3

Source: BGS, World Mineral Production, 2016-2020.

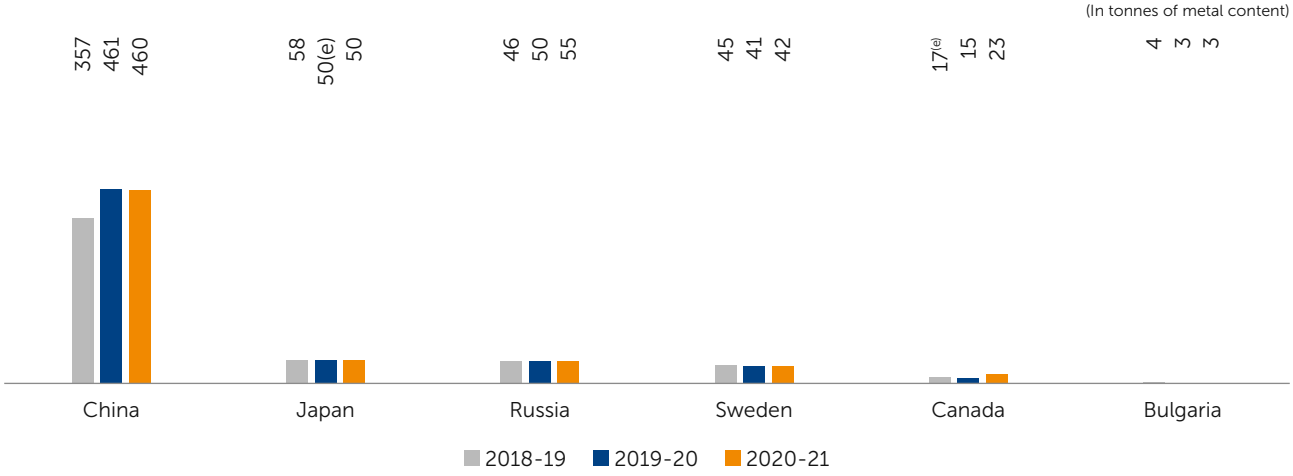


Fig 2: Country wise production of Tellurium

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 and 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 2020-21 increased substantially by 122% to 40 tonnes from 18 tonnes in 2019-20. Exports were mainly to Netherlands (13%), Canada (10%) and Ukraine (8%). There were negligible amount of exports of selenium from Iran, UAE, Philippines (3% each) during 2020-21 (Fig 3). Exports of tellurium were negligible during 2020-21 (Tables-5 & 6).

Table-5: Exports of Selenium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	18	46422	40	43423
Ukraine	-	-	3	13775
Canada	4	13611	4	13775
Iran	1	6726	1	5813
Netherlands	-	-	5	4159
Egypt	-	-	++	1670
UAE	1	47	1	1099
USA	++	661	++	923
Philippines	-	-	1	555
Vietnam	-	-	++	341
Australia	-	-	++	338
Other countries	12	25377	25	1857

Figures rounded off

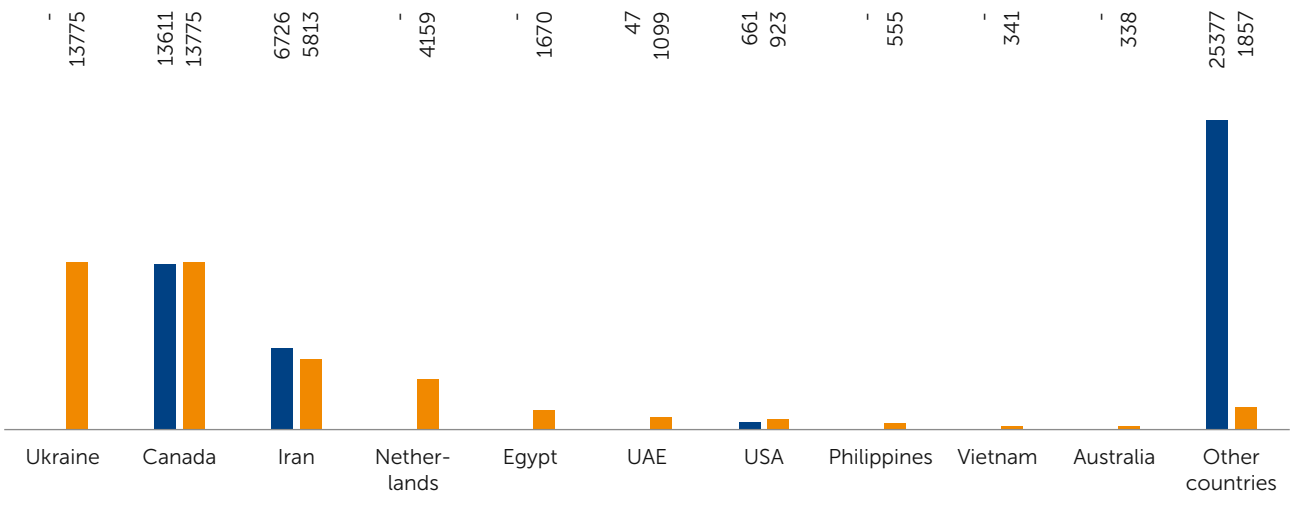


Fig 3: Country wise Value of Import of Selenium

Table-6: Exports of Tellurium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	122	++	37
Belgium	++	106	++	37
Kenya	++	16	-	-

Figures rounded off

Imports

Imports of selenium during 2020-21 increased substantially by 22% to 701 tonnes as compared to 574 tonnes in the preceding year. Imports were mainly from Belgium (29%), Japan (27%), Korea (20%), Germany & Philippines (7% each) & Netherlands (3%). Imports of tellurium decreased by 33% to 2 tonnes as compared to 3 tonnes in the preceding year. Imports were mainly from China (100%). Negligible quantities were also contributed from other countries (Tables-7 & 8) (Fig 4 + Fig 5).

Table-7: Imports of Selenium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	574	708675	701	681519
Belgium	135	169693	206	200846
Japan	134	167932	186	187058
Korea	152	177782	142	128783
Germany	16	25438	48	49138
Philippines	23	25643	47	42209
Netherlands	28	36434	22	22370
Hong Kong	9	8121	17	16582
USA	4	10042	11	13220
Russia	10	8914	10	7655
China	18	25911	5	6959
Other countries	45	52765	7	6699

Figures rounded off

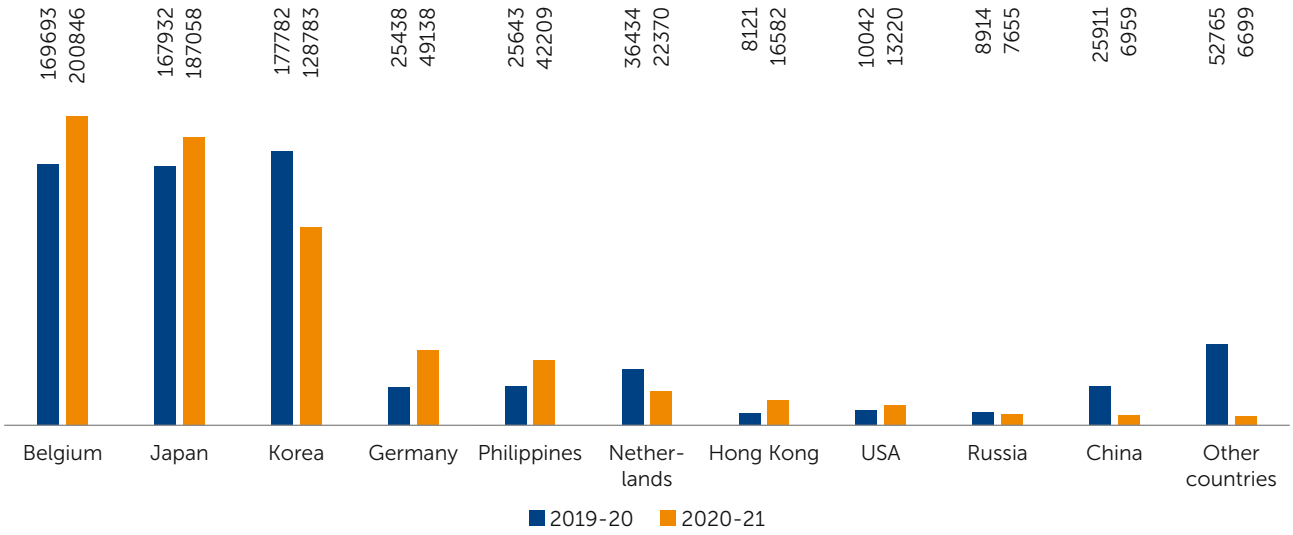


Fig 4: Country wise Value of Import of Selenium

Table-8: Imports of Tellurium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3	23332	2	21250
China	2	9515	2	11901
Hong Kong	1	5632	++	2948
Canada	++	6076	++	2633
Germany	++	30	++	2494
Japan	++	580	++	387
Luxembourg	-	-	++	313
USA	++	195	++	295
Italy	-	-	++	271
Belgium	++	1073	++	8
Belarus	++	231	-	-

Figures rounded off

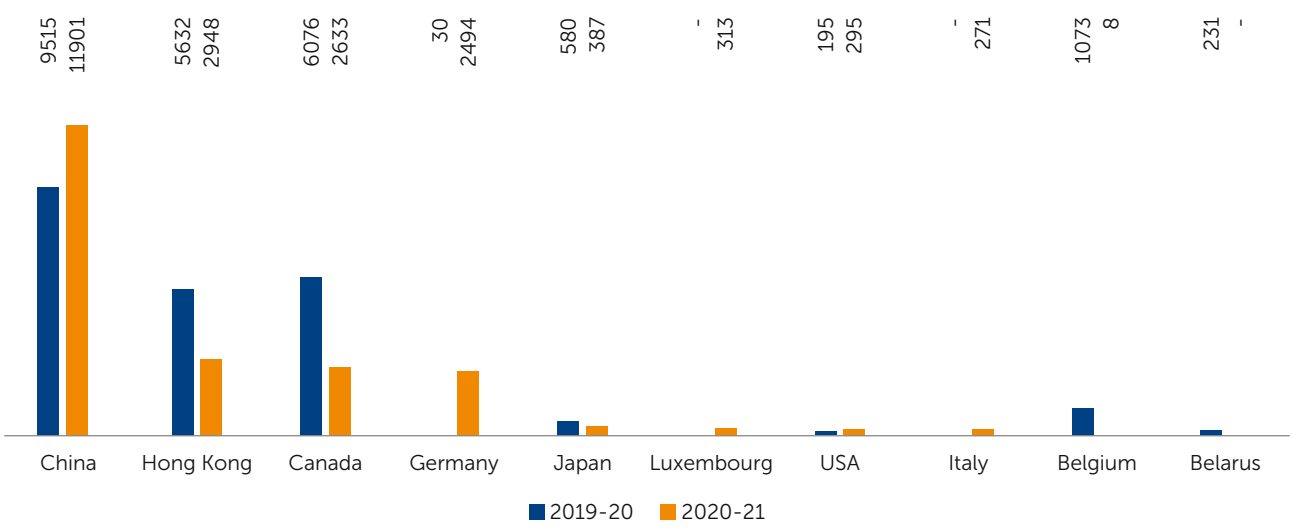


Fig 5: Country wise Value of Import of Selenium

FUTURE OUTLOOK

The supply of selenium is dependent on the supply of main product from which it is derived, copper and also to a lesser extent by the supply of nickel where the nickel production is from sulphide ore. The selenium prices are often inversely related to the supply of copper and nickel.

China has been purchasing large quantities of crude selenium. As this material becomes scarce, the prices for standard grade selenium may rise. The combination of these two factors, the decline of selenium containing concentrates from North America and the growth of Chinese demand, should firm up the prices for selenium in the short term.

Demand for selenium in photoreceptors is likely to see further decline as the cost of substituting organic compounds decreases. The Photoreceptor Industry which was once a major consumer of selenium and tellurium has reached the replacement stage. Selenium has been substituted by alternative material in newer models.

Further, use of selenium in cancer prevention and other health applications may eventually lead to increased consumption of the metal. Dosages taken directly for human consumption will not affect the demand for the metal because only minute quantities are necessary for effective therapy.

The demand and supply of tellurium has remained fairly balanced for a decade. In short term, significant increases are not anticipated in either consumption or production, although reduction in copper production may have a bearing on tellurium supply. An increase in demand for high purity tellurium for cadmium telluride solar cells might have a major impact on tellurium consumption. The use of tellurium alloys in DVD's consumes only small amounts of tellurium and will, therefore, have minimal impact on tellurium demand.

15. Silver

568.64
(million tonnes) Total reserves/ resources of sil er ore as on 1st April 2020

800
(tonnes per annum) Silver refining capacity as per Annual Report of HZL 2020-21

615
(tonnes) Exports of silver in 2020-21

1,484
(tonnes) Imports of silver in 2020-21

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 (Fig 1).

The total reserves/resources of silver in the country as on 1.4.2020 in terms of metal content was estimated at 30,267 tonnes, of which 7,707 tonnes are under 'Reserves' and 22,560 tonnes are under the 'Remaining Resources'. By States, Rajasthan accounted for about 86% reserves/resources in terms of ore, Karnataka & Jharkhand 4% each, Andhra Pradesh 3% and Madhya Pradesh, Uttarakhand, Odisha, Meghalaya, Sikkim, Tamil Nadu and Maharashtra together shared 3% ore reserves/remaining resources (Table-1) (Fig.2). As per reserves & resources summary of HZL 2020-21, grade of silver was 61 gram/tonne under Total Reserves category, 63 gram/tonne under measured and indicated Resources category and 66 gram/tonne under inferred Resources categories.

Table-1: Reserves/Resources of Silver as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total													
Ore	61604192	67971000	40870828	170446020	2330000	18445543	53914460	41320000	70926000	211261729	0	398197732	568643752
Metal	2155.3	4981.73	570.04	7707.07	172.2	824.44	663.67	3881.88	4575.73	12442.92	0	22560.84	30267.91
By State													
Andhra Pradesh													
Ore	0	0	0	0	0	0	16950000	0	0	0	0	16950000	16950000
Metal	0	0	0	0	0	0	128.13	0	0	0	0	128.13	128.13
Jharkhand													
Ore	0	0	0	0	0	0	0	0	0	23840000	0	23840000	23840000
Metal	0	0	0	0	0	0	0	0	0	5.22	0	5.22	5.22
Karnataka													
Ore	17480000	4640000	0	22120000	0	0	69462	0	1490000	2254150	0	3813612	25933612
Metal	4.43	1	0	5.43	0	0	0.48	0	0.39	3.42	0	4.29	9.72
Madhya Pradesh													
Ore	0	0	0	0	0	0	0	0	2096000	1120000	0	3216000	3216000
Metal	0	0	0	0	0	0	0	0	150.61	9.25	0	159.86	159.86
Maharashtra													
Ore	0	0	0	0	0	0	0	0	0	235000	0	235000	235000
Metal	0	0	0	0	0	0	0	0	0	0.23	0	0.23	0.23
Meghalaya													
Ore	0	0	0	0	0	0	0	0	880000	0	0	880000	880000
Metal	0	0	0	0	0	0	0	0	19.8	0	0	19.8	19.8

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Odisha													
Ore	0	0	0	0	0	960500	119000	0	0	670000	0	1749500	1749500
Metal	0	0	0	0	0	27.34	3.4	0	0	34.17	0	64.91	64.91
Rajasthan													
Ore	44124192	63331000	40870828	148326020	2330000	17049200	36712218	39420000	64730000	182142579	0	342383997	490710017
Metal	2150.87	4980.73	570.04	7701.64	172.2	781.85	531.62	3720.28	4384.86	12349.76	0	21940.57	29642.21
Sikkim													
Ore	0	0	0	0	0	435843	63780	300000	0	150000	0	949623	949623
Metal	0	0	0	0	0	15.25	0.04	27.6	0	13.8	0	56.69	56.69
Tamil Nadu													
Ore	0	0	0	0	0	0	0	0	330000	460000	0	790000	790000
Metal	0	0	0	0	0	0	0	0	15.87	26.68	0	42.55	42.55
Uttarakhand													
Ore	0	0	0	0	0	0	0	1600000	1400000	390000	0	3390000	3390000
Metal	0	0	0	0	0	0	0	134	4.2	0.39	0	138.59	138.59

Figures rounded off.

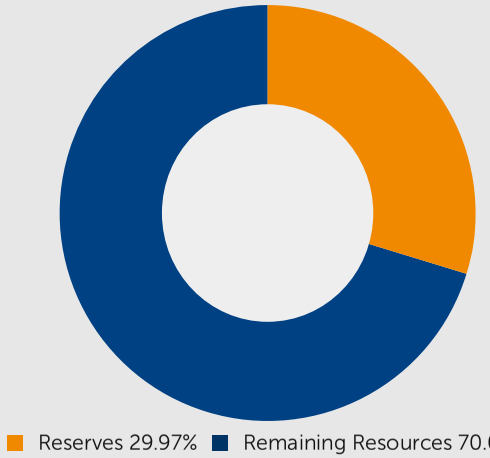


Fig 1. Reserves/resources of Silver Ore as on 1.4.2020 (P)

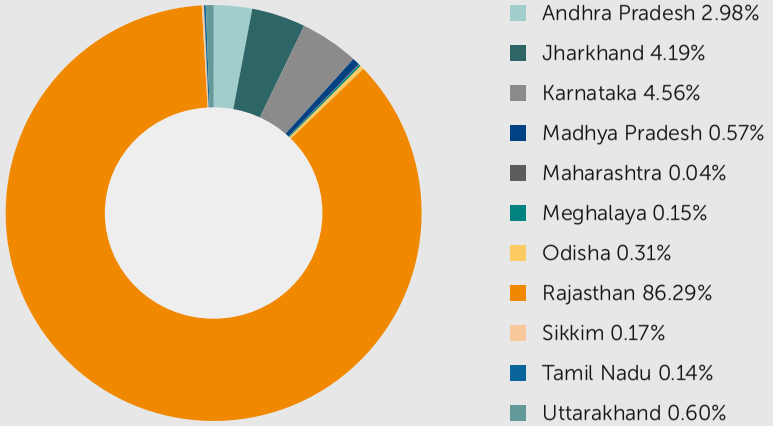


Fig 2. Statewise Reserves/Resources of Silver Ore as on 1.4.2020 (P)

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 2020-21, 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 2020-21, the production of silver at 705,796 kg increased by 16% as compared to the previous year. The production of silver from gold refining was 120 kg in 2020-21 as against 187 kg in 2019-20. One Private Sector and one Public Sector undertaking reported production of silver during 2020-21 (Tables- 2 to 4).

Table-2: Principal Producers of Silver, 2020-21

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*, 2018-19 to 2020-21

(By States)

(Quantity in kg; Value in ₹'000)

State	2018-19 (R)		2019-20 (R)		2020-21 (P)	
	Qty	Value	Qty	Value	Qty	Value
India	679386	25824756	609340	25616104	705796	42664424
Karnataka	214	7785	187	8066	120	7244
Rajasthan	679172	25816971	609153	25608038	705676	42657180

* Excludes by-product recovery of silver by Hindalco Industries Ltd at Dahej, Gujarat from imported copper concentrates

Table-4: Production of Silver*, 2019-20 and 2020-21

(By Sectors/States/Districts)

(Quantity in kg; Value in ₹'000)

State/District	2019-20 (R)		2020-21 (P)	
	Qty	Value	Qty	Value
India	609340	25616104	705796	42664424
Public sector	187	8066	120	7244
Private sector	609153	25608038	705676	42657180
Karnataka/Raichur	187	8066	120	7244
Rajasthan/Chittorgarh	609153	25608038	705676	42657180

* 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 40,582 kg and 63,040 kg silver from imported copper concentrates in 2020-21 and 2019-20, respectively.

In addition, Hindalco Industries Limited reported production of 40,582 kg and 63,040 kg silver from imported copper concentrates in 2020-21 and 2019-20 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 2021 report, Global silver recycling edged higher last year, by 7% to 5,665 tonnes (182.1Moz). 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 5,30,000 tonnes. Peru (22%), Australia (17% each), Poland (13%), Russia (8%), China (8%), Mexico (7%), Chile & USA (5% each) and Bolivia (4%) are the major countries having silver reserves (Table-5).

Table-5: World Reserves of Silver

(By Principal Countries)

(In tonnes of silver content)

Country	Reserves
World: Total (rounded off)	530000
Argentina	NA
Australia[a]	90000
Bolivia	22000
Chile	26000
China	41000
Kazakhstan	NA
Mexico	37000
Peru	120000
Poland	67000
Russia	45000
USA	26000
Other countries	57000

Source: USGS Mineral Commodity Summaries, 2022.

1:One tonne (1,000 kilograms)=32,150.7 troy ounces,

a: For Australia, Joint Ore Reserves Committee-compliant reserve were 25,000 tonnes.

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 24,563 tonnes during the year 2020 which decreased by 14% as compared to 28,353 tonnes in the preceding year. Mexico was the leading producer with 22% share in the total production followed by Peru (11%), China (13%), Chile (6%), Poland (6%), Russia & Australia (5% each) and USA & Kazakhstan (4% each). World mine production of silver is furnished in Table- 6 (Fig 3).

Table-6: World Mine Production of Silver

(By Principal Countries)

(In kilograms of metal content)

Country	2018	2019	2020
World:Total	28006638	28353780	24563120
Mexico	7243245	7485602	5605000
China	3421355	3443128	3377810
Peru	4160162	3860306	2723876
Chile	1370237	1309321	1575794
Poland	1471000	1455000	1423000
Russia	1400100	1407000	1380000
Australia	1254480	1325089	1337344
Kazakhstan	969347	1022068	1035181
USA	934000	977000	986000
Bolivia	1191024	1153110	929909
Other countries	4591688	4916156	4189206

Source: BGS World Mineral Production, 2016-20.

c:- Years ended 31 March following that stated.

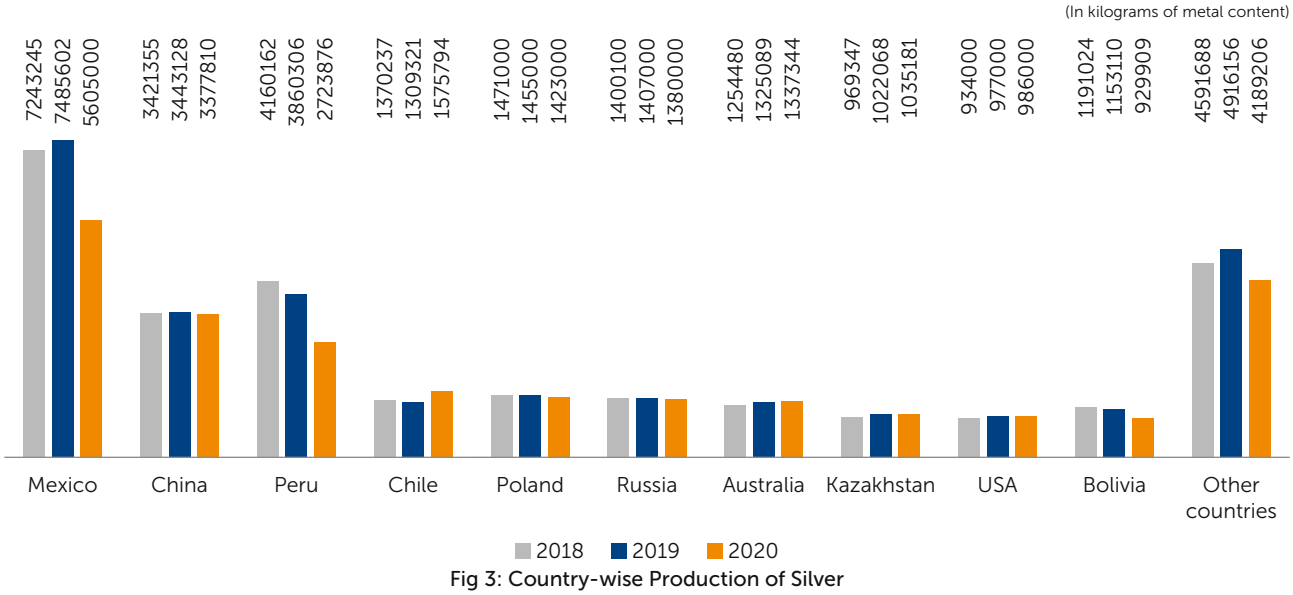


Fig 3: Country-wise Production of Silver

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 t from 2017 owing to increased production from Yamana Gold Inc.'s Cerro Moro Mine, which produced 128 t of silver after beginning commercial production on June 26. SSR Mining Inc.'s Puna operations decreased by 39% to 117 t of silver in 2018 from 192 t produced in the previous year.

Australia

In 2018, silver production in Australia increased by 12% to 1,254 t from 1,120 t (revised) in 2017. South32 Ltd.'s Cannington silver mine produced 416 t of silver in 2018, an 11% increase from 2017 production of 375 t. MMG Australia Ltd.'s Rosebery Mine produced 91 t, a 24% increase from 73 t in 2017, and the Dugald River Mine began operations in 2018, producing 28 t. BHP Group Ltd.'s Olympic Dam Mine produced 30 t, a 39% increase from 21 t in 2017.

Bolivia

Silver production in Bolivia in 2018 was 1,191 t, essentially unchanged compared with 1,196 t (revised) in 2017. During 2018, the San Bartolomé Mine produced an estimated 136 t 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 t in 2018, a slight decrease compared with 112 t 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 t in 2018, a 4% decrease from 366 t (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 a fire in its silver refinery, reducing refined silver production by 311 t (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 t 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 t, a slight decrease from the 6,109 t 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 t (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 t, 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 t), Cerro Verde (142 t), Tambomayo (122 t), El Brocal (121 t), Julcani (77 t), Yancocha (33 t), Tantahuatay (25 t), Mallay (16 t), Orcopampa (10 t), and La Zanja (7 t). Of the 1,030 t of silver produced by Buenaventura mines, 836 t 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 t in 2018 from 535 t 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 t (revised) in 2017. Silver production as a byproduct in gold mines in Russia increased by 392 t (32%). However, this increase was offset by a 50-t 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 increased manyfold to 615 tonnes in 2020-21 as compared to 30 tonnes in the preceding year. Exports were mainly to UK (78%), USA (11%), Canada (5%). Exports of silver-clad base metals also increased to 6,026 kg during 2020-21 from 3,898 kg in 2019-20. Exports of Semi-manufactured silver increased manyfold to 569 tonnes in 2020-21 as compared to 30 tonnes in the preceding year. Exports of silver-unwrought were 45 tonnes during the year 2020-21. Similarly, exports of silver powder were too negligible in both the years (Tables-7 to 11).

Table-7: Exports of Silver

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	30	680127	615	33934966
UK	2	14485	479	29198348
Canada	2	35347	34	1820793
Australia	++	3577	18	1107200
USA	12	234275	66	987913
UAE	2	139441	6	451871
Germany	5	68652	5	90279
Turkey	1	19438	1	49527
Sweden	++	5034	2	32397
Italy	1	17128	1	28768
Spain	++	1145	1	25758
Other countries	5	141605	2	142112

Figures rounded off

Table-8: Exports of Silver-clad Base Metals

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3898**	**12268**	**6026**	**23892**
Sri Lanka	3500	9730	5269	18053
Saudi Arabia	396	2356	730	5245
Germany	-	-	18	472
USA	-	-	5	103
Australia	-	-	4	15
Mauritius	-	-	++	3
Singapore	-	-	++	1
UK	2	182	-	-

Table-9: Exports of Silver: Semi-manufactured

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**30**	**674513**	**569**	**33851111**
UK	2	14485	479	29198154
Canada	2	35347	34	1820793
Australia	++	3565	18	1107194
USA	12	230635	20	906204
UAE	2	139441	6	451853
Germany	5	68127	5	90279
Turkey	1	19438	1	49527
Sweden	++	5034	2	32397
Italy	1	16908	1	28768
Spain	++	1145	1	25720
Other countries	5	140388	2	140222

Table-10: Exports of Silver: Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**++**	**2425**	**45**	**13671**
USA	++	913	45	13353
UK	-	-	++	194
New Zealand	++	60	++	72
Seychelles	-	-	++	21
Nepal	++	475	++	9
Hong Kong	-	-	++	9
Australia	++	12	++	6
UAE	-	-	++	4
Oman	-	-	++	3
Germany	++	421	-	-

Table-11: Exports of Silver: Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	3189	1	70184
USA	++	2727	1	68356
Singapore	-	-	++	1546
Bangladesh	-	-	++	112
Israel	-	-	++	65
Spain	-	-	++	38
Japan	-	-	++	31
Jordan	-	-	++	19
UAE	-	-	++	14
Kenya	-	-	++	3
Oman	++	174	-	-
Other countries	++	288	-	-

Imports

Imports of silver decreased drastically by 72% to 1,484 tonnes in 2020-21 as compared to 5,421 tonnes in the preceding year. Imports were mainly from the Hong Kong (42%), UK (14%), Russia (9%), and Austria (8%). Imports of silver-clad base metals also decreased to 500 kg in 2020-21 as against 574 kg in the previous year. Imports were mainly from Italy (60%) and Thailand (24%).

Imports of semi-manufactured silver were at 1195 tonnes during the year 2020-21 as compared to 589 tonnes in the previous year. Besides, imports of silver unwrought were at 279 tonnes during the year 2020-21 as compared to 4,833 tonnes in previous year. Imports were mainly from Hong Kong (48%), Thailand (20%). In 2020-21, imports of silver powder increased to 10 tonnes in 2020-21 from 5 tonnes reported in the previous year (Tables-12 to 16) Fig 4.

Table-12: Imports of Silver

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5421	191617874	1484	59602766
Hong Kong	1802	63498460	630	25251729
UK	961	34223525	213	8572283
Russia	344	12831977	140	5599051
Austria	143	5197187	124	4815459
China	89	3223864	86	3882315
Singapore	125	4615101	43	1986814
Thailand	180	6097693	55	1901035
Italy	60	1666311	46	1766814
Netherlands	170	6163839	40	1526491
USA	387	13721712	37	1364430
Other countries	1160	40378205	70	2936345

Figures rounded off

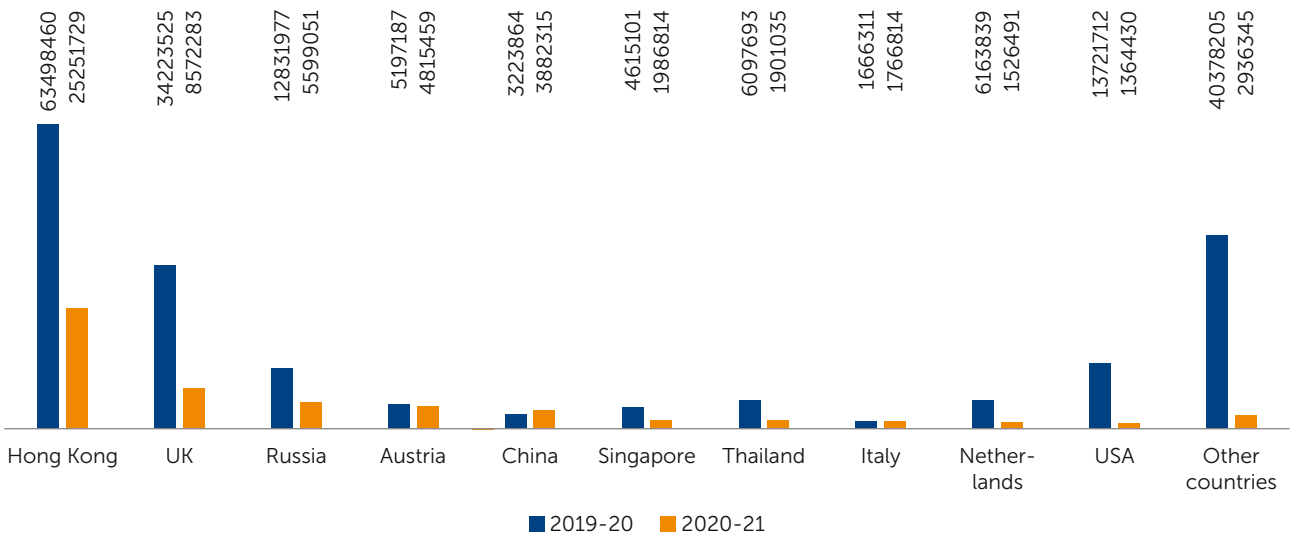


Fig 4: Country-wise Value of Import of Silver

Table-13: Imports of Silver-clad Base Metals

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**574**	**5565**	**500**	**7518**
Italy	-	-	300	3939
Thailand	-	-	120	2252
Germany	-	-	19	516
USA	74	3905	10	356
Malaysia	-	-	5	314
Japan	-	-	46	141
Brazil	500	1660	-	-

Figures rounded off

Table-14: Imports of Silver: Semi-manufactured

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**583**	**21357953**	**1195**	**48096027**
Hong Kong	199	7626895	494	20179854
UK	119	4897864	213	8571878
Russia	60	2436350	140	5595929
Australia	-	-	124	4815459
China	28	1021051	86	3876130
Netherlands	20	652719	40	1526491
USA	36	899845	27	864966
Korea, Rep. of	1	21608	21	733851
Italy	37	799975	27	652430
Germany	1	49489	10	533408
Other countries	82	2952157	13	745631

Figures rounded off

Table-15: Imports of Silver: Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4833	170217267	279	11350070
Hong Kong	1603	55871135	136	5071875
Thailand	180	6097577	55	1900014
Singapore	74	2972773	30	1457232
Italy	23	866007	19	1111913
Switzerland	353	12235280	20	694251
USA	350	12818559	8	481223
Germany	53	1898434	7	424407
UAE	4	165308	3	153326
Peru	2	68072	1	46555
China	61	2202714	++	6185
Other countries	2130	75021408	++	3089

Figures rounded off

Table-16: Imports of Silver : Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5	42654	10	156669
Brazil	++	19197	2	79950
Singapore	4	12818	6	32848
Germany	++	6372	++	20037
USA	1	3308	2	18241
Russia	-	-	++	3122
Italy	++	329	++	2471
Hong Kong	++	430	-	-
UK	++	101	-	-
China	++	99	-	-

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. This will be a great opportunity for India to build silver powder producing facilities themselves in order to facilitate the projected growth in domestic solar generating power capacity.

16. Tin

83.72
(million tonnes) Total reserves/ resources of tin ore as on 1st April 2020

16,865
(kg) Production of tin concentrates in 2020-21

750
(tonnes) Exports of tin & alloys including scrap in 2020-21

10,797
(tonnes) Imports of tin & alloys including scrap in 2020-21

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 tin are located in Haryana, Chhattisgarh and Odisha. About 64% of the total ore resources are located in Haryana and 36% in Chhattisgarh, while nominal resources have been reported from Odisha as well (Table-1).

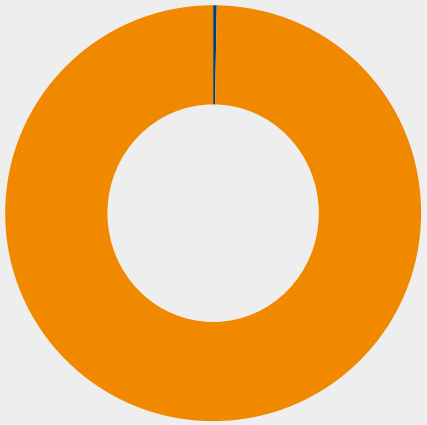
Table-1: Reserves/Resources of Tin as on 1.4.2020

(By Grades/States)

(In tonnes)

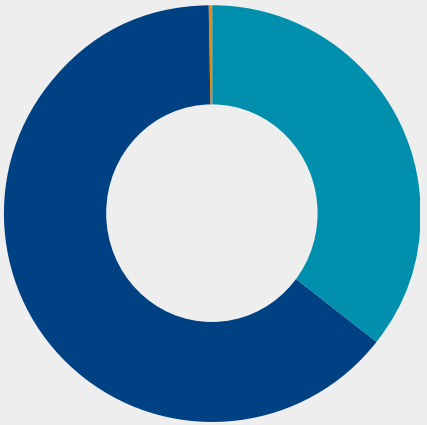
Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total													
Ore	2075	-	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.



Remaining Resources 99.997% Reserves 0.003%

Reserves/resources of Tin (Ore) as on 1.4.2020 (P)



Odisha, 0.02% Haryana, 64.39% Chhattisgarh, 35.59%

State wise Resources of Tin in India

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 2020-21 at 16,865 kg increased substantially by 9% as against 15,530 kg in the preceding year (Fig1). One Public Sector and five Private Sector mines reported production in 2020-21. All these mines are located in Chhattisgarh.

The mine-head closing stock of tin concentrates was 8,729 kg in 2020-21 as against 10,809 kg in 2019-20. 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, whereas Precious Minerals and Smelting Ltd employed 8 workers in the previous year on average daily basis (Tables-2 to 5).

Table-2: Principal Producers of Tin Concentrates, 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, 2018-19 to 2020-21

(By State)

(Quantity in kg; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	21212	14627	15530	10337	16865	9413
Chhattisgarh	21212	14627	15530	10337	16865	9413

Figures rounded off

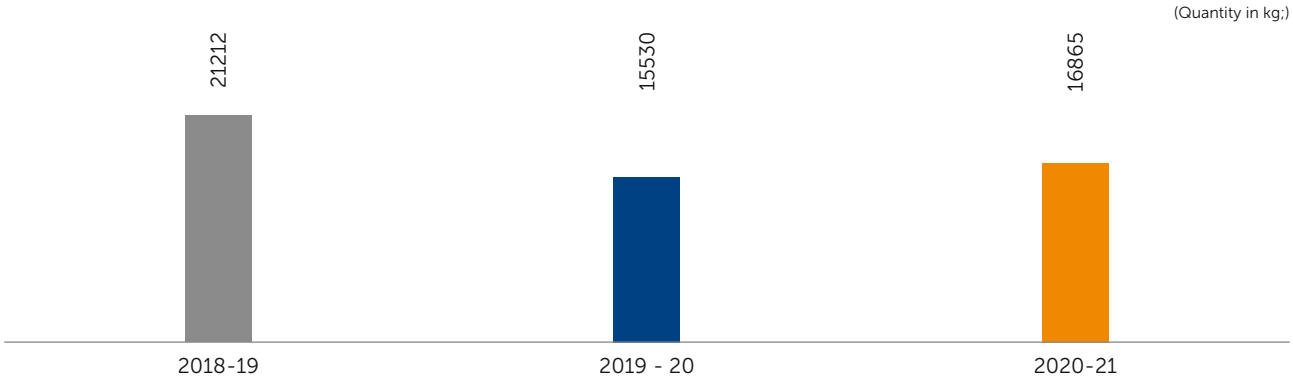


Fig 1: Production of Tin Ore

Table-4: Production of Tin Concentrates, 2019-20 and 2020-21

(By Sectors/State/District)

(Quantity in kg; Value in ₹'000)

State	2019-2020			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	6	15530	10337	6	16865	9413
Public sector	1	11603	6634	1	13859	7815
Private sector	5	3972	3703	5	3006	1598
Chhattisgarh	6	15530	10337	6	16865	9413
Dantewada	6	15530	10337	6	16865	9413

Table-5: Mine-head Closing Stocks of Tin Concentrates, 2019-20 & 2020-21

(By State)

(In kg)

State	2019-20	2020-21 (P)
India	15530	16865
Chhattisgarh	15530	16865

(P): Provisional

Tin Metal

The plant owned by Precious Minerals and Smelting Ltd reported production of 4,337 kg of tin metal in 2020-21 as against 6,063 kg in the preceding year (Fig 2). The plant is located at Jagdalpur in Dantewada district of Chhattisgarh (Table-6).

Table-6: Production of Tin Metal 2018-19 to 2020-21

(Quantity in kg; Value in ₹'000)

Year	Production	
	Quantity	Value
2018-19	7436	8918
2019-20	6063	7361
2020-21 (P)	4337	5400

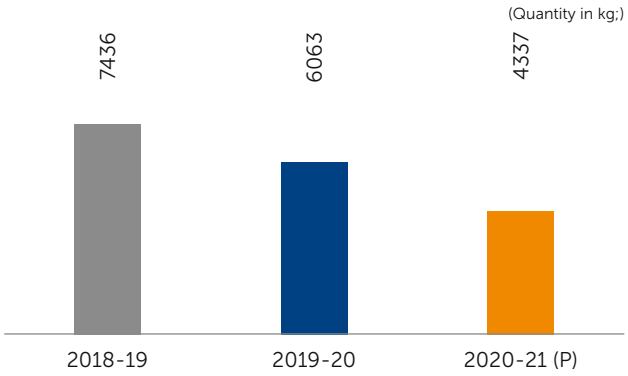


Fig 2: Production of Tin Metal

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 2021 were 4.9 million tonnes, located mainly in China (22%), Indonesia (16%), Australia (11%), Brazil (9%) and Bolivia (8%). 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)	4900
Australia	560(a)
Bolivia	400
Brazil	420
Myanmare	700
Chinae	1100
Congo (Kinshasa)e	130(e)
Indonesiae	800
Laose	NA(e)
Malaysia	81
Nigeriae	NA(e)
Peru	150
Russia	200
Rwandae	NA
USA	-
Vietname	11
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 11% during 2020 to 2,78,000 tonnes as compared to that 3,11,000 tonnes in the preceding year (Table-8). China which continued to be the largest producer of tin in 2020 with contribution of about 34% share in the total world production was followed by Indonesia (19%), Myanmar (13%) and Peru (7%) (Fig 3).

Table-8: World Mine Production of Tin

(By Principal Countries)

(In tonnes of metal content)

Country	2018	2019	2020
World: Total (rounded off)	325000	311000	278000
Australia	6871	7738	8118
Bolivia	17251	17147	14709
Brazil	17100	17000	16893
Myanmar	55000	50000	36000
China	94838	85840	94463
Congo, D. Rep. of	8950	12431	13526
Indonesia	82809	77468	52617
Peru[(a)]	18601	19853	20647
Vietnam	5745	6369	6798
Other countries	17568	16815	14570

Source: BGS, World Mineral Production, 2016-2020.

(a) Recoverable

* Estimated

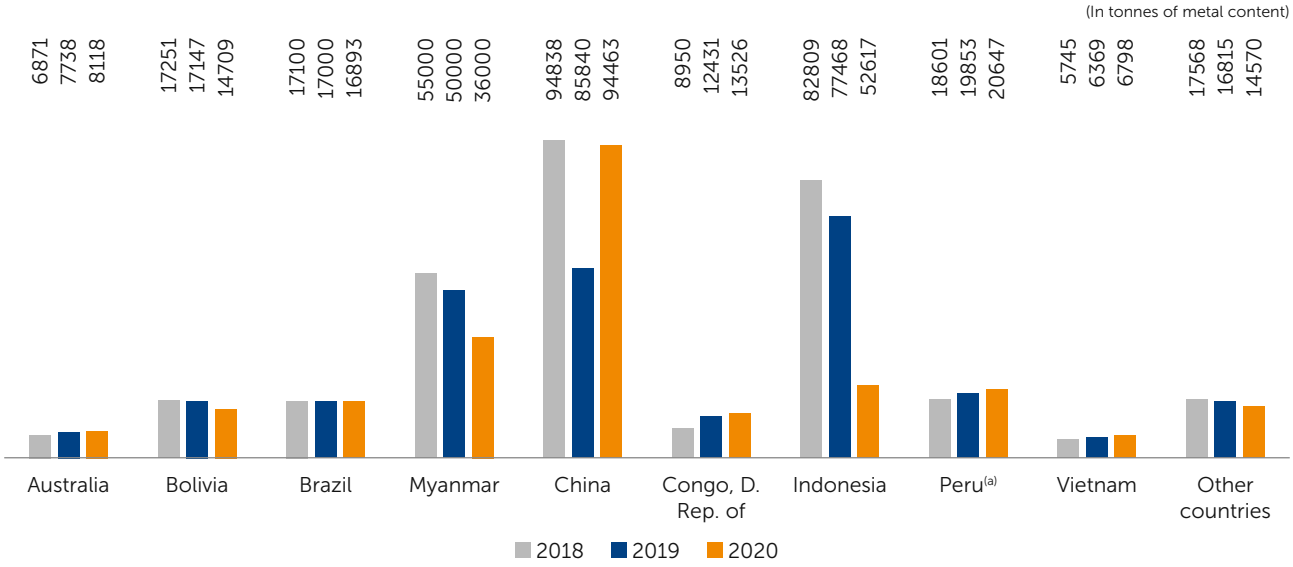


Fig 3: Country wise Production of Tin

A generalised view of the development in various countries, along with country-wise description sourced from latest available publication of Minerals Yearbook of 'USGS' 2017 are presented as below:

Australia

Aus Tin Mining Ltd successfully completed its first sale of 5 tonnes of tin in concentrate from the Granville tin-processing plant in Tasmania. The Granville plant had processed tailings that were assayed at about 1% tin. The plant initially re-treated the existing tailings at the site and then later in the year began processing stockpiled ore. Aus Tin Mining received regulatory approval for a trial mine and pilot plant at the Taronga Stage 1 project. The Taronga project was expected to produce between 25,400 tonnes and 39,800 tonnes of tin in concentrate over the life of the project.

Brazil

Minsur announced in its annual memo that the Pitinga Mine produced 6,983 tonne of tin in concentrate in 2017, essentially unchanged from the 6,875 tonne produced in 2016. All concentrates were sent to the company's Pirapora refinery in Sao Paulo, which produced 6,582 tonne of refined tin in 2017, 12% more than in 2016.

Myanmar

Myanmar accounted for most of China's tin concentrate imports in 2017, supplying tin ore and concentrates containing an industry-estimated 47,000 tonnes of tin. Myanmar's ore continued to be produced predominantly in Wa County, or Wa Special Region 2 in northern Shan State, close to the border with China.

China

In February, Yunnan Tin Group Co. Ltd. announced an expansion of the Wenshan Dulong zinc-indium-tin-copper mine. The expansion will increase ore capacity to 3.6 million metric tons per year (Mt/yr) from 2.1 Mt/yr. The mine was operated by Yunnan Hualian Zinc and Indium Co., Ltd., a subsidiary of Yunnan Tin Group Co. Ltd., and had increased production threefold since 2012, to 6,500 t of contained tin in 2017. The increased production was a result of technological upgrades and the construction of a new processing plant. An additional 8,000 metric tons per year (t/yr) of production during the next several years was planned.

Indonesia

PT Refined Bangka Tin restarted operations in late 2016, after closing in February 2016 because of low tin prices and more stringent environmental regulations. PT Refined Bangka Tin, which started operating in 2009, was one of the leading privately owned tin smelters in the world. PT Refined Bangka Tin typically exported about 5,000 t/yr of tin but reported producing between 2,400 and 3,600 t/yr of tin. In August, the Governor of Bangka Belitung Island announced a moratorium on issuing new licenses for tin mining owing to the need to assess and inspect damage from illegal mining operations and illegal operations that exported tin concentrate. The moratorium was to last only until new regulations being drafted by the Government were put in place, which were expected to be completed within 3 months. Because the moratorium restricted only the issuance of new licenses, and not existing ones, supply was not expected to be affected in the short term.

FOREIGN TRADE

Exports

There were nil exports of tin ores & concentrates during the year 2020-21 and negligible export in 2020-21. Exports of tin & alloys including scrap decreased by 21% to 750 tonnes in 2020-21 as compared to 944 tonnes in the preceding year. Out of the total exports in 2020-21, tin & alloys reported 570 tonnes (76%), tin & alloys (worked) was 178 tonnes (24%) and tin waste & scrap were negligible. Exports of tin & alloys including Scrap were mainly to Republic of Korea, (32%), UAE (21%) and Nepal (14%) (Tables - 9 to 17).

Table-9: Exports of Tin Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	1	-	-
Nepal	++	1	-	-

Figures rounded off

Table-10: Exports of Tin & Alloys Incl. Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	944	740863	750	784385
UAE	219	234469	161	286412
Korea, Rep. of	278	203163	237	186018
Belgium	34	16384	54	66776
UK	32	46620	20	29999
Saudi Arabia	23	31521	18	28552
USA	13	9491	43	27065
Sri Lanka	16	32661	13	26394
Poland	-	-	21	26186
Nepal	156	34623	106	18939
Kenya	1	1531	13	18603
Other countries	172	130400	64	69441

Figures rounded off

Table-11: Exports of Tin & Alloys

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	681	694813	570	731861
UAE	213	228302	160	285280
Korea, Rep. of	272	202426	236	185246
Belgium	22	14673	54	66589
UK	32	46464	18	29253
Poland	-	-	21	26186
Saudi Arabia	22	29915	15	23778
Sri Lanka	15	30623	10	23424
Kenya	1	1504	11	17284
Taiwan	6	6983	9	13594
USA	5	6739	9	12560
Other countries	93	127184	27	48667

Figures rounded off

Table-12: Exports of Tin & Alloys:Worked

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	263	46041	178	51368
USA	8	2752	34	14498
Nepal	135	11991	100	11003
Saudi Arabia	1	1606	3	4774
Netherlands	4	1795	10	3878
Sri Lanka	1	2038	3	2970
Israel	++	157	4	2865
Bahrain Is	-	-	10	2244
Italy	-	-	1	1448
Kenya	++	27	2	1310
UAE	6	6167	1	1132
Other countries	108	19508	10	5246

Figures rounded off

Table-13: Exports of Tin Waste & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	9	2	1156
Swaziland	-	-	1	744
Nepal	-	-	1	385
Colombia	-	-	++	11
Kenya	-	-	++	9
USA	-	-	++	7
Liberia	++	9	-	-

Figures rounded off

Table-14: Exports of Tin & Alloys : NES

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	478	409127	380	423846
Korea, Rep. of	272	202287	236	185246
UAE	133	117178	48	114878
Belgium	22	14610	36	32196
UK	29	46109	18	29253
Poland	-	-	21	26186
Hong Kong	3	3314	6	9482
Taiwan	2	2304	4	6854
Sri Lanka	-	-	1	4067
Japan	++	241	2	3327
Bangladesh	5	6052	2	2804
Other countries	12	17032	6	9553

Figures rounded off

Table-15: Exports of Tin : Anode, Cathode etc. of Tin Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	82	109952	44	70911
Saudi Arabia	18	25123	14	22778
Kenya	1	1504	11	17284
UAE	13	16933	6	7930
Sri Lanka	4	6631	5	7669
Nepal	20	22440	4	6570
Congo, D .Rep	7	10054	2	3274
Nigeria	4	5165	1	1770
Ghana	++	45	1	938
Sudan	++	719	++	794
Qatar	1	1610	++	540
Other countries	14	19728	++	1364

Figures rounded off

Table-16: Exports of Tin Blocks

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	6	1586	++	547
Oman	--	--	++	537
Nepal	++	20	++	6
Cameroon	--	--	++	4
Fiji Is	--	--	++	++
Japan	3	1069	--	--
UK	3	355	--	--
Singapore	++	141	--	--
Algeria	++	1	--	--
Other countries	++	++	++	++

Figures rounded off

Table-17: Exports of Tin (Scrap)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	9	2	1156
Swaziland	-	-	1	744
Nepal	-	-	1	385
Colombia	-	-	++	11
Kenya	-	-	++	9
USA	-	-	++	7
Liberia	++	9	-	

Figures rounded off

Imports

The imports of tin ores & concentrates in 2020-21 was negligible as that of the previous year (Fig 4). Imports of tin & alloys including scrap were at 10,797 tonnes in 2020-21 from 11,746 tonnes recorded in the previous year.

Imports of tin & alloys were mainly from Indonesia (70%), Singapore (12%) and China (4%). In 2020-21, imports of tin & alloys were at 10,382 tonnes as compared to 11,225 tonnes in the previous year. Imports of tin & alloys (worked) were at 415 tonnes, while imports of tin alloys (NES) were at 73 tonnes. (Tables -18 to 26).

Table-18: Imports of Tin Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	206	2	899
Nigeria	--	--	2	768
Korea, Rep. of	++	125	++	131
Burundi	++	81	--	--

Figures rounded off

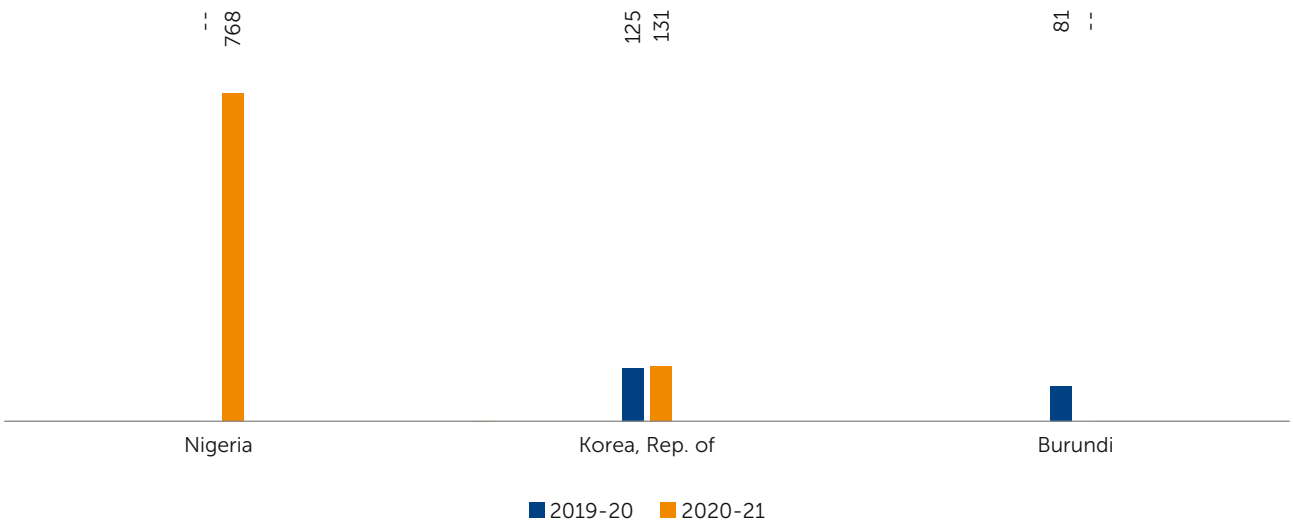


Fig 4: Country wise Value of Import of Tin

Table-19: Imports of Tin & Alloys, Incl. Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**11746**	**15254405**	**10797**	**14848133**
Indonesia	9216	12145857	7517	10413091
Singapore	802	1148386	1331	1822729
Malaysia	497	681104	1145	1712445
Tanzania	42	54773	164	268817
China	548	290573	415	234296
Germany	65	104328	61	95835
Korea, Rep. of	42	105486	34	86007
Japan	435	679374	25	56106
Rwanda	--	--	25	37565
South Africa	--	--	25	33687
Other countries	99	104524	55	87555

Figures rounded off

Table-20: Imports of Tin & Alloys

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**11225**	**14998805**	**10382**	**14585191**
Indonesia	9216	12145857	7517	10413091
Singapore	800	1144478	1331	1821181
Malaysia	488	662235	1122	1677012
Tanzania	42	54773	164	268817
China	127	151950	81	104787
Germany	63	97075	59	89456
Korea, Rep. of	40	105095	29	84814
Rwanda	--	--	25	37565
South Africa	--	--	25	33687
Taiwan	11	17109	16	28570
Other countries	438	620233	13	26211

Figures rounded off

Table-21: Imports of Tin & Alloys : Worked

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**521**	**255514**	**415**	**262942**
China	421	138621	334	129509
Japan	14	31944	24	52920
Malaysia	9	18869	23	35433
Italy	9	13771	8	12772
Hong Kong	53	23936	14	9634
Spain	8	9661	5	6486
Germany	2	7253	2	6379
Israel	++	1762	++	2022
UAE	++	101	++	1990
Singapore	2	3824	++	1548
Other countries	3	5772	5	4249

Figures rounded off

Table-22: Imports of Tin (Scrap)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	86	--	--
Singapore	++	84	--	--
China	++	2	--	--

Figures rounded off

Table-23: Imports of Tin Alloys, NES

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	69	117384	73	145069
Germany	57	85075	50	78695
Malaysia	9	27236	19	59383
Hong Kong	--	--	2	3098
Italy	++	752	1	1716
Singapore	2	2873	1	1073
China	--	--	++	596
USA	++	132	++	508
Spain	1	793	--	--
UK	++	488	--	--
Canada	++	34	--	--
Other Countries	++	1	++	++

Figures rounded off

Table-24: Imports of Tin & Alloys : Worked

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	245	372554	217	344238
China	102	114140	81	104191
Korea, Rep. of	39	103888	29	83511
Malaysia	14	21062	33	50716
Singapore	38	50740	26	39863
Taiwan	4	6682	10	18541
Indonesia	21	18708	20	17514
Germany	6	11665	9	10652
Canada	2	3780	6	9275
Hong Kong	13	22647	2	6028
Japan	6	17207	1	3186
Other countries	++	2035	++	762

Figures rounded off

Table-25: Imports of Tin: Anode, Cathode Etc of Tin Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	10904	14498291	10085	14084187
Indonesia	9195	12127149	7497	10395577
Singapore	760	1090865	1304	1780242
Malaysia	465	613937	1070	1566913
Tanzania	42	54773	164	268817
Rwanda	--	--	25	37565
South Africa	--	--	25	33687
Korea, Rep. of	1	1207	++	1138
Germany	++	207	++	109
UK	++	213	++	66
USA	++	184	++	56
Other countries	441	609756	++	17

Figures rounded off

Table-26: Imports of Tin Blocks

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7	10576	7	11697
Taiwan	7	10427	6	10029
Finland	--	--	1	1500
Korea, Rep. of	--	--	++	165
Singapore	--	--	++	3
Germany	++	128	--	--
Portugal	++	16	--	--
USA	++	5	--	--

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.

17. 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 2020-21

292
(tonnes) Exports of tungsten and alloys including scrap in 2020-21

327
(tonnes) Imports of tungsten and alloys including scrap in 20 20-21

Tungsten, also known as 'wolfram' is a verydense 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). 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.

Table-1: Reserves/Resources of Tungsten as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

Grade/State	Total (A)	Remaining Resources							Total Resources (A+B)
		Feasibility	Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total	
		STD211	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total									
Ore	0	2230000	173063	23276152	23259954	23912049	16581246	89432464	89432464
Contained WO_3	0	3568	450	19298.8	16994.84	99772.15	4566.28	144650.1	144650.1
By States									
Andhra Pradesh									
Ore	0	0	0	3640000	4700800	5952500	509000	14802300	14802300
Contained WO_3	0	0	0	5096	6574.64	8273.65	318.28	20262.57	20262.57
Haryana									
Ore	0	2230000	0	0	0	0	0	2230000	2230000
Contained WO_3	0	3568	0	0	0	0	0	3568	3568
Karnataka									
Ore	0	0	0	15361152	11805499	172921	9338246	36677818	36677818
Contained WO_3	0	0	0	2915	1775	142	1403	6235	6235
Maharashtra									
Ore	0	0	0	4275000	5461250	386000	0	10122250	10122250
Contained WO_3	0	0	0	11287.8	7117.92	185	0	18590.72	18590.72
Rajasthan									
Ore	0	0	0	0	963666	17000628	5964000	23928294	23928294
Contained WO_3	0	0	0	0	1421.44	90171.5	2115	93707.94	93707.94
Tamil Nadu									
Ore	0	0	0	0	0	0	250000	250000	250000
Contained WO_3	0	0	0	0	0	0	50	50	50
Uttarakhand									
Ore	0	0	0	0	138000	0	520000	658000	658000
Contained WO_3	0	0	0	0	25	0	680	705	705
West Bengal									
Ore	0	0	173063	0	190739	400000	0	763802	763802
Contained WO_3	0	0	450	0	80.84	1000	0	1530.84	1530.84

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 2020-21. 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, Nagpur 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 3.7 million tonnes, distributed broadly amongst China (51%), 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)	3700
Austria	10
Bolivia	NA
China	1900
Korea, Rep.of	29
Portugal	5.1
Russia	400
Rwanda	NA
Spain	52
USA	NA
Vietnam	100
Other countries	1200

Source: USGS, Mineral Commodity Summaries, 2022

The world mine production of tungsten in terms of metal content in 2020 increased marginally by 2% to 92,500 tonnes from 90,400 tonnes in 2019. China was the leading producer (82%) followed by Vietnam (9%), Russia (3%) and Austria, Bolivia, Korea Rep. of & Rwanda (1% each) (Table-3).

Table-3: World Mine Production of Tungsten
(By Principal Countries)

(In tonnes of metal content)

Country	2018-19	2019-20	2020-21
World:Total (rounded)	81200	90400	92500
Austria	936	892	896
Bolivia	1043	813	1030
China	64938	75452	76000
Congo, Dem. R.	230	700	128
Korea,Rep.of	1370e	1130e	1100e
Russia	2661	2825	2692
Rwanda[a]	1039	1303	956
Spain	856	414	184
Vietnam	4350	4816	8066
Other countries	3764	2055	1463

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 decreased by 7% to 292 tonnes in 2020-21 from 313 tonnes in the previous year. Exports were mainly to Germany (51%), Finland (13%), Sweden (7%), Japan (6%), USA (5%), Thailand & Bangladesh (2% each). 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	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**313499**	**870314**	**292331**	**835275**
Germany	31494	116923	148034	227357
Japan	3935	65339	18744	108756
Finland	8737	27597	38225	59983
Singapore	10297	40174	4294	51744
Sweden	20914	54808	20575	48912
USA	29359	70194	15543	42911
Bangladesh	6055	40321	4904	40165
Poland	2626	45080	1852	33891
Mexico	35300	45582	3626	26612
Thailand	44616	29520	5459	25002
Other countries	120166	334776	31075	169942

Figures rounded off

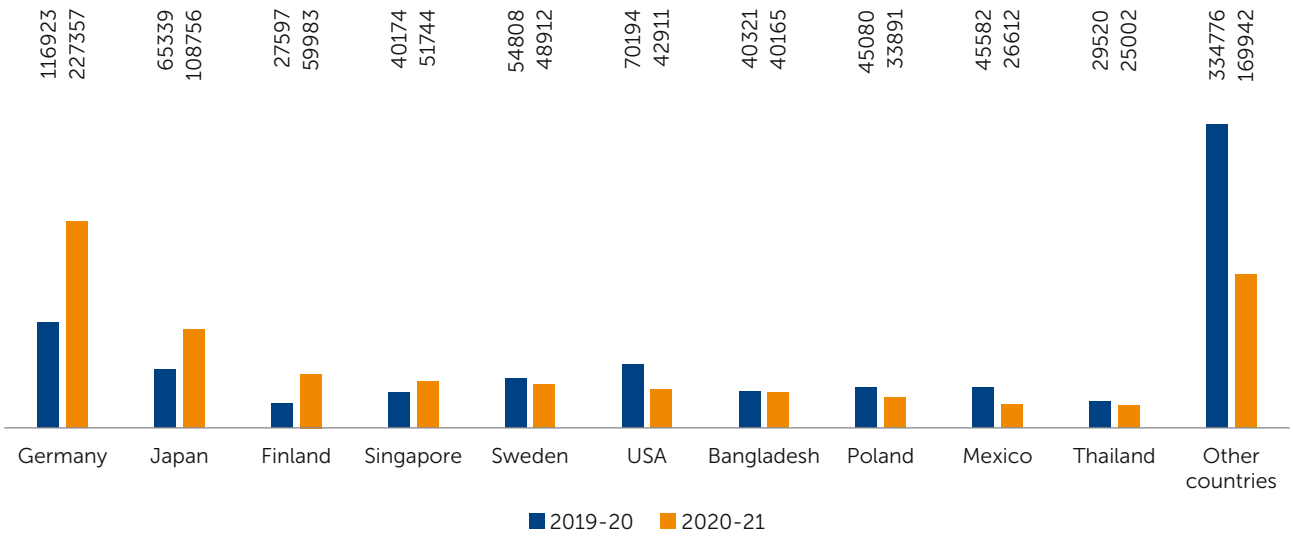


Fig 1: Country wise Value of Export of Tungsten

Table-5: Exports of Tungsten Wire

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**23701**	**348027**	**16999**	**296924**
Japan	3822	64398	5338	93616
Germany	4337	84344	2445	55020
Poland	2591	44709	1852	33891
Italy	2748	40068	1858	22503
Korea, Rep. of	931	13384	919	14684
USA	573	11934	610	14110
France	703	11229	745	12023
China	651	6185	346	10127
Switzerland	430	7002	546	9611
Sweden	914	14406	564	8930
Other countries	6001	50368	1776	22409

Figures rounded off

Table-6: Exports of Tungsten Waste & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**121385**	**138381**	**144607**	**174279**
Germany	19947	24625	107200	124506
Finland	8000	8976	23900	34322
Japan	-	-	13406	15140
UAE	-	-	100	309
Nepal	-	-	1	2
Vietnam	37330	44150	-	-
USA	15500	20895	-	-
Korea, Rep. of	15000	15789	-	-
Netherlands	14931	10606	-	-
Singapore	7948	10080	-	-
Other countries	2729	3260	++	++

Figures rounded off

Table-7: Exports of Tungsten Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1871**	**1645**	**48391**	**58097**
Germany	-	-	32910	38030
Finland	-	-	14000	16905
Austria	-	-	186	1926
Nigeria	1580	612	997	711
Kenya	-	-	80	175
Cameroon	-	-	35	83
Israel	-	-	2	65
Singapore	-	-	3	35
Rwanda	-	-	14	29
Oman	-	-	10	27
Other countries	291	1033	154	111

Figures rounded off

Table-8: Exports of Tungsten Filament

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**7226**	**70313**	**5027**	**51388**
Bangladesh	2308	39063	4341	39933
Iran	2023	22390	274	5724
Sri Lanka	184	3371	178	3338
China	73	1976	28	923
UAE	-	-	38	777
Indonesia	-	-	100	317
Nepal	30	367	47	186
Nigeria	-	-	10	108
Korea, Rep.of	-	-	3	41
Gambia	-	-	2	26
Other countries	2608	3146	6	15

Figures rounded off

Table-9: Exports of Tungsten & Alloys Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	159316	311948	77307	254587
Singapore	2349	30094	4291	51709
Sweden	20000	40402	20011	39982
USA	13286	37365	14933	28801
Mexico	35300	45582	3626	26612
Thailand	41878	26208	5459	25002
Taiwan	133	2932	1575	16413
China	2171	11962	2727	13344
Germany	7185	7547	5479	9801
France	4265	4497	770	8020
Turkey	557	6453	1220	6683
Other countries	32192	98906	17216	28220

Figures rounded off

Table-10: Exports of Tungsten Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16810	33469	8083	17188
USA	11650	26957	7663	15684
Malaysia	-	-	300	1033
Egypt	6	20	100	426
Sri Lanka	-	-	20	45
China	1760	3871	-	-
UK	2260	1205	-	-
Thailand	800	1092	-	-
Turkey	22	146	-	-
Puerto Rico	50	127	-	-
Kenya	30	32	-	-
Other countries	232	19	++	++

Figures rounded off

Table-11: Exports of Tungsten & Alloys: Worked Nes

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	142506	278479	69224	237399
Singapore	2349	30094	4291	51709
Sweden	20000	40402	20011	39982
Mexico	35300	45582	3626	26612
Thailand	41078	25116	5459	25002
Taiwan	133	2932	1575	16413
China	411	8091	2727	13344
USA	1636	10408	7270	13117
Germany	7185	7547	5479	9801
France	4265	4497	770	8020
Turkey	535	6307	1220	6683
Other countries	29614	97503	16796	26716

Figures rounded off

Imports

Imports of tungsten and alloys including scrap decreased by 15% to 327 tonnes in 2020-21 from 386 tonnes in the previous year. Imports were mainly from China (43%), Austria (16%), Korea, Rep. of (14%), USA (13%), Germany & Singapore (3% each). Imports of tungsten ores and concentrates also decreased by 73% to 121 tonnes in 2020-21 from 447 tonnes in the previous year. Imports were mainly from Netherlands (50%) followed by Japan (35%) and Belgium (15%) (Tables-12 to 21) Fig 2.

Table-12: Imports of Tungsten & Alloys Incl. Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	385732	1467498	326673	1451447
China	181121	580762	141891	522068
Austria	40160	307042	51301	448758
Korea, Rep. of	61272	182133	44631	142538
USA	37805	81918	42767	100869
Singapore	11304	63899	9643	57729
Germany	11445	40112	8316	40968
Argentina	4000	17341	7000	30091
Israel	3300	7881	8062	20522
UK	9998	27928	4967	17922
Switzerland	3761	24015	1285	15366
Other countries	21566	134467	6810	54616

Figures rounded off

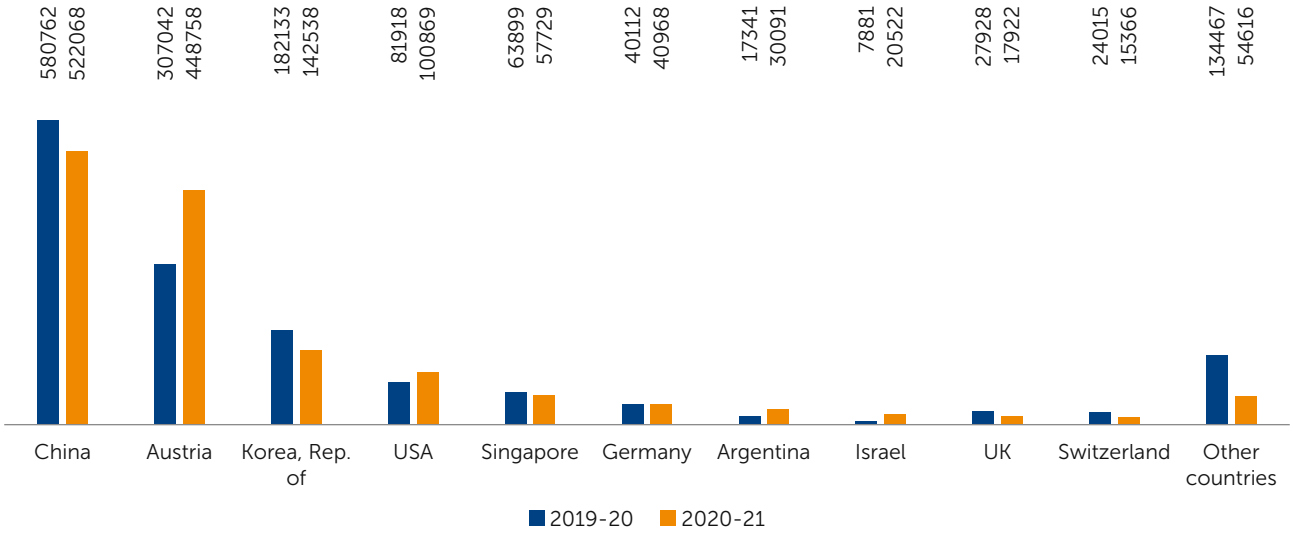


Fig 2: Country wise Value of Import of Tungsten

Table-13: Imports of Tungsten Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	447	69234	121	9104
Netherlands	380	51267	61	3542
Japan	35	13753	42	3334
Belgium	-	-	18	1789
Singapore	2	1741	++	439
Sweden	30	2473	-	-

Figures rounded off

Table-14: Imports of Ferro-Tungsten

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4	9250	13	23282
China	4	7519	9	15511
Belgium	-	-	4	7448
USA	++	292	++	171
Turkey	-	-	++	152
UK	++	1439	-	-

Figures rounded off

Table-15: Imports of Tungsten Wire

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	102192	513732	106049	565540
China	70491	311418	68502	296869
Austria	23065	170382	31614	253195
Singapore	6680	16202	5107	12106
Hungary	1180	2461	648	1419
Japan	202	4942	23	856
Belgium	25	135	45	388
Germany	254	3164	17	261
USA	34	482	71	182
UK	23	1257	14	127
Poland	107	2323	2	84
Other countries	131	966	6	53

Figures rounded off

Table-16: Imports of Tungsten Waste & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	19118	28993	-	-
UK	7536	12796	-	-
Belgium	6665	9856	-	-
Germany	4917	6341	-	-

Figures rounded off

Table-17: Imports of Tungsten Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	89051	206483	41373	141036
China	66309	124181	23787	62078
USA	14063	24591	10693	30037
Austria	5920	45676	3123	25184
UK	202	4168	208	7687
Germany	2215	5869	1611	6115
Hong Kong	-	-	1153	5740
Italy	316	1748	798	4195
Japan	26	250	-	-

Figures rounded off

Table-18: Imports of Tungsten Filament

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2105**	**35720**	**1155**	**36975**
Korea, Rep. of	344	16067	540	21610
Taiwan	154	6600	143	7057
China	1413	6752	192	2436
Germany	70	1448	79	1928
Thailand	65	3347	120	1430
Hong Kong	5	198	40	1371
USA	7	424	15	441
Japan	35	517	4	300
France	5	104	7	171
Singapore	2	172	1	100
Other countries	5	91	14	131

Figures rounded off

Table-19: Imports of Tungsten Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**109865**	**295158**	**99353**	**273186**
Korea, Rep. of	60830	165429	43550	117607
USA	22737	39749	24431	48979
China	12270	33173	12411	33759
Argentina	4000	17341	7000	30091
Germany	3213	16037	3521	20327
Israel	3300	7881	8000	19977
France	320	1729	251	1796
Hong Kong	-	-	150	499
Singapore	11	144	10	67
Thailand	-	-	28	64
Other countries	3184	13675	1	20

Figures rounded off

Table-20: Imports of Tungsten & Alloys: Worked Nes

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**63401**	**387412**	**78743**	**434710**
Austria	11175	90984	16555	170285
China	30638	105238	36999	126926
Singapore	4611	47381	4525	45456
USA	964	16672	7557	21230
Switzerland	3761	23997	1284	15339
Germany	776	7253	3088	12337
Japan	473	8707	579	12147
UK	962	4401	4745	10108
Italy	4	80	820	6942
Hong Kong	68	313	1102	5433
Other countries	9969	82386	1489	8507

Figures rounded off

Table-21: Imports of Tungsten & Alloys Unwrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (kg)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	173266	682570	178096	707896
Austria	11175	90984	16555	170285
China	42908	138411	49410	160685
Korea, Rep. of	60928	166066	44086	120899
USA	23701	56421	31988	70209
Singapore	4622	47525	4535	45523
Germany	3989	23290	6609	32664
Argentina	4000	17341	7000	30091
Israel	3300	7881	8058	20512
Switzerland	3761	23997	1284	15339
Japan	492	8795	579	12147
Other countries	14390	101859	7992	29542

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, defense 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.

18. Vanadium

24.63
(million tonnes) Total reserves/ resources of vanadium ore as on 1st April 2020

240
(tonnes) Exports of ferro-vanadium in 2020-21

480
(tonnes) Imports of ferro-vanadium in 2020-21

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.

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 anorthosite and gabbro.

As per NMI database, based on UNFC system, the total estimated reserves/resources of vanadium ore as on 1.4.2020 are placed at 24.63 million tonnes with an estimated V_2O_5 content of 64,594 tonnes. The entire resources of vanadium are placed under Remaining Resources category (Table-1)(Fig 1 & Fig 2).

Table-1: Reserves/Resources of Vanadium as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(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) as on 1.4.2020 (P)

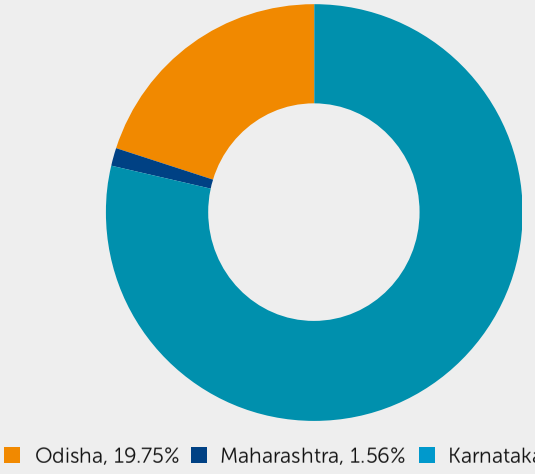


Fig 2: State wise Resources of Vanadium in India

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 (V_2O_5) in presence of steel scrap or by direct reduction in an electric arc furnace. The resultant vanadium steels can be divided into micro-alloy or low-alloy steels with less than 0.15% vanadium and high-alloy steels with up to 5% vanadium.

Non-metallurgical applications include its use as catalyst and in ceramic, chemical, pigments, health preparations and electronic industries. It is also used to produce super conductive magnets with a field of 1,75,000 gauss. The most common oxide of vanadium, i.e., vanadium pentoxide (V_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 24 million tonnes of metal located mainly in China (40%), Australia (25%),Russia (21%),South Africa (15%) 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)	24,000
USA	45
Australia	6000
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 2020 was 95,000 tonnes of metal content which was same as compared to the previous year. This includes vanadium in slag product and from refining and burning of heavy oils. Major producing countries were China (56%), Russia (21%) and South Africa (15%) (Table-3) (Fig 3).

Table-3: World Mine Production of Vanadium

(By Principal Countries)

(In tonnes of metal content)

Country	2018-19	2019-20	2020-21
World: Total (rounded off)	79000	95000	95000
China	40000	54000	53000
Russia	17052	18380	19530
South Africa	14904	14858	14421
Brazil	5505	5923	6622
Kazakhstan	1000	1000	1000
USA	-	460	170
India	442	400	400

Source: BGS, World Mineral production, 2016-20

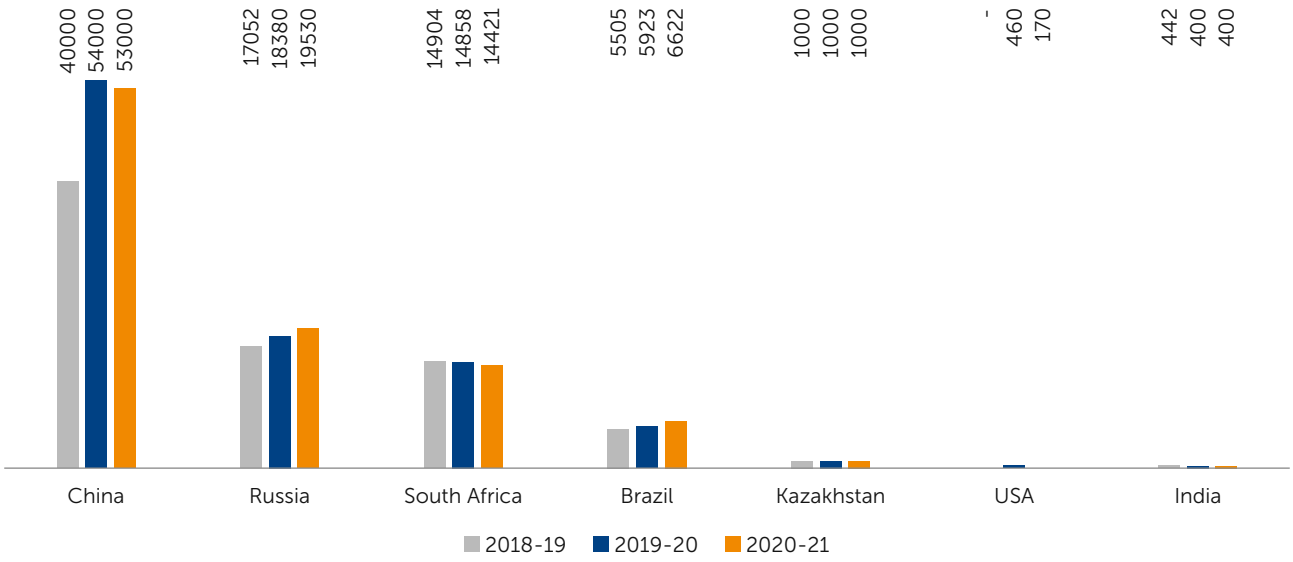


Fig 3: Country-wise Production of Vanadium

Remaining countries together contributed 8% of the total world mine production. Most of the world's vanadium supply originates from primary sources or co-production.

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 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 Standardization Administration of China (SAC) released a new standard for high-strength rebar that would decrease the use of substandard 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 authorized 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 decreased drastically by to 55%, 240 tonnes in 2020-21 as compared to 531 tonnes during the previous year. Exports were mainly to UAE (43%), Thailand (18%), Netherlands (17%), Oman (13%), Belgium (8%) and Brazil (1%) (Table-4) and Fig 4.The exports of vanadium ore and concentrates were reported at Nil in 2020-21 which was 10 tonnes during last year (Table#5).

Table-4: Export of Ferrovanadium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	531	883571	240	346840
UAE	103	140008	102	141985
Thailand	16	29814	42	64449
Netherlands	82	121635	40	55916
Oman	8	12390	32	49299
Belgium	225	398727	20	26199
Brazil	2	5191	2	3803
France	-	-	1	2162
Turkey	1	1832	1	1508
Indonesia	++	617	++	507
Malaysia	++	317	++	386
Other countries	94	173040	++	626

Figures rounded off

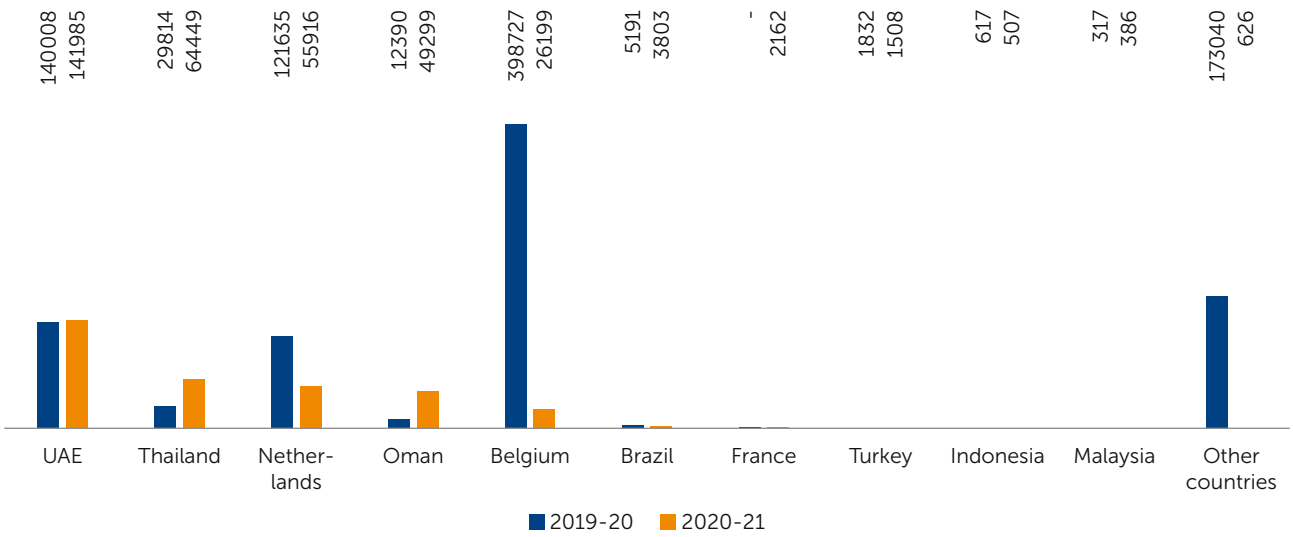


Fig 4: Country-wise Value of Export of Vanadium

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 480 tonnes during the year 2020-21 as compared to 595 tonnes during the previous year. The imports were mainly from Germany (39%), Japan (24%) and Korea, Rep.of (16%) (Table-6) and Fig 5. The imports of vanadium ores and concentrates during 2020-21 decreased by massive 86% to 999 tonnes as compared to 7,006 tonnes in the previous year.The imports were mainly from Canada (38%), Mexico (20%) and UAE & Korea, Rep. of (15% each) (Table-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	595	1143397	480	613762
Germany	216	342960	188	260094
Korea, Rep of	56	151770	76	131424
Japan	124	224188	113	124205
Switzerland	10	13218	20	32604
Czech Republic	10	12928	30	29993
UAE	-	-	48	26724
Netherlands	33	107490	5	8711
UK	++	15	++	7
Russia	92	174162	-	-
China	14	78472	-	-
Other Countries	40	38194	-	-

Figures rounded off

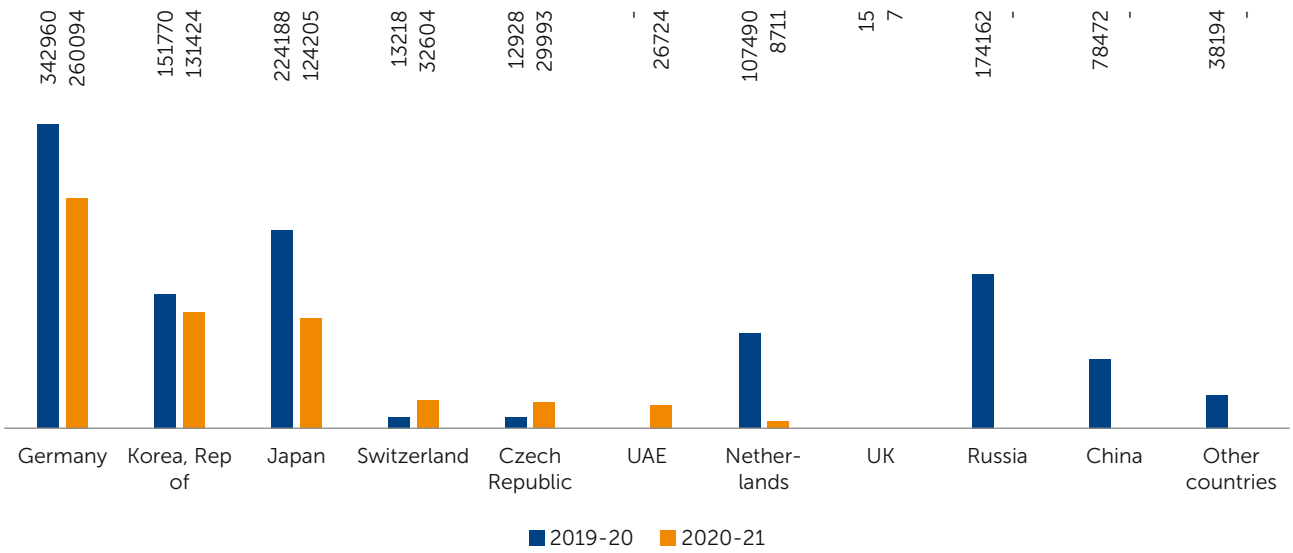


Fig 5: Country-wise Value of Import of Vanadium

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	7006	349104	999	77967
UAE	-	-	146	27377
Mexico	46	7924	200	14406
Canada	2762	100607	375	11608
Korea,Rep of	-	-	148	10560
Taiwan	19	10940	54	8045
Netherlands	66	17462	74	5613
USA	-	-	2	358
Kuwait	4113	212171	-	-

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, 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 ferro-vanadium. 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 ferro-vanadium.

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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