

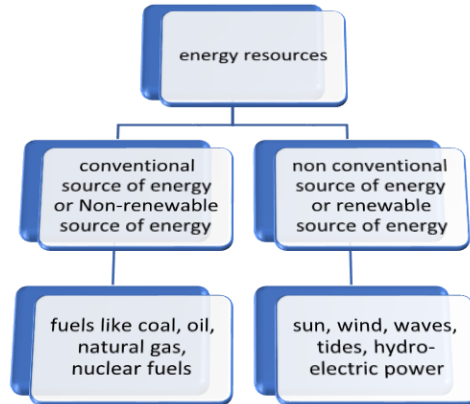
Notes on Minerals & Energy of India



Energy & Minerals of India

Energy

Energy is an important input for production and rapid growth of GDP. Energy is essential for the generation of power which is used in agriculture, industry, transport and other sectors of the economy. Energy resource can be broadly classified as:



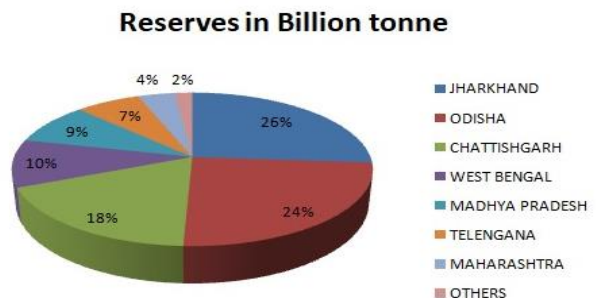
Conventional sources which cannot be compensated and can be exhaustible in nature. Some of the important conventional sources are:

Coal

In India coal deposit occur in two geographical areas:

1. **Gondwana coal formation**- it is around 200 million years old and accounts for 98% of the total reserve and 99% of total production. The coal is generally in bituminous nature. It is found in river valleys of Mahanadi, Godavari, Damodar, Indravati, Narmada etc.
2. **Tertiary coal fields**- it is of Eocene-Miocene period and around 50 million years old. It is predominantly lignite coal fields. It found in Neyveli, Tamilnadu and other includes Assam, Arunachal Pradesh, and Meghalaya etc.

- Coal is the primary source of India's energy demand. It roughly includes 50% of primary commercial supply and will increase in the next ten years.
- According to the carbon content, coal is classified as Anthracite (80-95%), Bituminous(40-80%), lignite (40-55%) and Peat (less than 40%). Also, the moisture content will go higher with reducing carbon content.
- Jharia is the largest coalfield, followed by Raniganj. The most important coal mining centres are Singrauli of Madhya Pradesh, Korba of Chhattisgarh, Talcher in Orissa,



Chanda Wardha, Kamptee and Chander in Maharashtra and Pandur mines of Andhra Pradesh.

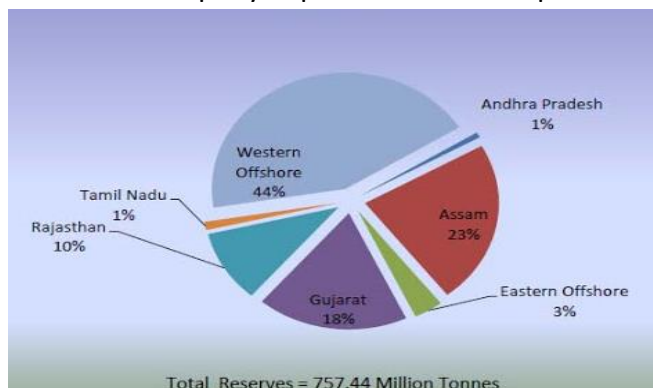
- The coal industry is facing numerous problems – Indian coal is of poor quality, and mining techniques are also old and not effective. Coal distribution is uneven in the country, and transportation cost is very high. Usually negligible safety measures for the workers in mines. Due to administrative works or hurdles lot of mines are stagnant and open cast mining is also a problem.

Petroleum

Crude petroleum consists hydrocarbon of liquid in the gaseous state. It varies in chemical compositions, colour and specific gravity. It forms deep in the Earth from the organic matter from dead plants and matters. It is found in sedimentary rocks of Marine origin of Tertiary period.

Petroleum deposit is distributed as:

1. **Gujarat region** – Cambay-luni region, Ankleshwar, Vadodara, Ahmedabad-kalol region. Also, offshore oil is found in Aliabet near Bhavnagar.
 2. **Bombay High or Western coast offshore oilfields** – Bombay high oilfield are largest in India. It produces 65% of total production in the country.
 3. **Rajasthan** – Mangla and Jaisalmer region
 4. **East coastal region** – the area includes Krishna Godavari and Kaveri basins. In Krishna-Godavari Basin D-6 block is having oil and gas. Narimanam and Kovilappalare important oilfield in the Kaveri basin.
 5. **North-East region** – this is the oldest block of oil and found in 1890 in Digboi area. Digboi and Nahakatiya in Assam, Borholla in Nagaland, Nigru in Arunanchal Pradesh is having oil reserves. It is the second-largest production region.
- Only 20% of oil demand is domestically produced, and the other 80% is imported. The imports come from Saudi Arabia, UAE, Kuwait, Iran, Oman, Sudan and Russia etc. ONGC, Oil India Limited, Reliance and are some of the company in production and exploration.
 - Indian refinery sector is increasing in the past years. It primarily depend upon the imported crude oil. Indian Oil Corporation, HPCL, BPCL and reliance are some industries in the refinery sector.
 - India also announces a new Hydrocarbon Exploration Licensing Policy (HELP) to increase the licensing and investment in the mining sector.



Natural Gas

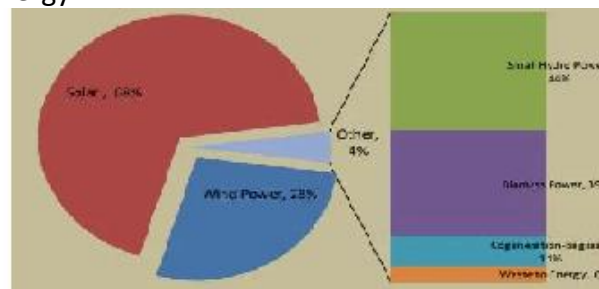
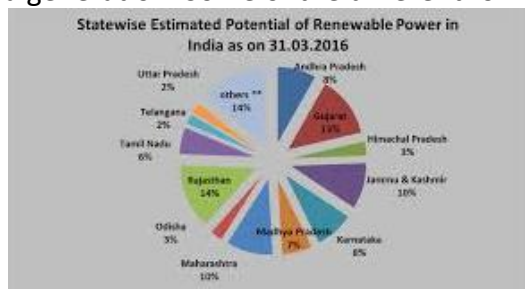
It is emerging as an environmentally safe and cheaper option than petroleum. Out of total reserves, 75% lay in Bombay high and Bassein oilfields. GAIL (Gas Authority and India Limited) is

the sole authority with transportation and allocation of natural gas. Most of the natural gas production is going in chemical fertilizers industry, and other is in LPG and power generation. Recently production of natural gas and import both have fallen short of demand. This is because of low production in Bassein and Krishna Godavari Basin, also the restriction of production in Gujarat and Andhra Pradesh.

Most of the natural gas production comes from offshore regions: Mumbai high complex. Come onshore fields are Assam, Andhra Pradesh and Gujarat.

New unconventional sources include Shale gas, Coal bed methane, methane hydrates and tight sandstones. HELP policy also includes the exploration and exploitation of these resources.

Non-conventional energy is that energy which is not depleted when it is used such as solar, biomass, hydro and wind etc. These energies are ecologically safe and having high potential for a generation. Some of the different forms of energy:



Solar energy

- India is a tropical country and almost having 300 solar days. The potential of this energy is unlimited. In 2016 around 8727 MW capacity project is installed in India.
- The government of India set a target in 2015 of adding 100 GW of solar energy. It was under the National Action plan on climate change.
- The national solar mission is also to promote the development and use of solar energy for power generation. The main objective of this mission was to reduce the cost of solar power generation in the country for the long term.
- The main programmes running to achieve these targets are Solar Parks, solar defence scheme, solar Canal Banks and canal tops, Solar pumps and solar rooftops etc.

Wind energy

- Out of total renewable power development target of 175 GW by the year 2022, 60 GW needs to be generated from wind energy.
- During the year 2015-16 highest power capacity of 3.2 GW was made. The present wind capacity in the country is around 28.28 GW. India is globally placed 4th position after China, USA and Germany.
- It mainly spread across Tamil Nadu (7456 MW), Gujarat (3642 MW), Maharashtra (4437 MW), Karnataka, Rajasthan, Madhya Pradesh and Andhra Pradesh are leading states in the country.
- India is having long coastline and having a good possibility of developing wind power projects. The government also cleared the National Offshore Wind energy policy.

Tidal energy

India possesses around 8000 MW tidal energy potential. Sundarbans, Gulf of Kambhat, Gulf of Kachchh are the potential areas.

Ocean currents are the storehouse of infinite energy. This energy can be made to create efficient energy system.

Bio-mass energy

It refers to energy derives from biological products. These products include agricultural residues, municipal, industrial and other wastes. It is an efficient form of energy conversion. It can be converted into electrical energy, heat energy or gas for cooking. This can also improve the economic and social life of rural areas. It also processes the garbage and waste material.

- During 2016-17 India achieved installation of 51 MW biomass of power plant against the target of 400 MW.
- Biofuels are also known as non-conventional fuels derived from the non-fossil plant sources and cleaner alternative of diesel. Biofuel in India mainly centres on cultivation and processing of Jatropha plant seeds and producing ethanol from sugarcane. Ethanol can be blended with petrol for automobile and biodiesel can mix with high-speed diesel.
- Ministry of Petroleum and natural gas is preparing a road map to increase production than consumption in India. Government has set a target of 10% reduction in crude import by 2022, which can be achieved by biofuels production.

Small hydro projects

In the last two years, around 14.30 GW of energy is reported. It was under Grid-connected renewable power in which 0.53 GW was from small hydropower generation.

Energy from waste

According to Ministry of new and renewable energy, there is a potential of 1700 MW from urban waste and 1300 MW from industrial waste.

Important facts:

- India per capita consumption is continuously increasing. It reached 1075 kWh in 2015-16 from 734 kWh in 2008-09. It is an increase of 46% in 8 years.
- India's per capita consumption is 1/3rd of world average or just 10% of Australia. Per capita consumption in the UK is five times than India. Among BRICS countries India is lowest in consumption.
- Also, variation in states is wide: highest per capita consumption is in UTs. Bihar is having the lowest per capita consumption around 1/6th of the national average. States like Puducherry, Goa, Punjab, Gujarat, Haryana and Delhi consumption is above the national average. North-Eastern states are below the national average.
- India is the third-largest consumer of energy after USA and CHINA. But it is not having abundant resources. It is necessary for having sustained economic growth. Energy security is an important phenomenon to discuss and form major policies on it.

- BEE (Bureau of Energy Efficiency) is working for energy conservation, and New Energy Policy is also formed to develop sustainable objective in the energy sector.

Minerals

Earth's crust is made up of different metals, which are extracted from minerals. Almost everything is made up of minerals.

Minerals

A Mineral is a natural substance of organic as well as inorganic origin with definite physical as well as chemical properties.

Minerals are formed in various types of geological environment, under varying conditions.

The natural process creates minerals without any human interference.

They can be identified based on their physical properties such as density, color, hardness, and chemical properties such as solubility.

Minerals are extracted from the ores.

Ore

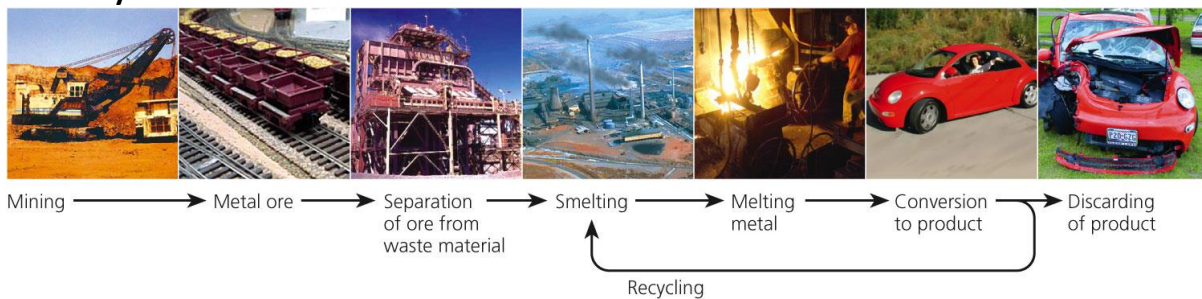
The ore is used to describe an accumulation of any minerals mixed with other elements.

For economical viable extraction, mineral content must be high.

Types of ores and their desired material extracted are:

- Magnetite - Iron
- Bauxite - Aluminium
- Limestone - Lime
- Sandstone - Silica.

The Life Cycle of a Metal Resource



IMPORTANCE OF MINERALS:

- (a) Minerals are the backbone of industrial development because of usage.
- (b) Minerals are used for making tools, implements, machines, etc.
- (c) Minerals are used in the manufacturing of jewelry, coins, utensils, decorative items, etc.
- (d) Minerals are used for construction work.
- (e) Minerals are used for health purposes.

In short, Minerals are used in many forms of life to lead a happy and comfortable life.

PROPERTIES OF MINERALS:

- (a) Minerals are non-renewable 'exhaustible' resources.
- (b) Minerals are present in impure form and takes million of years to form.
- (c) Minerals are distributed unevenly throughout the world.

How are minerals extracted?

Mining, Drilling, and Quarrying can extract minerals.

(a) Mining: Mining is the process of taking out minerals from rocks buried under the earth's surface

(i) Open Cast Mining: The minerals that lie at a very low depth or shallow depths are taken out by removing the top layer or surface layer is known as "Open Cast Mining."

(ii) Shaft Mining: Deep bores, called shafts, have to be made to reach mineral deposits that lie at great depth. It is known as "Shaft Mining."

(b) Drilling: Petroleum and natural gas occur far below the earth's surface. Deep wells are bored to take them out; this is called "Drilling."

(c) Quarrying: Minerals that lie near the earth's surface are simply dug out by the process known as "Quarrying."

Distribution of Minerals

- Minerals are unevenly present on the earth's surface.
- All minerals are exhaustible, i.e., will exhaust after a certain time.
- However, these minerals take a long time to form, but they cannot be replenished immediately at the time of need.
- More than 97% of coal reserves occur in the valleys of Damodar, Sone, Mahanadi, and Godavari rivers.

Petroleum reserves in India are located in the sedimentary basins of Assam, Gujarat, and Mumbai High

MODE OF OCCURRENCE OF MINERALS:

Minerals are found in the following places:

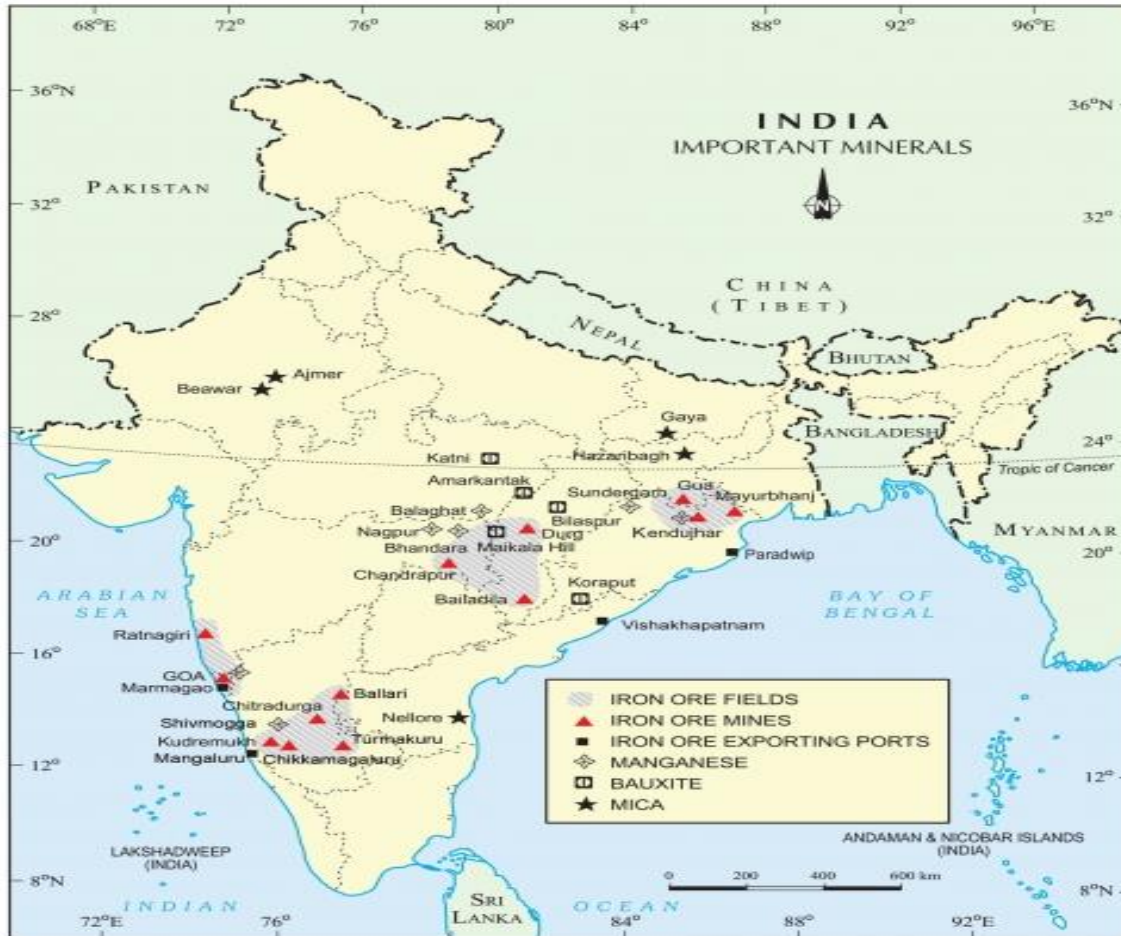
1. In igneous and metamorphic rocks: The smaller occurrences are called veins and the larger occurrences are called lodes. They are usually formed when minerals in liquid/molten and gaseous forms are forced upwards through cavities towards the earth's surface. Examples: tin, copper, zinc, lead, etc.

2. In sedimentary rocks: In these rocks, minerals occur in beds or layers. Coal, iron ore, gypsum, potash salt and sodium salt are the minerals found in sedimentary rocks.

3. By decomposition of surface rocks: Decomposition of surface rocks and removal of soluble constituents leaves a residual mass of weathered material which contains ores. Bauxite is formed in this way.

4. As alluvial deposits: These minerals are found in sands of valley floors and the base of hills. These deposits are called placer deposits. They generally contain those minerals which are not corroded by water. Examples: gold, silver, tin, platinum, etc.

5. In ocean water: Most of the minerals in ocean water are too widely diffused to be of economic importance. But common salt, magnesium and bromine are mainly derived from ocean waters.



TYPES OF MINERALS

Over 2000 minerals have been identified, and only a few have been abundantly found. A basic classification for minerals is:

- Native elements. Eg. Gold, Silver, Mercury, graphite, diamond.
- Oxides. e.g., corundum (incl. sapphire), hematite, spinel.
- Hydroxides. Eg. Goethite, brucite.
- Sulfides. Eg. Pyrite, galena, sphalerite.
- Sulfates. Eg. Baryte, gypsum.
- Carbonates. Eg. Calcite, magnesite, dolomite.
- Phosphates. Eg. Apatite, monazite.
- Halides. Eg. Fluorite, halite (rock salt).
- Silicates (most common)
- Orthosilicates. Eg. Garnet, olivine.
- Ring silicates. Eg. Tourmaline, beryl.
- Chain silicates. Eg. Pyroxenes, amphiboles.
- Sheet silicates. Eg. Muscovite mica, biotite mica, clay minerals
- Framework silicates. Eg. Quartz, feldspars, zeolites

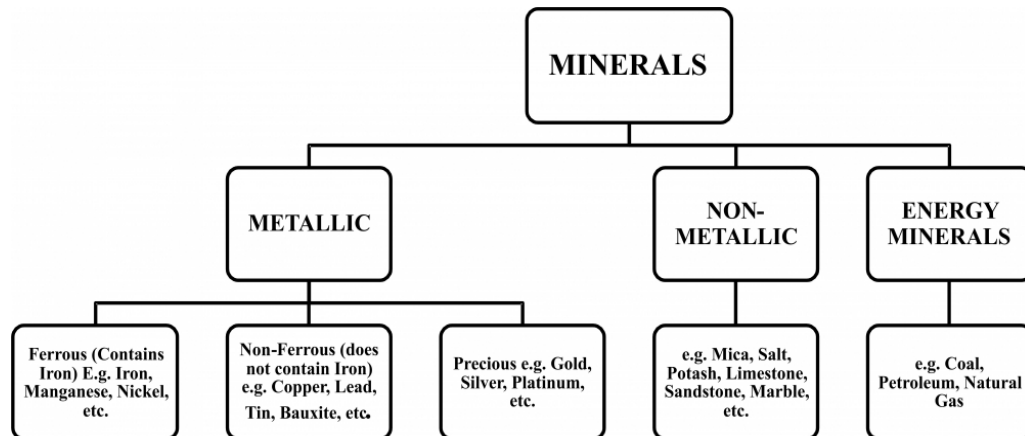
Classification of minerals based on chemical and physical properties

Minerals are classified into three types

Metallic

Non-metallic

Energy resource



Metallic minerals:

Metallic minerals are those minerals from which material extracted is of metallic nature

Metallic minerals are further classified into

Ferrous Minerals

Non-Ferrous Minerals

Precious Minerals

Ferrous Minerals: Ferrous minerals account for about three-fourths of the total value of the production of metallic minerals.

- Provide a strong base for the development of the metallurgical industry.
- India exports a good quantity of ferrous minerals.

IRON ORE is an example of ferrous minerals.

IRON ORE:

- Iron ore is the basic mineral and is the backbone of industrial development.
- India is rich in good quality iron ores.
- Magnetite is the finest iron ore with a very high content of iron up to 70%. It has excellent magnetic properties because of which it becomes very valuable for the electrical industry.
- Hematite ore is the most important industrial iron ore; in terms of quantity usage. The iron content of hematite is 50-60%.

1. Major Iron Ore Belts in India:

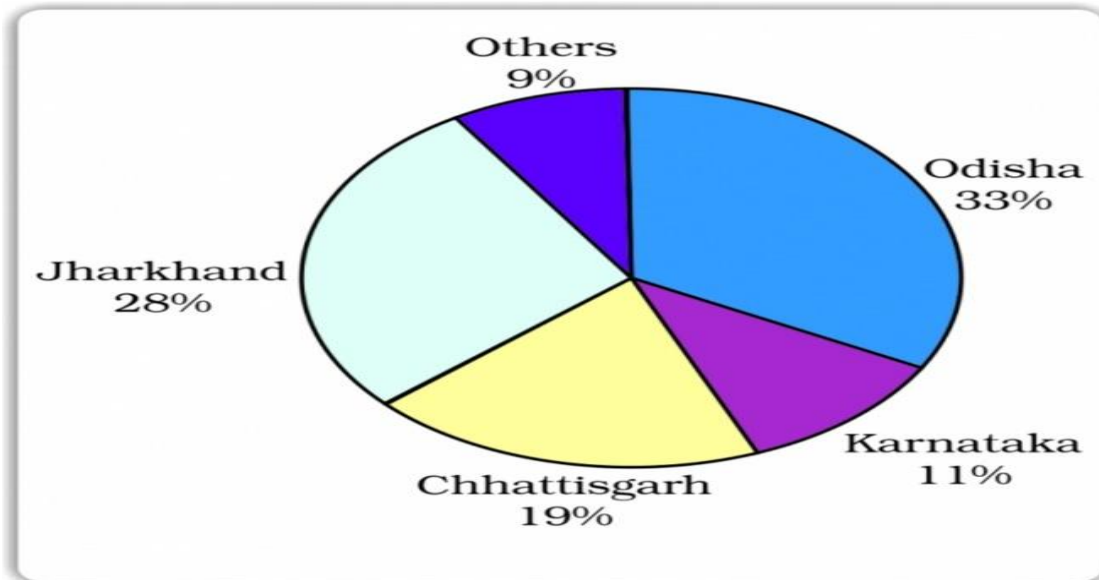
1. Badampahar mines in the Mayurbhanj and Kendujhar districts of Orissa have high-grade hematite ore. Additionally, hematite iron ore is mined in Gua and Noamundi in Singhbhum district of Jharkhand.
2. **Durg Bastar Chandrapur Belt:** This belt lies in Chhattisgarh and Maharashtra. The Bailadila range of hills in the Bastar district of Chhattisgarh has very high-grade

hematite ore. This hilly range has 14 deposits of super high-grade hematite ore. Iron from these mines is exported to Japan and South Korea via Vishakapatnam port.

3. **Bellary Chitradurga Chikmagalur Tumkur Belt:** This belt lies in Karnataka.

The Kudremukh mines located in the Western Ghats are a 100 percent export unit.

The ore from these mines is transported as slurry through a pipeline to a port near Mangalore.



MANGANESE: Manganese is the other example of Ferrous Minerals.

(a) Manganese is mainly used in the manufacturing of steel and ferromanganese alloy.

(b) Nearly 10 kg of manganese is required to manufacture one tonne of steel.

(c) It is also used in manufacturing bleaching powder, insecticides, and paints.

(d) Odisha is the largest producer of manganese ores in India. It accounted for one-third of the country's total production in 2000-01.

NON-FERROUS MINERALS: Copper, Bauxite, Lead, Zinc, Gold, etc.

(a) The availability of Non-Ferrous minerals in India is NOT of a satisfactory level.

(b) E.g., Copper, Bauxite, Lead, Zinc, Gold, etc.

(c) These minerals play a vital role in a number of metallurgical, engineering, and electrical industries.

COPPER:

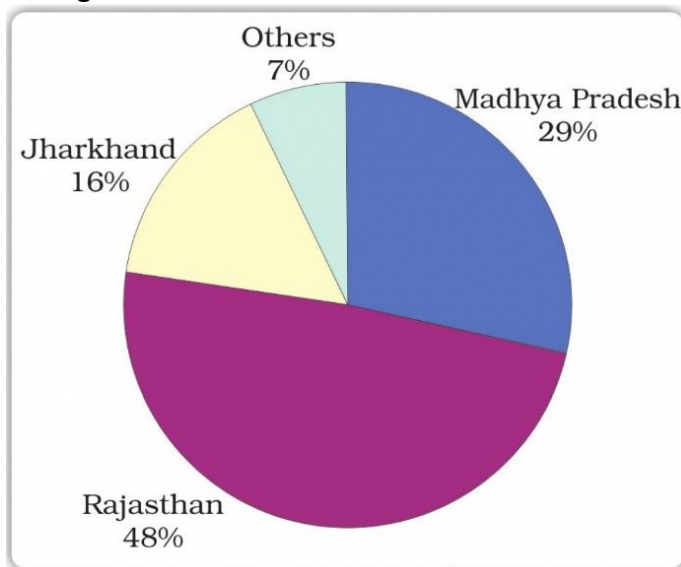
(a) Copper is mainly used in electrical cables, electronics, and chemical industries.

(b) Copper is a good conductor of electricity.

(c) India doesn't have good reserves of copper.

(d) Leading producers of copper in India are:

1. Khetri mines of Rajasthan.
2. The Balaghat mines in Madhya Pradesh.
3. Singhbhum district of Jharkhand.



BAUXITE:

- (a) Bauxite is a clay-like substance, out of which aluminum is obtained.
- (b) Aluminum is incredibly popular because it is Lightweight, Strong, Durable, Ductile, Malleable, etc.
- (c) Amarkantak Plateau, Maikal hills, and the plateau region of Bilaspur-Katni are the main areas of bauxite deposits.
- (d) In 2009-10 Orissa was the largest producer of bauxite in India with 34.97%.
- (e) Panchpatmali in Koraput district is the most important center of the bauxite deposit in Orissa.
- (f) Aluminum is used in Automobiles, Aircraft, Spacecraft, Packaging (Cans, Foil, frame). Food and beverage containers, etc.

Diamond:

Diamond deposits in India

Till now, all India resources of diamonds were placed at around 31.86 million carats.

By grades, about 2.37% of resources are of Gem variety, 2.64% of Industrial variety and the bulk of the resources (95%) are placed under the Unclassified category.

By States, the distribution of diamond deposits is as following

1. Madhya Pradesh accounts for about 90.18% resources
2. Andhra Pradesh 5.72%
3. Chhattisgarh 4.09%

Diamond occurrences are reported since prehistoric times in the country. Presently, diamond fields of India are grouped into four regions:

1. South Indian tract of Andhra Pradesh, comprising parts of Anantapur, Cuddapah, Guntur, Krishna, Mahabubnagar and Kurnool districts
2. Central Indian tract of Madhya Pradesh, comprising Panna belt
3. Behradin-Kodawali area in Raipur district and Tokapal, Dugapal, etc. areas in Bastar district of Chhattisgarh
4. Eastern Indian tract mostly of Odisha, lying between Mahanadi and Godavari valleys.

In India, there is only one mine at Majhgaon in Panna (Madhya Pradesh) of NMDC for a production capacity of 84,000 carats and the total diamonds recovered from this mine so far are little more than 1 million carats.

Precious Minerals:

Gold:

Gold Deposits in India

In India, the total resources of gold ore are estimated at 494 million tonnes, of which 24 million tonnes only are placed in reserve category and the remaining 470 million tonnes under the resource category.

The total resource in terms of metal (primary gold) is at 659.84 tonnes.

By states, largest resources in terms of gold ore (primary) are located in

1. Bihar (45%)
2. Rajasthan (23%)
3. Karnataka (22%)
4. West Bengal (3%)
5. Andhra Pradesh and Madhya Pradesh (2% each)
6. The remaining 3% resources of ore are located in Chhattisgarh, Jharkhand, Kerala, Maharashtra, and Tamil Nadu.

In terms of metal content,

1. Karnataka
2. Rajasthan
3. Bihar, Andhra Pradesh
4. Jharkhand, etc.
5. Karnataka (22): Kempinkote, Manighatta, South Kolar cluster mines, KGF west reefs, Hanni Ajjampur, Karajgi, Chinmulgund, Ganajur, Kuluvalli, Bhavihal, Mangalgatti, Lakkikoppa, Hiriur, Hosur-Champion, Yelisirur, Hirenagur, Buddini Maski, Kadoni, Uti South-West, Hutti North-Prospect, Jainapur, Wandalli, and Surapalli

6. Andhra Pradesh (5): Bhadrampalle, Ramapura, Venkatampalli, Chinnabhari, and Jibutil
7. Madhya Pradesh (1): Gurharpahar Sankorwa
8. Chhattisgarh (3): Sonakhan, Sonadehi, and Pathalgaon cluster
9. Jharkhand (2): Parasi and Lawa

Silver

Silver Deposits in The World

80 % of all silver produced in the world comes as a by-product of industrial processes and so silver mining is concentrated in only a handful of countries.

Exclusive silver mining forms a paltry 20% of overall silver production, with the main demand arising from industrial needs.

Mexico is the world leader in terms of silver production from mines, followed by countries such as Peru, Australia, China, Chile, Bolivia, USA, and Russia, among others.

Since the 1980 s, silver production has been outpaced by consumption giving rise to rates over the years.

Silver Deposits in India

India is not a major producer of silver.

Imports drive most of the silver consumption in India.

It generally occurs with lead, zinc, copper, and gold ores and is extracted as a by-product of electrolysis or chemical methods. The chief ore minerals of silver are Argentite, stephanite, pyrargyrite, and proustite.

By states, largest resources in terms of silver ore are located in

1. Rajasthan accounts (87%)
2. Jharkhand (5%)
3. Andhra Pradesh (4%)
4. Karnataka (2%).

In terms of production, the following states are the top producer of silvers in the country

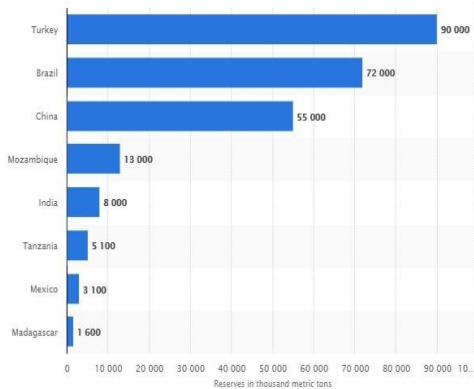
1. Andhra Pradesh (42.43%)
2. Bihar-Jharkhand (32.18%)
3. Rajasthan (25.03%)
4. Karnataka (0.36%).

Non-Metallic:

Graphite

1. Graphite, also known as plumbago or blacklead or mineral carbon, is a stable form of naturally occurring carbon.

2. Natural graphite is categorized into two commercial varieties (i) crystalline (flaky) graphite and (ii) amorphous graphite.
3. Both flaky and amorphous varieties of graphite are produced in India.
4. The quality of graphite depends upon its physical qualities and carbon content.
5. Graphite is used as a raw material in a large number of industries such as crucible, foundry facing, dry cell battery, lubricants, pencils, and paints, etc.



Rank	Country	World Production, By Country (Metric tons)
1	China	750,000
2	India	170,000
3	Brazil	95,000
4	Korea, Democratic People's Republic Of	30,000
5	Canada	20,000
6	Russian Federation	14,000
7	Mexico	7,148
8	Ukraine	5,800
9	Turkey	5,300
10	Madagascar	4,300
11	Zimbabwe	4,000
12	Sri Lanka	3,700
13	Norway	1,500
14	Austria	500

Source: United States Geological Survey (USGS) Minerals Resources Program

Graphite deposits in India

India is the second-largest producer of graphite in the world, preceded by China. The total resources of graphite in India, till April 2013 is placed at about 188.67 million tonnes.

By states, total Graphite resources are distributed in the following manner:-

1. Arunachal Pradesh accounts for 39% of the total resources
2. Jammu & Kashmir (33%),
3. Odisha (10%), Jharkhand (9%)
4. Tamil Nadu (4%),

However, in terms of reserves,

1. Jharkhand has the leading share of about (52%)
2. Tamil Nadu (41%)
3. Odisha (6%)

Active mining centers of graphite are in

- **Jharkhand** - Latehar & Palamu districts
- **Odisha** - Bargarh, Nuapada, Rayagada & Balangir districts
- **Tamil Nadu** - Madurai & Sivagangai districts

Mica

- (a) Mica is a mineral that is made up of a series of plates or leaves.
- (b) The mica sheets can be so thin that a thousand of them can be layered into a few centimeter-thick mica sheets.
- (c) Mica has excellent dielectric strength, low power loss factor, insulating properties, and resistance to high voltage.
- (d) Mica is widely used in electric and electronic industries.
- (e) Mica deposits are found on the northern edge of the Chota Nagpur plateau.
- (f) Koderma-Gaya-Hazaribagh belt of Jharkhand is the leading producer of mica.
- (g) Ajmer in Rajasthan and Nellore in Andhra Pradesh are the other important producers of mica

ROCK MINERALS

Limestone

- (a) Limestone is found in sedimentary rocks of most geological formations.
- (b) It is found in the association of rocks composed of calcium carbonates or calcium and magnesium carbonates.
- (c) It is the base raw material for the cement industry.
- (d) It is also used for the smelting of iron ore in the blast furnace.
- (e) Major producers of Limestone in India are Karnataka, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Rajasthan, and Gujarat.

HAZARDS OF MINING

- (a) Mining is a hazardous industry, both for the workers and the residents.
- (b) The Miners have to work under tough conditions where no natural light is available.
- (c) There is always a risk of collapse of mine roof, inundation with water, and fire.

- (d) The areas around mines face the problem of too much dust from the mines.
- (e) Slurry from mines damages the roads and the farmland.
- (f) Houses and clothes become dirty more often than in other areas.
- (g) Miners are at great risk of getting afflicted with pulmonary disorders.
- (h) Cases of respiratory tract diseases are very high in mining areas.

CONSERVATION OF MINERALS

- (a) It takes millions of years for the formation of minerals.
- (b) Compared to the present rate of consumption, the replenishment rate of minerals is very slow.
- (c) Hence, mineral resources are finite and non-renewable.
- (d) Due to this, we must conserve mineral resources.
- (e) Minerals are a non-renewable resource.
- (f) It takes thousands of years for the formation and concentration of minerals.
- (g) The rate of formation is much lower than the rate at which humans consume these minerals. It is necessary to reduce wastage in the process of mining.
- (h) Recycling of metals is another way in which the mineral resources can be conserved.

There Are Several Ways to Remove Mineral Deposits (1)

- Surface mining
 - Shallow deposits removed
 - Overburden removed first
 - Spoils: waste material
- Subsurface mining
 - Deep deposits removed

There Are Several Ways to Remove Mineral Deposits (2)

- Type of surface mining used depends on
 - Resource
 - Local topography
- Types of surface mining
 - Open-pit mining
 - Strip mining
 - Contour strip mining
 - Mountaintop removal

