LECTURE 1:

Energy is the capacity for doing work.

Potential energy is energy deriving from position. E.g.: Water in an elevated reservoir has gravitational PE.

A lump of coal or petrol together with oxygen needed for their combustion have

chemical energy.

Moving bodies possess kinetic energy (KE).

Other forms of energy are electrical and nuclear, light and sound.

Energy can be converted from one form to another, but the total quantity stays the same according to the law of conservation of energy.

For e.g. As an apple falls, it loses gravitational PE but gains KE.

Although energy is never lost, after a number of conversions, it tends to finish up as the

KE of random motion of molecules (of the air for e.g.) at relatively low temperatures. This

is degraded energy that is difficult to convert to other forms.

Energy Sources :

The energy sources are classified as

1) Primary energy sources
2) Secondary energy fuels and
3) Supplementary sources

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1) **Primary Energy Sources**

Primary Energy Sources provide a net supply of energy. For e.g. Coal, Oil, Uranium etc. Their energy yield is defined as the energy fed by the material to the energy received from the environment, is very high. It is very important to use these fuels sparingly because of its limited availability. Primary Fuels contribute a large amount of energy.

2) **Secondary Fuels**

Secondary Fuels do not produce net energy. Intensive Agriculture is an example in which energy yield is less than the input.

3) **Supplementary Sources:**

Supplementary sources are those whose net energy yield is zero, requiring highest investment in terms of energy. Thermal insulation is an example for supplementary source.

Coal, natural gas, oil and nuclear energy using breeder reactor are net energy yielders and are primary sources of energy.

Secondary Sources are Solar Energy, Wind Energy, and Water Energy

Solar Energy can be used through Plants, Solar Cells, and Solar Heaters.

Solar Tower, Solar Drying and Solar Heating are other examples.

Wind, Tide, Wave, and Hydroelectric applications are better sources.

Other sources which may be useful in future are Geothermal, Ocean thermal, Solar Wind etc.

Energy resources are stores of convertible energy.

Non renewable resource$_{235}$ s include the fossil fuels (coal, oil, and gas) and Nuclear-fission fuels-
for example U^{235}.

Renewable sources such as wind, tidal, and geothermal power have so far been less exploited.

Hydroelectric projects are well established and wine turbines and tidal systems are being developed.

Alternate Energy :-

Alternate Energy is the energy from sources that are renewable and ecologically safe, as opposed to sources that are non-renewable with toxic by-products such as coal, oil or gas (fossil fuels) and Uranium(for nuclear power).

The most important alternate energy source is flowing water, harnessed as hydroelectric power. Other sources include the Ocean's tides and waves, wind power (harnessed by wind mills and wind turbines) the Sun (Solar energy) and the heat trapped in the Earth's Crust (geothermal energy).

Renewable Resource:-

Renewable Resource is the natural resource that is replaced by natural process in a reasonable amount of time. Soil, Water, Forests, Plants and Animals are all renewable resources s long as they are properly conserved. Solar, Wind Wave and geothermal energies are based on renewable resources and have so far been less exploited.

Non-Renewable Resource:-

Non-Renewable Resource is the natural resource such as coal or oil, that takes thousands of millions of years to form naturally and can therefore not be replaced once it is consumed. The main energy sources used by human beings are non-renewable resources.

Non renewable resources have a high carbon content because their origin has in the photosynthetic activity of plants millions of years ago. The fuels release this carbon back into the atmosphere as CO_2 . The rate at which such fuels are being burnt is thus resulting in rise in the concentration of CO_2 in the atmosphere.

Energy Resources :

There are different forms of energy. Fuels such as coal, oil (Petroleum), and wood contain Chemical energy. When these fuels are burnt, the Chemical energy changes to heat and light energy.

Electricity is the most important form of energy in the industrialized world, because it can be transported over long distances through cables and transmission lines. It is also a very convenient form of energy, since it can power a wide variety of household appliances and industrial machinery. It is produced by converting chemical energy from coal, oil or natural gas in power stations.

Energy resources fall into two broad groups ;

Renewable and Non-Renewable

Renewable resources : are those which replenish themselves naturally and will either always be available (hydro-electric power, Solar energy, Wind energy, Wave power, tidal -energy, and geothermal energy) or will continue to be available

provided supplies are given sufficient time to replenish themselves (peat and firewood).

Non-Renewable resources : are those which are in limited supplies and which once used are gone forever. These include coal, oil, natural gas and U.

Fossil fuels: Coal, oil and natural gas are called Fossil fuels because they are the fossilized remains of plants and animals that lived hundreds of millions years ago.

Burning fossil fuels releases chemicals that cause acid rain, and is gradually increasing the CO_2 in the atmosphere, causing global warnings.

Fossil fuels resources are not evenly distributed around the world.

Over half the world's known oil reserves are in the Middle East; about 40% of the reserves of natural gas are in the common wealth of Independent States (CIS) , 25% in the Middle East. About 2/3 of the worlds' coal is shared between North America, the CIS and China.

Uranium :

U is a radioactive metallic element and a very concentrated source of energy: large reserves are found in Australia, North America and South Africa. U is used to produce electricity in a nuclear power station. A single ton of U can produce as much energy as 15,000 tons of coal, or 10,000 tons of oil.

U is used in the type of nuclear power station now in operation, the worlds' known U supplies have about the same energy content as the known oil reserves.

However, these power stations known as fast or breeder reactors, release virtually all of its energy. These reactors would increase the worlds' U energy reserves by 60 times.

However although nuclear power stations do not produce CO_2 or cause acid rain, they do produce radioactive waste that is dangerous and difficult to process or store safely.

Solar Energy :

Many renewable resources take advantage of the energy in sunlight. The Sun's energy can be tapped directly by photo voltaic cells that convert light into

electricity. Other Solar energy plants use mirrors to direct sunlight onto pipes containing a liquid. The liquid boils and is used to drive an electricity generator.

The Solar energy also drives the wind and waves, so energy produced by wind farms and Wave-driven generators is also derived from the Sun.

Gravitational Energy :

Hydroelectricity and tidal power stations make use of gravitational forces. The Earth's gravity pulls water downward through the turbines in a hydroelectric power station.

In a tidal power station, the Moon's gravity lifts the water as the tides rise, giving the Water potential energy (energy due to position) which is released as the water flows through the turbine.