

ENERGY RESOURCES

Energy is an important input or resource for development. Energy is required in various spheres of Human development such as household, agriculture, transport, Industries etc.

Renewable and non-renewable energy resources

Renewable (inexhaustible) energy resources

These are those sources of energy which can be renewed or replenished over a short period of time for example firewood or fuel wood, petroplants, animal dung, plant Biomass, solar energy, wind energy, water energy, geothermal and dendrothermal energy.

Non-renewable (exhaustible) energy resources

These resources are limited in amount. They are replenished or renewed over a longer period of time. For example coal, mineral oil, natural gas, nuclear energy.

Another classification, categorise the energy resources into two types conventional and non conventional energy resources.

Conventional energy resources

These mainly include the non-renewable resources of energy. They are called conventional because they have been in use for a long period of time. They include Coal, Oil, natural gas, firewood, hydropower, nuclear etc.

COAL (black gold)

Most of the world's coal was formed in CARBONIFEROUS AGE (350 million years ago). India has 107,727 million tonnes of coal Reserves. All India production of coal stands at 728.72 million tonnes (2018-19).

India ranks second in world in coal production after China. Major coalfields of India Raniganj, Jharia, East Bokaro, West Bokaro, Singrauli, Talchar, Chanda-wardha and Godavari Valley. Talchar coalfields host the highest geological Reserve of coal in InIndia.

Types of coal: the main types of coal found in India are Peat, lignite, bituminous coal and anthracite.

- i) **Peat:** has less than 40 to 55% carbon.
- ii) **Lignite (brown coal):** has 40 to 55% carbon.
- iii) **Bituminous coal:** it contains 40 to 80 % carbon.
Most of the coal found in India belong to this category.
- iv) **Anthracite coal:** it the best type of coal as it contains 80 to 95 % carbon.

OIL AND NATURAL GAS

Petroleum and natural gas are one of the most important sources of energy which have great demands for the purpose of economic development. It provides lubricants and raw materials for a number of chemical industries such as kerosene, diesel, petrol, aviation fuel, synthetic rubber, detergents, dyes, pigments, explosives etc.

Petroleum and natural gas basins in India are as follows:

The upper Assam basin

The Western Bengal basin

The Western Himalaya basin

The Rajasthan Saurashtra- Kachchh basin

The Northern Gujarat basin

Natural gas contains Methane (50-90% by volume). It also contains smaller amounts of eth-

ane, propane and butane and a little amount of H₂S.

Natural gas production in India is 32.8 87 billion cubic metre in the year 2018-19. Offshore production was 22.11 BCM and onshore production was 10.75 BCM. Assam is the the highest gas producing state. Almost 70% of India's natural gas reserves are found in Bombay High basin and in Gujarat.

Note: Onshore oil fields are those oil fields which are present deep under the surface of earth and are also called on land oil fields. Offshore oil fields are those oil fields which are underneath the sea bed i.e. on water.

Mumbai High field earlier called Bombay High fields is an Offshore oil field, 176 kilometre off the West Coast of Mumbai. Its operations are run by ONGC (Oil and natural gas commission).

THERMAL POWER

Thermal power station is a power station in which heat energy is converted to Electricity. Water is heated into steam, which is used to drive an electrical generator. As

of July 2020, India has a total thermal installed capacity of 231.45 GW. Almost 86% of the thermal power is obtained from coal and the rest from lignite, diesel and gas.

Private sector	46.9%
States	27.9%
Centre	25.3%

FIREWOOD (FUEL WOOD)

In rural India, over 77% of households in the country continued to depend on firewood and chips for cooking, with only 9% using LPG. In urban India 62% of households used LPG (liquefied Petroleum gas) as a major fuel for cooking and 20% households used firewood and chips (NSSO 2007-08).

PNG(piped natural gas) can be used for cooking, water heating, space heating, air conditioning, refrigeration and power generation (According to GAIL).

Briquette: it is a compressed block of coal dust or other combustible Biomass material such as charcoal, sawdust wood chips, peat or paper used for fuel. It is a smokeless fuel alternative developed by IIT New Delhi.

HYDROPOWER

Water energy is most conventional renewable source of energy. This energy is obtained from water flow or water falling from a height. Hilly and Highland areas are suitable for this purpose, where there is continuous flow of water in large amount from high slopes.

Examples: Bhakhra Nangal project on Sutlej, Bokaro panchet, Tilaiya on DamodarValley, Tehri dam project on Bhagirathi River, Sardar Sarovar Dam(Gujarat) Narmada Valley project. In the year 2019-20 total hydroelectric power generation in India was 156 Twh (tera watt hour).

NUCLEAR ENERGY

Nuclear power stations use Nuclear Fission to generate energy from the reaction of Uranium 235 (an isotope of Uranium). The atoms of Uranium rods are split in the process releasing a large amount of energy. The process continues as chain reaction with other nuclei. The released heat boils water to create steam, which spins a turbine generator, producing electricity. As of November 2020 India has 22 nuclear reactors in operation in 7 nuclear power plants with a total installed capacity of 6780 MW. It supplies 3.22 % of Indian Electricity.

Examples Tarapur (Maharashtra), Kota (Rajasthan), Kalpakkam (Tamilnadu), kakrapar (Gujarat), Karwar (Karnataka), Narora (U.P.).

Non-conventional energy resources (Alternative sources of energy)

Due to day by day increasing demands and depleting supplies of conventional energy resources (mainly fossil fuels) some new sources of energy have been identified. These are called the non-conventional energy resources. Governments around the world are focusing their efforts on shifting to non-conventional energy resources. These resources include solar energy, wind energy, ocean (tidal) energy, wave energy, geothermal and Biomass energy etc. These resources are renewable, inexpensive and pollution free.

SOLAR ENERGY

It is renewable, causes no pollution, has no fuel costs and no waste byproducts. India's solar installed capacity was 36.9 GW as of November 2020. A target of 100 GW by 2022 has been set.

Both central and state offer subsidy schemes to people for installing solar rooftop systems. The central government pays 30% subsidy for the systems. The photovoltaic conversion system converts solar radiations directly into electricity through Silicon solar cells. Solar thermal devices like solar cookers, solar water heaters, solar air heaters, Solar dryers, Solar wood seasoning kilns and silicon systems have been developed.

WIND ENERGY

It is renewable, no waste by products and causes no pollution. But wind energy is quite unpredictable. When wind speed is low, less energy is generated. Wind power harnesses the energy of the Wind to propel the Blades of the wind turbines. These turbines cause the rotation of magnets which create electricity. Wind Towers are usually built together on wind farms. Wind power generation capacity in India has significantly increased in recent years. As of 2021 February the total installed wind power capacity was 38.7 89 GW, the fourth largest installed wind power capacity in the world. Tamil Nadu tops the list of states with the largest installed wind power generation capacity in the country.

OCEAN OR TIDAL ENERGY

Tidal power or tidal energy is a form of hydropower that converts the energy of Tides into electricity. A water turbine is placed in a tidal current which turns an electric generator or gas compressor that stores the energy until needed.

India is surrounded by sea on three sides. So, its potential to harness tidal energy is huge. India's identified tidal power potential is 10000 megawatts.

Most potent sites are Gulf of Cambay and Gulf of Kutch.

WAVE ENERGY (WATER)

wave power system convert the motion of the Waves into usable mechanical energy, which in turn can be used to generate electricity. These systems can be floating or fixed to the seabed Offshore. It is estimated that the annual wave energy potential along the Indian coast is about 60,000 megawatt approximately.

GEOHERMAL ENERGY

It utilizes the heat in the interior of the earth for power generation. This is possible in volcanic regions or where hot water springs and geysers occur.

BIOENERGY (BIOMASS)

Biomass is all plant material or vegetation, raw or processed, Wild or cultivated. It is essentially stored solar energy that can be converted to electricity and heat. Biomass energy comes from three sources.

1. Agricultural crop residues
2. Municipal and industrial waste
3. Energy plantations

1. Agricultural crop residues: A large quantity of Crop Residue Biomass is generated in India. Amongst all the crops, sugarcane produces the highest amount of surplus residue followed by rice. The estimated annual bioenergy potential from the surplus crop Residue Biomass is 4.15 EJ equivalent to 17% of India's total primary energy consumption.

Farmers Resort to stubble burning as a cheap alternative for crop Residue management. This leads to severe environmental damage.

Cellulose, hemicellulose and Lignin are three main components of biomass. In pyrolysis cellulose and hemicellulose is decomposed in a short interval of of time with temperature ranging between 573 K to 673 k. Because of homogeneous structure it is used for production of bio-oil. While Lignin does not decompose uniformly constantly upto 973 K and it produces charcoal.

Bio-oil: bio oil is a kind of liquid fuel produced from Biomass material such as agricultural crop Residues, algal Biomass etc. Via a thermochemical process. Being clean, in expensive and green,.it is considered as a good alternative for conventional fuel and could help in reducing environmental pollution. It is carbon neutral, easy to use and transport.

Pyrolysis: it is the heating of an organic material such as Biomass in the absence of oxygen. Because no oxygen is present the

material does not combust but the chemical compounds (cellulose hemicellulose and Lignin) that makes up that material, thermally decompose into combustible gases and charcoal.

2. Municipal and industrial waste Municipal solid waste is non liquid waste that comes from homes, Institutions and small businesses. Industrial waste is waste that comes from the production of consumer goods, mining, agriculture and petroleum extraction and refining.

Processing of municipal solid waste the biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of waste. Mixed waste containing recoverable resources shall follow the route of recycling.

Method of Industrial waste management

(i) **Segregation and recycling** much of the waste that is generated by company's production shipping and packaging needs is not reusable and compostable but it is recyclable.

(ii) **Landfills** are one of the most common ways to dispose waste in America. It is the oldest and the most common method of waste disposal. Here waste materials are dumped or buried in an area of land.

(iii) **Composting** it is an aerobic method of decomposition of organic solid waste. In this process the organic waste decomposes to produce a humus like substance called compost which is good for plant growth.

3. **Energy plantation** energy plantations means growing select species of trees and shrubs which are harvestable in a comparatively shorter time and are specifically meant for fuel. The fuel wood may be used directly in wood burning stoves and boilers or processed into methanol, ethanol and producer gas (a low-grade well fuel gas consisting largely of Nitrogen and carbon monoxide)

Biogas (gobar gas)

Biological gasification is an anaerobic digestion of the Biomass by a mixed microbial population

which generates Methane and CO₂ as its major end products.

It contains:

Methane:	55 to 70%
CO ₂ :	30 to 45%
H ₂ S:	1 to 2%
Nitrogen:	0 to 1%
Hydrogen:	0 to 1%
CO :	in traces
Oxygen:	in traces

Biodiesel it is oil derived from vegetable sources and used as a substitute for Diesel. It consists of long chain alkyl esters. Biodiesel is typically made by chemically reacting lipids with alcohol producing fatty acid esters.

Plants for biodiesel production:

Euphorbiaceae -*Jatropha curcas*
Leguminosae-*Pongamia pinnata*.

✿✿ THANKS ✿✿

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