

## **LECTURE-1      Classification of Energy sources**

About 70% of India's energy generation capacity is from fossil fuels, with coal accounting for 40% of India's total energy consumption followed by crude oil and natural gas at 24% and 6% respectively. India is largely dependent on fossil fuel imports to meet its energy demands — by 2030, India's dependence on energy imports is expected to exceed 53% of the country's total energy consumption. In 2009-10, the country imported 159.26 million tonnes of crude oil which amount to 80% of its domestic crude oil consumption and 31% of the country's total imports are oil imports. The growth of electricity generation in India has been hindered by domestic coal shortages and as a consequence, India's coal imports for electricity generation increased by 18% in 2010.

Due to rapid economic expansion, India has one of the world's fastest growing energy markets and is expected to be the second-largest contributor to the increase in global energy demand by 2035, accounting for 18% of the rise in global energy consumption. Given India's growing energy demands and limited domestic fossil fuel reserves, the country has ambitious plans to expand its renewable and nuclear power industries. India has the world's fifth largest wind power market and plans to add about 20GW of solar power capacity by 2022. India also envisages to increase the contribution of nuclear power to overall electricity generation capacity from 4.2% to 9% within 25 years. The country has five nuclear reactors under construction (third highest in the world) and plans to construct 18 additional nuclear reactors (second highest in the world) by 2025.

### **Types of Energy**

Basically energy can be classified into two types:

Potential Energy

Kinetic Energy

### **Potential Energy**

Potential energy is stored energy and the energy of position (gravitational). It exists in various forms.

### **Kinetic Energy**

Kinetic energy is energy in motion- the motion of waves, electrons, atoms, molecules and substances. It exists in various forms.

## **Various Forms of Energy**

### **Chemical Energy**

Chemical energy is the energy stored in the bonds of atoms and molecules. Biomass, petroleum, natural gas, propane and coal are examples of stored chemical energy.

### **Nuclear Energy**

Nuclear energy is the energy stored in the nucleus of an atom - the energy that holds the nucleus together. The nucleus of a uranium atom is an example of nuclear energy.

### **Stored Mechanical Energy**

Stored mechanical energy is energy stored in objects by the application of a force. Compressed springs and stretched rubber bands are examples of stored mechanical energy.

### **Gravitational Energy**

Gravitational energy is the energy of place or position. Water in a reservoir behind a hydropower dam is an example of gravitational energy. When the water is released to spin turbines, it becomes rotational energy.

### **Radiant Energy**

Radiant energy is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Solar energy is an example of radiant energy.

### **Thermal Energy**

Thermal energy (or heat) is the internal energy in substances- the vibration and movement of atoms and molecules within substances. Geothermal energy is an example of thermal energy.

### **Electrical Energy**

Electrical energy is the movement of electrons. Lightning and electricity are examples of electrical energy.

### **Motion**

The movement of objects or substances from one place to another is motion. Wind and hydropower are examples of motion.

## **Sound**

Sound is the movement of energy through substances in longitudinal (compression/rarefaction) waves.

## **Light Energy**

Light energy is a type of wave motion. That is, light is a form of energy caused by light waves. It enables us to see, as objects are only visible when they reflect light into our eyes

## **Nuclear Energy**

Nuclear energy is a controversial energy source. It is not a renewable energy source, but because it is a technology not based on fossil fuels many people think nuclear power plants could play an important role in reducing carbon emissions and battling climate change. However, many others feel the risk of accidents and the issues of storing nuclear waste for thousands of years are too significant to warrant the development of this energy source.

## **Classification of energy resources**

The various sources of energy can be conveniently grouped as

**Commercial primary energy resources:** Non-renewable sources of energy or conventional sources of energy are being accumulated in nature for a very long time and can't be replaced if exhausted. Nature gifted resources which are consumed can't be replaced. Eg: coal, petroleum, natural gas, thermal power, hydro power and nuclear power are the main conventional sources of energy.

**Renewable sources of energy:** Energy sources, which are continuously and freely produced in the nature and are not exhaustible are known as the renewable sources of energy. Eg: solar energy, biomass and wood energy, geo thermal energy, wind energy, tidal energy and ocean energy. But main attention has to be directed to the following sources of renewable namely, a) solar photovoltaic, b) wind, and c) hydrogen fuel cell.

**New sources of energy:** The new sources of energy are available for local exploitation. In many cases, autonomous and small power plants can be built to avoid transmission losses. Most prominent new sources of energy are tidal energy, ocean waves, OTEC, peat, tar sand, oil shales, coal tar, geo thermal energy, draught animals, agricultural residues etc., The total energy production in India is  $14559 \times 10^{15}$  joules. 93% of India's requirement of commercial energy is being met by fossil fuels, with coal contributing 56%, and oil and natural gas contributing 37%. Waterpower and nuclear power contributing only 7% of total energy production. Comparing the total energy

production in India from commercial sources with that of world, it is only 3.5% of total world production.

<b>Energy resource</b>	<b>Advantages</b>	<b>Disadvantages</b>
<b>Fossil fuels</b>	<p>Provide a large amount of thermal energy per unit of mass</p> <p>Easy to get and easy to transport</p> <p>Can be used to generate electrical energy and make products, such as plastic</p>	<p>Nonrenewable</p> <p>Burning produces smog</p> <p>Burning coal releases substances that can cause acid precipitation</p> <p>Risk of oil spills</p>
<b>Nuclear</b>	<p>Very concentrated form of energy</p> <p>Power plants do not produce smog</p>	<p>Produces radioactive waste</p> <p>Radioactive elements are nonrenewable</p>
<b>Solar</b>	<p>Almost limitless source of energy</p> <p>Does not produce air pollution</p>	<p>Expensive to use for large-scale energy production</p> <p>Only practical in sunny areas</p>
<b>Water</b>	<p>Renewable</p> <p>Does not produce air pollution</p>	<p>Dams disrupt a river's ecosystem available only in areas that have rivers</p>
<b>Wind</b>	<p>Renewable</p> <p>Relatively inexpensive to generate</p> <p>Does not produce air pollution</p>	<p>Only practical in windy areas</p>
<b>Geothermal</b>	<p>Almost limitless source of energy</p> <p>Power plant require little land</p>	<p>Only practical areas near hot spots</p> <p>Waste water can damage soil</p>
<b>Biomass</b>	<p>Renewable</p>	<p>Requires large area of farmland</p> <p>Produces smoke</p>

## **Total Installed Capacity (June 2012)**

<b>Source</b>	<b>Total Capacity (MW)</b>	<b>Percentage</b>
<b>Coal</b>	116,333.38	56.65
<b>Hydroelectricity</b>	39,291.40	19.13
<b>Renewable energy source</b>	24,832.68	12.09
<b>Gas</b>	18,903.05	9.20
<b>Nuclear</b>	4780	2.32
<b>Oil</b>	1,199.75	0.58
<b>Total</b>	2,05,340.26	

<b>Sector</b>	<b>Total Capacity (MW)</b>	<b>Percentage</b>
<b>State Sector</b>	86,275.40	42.01
<b>Central Sector</b>	62,073.63	30.22
<b>Private Sector</b>	56,991.23	27.75
<b>Total</b>	2,05,340.26	