IASBABA

[GEOGRAPHY VALUE ADD SET 4 – BLOCK 3-PART 1]

Integrated Learning Programme 2018 is a step towards 'Enabling a person located at the most remote destination a chance at cracking AIR 1 in UPSC/IAS'

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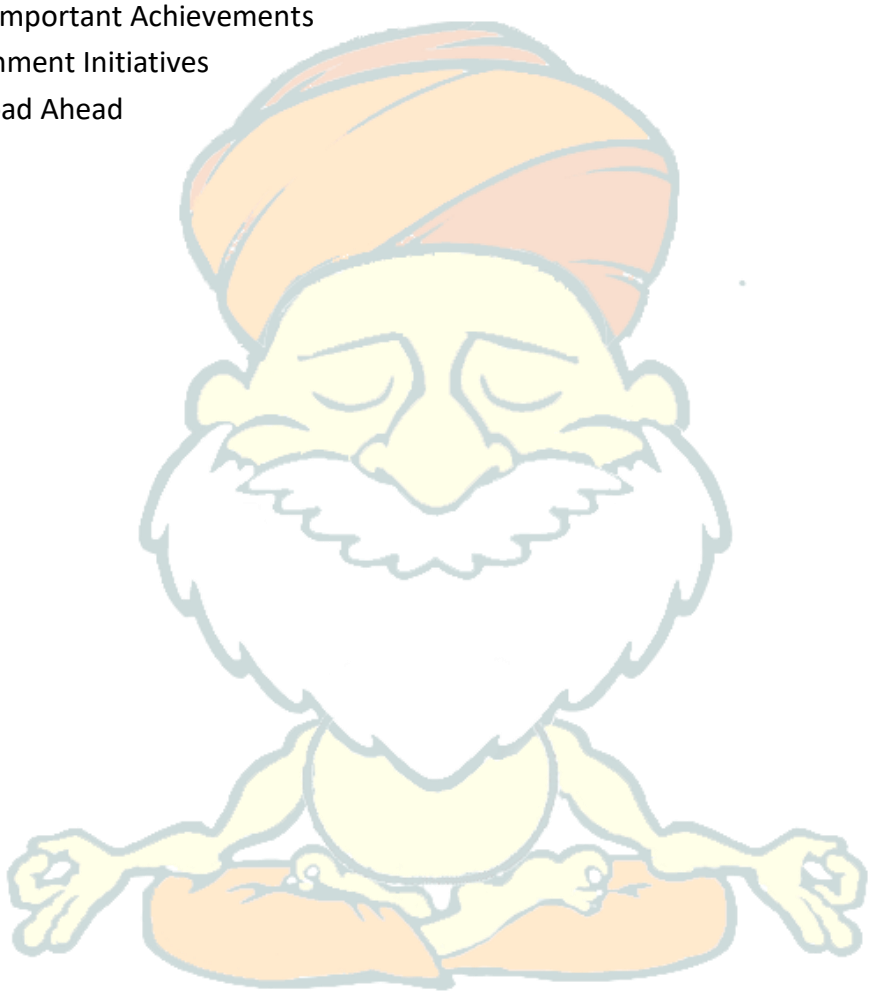


Resources

Introduction

Resource: "Anything that can be used to satisfy a need is a resource"(NCERT definition)

A **resource** is a source or supply from which benefit is produced. Typically resources are materials, energy, services, staff, knowledge, or other assets that are transformed to produce benefit and in the process may be consumed or made unavailable. Benefits of resource utilization may include increased wealth, meeting needs or wants, proper functioning of a system, or enhanced well-being. From a human perspective a natural resource is anything obtained from the environment to satisfy human needs and wants.

All resources have two things in common- Utility and Value

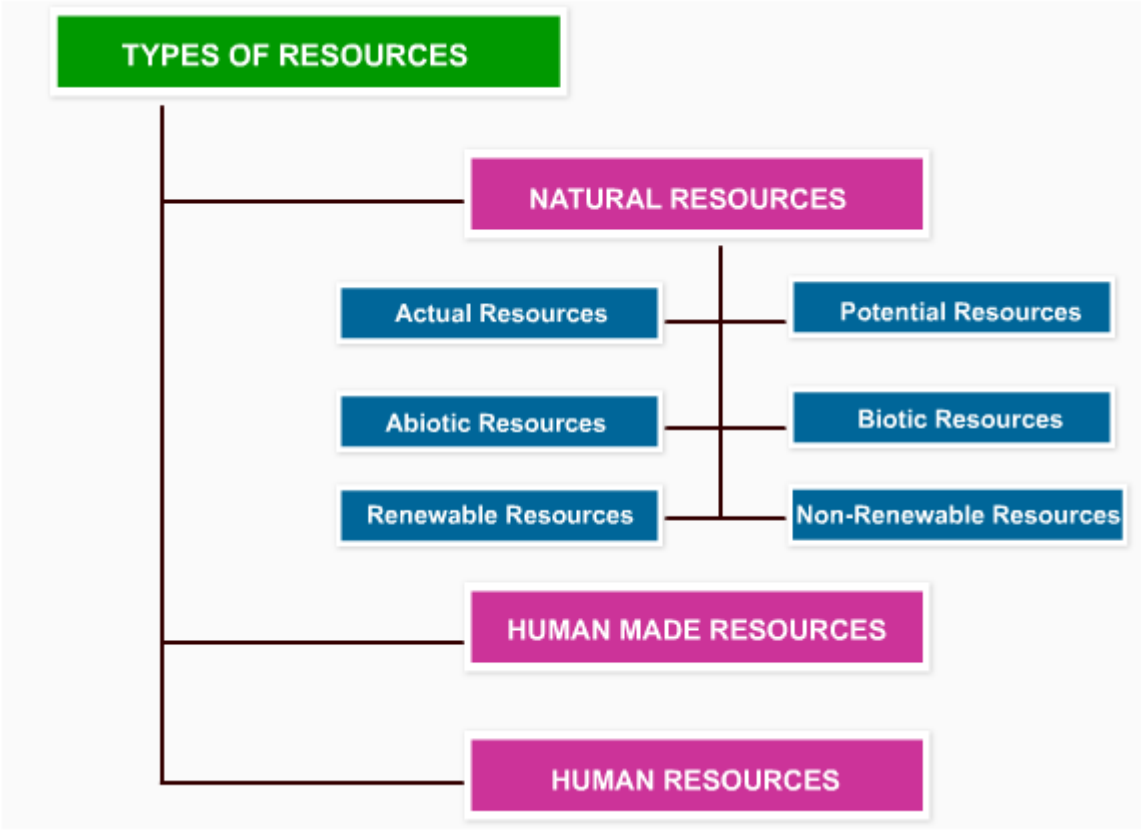
Utility: Utility or Usability is what makes a substance a resource.

Value: Value refers to its worth. Some resources have tangible economic value like petrol, while others might not have an economic value, but they will still be resources, like a beautiful landscape, fresh air etc.

An important point to be remembered is that,

"Resources are not, they become." - Zimmerman

Utility of a substance or object depends upon the time and the technology available. Time and technology are two important factors that can change substances into resources. Both are related to the needs of the people. People themselves are the most important resource. It is their ideas, knowledge, inventions and discoveries that lead to the creation of more resources. Each discovery or invention leads to many others. The discovery of fire led to the practice of cooking and other processes while the invention of the wheel ultimately resulted in development of newer modes of transport. The technology to create hydroelectricity has turned energy in fast flowing water into an important resource.



Classification of Resources

Resources are broadly classified as- Natural Resources, Human-made resources and Human Resources.

Natural Resources: Natural resources are the materials provided by the nature that can be directly or indirectly used by humans for their personal or economic gain. The Earth's *natural resources* are vital to the survival and development of the human population. A natural resources value rests in the amount available and the demand for it.

Some examples of natural resources are: Sunlight, Water, sir, minerals, Plants and animals etc.

Depending upon various factors, Natural Resources are further classified into different categories.

1) Based on the need of development:

On the basis of need of development, the resources are classified as – Directly usable resources and resources that need development.

Resources that need development are further classified into –

- Actual Resources
- Potential Resources

Actual Resources: Actual resources are those which are currently being used. They are already surveyed and quantified to a large extent. Eg- Coal, petroleum, metal ores, Forests etc.

Potential Resources: These are those resources which are present in a region but are not currently used. This can be due to non-availability of technology or proper amount. These resources can be potentially used in future. Eg, Thorium found in Kerala is a potential resource that can be used in future.

(NOTE: Do find more examples of potential resources.)

2) Based on the origin of Natural Resource:

On the basis of origin, natural resources are classified into Biotic and Abiotic.

Abiotic Natural Resource: These resources have an inorganic origin i.e. they comprise of non-living things like land, water, air, metals etc.

Their use and viability depends upon their accessibility and their value. Their total reserve cannot be increased by human efforts.

Biotic Natural Resources: These resources have an organic origin. These include forests and forest product, flora and fauna, and also coal, petroleum etc.

3) Based on availability and distribution of the resource:

This is the most famous classification which you must have read many times.

On the basis of availability, the natural resources are classified as –

- Renewable Resources

- Non-Renewable Resources

Renewable resources are those which can be replenished by nature in a short period of time. These include, air, water, crops, forests etc. However, their rate of replenishment can differ according to the resource.

Non-renewable resources are formed over a very long geological period. These include minerals and fossil fuels. Since their rate of formation is very slow, they cannot be replenished quickly once they are used. Hence their supply is limited and exhaustible. There are some resources which can be recycled, like metals etc. while some resources cannot be recycled eg. Coal, natural gas etc.

After Industrial revolution and population blast, the demand for these resources increased exponentially. This not only resulted in quick depletion of these resources but also caused ecological imbalance, destruction of habitat and pollution.

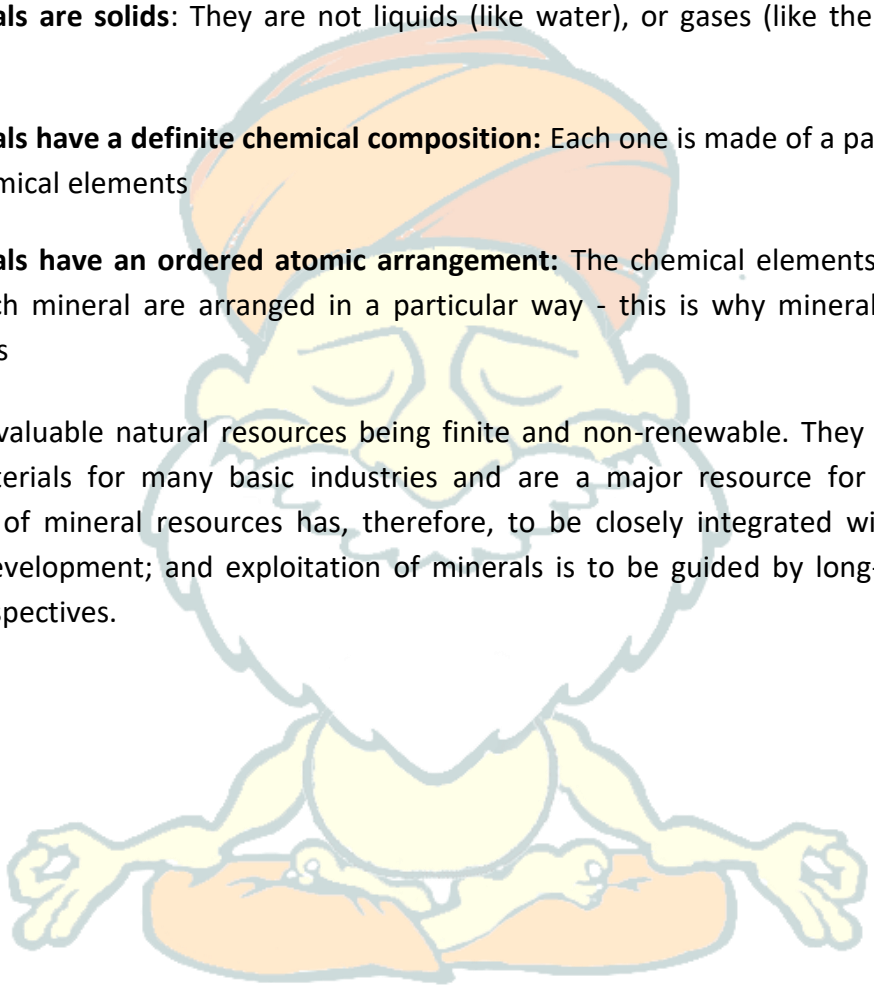
To prevent all this destruction, the idea of **Sustainable development** was put forward. **Sustainable development will be dealt in detail in Environment Value Add in later sets.**

Mineral Resources

A mineral is a naturally occurring inorganic solid, with a definite chemical composition, and an ordered atomic arrangement. This may seem a bit of a mouthful, but if you break it down it becomes simpler.

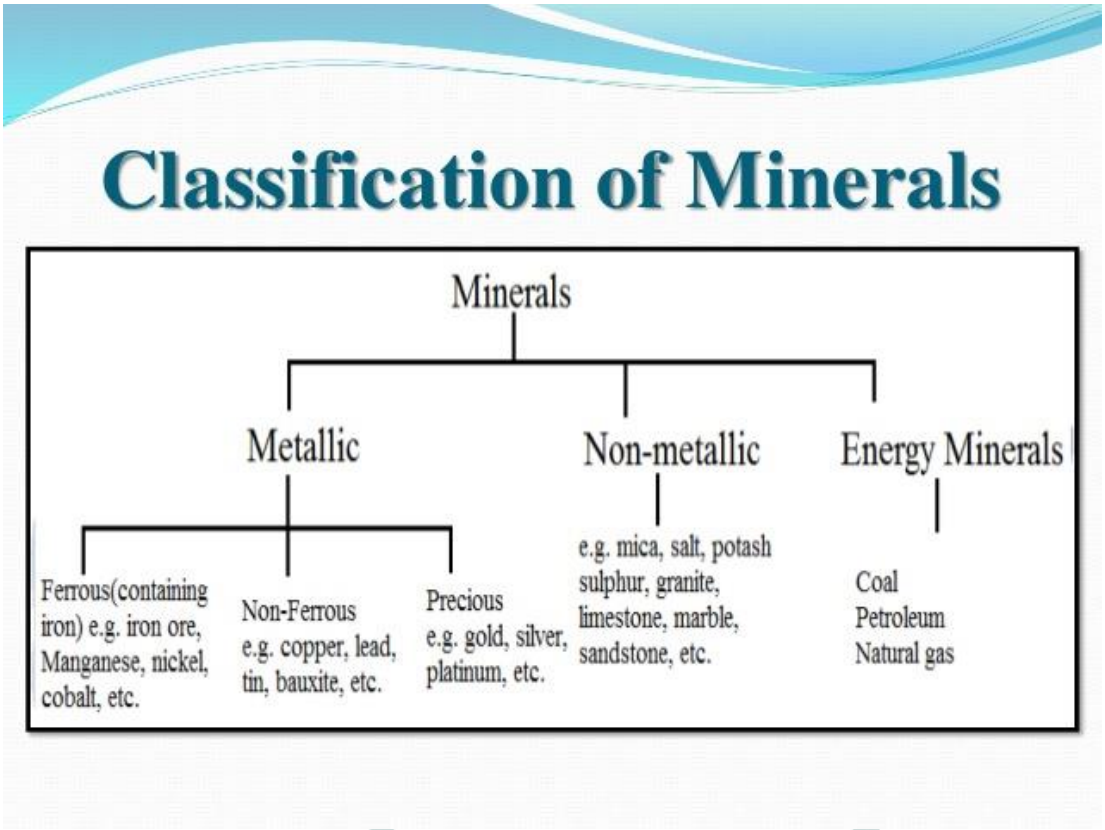
- **Minerals are naturally occurring**. They are not made by humans
- **Minerals are inorganic** They have never been alive and are not made up from plants or animals
- **Minerals are solids**: They are not liquids (like water), or gases (like the air around you)
- **Minerals have a definite chemical composition:** Each one is made of a particular mix of chemical elements
- **Minerals have an ordered atomic arrangement:** The chemical elements that make up each mineral are arranged in a particular way - this is why minerals 'grow' as crystals

Minerals are valuable natural resources being finite and non-renewable. They constitute the vital raw materials for many basic industries and are a major resource for development. Management of mineral resources has, therefore, to be closely integrated with the overall strategy of development; and exploitation of minerals is to be guided by long-term national goals and perspectives.

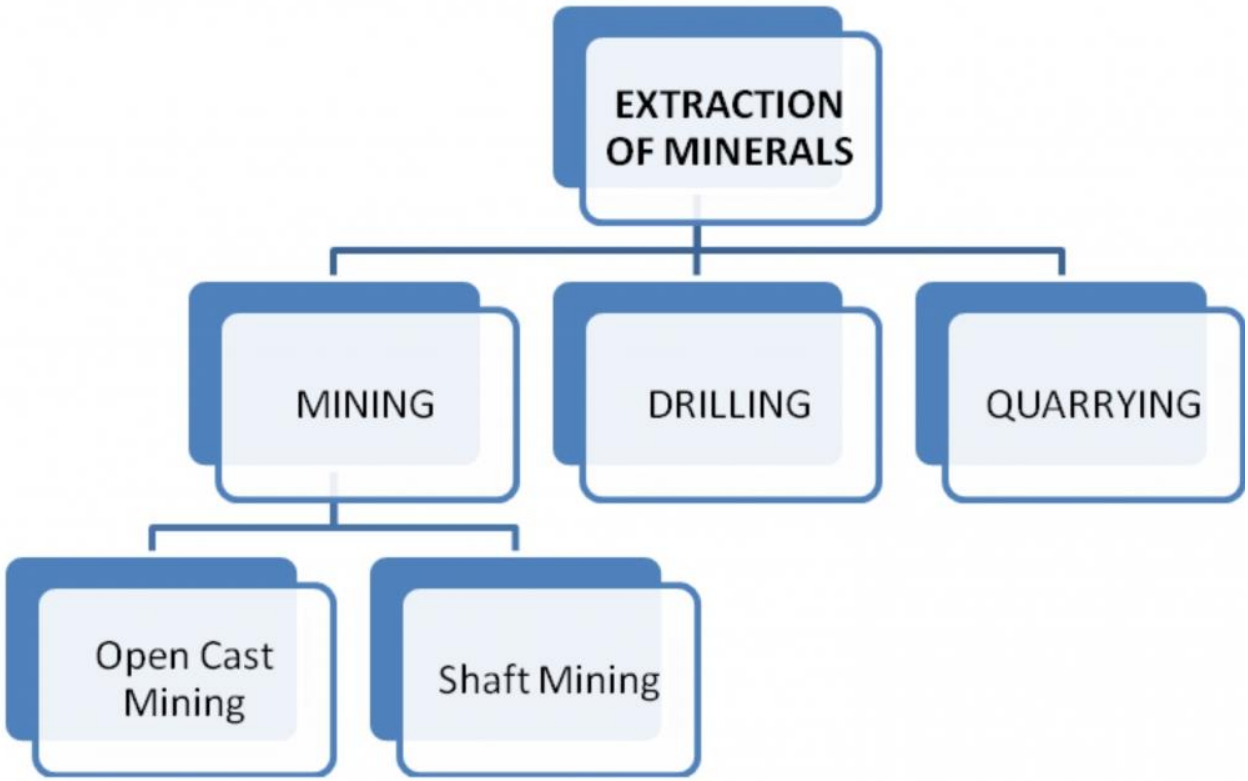


Types of minerals:

Minerals are broadly classified into following ways:



Extraction of Minerals:



Open Cast Mining: Open-pit mining, also known as opencast mining, open-cut mining, and strip mining, means a process of digging out rock or minerals from the earth by their elimination from an open pit or borrow.

The word is used to distinguish this type of mining from extractive methods that need tunneling into the earth. Open-pit mines are used when deposits of commercially helpful minerals or rock are found close to the surface; that is, where the overburden (layer material covering the valuable deposit) is comparatively thin or the material of interest is structurally inappropriate for tunneling.

Open Cast Mining

Shaft Mining: *Shaft mining* is a form of underground mining using shafts driven vertically from the top down into the earth to access ore or minerals. **Shaft mining** or **shaft** sinking refers to the method of excavating a vertical or near-vertical tunnel from the top down, where there is initially no access to the bottom.

Shaft Mining

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

Quarrying: *Quarrying*, open, or surface, excavation of rock used for various purposes, including construction, ornamentation, road building, and as an industrial raw material.

Quarry

NOTE: World Distribution of minerals will be covered separately in World Resources module.

Uses of Minerals:

Following points can be cited as the general uses of the minerals:

- Mineral resources can be found in almost every aspect of our lives. Granite is widely used as building stone is one of the hardest rocks found in nature. It is made up of three minerals - quartz, feldspar and mica. Gypsum is used in plaster cast which is used on broken arms or legs.
- The lead in your pencil is made from graphite while crayons and paints are made from talc.

- The fireworks are made from yellow-coloured mineral called sulphur, also used for making matches and explosives, sulphuric acid, fertilizers, chemicals and dyestuff.
- Copper is a good conductor of heat and electricity obtained from metallic mineral called chalcopyrite or copper pyrite. It so flexible that it can be rolled into flat sheets, wires and other shapes. Hence, copper is used extensively in various electrical appliances. It is also used to make electrical cables and wires, switches, coins, cooking utensils and water pipes. Copper is also used in plumbing, heating, roofing and construction.
- Iron is another very important metal that is obtained from minerals such as limonite, hematite and magnetite. These minerals are called iron ores. Iron is mainly used to manufacture steel. Iron and steel are used in almost all industries for manufacturing ships, airplanes, cars, cycles, trucks and vans.
- They are widely used in the construction industry to make building support and structures. Iron is also used in the manufacture of computers, and office stationery like staples, nails and paper clips.
- The mineral manganese is a key component in the production of iron and steel. Today, the technique devised by the Hittites is called smelting of iron.
- Aluminum is another very important metal that is obtained from its ore bauxite. It is used in the manufacture of automobiles and airplanes, and building and electrical materials. It is also used in the bottling and canning industries; kitchen cookware and foil, and personal product like deodorants and cosmetics.
- Gold and silver are rare metals that are popularly used to make jewellery. They are also used to make medallions and coins, and in dentistry and medicine.
- Certain minerals, called gemstones, are also used to make jewellery. They are hard and come in many beautiful colours. Some gemstones, like diamonds, sapphires, emeralds and rubies, are rare and very expensive and are known as precious stones.
- Some gemstones, like turquoise, garnet, amethyst, aquamarine, topaz, moonstone, peridot and opal, are not as rare and so are known as semi-precious stones.
- Gemstones are first cut and polished, then set into precious metals like gold, silver and platinum to make artistic jewellery.

- Diamond is the hardest mineral found on the earth and so is used for making cutting tools that are used for cutting other gemstones.
- Minerals are also very essential for all living beings.
- Iron is present in every living cell. It is very essential for the production of haemoglobin, which is the primary component of red blood cells. Other minerals like zinc, manganese, copper and fluoride are also required in very small amounts in our diet.

Need for conservation of minerals:

Minerals are non-renewable resources. They cannot be replenished and their new reserves created once these are depleted. Also these are earthly treasure which belongs to entire mankind of present and future generations.

They have decisive role cultural, social and economic development of mankind. We have moral and social obligations conserve them, avoid their misuse and wastage a: preserve them for use in future.

This could only be possible through the adoption of conservation techniques. In India conservation strategy is more important because of the scarcity of certain important minerals which need conservation and new technological revolution currently going on in the count which will evolve better mining and processing technology in future for judicious exploitation mineral resources.

Conservation measures:

There are three basic ways of conserving minerals for future use – reduce, recycle, reuse.

You can reduce the amount of waste you create by choosing what rubbish you throw away. Recycling means to return a waste product to a place where it is remade into either the same product or something different. The reuse of metals will also help in reducing the rate of consumption, and help in the conservation of minerals.

Apart from this, the following measures can be taken by the government:

1.New researches should be undertaken to find out and develop 'replacement minerals' for us in place of scarce minerals which are in short supply and are going to be depleted soon.

2. Researches should also be carried on to develop new technology which should avoid wastage and promote maximum utilisation of by-products.

3. There should be curbing on wasteful mining methods. Miners should be imparted training to adopt new techniques of mining, use latest technology and machines and take maximum precaution' cause little damage to the environment.

4. There should be proper development of infrastructural facilities in mining areas, suite location for processing plants and refineries and encouragement to private sectors to establish research units and adequate provision for financial support and loans.

5. Processing plants should invariably be coated in mining areas to reduce transport cost. In case of weighty materials like coal it is better to convert it into coking coal or in electricity near the pit heads.

6. There is a great scope for the expansion of several mineral-based industries which open new vista for economic development.

7. New explorations should be carried on to find out locations and new areas of minerals using latest technology. In case of India sea floor exploration and mining may yield good dividend.

Distribution of Key mineral Resources in India:

Ferrous Metals

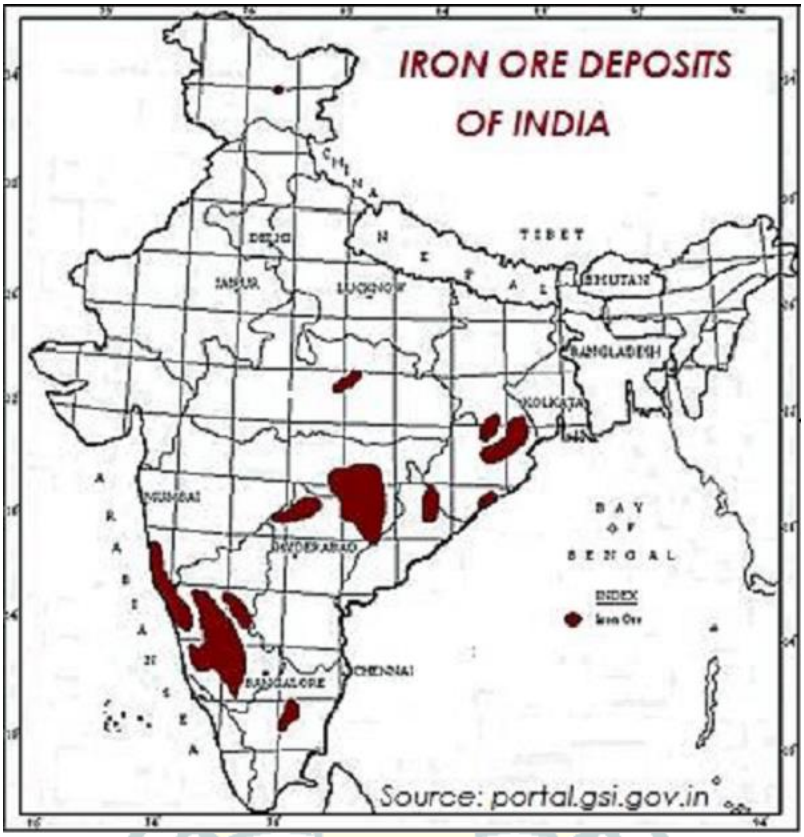
Iron Ore:

The value of annual iron ore production exceeds the combined output of all other ferrous and ferroalloy minerals. Bulk of this production is used in manufacturing industry.

Major iron-ore reserves in India occur in the peninsular plateau within crystalline schist rocks of Dharwar and Cuddapa systems.

Mainly oxide form of iron-ores are widespread in India, of which by far hematite (Fe_2O_3) is most important, followed by Magnetite (Fe_3O_4) and Limonite ($Fe_3O_4.2H_2O$). Carbonate iron ore, i.e., Siderite, is almost absent in India.

Recent estimates revealed that total amount of Indian iron-ore reserve is about 20,710 million tonnes, out of which 12,317 million tonnes may be classed as hematite and 540 million tonnes are of magnetite in grade.



Hematite varieties are generally abundant in peninsular plateau; comprising Jharkhand, Orissa, Madhya Pradesh, Maharashtra, Goa and Karnataka. Indian hematite's are of very high grade, containing more than 70% ferrous content.

Magnetite ores are abundant in the southern iron-ore producing states of Karnataka, Andhra Pradesh and Tamil Nadu. Indian magnetite's are to some extent inferior in grade, compared to hematite's, containing on an average 62% iron.

Manganese

Like iron-ore, manganese ores are also abundant in Dharwar and Kuddapa series of pre-Cambrian era. Total reserve of Indian manganese exceeds 406 million tonnes. Indian ores contain more than 50% manganese associated with lesser impurities. India ranks sixth in the world in manganese production.

Distribution:

Bulk of the manganese is extracted from the mines of Orissa, Madhya Pradesh, Maharashtra, Andhra Pradesh, Goa and Bihar.

In Madhya Pradesh, the major manganese mining region is located in the districts of Balaghat, Chindwara and Shadol district. Manganese ores are widespread in Singbhum district of Jharkhand. Maharashtra is also rich in manganese reserve.

Chromite:

Chromite is an important Ferro-alloy used in refractory and chemical industry. Total estimated chromite ($FeCr_2O_3$) reserve in India is 86 million tonnes. Important chromite deposits are found in Cuttack and Keonjhar districts of Orissa, Chitradurga, Hassan, Shimoga districts of Karnataka, Bhandara and Ratnagiri districts of Maharashtra, Singbhum district of Jharkhand and several other small deposits in other states.

Tungsten:

Major ore of tungsten is wolfram tri-oxide or WO_3.

Estimated reserve of tungsten is around 38.11 million tonnes. Chief producing areas are Rajasthan and Maharashtra.

Bauxite:

Bauxite ($Al_2O_3.2H_2O$), considered as the primary ore of aluminium, occurs in India in substantial amounts. According to the latest estimate, the total reserve of bauxite in the country is around 2,462 million tonnes. India secured fifth position in her bauxite reserve in the world. As indigenous aluminium industry is still ill-developed, a large amount of bauxite is generally exported to the developed countries.

Bauxite deposits are scattered in India in the states of Madhya Pradesh, Andhra Pradesh, Bihar, Goa, Gujarat, Karnataka and several other states. Distributional pattern of bauxite deposits reveals close proximity of its location with iron ore deposits.

Jharkhand ranks first in bauxite deposit where Palamau, Lohardaga, Ranchi and Monghyr districts contain some prestigious bauxite mines.

Copper:

Major copper ores extracted in India are bornite, chalcopyrite and tetrahidrite. Among these, according to volume and quality, chalcopyrite is the most important. Major copper-producing states in India are Bihar, Andhra Pradesh, Madhya Pradesh and Sikkim.

In Rajasthan, copper deposits are extensive in Khetri and Khoh—Dariba in Alwar district. The Khetri-Singhana area also possesses a number of copper mines. Most important of these is the Barkhera copper mine.

Lead and Zinc Ore

Chief lead ore is Galena (PbS) and Sphalerite is the major zinc ore. Total combined reserve of lead and zinc ores are estimated at about 179 million tonnes, out of which 2.3 million tonnes lead and 10 million tonnes of zinc may be classed as recoverable reserve.

Zinc ores are mostly found in places like Zawar, Balaria, Mochia Mogra of Rajasthan. Apart from zinc, lead deposits are also found at Dhanbad of Bihar and South Arcot district of Tamil Nadu.

Gold:

The Indian reserve of gold ore is placed at 17.7 million tonnes. Most of the gold is extracted from the Kolar mines, Hutti mine and Ramgiri field in Kolar, Raichur and Anantapur districts, respectively, in Karnataka and Andhra Pradesh.

Non-Metallic Minerals:

Gypsum:

India has a vast reserve of gypsum, ranging about 238 million tonnes. Gypsum deposits mostly occur in Bikaner, Jaisalmir and Udaipur in Rajasthan and the Runn of Kutch in Gujarat. Apart from these two principal producing states, some gypsum also occurs in Tiruchirapalli in Tamil Nadu. The total Indian reserve of gypsum is around 239 million tonnes.

Mica:

India secures the world's top position both in reserve and production of mica. In 1999, Indian mica trade alone constituted 60 per cent of the world mica consumption. In large tracts of Jharkhand, Rajasthan and Tamil Nadu, both Muscovite and Biotitic varieties of mica occur. They often coexist with gneisses and schist's of Dharwarian rocks.

Jharkhand is, so far, contributing the largest amount of mica from its innumerable mines located in the Hazaribagh, Giridih, Monghyr, Ranchi and Gaya districts. Among all the mines, Kodarma in Hazaribagh is perhaps contributing the largest amount of good quality mica. Singbhum and Palamau districts also have some mica fields.

Limestone:

Reserve of limestone is placed at 75,679 million tonnes. Limestone ores are widespread in several states. Leading production centres are located in Madhya Pradesh, Tamil Nadu, Andhra Pradesh, Gujarat and Bihar. Limestone ($CaCO_3$) is extensively used in paper, cement and fertilizer industries.

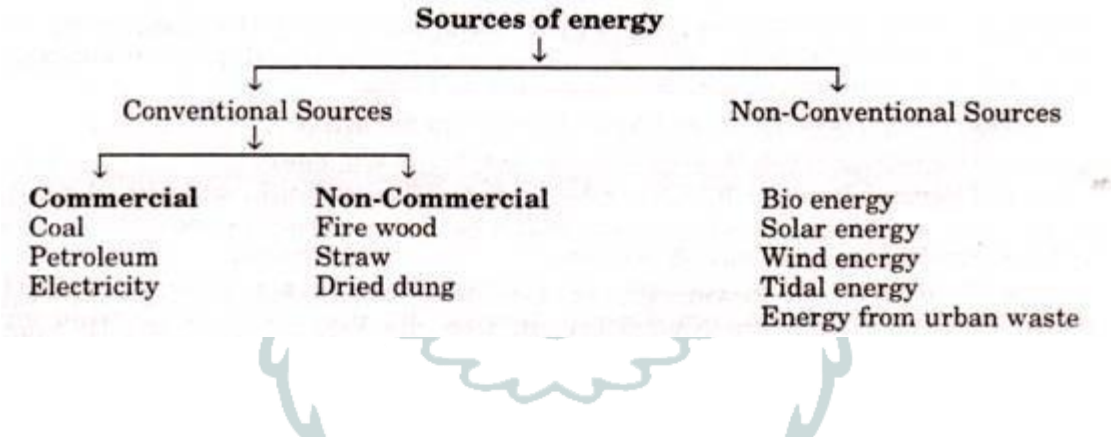
Guntur, Kurnool and Khammam districts of Andhra Pradesh, Gulbarga district of Karnataka, Raipur and Jabbalpur in Madhya Pradesh and Son Valley of Bihar are the leading limestone-producing areas.

Dolomite:

Dolomite reserve in India was identified as 4,387 million tonnes. It is mainly used in the production of iron & steel. Reserves are distributed over Orissa, Madhya Pradesh, and Gujarat etc.

Energy Resources:

Energy is required to perform various activities in every field. Heat and electricity are two different forms of energy. The most common sources of generating heat and electricity are firewood, coal, petroleum and natural gas. These sources are called conventional sources of energy.



Conventional Sources of Energy

I. The sources of energy which have been in use for a long time, e.g., coal, petroleum, natural gas and water power.

II. They are exhaust able except water.

III. They cause pollution when used, as they emit smoke and ash.

IV. They are very expensive to be maintained, stored and transmitted as they are carried over long distance through transmission grid and lines.

Non-Conventional Sources of Energy

I. The resources which are yet in the process of development over the past few years. It includes solar, wind, tidal, biogas, and biomass, geothermal.

II. They are inexhaustible.

III. They are generally pollution free.

IV. Less expensive due to local use and easy to maintain.

Conventional Sources of Energy:

Firewood: Firewood is primarily used for cooking and heating. However, it is not a very convenient and eco-friendly source of energy. Collecting firewood and cooking with it is time consuming and also burning firewood releases carbon monoxide in the air. This results in air pollution and higher levels of greenhouse gases. Firewood is also the main cause of deforestation.

Fossil Fuels:

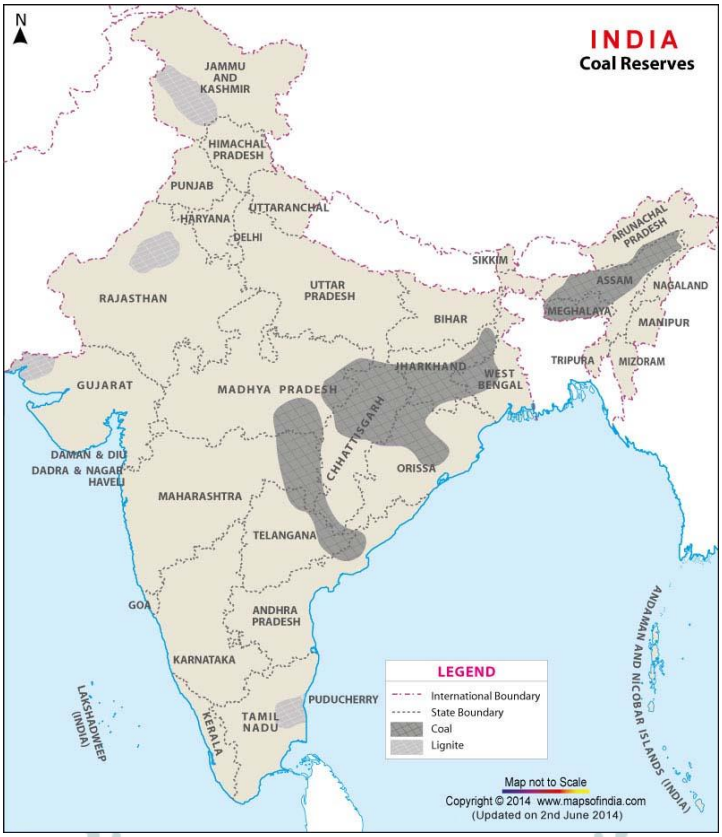
Fossils are remains of plants and animals that were buried under the earth for millions of years. Coal, petroleum and natural gas are fossil fuels as they are formed from fossils.

Coal:

Coal is a combustible black or brownish-black sedimentary rock with a high amount of carbon and hydrocarbons. Coal is classified as a nonrenewable energy source because it takes millions of years to form. Coal contains the energy stored by plants that lived hundreds of millions of years ago in swampy forests.

- The plants were covered by layers of dirt and rock over millions of years. The resulting pressure and heat turned the plants into a substance now known as coal.
- Coal is classified into four main types, or ranks: **anthracite, bituminous, lignite and peat**.
- The ranking depends on the types and amounts of carbon the coal contains and on the amount of heat energy the coal can produce. The rank of a coal deposit is determined by the amount of pressure and heat that acted on the plants over time.
- **China, US, India, Australia and Indonesia** are the top five coal producing nations of the world.
- According to the latest available estimates of the Geological Survey of India, the total recoverable coal reserves in India in 2005 was around 247.85 billion tonnes. Though most of this coal is lying below 1,000 metres, at places coal seams are situated just below the crust.

- A large amount of good quality coal has already been mined out. At present only 10,000 million tonnes of coal in India may be regarded as good quality coal.

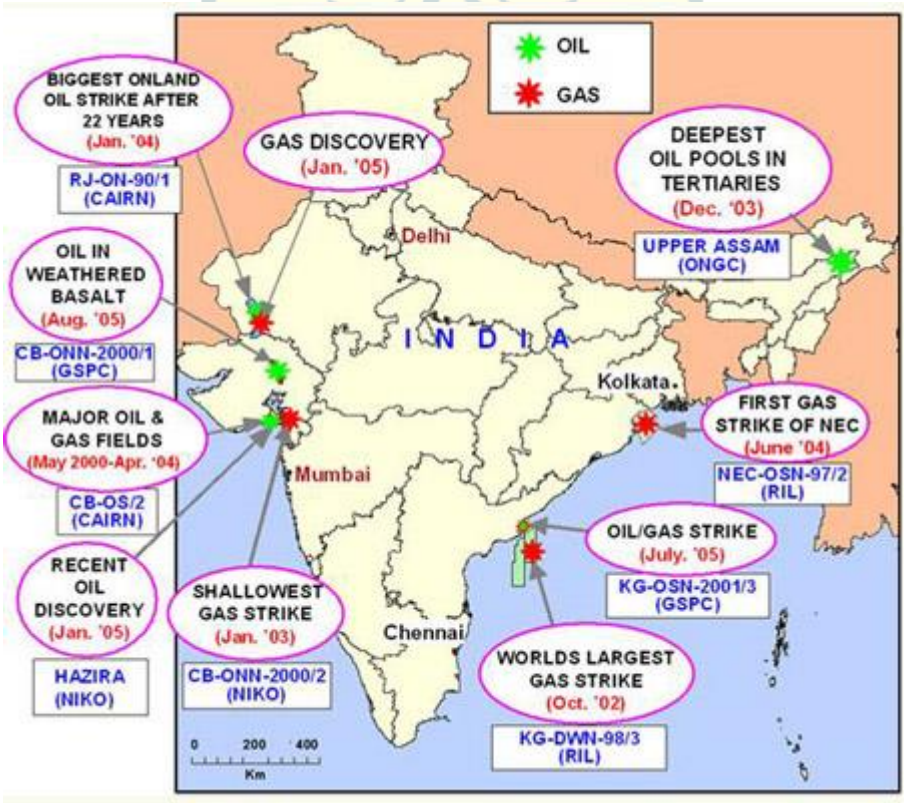


Indian coal deposits were formed in two distinctly separate geological period, Gondowana and Tertiary. Among these the Gondowana variety is high grade coal, ranging from bituminous to sub-bituminous, containing 60 to 80 per cent carbon. It was deposited between permo-carboniferous to creteceous period. The Permian series coal is regarded as the best among the Gondowana coal series.

Among different coal producing states of India**, Jharkhand** possesses largest amount of coal, followed **by Orissa, Madhya Pradesh, West Bengal, Andhra Pradesh and Maharashtra**.

Petroleum and Natural Gas:

- Petroleum is another important conventional source of energy. The word petroleum means rock oil and is found between layers of rocks in the form of a thick black liquid.
- In its raw form petroleum is called crude oil which is drilled from oil fields located in off-shore and coastal areas. The major petroleum producing countries in the world are Iran, Iraq, Saudi Arabia and Qatar.
- A major advantage of petroleum is that it can be easily transported in tankers. Natural gas is another fossil fuel that is traditionally used as a source of energy. It is found with petroleum deposits and is released when the crude oil is brought to the surface.
- Petroleum and petroleum products are mainly used as motive power. It is a compact and convenient liquid fuel which has revolutionised transportation on land, in the air and on water. It can be easily transported from the producing areas to the consuming areas with the help of tankers and more conveniently, efficiently and economically by pipelines.
- It emits very little smoke and leaves no ash, (as is the case in coal utilisation) and can be used upto the last drop. It provides the most important lubricating agents and is used as an important raw material for various petro-chemical products.



Pipeline transportation in India:

Pipelines are most convenient, efficient and economical mode of transporting liquids like petroleum, petroleum products, natural gas, water, milk, etc. Even solids can also be transported through pipelines after converting them into slurry.

Advantages of Pipeline:

Pipelines have the following advantages over other means of transport:

1. They are ideally suited to transport the liquids and gases.

2. Pipelines can be laid through difficult terrains as well as under water.

3. It involves very low energy consumption.

4. It needs very little maintenance.

5. Pipelines arc safe, accident-free and environmental friendly.

Disadvantages of Pipelines:

Following are the main disadvantages of pipeline transport:

1. It is not flexible, i.e., it can be used only for a few fixed points.

2. Its capacity cannot be increased once it is laid.

3. It is difficult to make security arrangements for pipelines.

4. Underground pipelines cannot be easily repaired and detection of leakage is also difficult.

Currently there are 6 Major Pipelines in India:

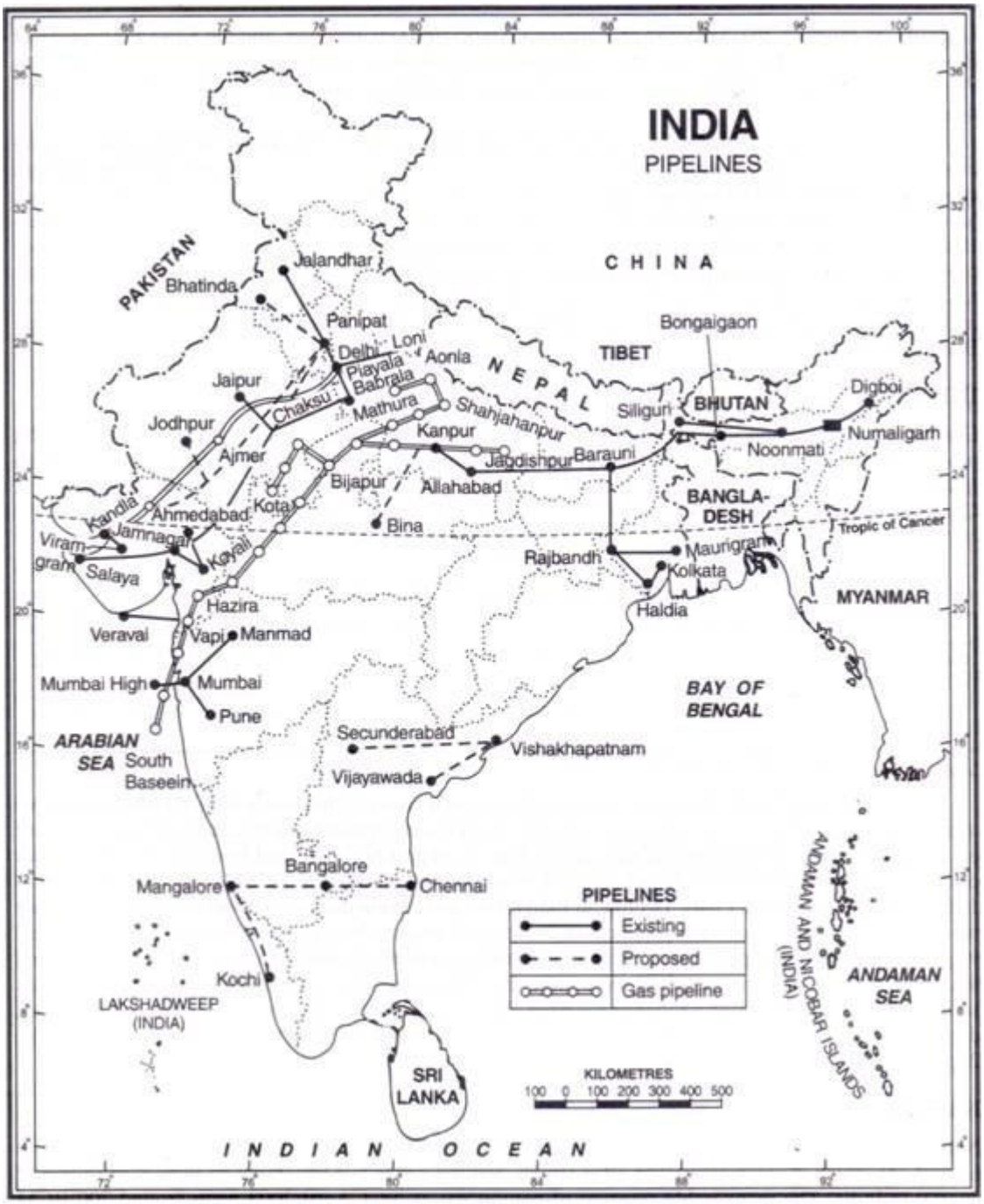


FIG. 26.7. India : Pipelines

1. Naharkatia-Nunmati-Barauni Pipeline:

This was the first pipeline constructed in India to bring crude oil from Naharkatia oilfield to Nunmati.

It was later extended to transport crude oil to refinery at Barauni in Bihar. It is 1,167 km long. It is now extended to Kanpur in U.P. The pipeline between Naharkatia and Nunmati became operative in 1962 and that between Nunmati and Barauni in 1964. Construction work on pipeline from Barauni to Kanpur and Haldia was completed in 1966. It has a number of pumping stations and subsidiary pipelines.

2. Mumbai High-Mumbai-Ankleshwar-Kayoli Pipeline:

This pipeline connects oilfields of Mumbai High and Gujarat with oil refinery at Koyali. A 210 km long double pipeline connects Mumbai with Mumbai High. It provides facilities for transporting crude oil and natural gas. Ankleshwar-Koyali pipeline was completed in 1965. It transports crude oil from Ankleshwar oilfield to Koyali refinery.

3. Salaya-Koyali-Mathura Pipeline:

An important pipeline has been laid from Salaya in Gujarat to Mathura in U.P. via Viramgram. This is 1,256 km long pipeline which supplies crude oil to refineries at Koyali and Mathura. From Mathura, it has been extended to the oil refinery at Panipat in Haryana and further to Jalandhar in Punjab. It has an offshore terminal for imported crude oil.

4. Hajira-Bijapur-Jagdishpur (HBJ) Gas Pipeline:

This pipeline has been constructed by Gas Authority of India Limited (GAIL) to transport gas. It is 1,750 km long and connects Hazira in Maharashtra to Bijapur in M.P. and Jagdishpur in U.P. It carries 18 million cubic metres of gas every day to three power houses at Kawas (Gujarat), Anta (Rajasthan) and Auraiya (U.P.) and to six fertilizer plants at Bijapur, Sawai Madhopur,. Jagdishpur, Shahjahanpur, Aonla and Babrala.

The construction of this pipeline is a unique engineering feat. The pipeline passes through 343.7 km long rocky area, 56.3 km long forest area, besides crossing 29 railway crossings and 75 big and small rivers.

This is the world's largest underground pipeline and has brought about a big transformation in the economy of Gujarat, Madhya Pradesh, Rajasthan and Uttar Pradesh. It has been extended upto Delhi so that enough gas is made available to meet the growing demand of the capital city.

5. Jamnagar-Loni LPG Pipeline:

This 1,269 km long pipeline has been constructed by Gas Authority of India Limited (GAIL) at the cost of Rs. 1,250 crore. It connects Jamnagar in Gujarat to Loni near Delhi in U.P. and passes through the states of Gujarat, Rajasthan, Haryana and U.P. This is the longest LPG pipeline of the world.

It is like transporting 3.5 lakh LPG gas cylinders across 1,269 km every day and its capacity is being increased to 5.0 lakh cylinder per day. It will result in net saving of Rs. 500 crore per year by eliminating road tanker movement and lead to reduction of about 10,000 tonnes of pollutant emission per year.

6. Kandla-Bhatinda Pipeline:

This 1,331 km long pipeline is proposed to be constructed for transporting crude oil to the proposed refinery at Bhatinda. It is to be constructed by IOC at the estimated cost of Rs. 690 crore.

Proposed Pipelines:

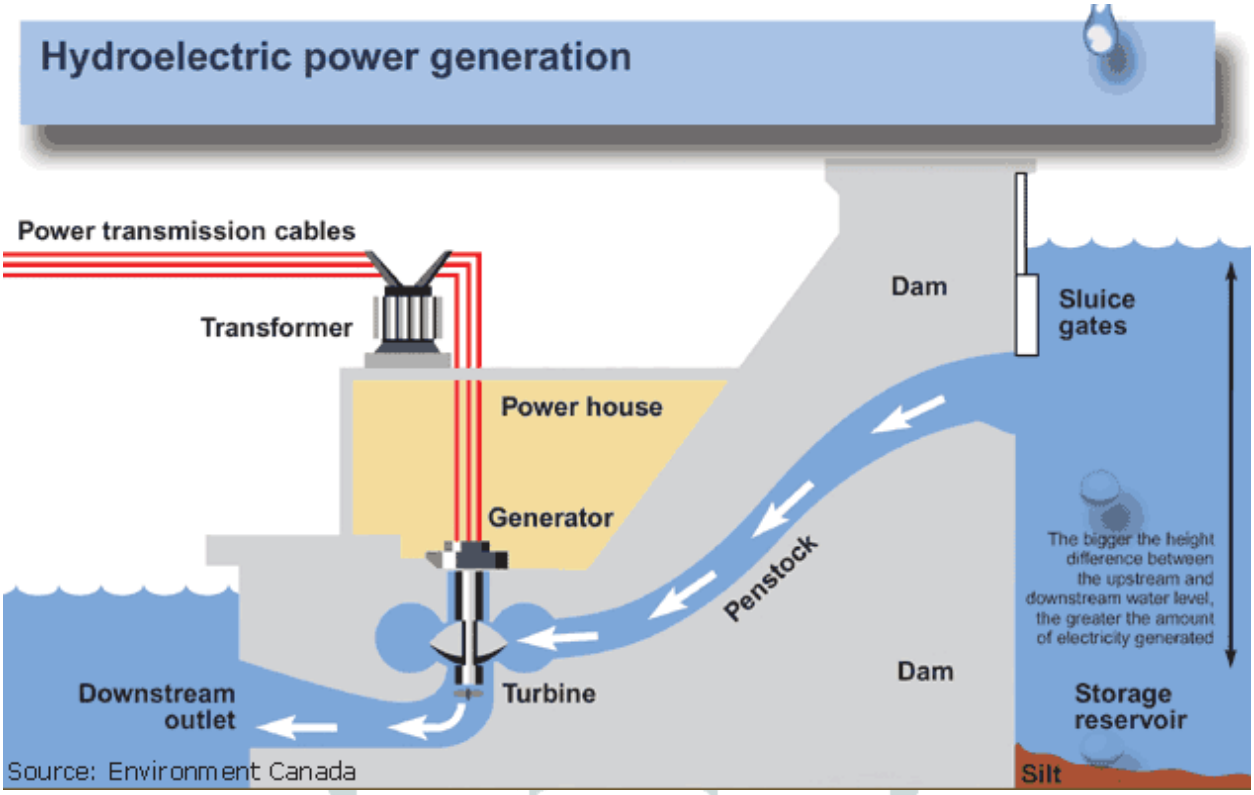
Apart from the above mentioned important pipelines, several other pipelines have also been laid in different parts of the country. Construction of some of them has already been completed while others are at different stages of completion.

Important pipelines include the Kalol-Sabarmati Crude Pipeline, the Nawgam-Kalol-Koyali Crude Pipeline, the Cambay-Dhiwaran Gas Pipeline, the Ankleshwar- Uttaran Gas Pipeline, the Ankleshwar-Vadodara Associated Gas Pipeline, and the Koyali-Ahmedabad Products Pipeline. Mumbai is an important centre for petroleum products. As such, it is joined with Pune and Manmad by pipelines. The Haldia-Kolkata pipeline caters to the needs of Kolkata and its neighbouring areas.

Hydel Power:

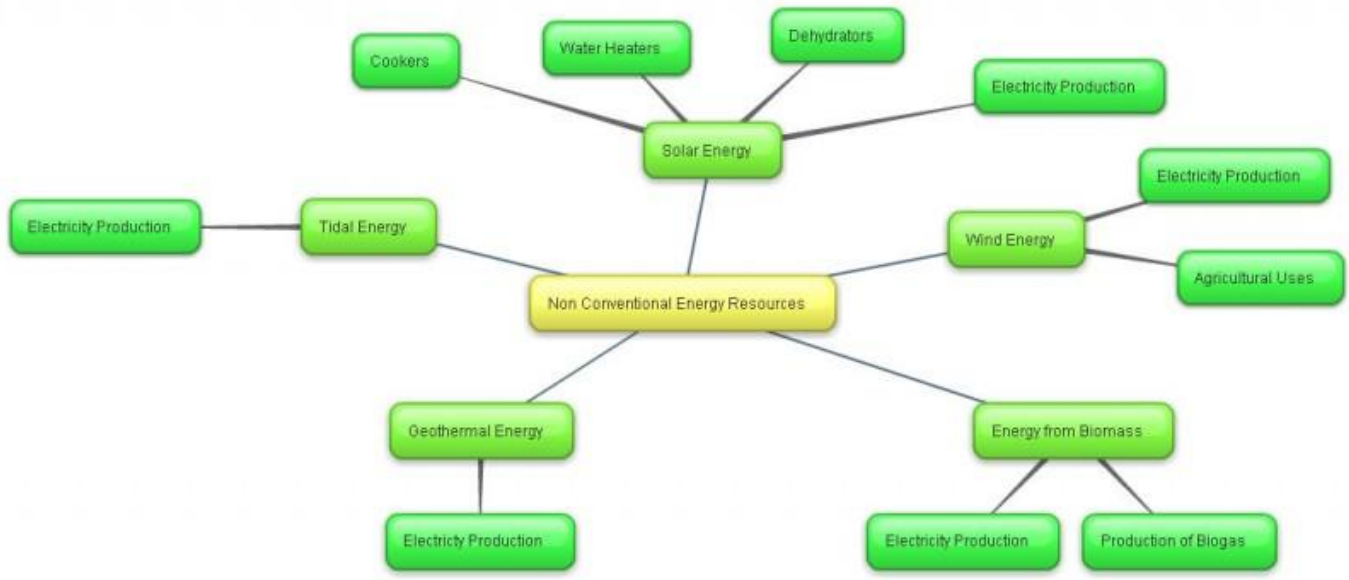
Electricity is also generated from the energy of flowing water. The energy derived from flowing water is called hydropower. The electricity generated from hydropower is called

hydroelectricity. Norway was the first country in the world to develop hydroelectricity. The leading producers of hydro power in the world are Paraguay, Norway, Brazil, and China.



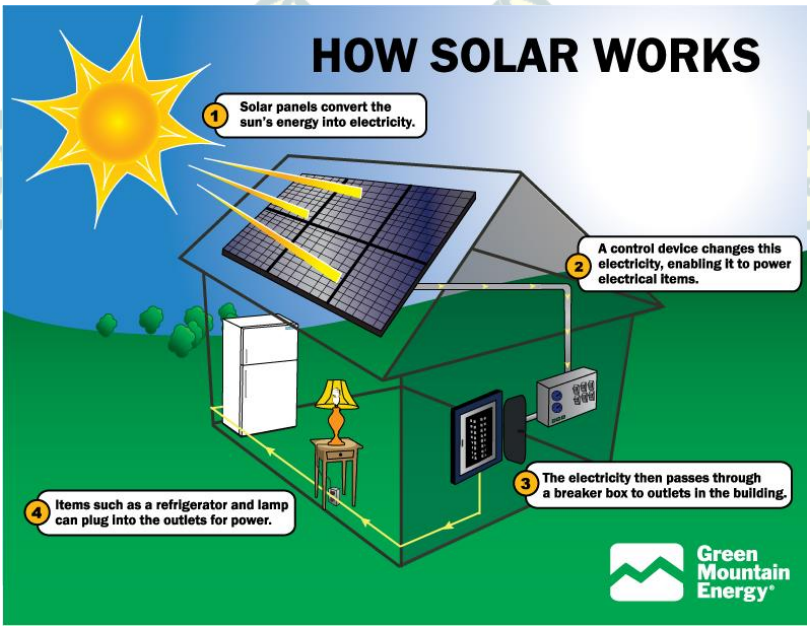
Non-conventional Energy Resources:

Non-conventional energy resources are basically those resources which can be used to harness energy in different forms rather than the conventional fossil fuels and nuclear energy. Non-conventional energy resources are ecofriendly and do not have adverse effects on the environment. They are also renewable, i.e. over the years these sources are renewed. The non-conventional energy resources include solar energy, tidal energy, wind energy, energy from biomass and geothermal energy.



Solar energy:

Solar energy is the most commonly used non-conventional source of energy. These days it is being used to produce electricity and also in various other applications for example solar cookers, solar water heaters, etc. Solar cells and solar panels are used to convert light energy to electrical energy, which in turn can be used where ever required. But due to its low efficiency and high cost, it isn't quite the popular choice of the people.



Wind Energy:

Wind energy is a form of solar energy. Wind energy (or wind power) describes the process by which wind is used to generate electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. A generator can convert mechanical power into electricity. Mechanical power can also be utilized directly for specific tasks such as pumping water.

But this is not feasible because of the high investment required for installation of a wind mill. Also the price at which per unit of electricity is produced is higher than all other sources.

Tamil Nadu is the highest producer of wind energy in India.

Tidal Energy:

Tidal energy is the energy harnessed by the tides or waves of the sea. The rise and fall in the water of the sea is called a tide. This happens due to the gravitational pull of the sun and the moon. It is estimated that India has a potential of harnessing 8000-9000 MW of tidal energy. This harnessing of tidal energy requires an engineered set up under water.

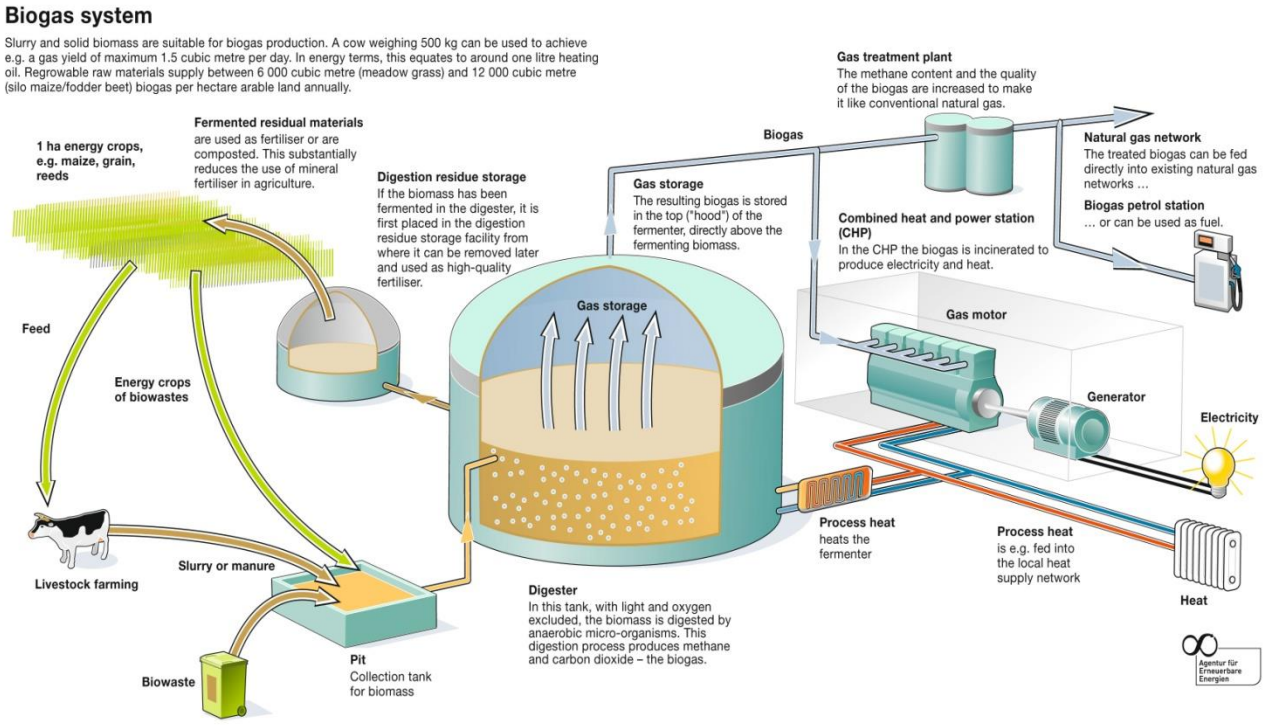
Geo-Thermal Energy:

Geo-thermal energy is the energy harnessed using the heat of the earth's interior. It is usually harnessed by hot water springs, where in the hot steam is again sent into a cylinder which is in turn connected to a turbine and thus produce electricity. As of now, this is not at feasible at many areas because the amount of energy spent on pumping of water and other mechanisms is more than that energy which can be harnessed.

Biogas:

Biogas means a gas produced by the anaerobic digestion or fermentation of organic matter. The organic matter can be manure, sewage sludge, municipal solid waste, biodegradable waste or any other biodegradable feedstock. *Biogas* is mainly methane and carbon dioxide.

Anaerobic respiration produces methane along with other gases which forms biogas. This biogas can be used for heating and cooking purposes. Biogas can also be used to produce electricity. This is gaining popularity, especially in the villages of India where the people suffer a minimum power cut of 8 hours/day.



(Note: Nuclear Energy will be covered in detail in Science and Technology Module)

India's Power Scenario

Power is one of the most critical components of infrastructure crucial for the economic growth and welfare of nations. The existence and development of adequate infrastructure is essential for sustained growth of the Indian economy.

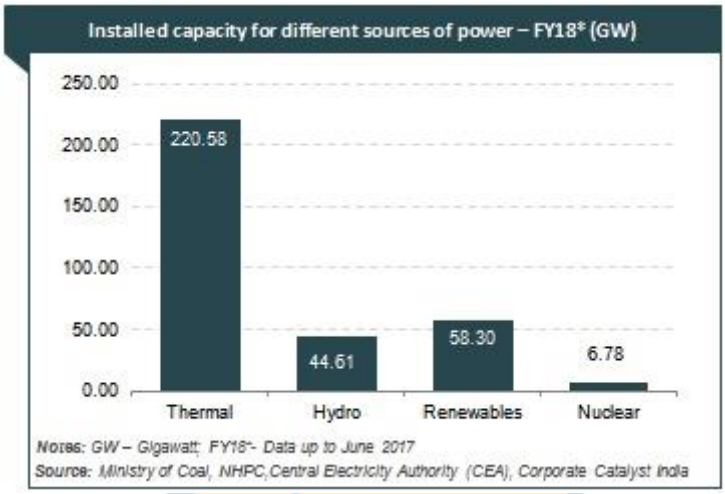
India's power sector is one of the most diversified in the world. Sources of power generation range from conventional sources such as coal, lignite, natural gas, oil, hydro and nuclear power to viable non-conventional sources such as wind, solar, and agricultural and domestic waste. Electricity demand in the country has increased rapidly and is expected to rise further in the years to come. In order to meet the increasing demand for electricity in the country, massive addition to the installed generating capacity is required.

India ranks third among 40 countries in EY's Renewable Energy Country Attractiveness Index, on back of strong focus by the government on promoting renewable energy and implementation of projects in a time bound manner.

Some important Achievement:

- For the 12th Five-Year Plan, a total of 88.5 GW of power capacity addition is targeted; of which, 72.3 GW constitutes thermal power, 10.8GW hydro power & 5.3 GW nuclear power
- In January 2017, the 2nd unit of Kundankulam Nuclear Power Project, attained a capacity of 1000Mwe & this is anticipated to strengthen the overall power generation capacity in India.
- In February 2017, a 40-killowatt solar power plant was inaugurated at Don Bosco Higher Secondary School in Johrat City, Assam.
- In May 2017, the government approved the raising of bonds worth US$351.03 million for renewable energy through the Indian Renewable Energy Development Agency (IREDA).
- As of June 2017, total thermal installed capacity in the country stood at 220.58 GW, while hydro & renewable energy installed capacity totalled to 44.61 GW & 58.3 GW, respectively.
- With electricity production of 1,160.1 BU in India in FY17, the country witnessed growth of around 4.72 per cent over the previous fiscal year.
- Over FY10–FY17, electricity production in India grew at a CAGR of 7.03 per cent.
- The 12th Five Year Plan projects that, total domestic energy production would reach 844 million tonnes of oil equivalent (MTOE) by 2021–22.

Notes: FY - Indian Financial Year (April-March), BU – Billion Unit
Source:BP Statistical Review, Ministry of Power



Government Initiatives

The Government of India has identified power sector as a key sector of focus so as to promote sustained industrial growth. Some initiatives by the Government of India to boost the Indian power sector:

- The 'Pradhan Mantri Sahaj Bijli Har Ghar Yojana', with an outlay of Rs 16,320 crore (US$ 2.51 billion), has been launched by the Government of India with the aim of providing electricity access to over 40 million families in the country by December 2018.
- The Ministry of Environment, Forest and Climate Change, Government of India has clarified that solar PV (photovoltaic) power, solar thermal power projects, and solar parks will not require the environment clearance which was mandatory under the provisions of Environment Impact Assessment (EIA) notification, 2006.
- By installing 3 million LED street lights to illuminate 50,000 kilometres of roads in India under the Street Lighting National programme (SLNP), the state-run Energy Efficiency Services Limited has achieved 390 million kWh in annual energy savings, according to the Ministry of Power, Government of India.
- The Ministry of Power, Government of India, has taken various measures to achieve its aim of providing 24X7 affordable and environment friendly 'Power for All' by 2019, which includes preparation of state specific action plans, and implementation of Green Energy Corridor for transmission of renewable energy, among other measures.
- India has become an associate member of the International Energy Agency (IEA), which makes the Paris-based body more significant, indicating India's growing prominence in playing an important role in the global energy dialogue, according to the IEA.

- The Government of India plans to auction coal blocks for commercial mining by the end of December 2017, which would end the monopoly of state-run firms in coal mining and help in achieving the country's target of producing 1 billion tonnes of coal by 2020.
- The Cabinet Committee on Economic Affairs (CCEA) has approved a new coal linkage policy, aimed at providing necessary supply of fuel to power plants through reverse auction
- The Government of India has announced plans to implement a US$ 238 million National Mission on advanced ultra-supercritical technologies for cleaner coal utilisation.
- The Cabinet Committee on Economic Affairs (CCEA) has approved the enhancement of capacity of the Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects from 20,000 megawatt (MW) to 40,000 MW, which will ensure setting up of at least 50 solar parks each with a capacity of 500 MW and above in various parts of the country.
- The Union Cabinet, Government of India has given its ex-post facto approval for signing of a Memorandum of Understanding (MoU) on Renewable Energy between India and Portugal, which will help strengthen the bilateral cooperation between the two countries.
- The Ministry of New and Renewable Energy plans to introduce a fixed-cost component to the tariff for electricity generated from renewable energy sources like solar or wind, in a bid to promote a green economy.
- The Union Cabinet has approved the ratification of International Solar Alliance's (ISA) framework agreement by India, which will provide India a platform to showcase its solar programmes, and put it in a leadership role in climate and renewable energy issues globally.

The Road Ahead

- The 2026 forecast for India's non-hydro renewable energy capacity has been increased to 155 GW from 130 GW on the back of more than expected solar installation rates and successful wind energy auctions#.
- India could become the world's first country to use LEDs for all lighting needs by 2019, thereby saving Rs 40,000 crore (US$ 6.23 billion) on an annual basis.
- India's solar power capacity addition is forecasted at 9.4 gigawatts (GW) in 2017 which is even higher than the previous estimates of 8.8GW of capacity addition&.
- The Indian power sector has an investment potential of Rs 15 trillion (US$ 225 billion) in the next 4–5 years, thereby providing immense opportunities in power generation, distribution, transmission, and equipment, according to Union Minister Mr Piyush Goyal.

- The government's immediate goal is to generate two trillion units (kilowatt hours) of energy by 2019. This means doubling the current production capacity to provide 24x7electricity for residential, industrial, commercial and agriculture use.
- The government has electrified 13,000 villages so far out of the total 18,452 villages and is targeting electrification of all villages by 2019, within the targeted 1,000 days.
- The Government of India is taking a number of steps and initiatives like 10-year tax exemption for solar energy projects, etc., in order to achieve India's ambitious renewable energy targets of adding 175 GW of renewable energy, including addition of 100 GW of solar power, by the year 2022. The government has also sought to restart the stalled hydro power projects and increase the wind energy production target to 60 GW by 2022 from the current 20 GW.