ENVIRONMENTAL SCIENCE

Unit II: Energy and Resource Conservation

After studying this unit you will learn the following concepts:

a. Renewable and non-renewable sources of energy

b. Sun as a source of energy

c. Conservation of resources

d. Energy use pattern and future needs

e. Energy conservation policies

Introduction and Definition of resources: Anything which has some utility for us is called a resource. Some resources have economic value, while some do not. For example; milk has economic value, but a beautiful landscape has no economic value. But both are important because both satisfy some human needs.

Classification of resources:

Natural resources can be classified on the basis of their level of development and use, origin, stock and distribution.

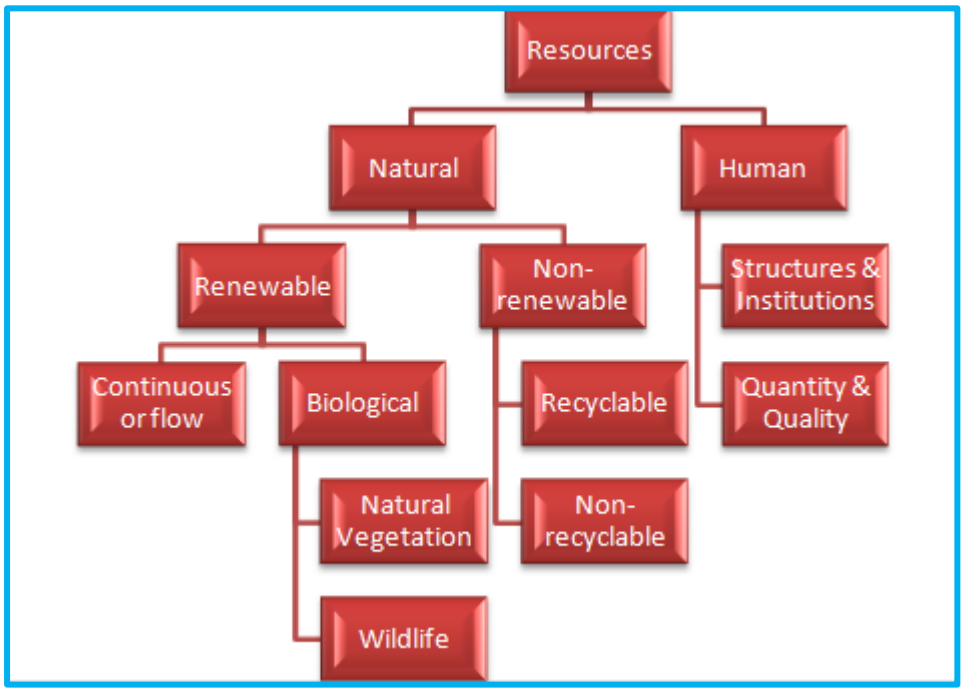

Fig.1: Classification of resources

a. Renewable and non-renewable sources of energy

1. **Renewable Resource:** Resources which can be quickly replenished are called renewable resources, e.g. wind energy, hydel energy, solar energy, etc.
2. **Non-renewable Resource:** Resources which cannot be replenished in the near future are called non-renewable resources, e.g. coal and petroleum. It takes

millions of years for the formation of coal and petroleum and hence they cannot be replenished in our lifetime.

b. Sun as a source of energy

The Sun is the primary source of energy for Earth's climate system: The Sun warms the planet, drives the hydro-logic cycle, and makes life on Earth possible. The amount of sunlight received on Earth's surface is affected by the reflection of the surface, the angle of the Sun, the output of the Sun, and the cyclic variations of the Earth's orbit around the Sun.

The Sun emits many forms of electromagnetic radiation in varying quantities. As shown in the following diagram, about 43 percent of the total radiant energy emitted from the Sun is in the visible parts of the spectrum. The bulk of the remainder lies in the near-infrared (49 percent) and ultraviolet section (7 percent). Less than 1 percent of solar radiation is emitted as x-rays, gamma waves, and radio waves.

The transfer of energy from the Sun across nearly empty space (remember that space is a vacuum) is accomplished primarily by radiation. Radiation is the transfer of energy by electromagnetic wave motion.

Once the Sun's energy reaches Earth, it is intercepted first by the atmosphere. A small part of the Sun's energy is directly absorbed, particularly by certain gases such as ozone and water vapor. Some of the Sun's energy is reflected back to space by clouds and Earth's surface.

Most of the radiation, however, is absorbed by Earth's surface. When the radiation is absorbed by a substance, the atoms in the substance move faster and the substance becomes warm to the touch. The absorbed energy is transformed into heat energy. This heat energy plays an important role in regulating the temperature of Earth's crust, surface waters, and lower atmosphere.

c. Conservation of Resources

Resource conservation means using the available resources carefully and giving them time to get renewed. Sustainable development means balancing our present needs of using resources without compromising the ability of future generations to meet their own needs. Basic principles of sustainable development are: Respect and care for all forms of life, right to a healthy and productive life for all human beings, conserve the earth's ecosystem and biological diversity, minimize the depletion of natural resources, sharing educational programmes and information to change people's attitude and adopt practices to save the environment and enabling communities and

groups to care for their own environment. The golden rule of conservation is - the three R's – Reduce, Reuse and Recycle. It is our responsibility to preserve and conserve the resources by sustaining the natural resources, conserving the diverse forms of life on earth, and minimizing damage to the environment.

- **Reduce:** We should reduce consumption.
- **Reuse:** We should reuse as many items as possible.
- **Recycle:** We should recycle discarded items wherever possible.

The future of our planet and its people depends upon how we maintain nature's life support system.

d. Energy Use Pattern and Future Needs

1. Energy Use Pattern:

India is the second largest commercial energy consumer in Non-OECD East Asia, comprising 19 percent of the region's total primary energy consumption. Economic growth in India has largely been associated with increased energy consumption. While 60% of total energy needs in India are met by commercial energy sources, remaining 40% are comprised of non-conventional fuels. Over past few years, climate change has become one of the main concerns driving energy policy. More than 150 countries, including India, have committed themselves under the United Nations Framework Convention on Climate Change to formulate and implement mitigation and adaptation measures to climate change. India accounts for over 3.5% of world carbon emissions. Since energy use is a major source of emissions, it is necessary to focus on the management of energy demand and supply as a means to abatement. While energy demand grows significantly with economic growth, this coupling varies over time, depending on various other things. Technological progress, energy efficiency programmes and structural changes contribute towards the variation in energy demand. Understanding the various components of energy demand is therefore important and necessary in order to deal with future emissions.

Energy use profile of the Indian economy

Sectoral demand for energy arises mainly from lighting and cooking in the household sector; irrigation and other operations in the agricultural sector; transport of passengers and freight and fuel input requirements in the industrial sector. Table 1 shows sector-wise activity level and energy consumption pattern in India. India's commercial energy consumption has increased from 130.7 million tonnes of oil

equivalent (mtoe) in 1991/92 to 176.08 mtoe in 1997/98. Per capita commercial energy consumption increased from 152.7 kilo grams of oil equivalent (kgoe) to 184.7 kgoe over the same period. Average annual growth rate for the agricultural GDP is 2.6 percent, the same figures for the industrial, transport and the service sectors are 6.8 percent, 7.6 percent and 6.4 percent respectively. Industrial sector has consistently remained the largest consumer of commercial energy, followed by the transport sector despite declining share of industrial sector from 50.4 percent in 1991-92 to 47.8 percent in 1997-98.

2. **Future Needs:**
    1. The world will need greatly increased energy supply in the future, especially cleanly-generated electricity.
    2. Electricity demand is increasing twice as fast as overall energy use and is likely to rise by more than two-thirds 2011 to 2035. In 2012, 42% of primary energy used was converted into electricity.
    3. Nuclear power provides about 11% of the world's electricity, and 21% of electricity in OECD countries.
    4. All major international reports on energy future suggest an increasing role for nuclear power as an environmentally benign way of producing electricity on a large scale.
    5. Renewable energy sources such as solar and wind are costly per unit of output and are intermittent but can be helpful at the margin in providing clean power.

e. Energy Conservation Policies

Energy conservation refers to efforts made to reduce energy consumption in order to preserve resources for the future and reduce environmental pollution. Conservation can be understood in two distinct senses. In the first sense traditional conservation means the use of fewer nonrenewable natural resources. The second sense in which conservation is used is to increase energy efficiency, such as increased fuel efficiency for vehicles or in-home heating.

1. **Policies and program using worldwide to improve efficiency**:
    1. Good housekeeping practices
    2. Regulation or standards
    3. Industrial co-generation
    4. Fuel switching

5. Fiscal policies like taxes, tax rebates, subsidies etc.
6. Agreements / targets
7. Energy audits
8. Energy dissemination and demonstration
9. Research and development

2. Energy conservation policies in India:

The Energy Conservation Act (EC Act) was enacted in 2001 with the goal of reducing energy intensity of Indian economy. Bureau of Energy Efficiency (BEE) was set up as the statutory body on 1st March 2002 at the central level to facilitate the implementation of the EC Act. The Act provides regulatory mandate for: standards & labeling of equipment and appliances; energy conservation building codes for commercial buildings; and energy consumption norms for energy intensive industries. In addition, the Act enjoins the Central Govt. and the Bureau to take steps to facilitate and promote energy efficiency in all sectors of the economy. The Act also directs states to designate agencies for the implementation of the Act and promotion of energy efficiency in the state. The EC Act was amended in 2010 and the main amendments of the Act are given below:

1. The Central Government may issue the energy savings certificate to the designated consumer whose energy consumption is less than the prescribed norms and standards in accordance with the procedure as may be prescribed
2. The designated consumer whose energy consumption is more than the prescribed norms and standards shall be entitled to purchase the energy savings certificate to comply with the prescribed norms and standards
3. The Central Government may, in consultation with the Bureau, prescribe the value of per metric ton of oil equivalent of energy consumed
4. Commercial buildings which are having a connected load of 100 kW or contract demand of 120 kVA and above come under the purview of ECBC under EC Act.