

Government of India  
Ministry of Mines  
**INDIAN BUREAU OF MINES**

# **INDIAN MINERALS YEARBOOK 2012**

## **Volume-II METALS & ALLOYS**



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Indian Bureau of Mines

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# PREFACE

Indian Minerals Yearbook, 2012 is the 51<sup>st</sup> edition in the series. The Yearbook, 2012 is being brought out in three volumes. Volume-I comprising of 11 General Reviews, Volume-II comprising of 19 reviews on metals & alloys and Volume-III containing 50 mineral reviews. Volume-II contains reviews on different ferrous, non-ferrous, strategic and precious metals and their related metallurgical industries. The metal industry is the backbone for development of the country. The metal industry comprises of iron & steel, ferro-alloys and metals like aluminium, copper, lead-zinc, gold, silver, nickel, cobalt, molybdenum, etc.

It has been our constant endeavour to improve upon the coverage and content of the Yearbook and to present a fuller perspective of domestic and world developments in the field of minerals and metals to the extent possible.

The Yearbook, is the outcome of the coordinated efforts of Mineral Economics Division, Mining & Mineral Statistics Division and Publication Section. Material has also been drawn freely from the reports of the Mines Control & Conservation of Minerals Division and Ore Dressing Division of IBM. Various 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, besides related websites.

In the preparation of the Indian Minerals Yearbook, the Bureau has been receiving cooperation from the Central and State Government Departments, Public Sector Undertakings, Public and Private Companies and Research Organisations concerned with the mines, minerals and mineral-based industries. IBM is indebted to all of them for furnishing information and for their continued cooperation in this venture.

Nagpur

Date : 30<sup>th</sup> August, 2013



(C.S. GUNDEWAR)

Controller General  
Indian Bureau of Mines

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# EXPLANATORY NOTES AND SOURCES

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

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

The value of the mineral is reckoned in terms of the pit's mouth value 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 excepting captive mines where the value is calculated on the basis of the cost of production. Similar figures for ferrous metals and ferro-alloys are not available and hence not published. The value of metal production is based on the ex-plant value. The value of production of gold and silver recovered from imported ores/concentrates is not included in the total value of metal production. 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.

**Metals**

- a) Ferrous Joint Plant Committee, Kolkata as well as individual producers
- b) Ferro-alloys Indian Ferro-Alloys Producers' Association (IFAPA), Mumbai
- c) Non-ferrous Individual producers

**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) Industrial Minerals (UK)
  - iii) DGCI&S, Kolkata (Import Value)
- b) Metals
  - i) Producers and exporters
  - ii) Reserve Bank of India Bulletin
  - iii) World Metal Statistics (BGS)
  - 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 (BGS)
- v) Mineral Industry Surveys (USGS)
- vi) Canadian Minerals Yearbook

**Consumption**

## Minerals

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 organised sector only. Estimated consumption data is based on statistical norms in vogue.

**Reserves/Resources**

National mineral inventory prepared by IBM as per UNFC system has been referred to obtain reserve/resource figures of minerals so far finalised. The source of information for the remaining minerals is given against each mineral.

Besides, Annual Reports of various Ministries of Government of India, Annual Reports, pamphlets and websites of public sector undertakings and private companies, bulletins concerned with minerals and mineral-based industries, etc. were referred.

# ABBREVIATIONS

The following abbreviations and symbols are used:

APMDC	Andhra Pradesh Mineral Development Corp. Ltd	IMMT	Institute of Minerals & Materials Technology (Formerly RRL, Bhubaneswar)
BALCO	Bharat Aluminium Company Ltd	JPC	Joint Plant Committee
BGML	Bharat Gold Mines Limited	JV	Joint Venture
BGS	British Geological Survey, UK	KCC	Khetri Copper Complex
BIS	Bureau of Indian Standards	KMML	Kerala Minerals & Metals Ltd
BOT	Build, Operate, Transfer	LAPL	Large Area Prospecting Licence
BSMDC	Bihar State Mineral Development Corp. Ltd	LME	London Metal Exchange
c.i.f.	cost including freight	MALCO	Madras Aluminium Company Ltd
CSO	Central Statistical Office	MCDR	Mineral Conservation and Development Rules, 1988
DES	Directorate of Economics & Statistics	MCR	Mineral Concession Rules, 1960
DGCI&S	Director-General of Commercial Intelligence and Statistics	MECL	Mineral Exploration Corporation Ltd
DGM	Directorate of Geology and Mining	ML	Mining Lease
DMG	Directorate of Mining and Geology	MMDR Act	Mines & Minerals (Development & Regulation) Act, 1957
EEZ	Exclusive Economic Zone	MMTC	Minerals and Metals Trading Corp. Ltd
EU	European Union	MoU	Memorandum of Understanding
FDI	Foreign Direct Investment	NA	Not Available
FIMI	Federation of Indian Mineral Industries	NAS	Not Available Separately
f.o.b.	free on board	NALCO	National Aluminium Co. Ltd
f.o.b.t.	free on board trimmed	ND	Not Determined
f.o.r.	free on rail	NELP	New Exploration Licensing Policy
GMDC	Gujarat Mineral Development Corp. Ltd	NES	Not Elsewhere Stated
GSI	Geological Survey of India	NMDC	National Mineral Development Corp. Ltd
HCL	Hindustan Copper Ltd	NMI	National Mineral Inventory
HGML	Hutti Gold Mines Co. Ltd	NML	National Metallurgical Laboratory
Hindalco	Hindalco Industries Ltd	NQ	Not Quoted
HZL	Hindustan Zinc Ltd	N/v	Near Village/s
IBM	Indian Bureau of Mines	OMC	Orissa Mining Corporation Ltd
		PL	Prospecting Licence (Contd.)

**Abbreviations (contd.)**

PPP	Public Private Partnership
RP	Reconnaissance Permit
RRL	Regional Research Laboratory
RSMML	Rajasthan State Mines and Minerals Ltd
SAIL	Steel Authority of India Ltd
SCCL	Singareni Collieries Company Ltd
SMC	Sikkim Mining Corporation Ltd
STD	Standard (Code of UNFC)
TAMIN	Tamil Nadu Minerals Ltd
tpd	tonnes per day
tpy	tonnes per year
UAE	United Arab Emirates
TSL	Tata Steel Ltd (formerly Tata Iron and Steel Co. Ltd)

**Abbreviations (concl.)**

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	t	metric tonne
m	metre	'000 tonnes	thousand metric tonnes
mm	millimetre	lkm	line kilometre
cu m	cubic metre	crt	carat
'000 cu m	thousand cubic metres	g	gram
m cu m	million cubic metres	kg	kilogram
sq m	square metre	₹	Indian Rupees
km	kilometre	₹ '000	thousand Rupees
ha	hectare	kWh	kilo-watt-hour
sq km	square kilometre	s	Second

**Conversion Table**

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



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

The classification of reserves/ resources of various minerals based on UNFC system were first prepared by IBM as on 1.4.2000 and later, as on 1.4.2005. Reserves/resources are furnished mineralwise in State Reviews and gradewise and statewide in Mineral Reviews. Quinquennially updated resources for 68 minerals as on 1.4.2010 have been included in this edition of Indian Minerals Yearbook in State Reviews and Mineral Reviews. 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 also 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 latest edition of Mineral Conservation & Development Rules, 1988.

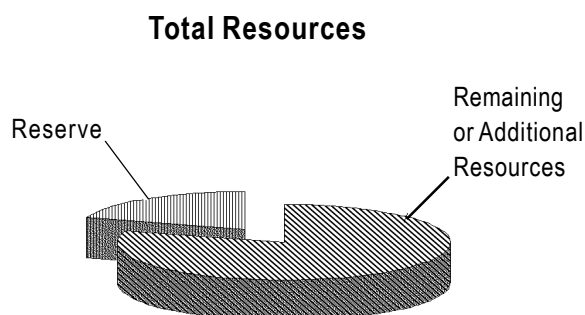
The UNFC consists of a three-dimensional system with the following three axes : Geological Assessment, Feasibility Assessment and Economic Viability. The process of geological assessment is generally conducted in stages of increasing details. The typical successive stages of geological investigation,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



### Diagrammatic 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.