

Chapter 8 Energy Resources

- Energy is defined as *the capacity to do work*.
- Mechanical energy: It is the energy possessed by a body by virtue of its position or configuration (potential energy).
- Kinetic energy: It is the energy possessed by a body by virtue of its motion.
- Total mechanical energy = Potential energy and kinetic energy
- Other forms of energy
 - Heat, light, electrical, sound, chemical, plasma etc.

What does the principle of conservation of energy state?

- Energy can neither be created nor destroyed. It only changes from one form to another.

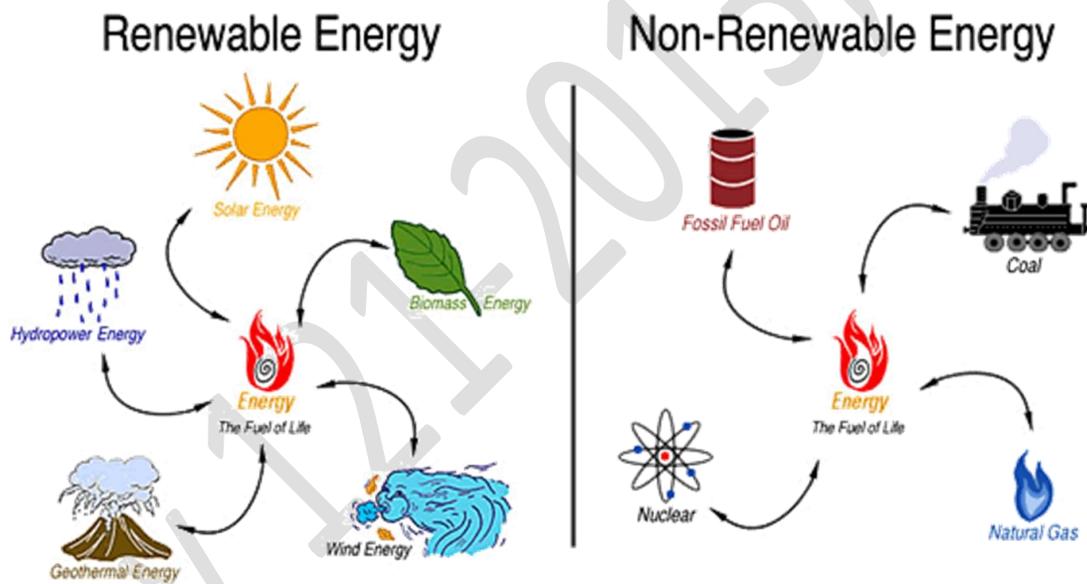
What are the major **types** of natural resources?

1. Renewable energy resources

Mostly biological in nature (agriculture, animal forestry), solar, wind, water etc.

2. Non-renewable energy resources

These are physical resources like fossil fuels (coal, petroleum, natural gas).



Energy **sources** can be of two types.

1. Conventional energy sources

They are in use for a longer period of time since 1700.

2. Non-conventional energy sources

They are alternative sources of energy which are both renewable and pollution free.

What are the different conventional sources of energy?

1. Biomass or dried fuel

- Wood leaves, cow dung, dried twigs
- Consumed for domestic purpose in rural areas, Less useful to industry

2. Fossil fuels

- Coal, Oil, Natural gas

Continent/Country	World's % (Coal)	Oil	Natural gas
CIS	23.4	7.8	56.0
Europe	15.2	2.3	5.5
North America	24.2	4.6	6.5
Latin America	1.0	18.5	7.6
Asia (except China)	7.2	2.8	9.5
China	11.1	3.3	
Africa	6.0	9.8	9.4

Middle East (%)	
Oil	89.2
Natural gas	45.2

Conventional sources of energy

Coal

- Present through out the world
- $2,730 \times 10^6$ Ton extracted per year
- Estimated mining 300-850 years

Natural gas

- CH₄ is major constituent
- Lower sulphur content
- Least polluting of all energy sources

Oil

- Has high energy content; major constituents Petrol, kerosene, diesel, naphtha

Nuclear energy

- Developed after World war II.
- It is a viable source of energy; It is a substitute for fossil fuel

Hydroelectric energy

- Obtained from water flow; most conventional renewable source of energy
- Mechanical energy of down flowing water is harnessed to generate electricity

What are the conditions that favour generation of hydroelectricity?

1. Uneven topography which leads to development of powerful water currents
2. Perennial rivers and temperatures above the freezing point
3. Presence of forest regulates rainfall and prevent soil erosion
4. Availability of knowhow in technology and funds to meet capital requirement

Non- Conventional sources of energy

Non-conventional energy source

- *The less polluting, environmentally clean sources of energy, which are socially relevant and can be used as alternatives to conventional source.*

What are the non conventional energy sources?

Solar energy, wind energy, tidal energy, geothermal energy, biomass energy

How can the Sun be the solution to the world's energy problem?

Solar energy

- Sun provides continuous supply of energy that exceeds demand
- The solar radiation comprise of X-ray, gamma ray and UV rays

- Earth receives only a small portion of Sun's radiation
- The average value of solar radiation incident on Earth is 1.2 KW/m^2
- About 0.3 KW/m^2 is reflected back by Earth
- Around 0.9 KW/m^2 is being utilized for photosynthesis and evaporation
- The remaining enormous amount of energy is available to life on Earth
- Amount of energy received from Sun each day is 600 times greater than the amount of energy produced each day by all the other sources taken together

How can solar energy be utilised as an alternative to the conventional energy resources?

1. In a passive heating system, the solar energy is converted directly to heat for use at the site of collection
2. In an active heating system, the solar energy is converted into heat, but the heat energy must be transferred from the region of collection to the place of use
3. The solar energy may also be used to generate electricity which may be transmitted along normal wires or used to operate solar batteries

Photovoltaic system

- Electromagnetic radiation produces electric signal
- In photovoltaic effect an EMF is produced between two layers of different material as a result of irradiation
- Electricity produced can be used for lighting
- This energy is free of chemical and noise pollution
- First solar desalination plant installed in Haryana

Wind Energy

How can wind be used to generate electricity?

- When wind has higher speed (5-10 m/s) it can be converted to electrical energy by attaching a wind-electric generator to the axle of the wind mill
- In California, USA 300 MW electricity is produced
- In India, Gujarat, Western Ghats have high wind density of $10 \text{ KW/m}^2/\text{day}$
- Mandvi (3.3 mW), Kutch (1.1 mW), Tuticorin (550 kW), Puri (550 kW)

Tidal Energy

How does tidal energy offer an alternative to the conventional sources of energy?

- The gravitational pull of the Sun and the Moon, along with the west to east rotation of the Earth causes tide. The greater the difference between high and low tides, the more is the energy that can be harvested.

What is OETC (ocean thermal energy conversion)?

- It is the temperature difference existing between warm surface of sea water ($29\text{-}30 \text{ }^\circ\text{C}$) and the cold deep sea water ($5\text{-}7 \text{ }^\circ\text{C}$) which is available at a depth of 800-1000 m in tropical waters.

Wind wave Energy

- The incessant motion of the sea surface in the form of wind waves provides a source of energy this is more efficient than direct collection of energy from wind.
- A multi purpose wave regulator system in the form of long barrier constructed on Indian coast line helps in harnessing this energy.

- It also helps in agriculture, space for transportation of lighter and faster crafts and shore protection from sea erosion.

Geothermal Energy

How can hot materials within Earth's crust be used to provide power to electrical generators? The Earth's core is very hot. When the hot material is close enough to the surface, they heat the ground water and form steam. Geysers and hot springs are the natural openings through which steam and hot water come up to the surface. In the areas where the steam is trapped underground, geothermal energy can be tapped by drilling wells to obtain steam. This steam can be used to provide power to electrical generators.

Biomass Energy

What is biomass?

- Biomass is accumulation of organic materials produced by living things
- New plant growth, residues and wastes, herbaceous plants, fresh water algae, aquatic plants, agricultural and forest residues and wastes.

Biogas Energy

How can biogas be a solution to the energy crisis in rural areas?

- About $22,425 \times 10^6$ m³ of biogas can be produced from animal dung.
- The slurry can produce 206×10^6 ton of organic manure. This can replace 1.4×10^6 ton N, 1.3×10^6 ton P₂O₅, 0.9×10^6 ton K₂O. Around $15-26 \times 10^6$ household can get biogas.

Energy plantation

- Some plants latex serve as a source of liquid HC. Denuded wasteland can grow shrubs and trees of high calorific value. They provide fuel wood, charcoal, fodder, power. Plants belonging to *Euphorbiaceae*, *Apocynaceae*, *Asclepiadaceae*, *Utricaceae* are energy plants.

Bagasse

What is bagasse?

Bagasse a waste of sugar mills, is a good source for energy generation. They produce 2,000 MW of surplus electricity. 40 % of that is being used by sugar mills for power and the remaining used for irrigation etc.

Hydel Energy

Why is hydel energy considered to be the cheapest source of eco-friendly energy generation in India?

Also known as hydraulic power, hydropower is the energy or force of moving water. The movement of water as it flows downstream creates kinetic energy that can be converted into electricity. It is also used for irrigation and operation of varied machines including textile machines, water mills and sawmills.