ENVIRONMENTAL SCIENCE AND ENGINEERING

SCHX1001

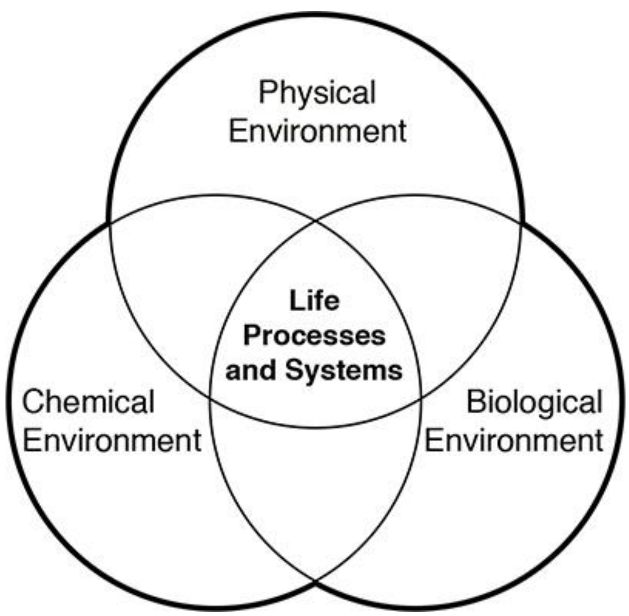
Course Material

UNIT I

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

Environment [1]

The complex of physical, chemical, and biotic factors (as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival. The aggregate of social and cultural conditions that influence the life of an individual or community.



Biotic and Abiotic Components of Environment

Natural environment includes all the living and non-living components occurring naturally on Earth. The biological components of the ecosystem that is the biotic components interact with the physical entities (abiotic components). The scientific study of the interaction of biotic community with each other and with abiotic components is known as Ecology.

Abiotic Components

The abiotic components are also known as the abiotic factors. The abiotic factors in ecology consist of the non-living and physical factors of the environment. Non-living components like pH value, solids, water, intensity of light as energy source, temperature of the atmosphere, humidity, physical factors of land like altitude, gradient and region and microclimate. The abiotic components have a strong influence on the distribution, behavior, relationship and structure of the living organisms.

Biotic Components

Biotic components are the living factors of the ecosystem. A biotic factor is any living component that includes a number of interrelated populations of different species in a common environment. A biotic factor can be any organism that affects any other organism including animals that consume other organism and food the organism consumes. Biotic factors in an environment require food and energy to survive. Based on the role of the biotic components in the ecosystem they are categorized into three main categories.

Producers - These are organisms that synthesize organic substances. Example: Plants.

Consumers - These are organisms that feed on other organisms. Consumers are of three trophic levels depending on the level and category of their food; they are primary consumer, secondary and tertiary consumers.

Decomposers - These are saprophytes - microorganisms that feed on dead and decayed waste matter. Example: Bacteria and fungi.

Forest Resources

In India, forests form 23 percent of the total land area. The word ‘forest’ is derived from the Latin word ‘foris’ means ‘outside’ (may be the reference was to a village boundary or fence separating the village and the forest land).

A forest is a natural, self-sustaining community characterized by vertical structure created by presence of trees. Trees are large, generally single-stemmed, woody plants. Forest can exist in many different regions under a wide range of conditions, but all true forests share these physical characteristics.

Because a forest is a natural community, no forest is static in time. That is, because forest communities respond to outside influences, most forests are in a state of constant flux. Depending upon the systems within which forest communities exist, such factors might include rainfall, fire, wind, glaciations, seismic activity, flooding, animal activity, insulation, and so on.

At any time, a forest is a collection of past responses to outside influences and internal competitive interactions. Therefore, the present status of any forest, indeed of any natural community, reflects what has gone on before.

Forests are of great significance both ecologically and economically. Forests provide a suitable habitat for animals and birds, protect soil from erosion and also provide a number of major and minor products which serve many purposes e.g. timber and firewood etc.

According to recent estimates, forests cover about 75 million hectares. Forests cover more than 60% of total area in Sikkim, Manipur, Tripura, Andaman and Nicobar Islands. Maharashtra, Andhra Pradesh and Orissa each have about 6 million hectares under forests. Forest areas are also covered in Himalaya region, the Western Ghats and the Eastern Ghats.

Kinds of Forests:

As a result of wide variety of soil, climatic conditions and relief, various kinds of forests are found in India.

1. Tropical Evergreen or Rain Forests:

These forests usually occur in areas where both temperature and rainfall (more than 200 cm) is quite high. The high rainfall enables growth of trees throughout the year. Trees grow to a height of 60 meters. Usually there is dense tree growth with large number of species of hardwood forests.

These forests are confined to rainy slopes of Western Ghats, plains of West Bengal, Orissa, Assam and other states of north east India. Some of the commercially useful trees in these forests are Ebony, Mahogany and Rose Wood. It is divided into tropical wet evergreen forests where annual rainfall is 250 cm and tropical semi-evergreen forests where annual rainfall is below 200 cm and temperature ranges from 24°C to 27°C with relative humidity 80 per cent.

2. Tropical Deciduous Forests:

These are known as monsoon forests because they form a natural cover almost all over India, particularly between the regions of 200 and 75 centimeters of rainfall. These forests are called deciduous because they shed leaves for about six to eight weeks in summer. These forests need a lot of care as they are less resistant to fire.

They are subdivided into two: moist and dry. These deciduous forests are confined to the eastern slopes of Western Ghats, Chotanagpur Plateau, and Shiwaliks in the north. Teak is an important species of moist deciduous region and Sal is the important tree of dry deciduous type. It has been observed that moist deciduous are getting replaced by dry deciduous forests.

3. The Thorn and Scrub Forests:

These forests occur in areas which have less than 75 cm rainfall annually. They are found scattered in the dry areas of Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Deccan region. These forests gradually fade away into scrubs and thorny bushes and constitute the typical desert vegetation, e.g.. Kikar, Babul, Khair, Date Palms are some of the useful trees.

4. Tidal Forests:

These types of forests are common in areas along the coasts and rivers which are affected by tides. They can survive both in fresh and salt water. The best examples of such forests are found in Bengal where Mangroves and Sundari trees thrive in Sunder bans.

5. The Forests of Himalayan Region:

These are found in Himalayas where the elevation of hills plays a major role. In the foothills of the Himalayas tropical deciduous forests occur. Above that up to the height of 3,500 meters coniferous forests comprising of pines, Silver Firs and Deodars are found. Still further up Alpine vegetation like scrubs and grasses are found.

Economic Value:

Forests are a source of great wealth. Out of total forest cover, 70% is of economic importance. Sal, Teak, Sandalwood are the most valuable hardwood trees. Conifers in Himalayan region cover 5% of total area and yield softwood of which Deodar, Chir, Pine are useful.

The total income from forestry is estimated at 1.5% of national income. Scientific management of forests, controlled felling of trees and replanting of cleared areas will increase forest yield, provide limber, bamboo and other products which we need. Forest based industries such as paper and synthetic fibers would be able to get adequate raw materials.

Use and Over Exploitation: A forest is a biotic community predominantly of trees, shrubs and other woody vegetation, usually with a closed canopy. This invaluable renewable natural resource is beneficial to man in many ways.

The direct benefits from forests are:

(a) Fuel Wood:

Wood is used as a source of energy for cooking purpose and for keeping warm.

(b) Timber:

Wood is used for making furniture, tool-handles, railway sleepers, matches, ploughs, bridges, boats etc.

(c) Bamboos:

These are used for matting, flooring, baskets, ropes, rafts, cots etc.

(d) Food:

Fruits, leaves, roots and tubers of plants and meat of forest animals form the food of forest tribes.

(e) Shelter:

Mosses, ferns, insects, birds, reptiles, mammals and micro-organisms are provided shelter by forests.

(f) Paper:

Wood and Bamboo pulp are used for manufacturing paper (Newsprint, stationery, packing paper, sanitary paper)

(g) Rayon:

Bamboo and wood are used in the manufacture of rayon (yarns, artificial silk-fibers)

(h) Forest Products:

Tannins, gums, drugs, spices, insecticides, waxes, honey, horns, musk, ivory, hides etc. are all provided by the flora and fauna of forests.

The indirect benefits from forests are:

(a) Conservation of Soil:

Forests prevent soil erosion by binding the soil with the network of roots of the different plants and reduce the velocity of wind and rain — which are the chief agents causing erosion.

(b) Soil-improvement:

The fertility of the soil increases due to the humus which is formed by the decay of forest litter.

(c) Reduction of Atmospheric Pollution:

By using up carbon dioxide and giving off oxygen during the process of photosynthesis, forests reduce pollution and purify the environment.

(d) Control of Climate:

Transpiration of plants increases the atmospheric humidity which affects rainfall and cools the atmosphere.

(e) Control of Water flow:

In the forests, the thick layer of humus acts like a big sponge and soaks rain water preventing run-off, thereby preventing flash-floods. Humus prevents quick evaporation of water, thereby ensuring a perennial supply of water to streams, springs and wells.

Human Interactions with Forests:

Human are indisputably a part of most forests. With the exception of extremely inaccessible forestlands, all forests present on Earth today have been influenced by human being for tens of thousands of years. In many cases, forest communities have never been without the influence of human activities.

Because of the widespread nature of human, activity in forests, it is tempting to think of human endeavor as one more outside factor influencing forest development. This approach is misleading, however, since it denies the role of self- awareness in human activity. Because human beings can understand cause and effect, and because we have amassed an increasingly deep body of knowledge about forest processes over the past ten millennia, human influences simply cannot be likened to the blind forces of nature.

Since pre-history, human beings have realized benefits from forested lands in the form of spiritual values, medicines, shelter, food, materials, fuel and more. Often, humans have sought to manipulate natural processes so as to compel forest systems to produce more of the goods and services desired by people.

Examples range from culturally modified trees and edge habitat maintained by the Haida and others in west-coastal North America to Pre-Colombian enrichment planting of Brazil nut trees in the Amazon to traditional coppice management in the English lowlands.

At times, human management has become as intensive as to become the primary set of factors under which the forest system operates. Such systems move towards the near total human control found in agricultural systems and cannot be thought of as forests in any natural sense, although they may continue to resemble forests superficially.

Deforestation:

Deforestation is the permanent destruction of indigenous forests and woodlands. The term does not include the removal of industrial forests such as plantations of gums or pines. Deforestation has resulted in the reduction of indigenous forests to four-fifths of their pre-agricultural area.

Indigenous forests now cover 21% of the earth's land surface. The World Resources Institute regards deforestation as one of the world's most pressing land-use problems. The difference between forests and woodlands is that whereas in a forest the crowns of individual trees touch to form a single canopy, in woodland, trees STOW far apart, so that the canopy is open.

Of great concern is the rate at which deforestation is occurring. Currently, 12 million hectares of forests are cleared annually. Almost all of this deforestation occurs in the moist forests and open woodlands of the tropics.

At this rate all moist tropical forest could be lost by the year 2050, except for isolated areas in -Amazonia, the Zaire basin, as well as a few protected areas within reserves and parks. Some countries such as Ivory Coast, Nigeria, Costa Rica, and Sri Lanka are likely to lose all their tropical forests by the year 2010 if no conservation steps are taken.

The destruction of forests due to unscrupulous and indiscriminate felling of trees has lead to an overall deterioration of our environment and is posing a serious threat to the quality of "life in future. Forest area in world has dwindled from 7,000 million hectares (year 1900) to 2S90 million hectares (year 1975). It is expected to further reduce to 2300 million hectares by year 2010 AD if the present trend of deforestation is not re-versed.

Causes of Deforestation:

(1) Population Explosion:

Population explosion poses a grave threat to the environment. Vast areas of forest land are cleared of trees to reclaim land for human settlements (factories, agriculture, housing, roads, railway tracks etc.) growth of population increases the demand for forest products like timber, firewood, paper and other valuable products of industrial importance, all necessitating felling of trees.

(2) Forest Fires:

Fires in the forests may be due to natural calamities or human activities:

(a) Smoldering of the humus and organic matter forming a thick cover over the forest floor (i.e. ground fires).

(b) Dried twigs and leaves may catch fire (i.e. surface fires).

(c) In densely populated forests, tree tops may catch fire by heat produced by constant rubbing against each other (i.e. crown fires).

(d) Human activities like clearing forest for habitation, agriculture, firewood, construction of roads, railway tracks and carelessness (throwing burning cigarette stubbs on dried foliage).

Fire destroys fully grown trees, results in killing and scorching of the seeds, humus, ground flora and animal life.

(3) Grazing Animals:

Trampling of the forest soil in the course of overgrazing by livestock has four reaching effects such as loss of porosity of soil, soil erosion and desertification of the previously fertile forest area.

(4) Pest Attack:

Forest pests like insects etc. destroy trees by eating up the leaves, boring into shoots and by spreading diseases.

(5) Natural Forces:

Floods, storms, snow, lightening etc. are the natural forces which damage forests.

Effects of Deforestation:

Forests are closely related with climatic change, biological diversity, wild animals, crops, medicinal plants etc.

Large scale deforestation has many far-reaching consequences:

(a) Habitat destruction of wild animals (tree-using animals are deprived of food and shelter.)

(b) Increased soil erosion due to reduction of vegetation cover.

(c) Reduction in the oxygen liberated by plants through photosynthesis.

(d) Increase in pollution due to burning of wood and due to reduction in Car- bon-dioxide fixation by plants.

(e) Decrease in availability of forest products.

(f) Loss of cultural diversity

(g) Loss of Biodiversity

(h) Scarcity of fuel wood and deterioration in economy and quality of life of people residing near forests.

(i) Lowering of the water table due to more run-off and thereby increased use of the underground water increases the frequency of droughts.

(j) Rise in Carbon dioxide level has resulted in increased thermal level of earth which in turn results in melting of ice caps and glaciers and consequent flooding of coastal areas.

LAND RESOURCES

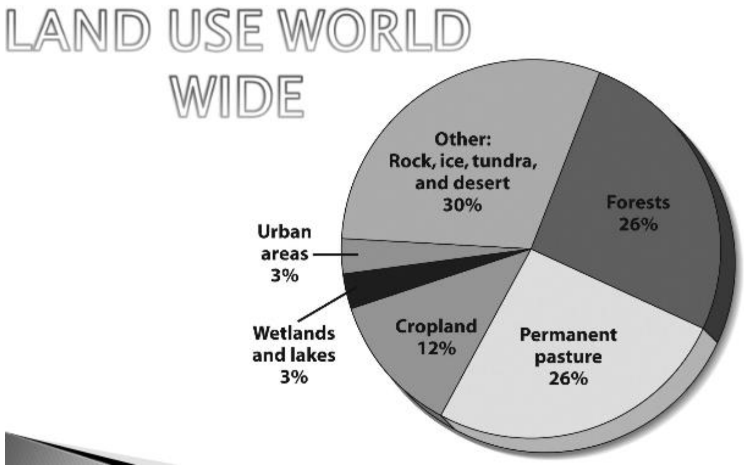
Land ecosystems cover nearly 30% of the Earth’s surface. The land surface changes over days, seasons, decades, and longer. Vegetation boundaries shift, cities grow, rain forests and farm lands shrink, amounts of trace chemicals in the air increase and decrease, rivers flood, forests burn, and volcanoes erupt. Activities of the growing human population cause or influence many of these changes.

"Land is a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface, including those of the near-surface climate, the soil and terrain forms, the surface hydrology (including shallow lakes, rivers, marshes, and swamps), the near-surface sedimentary layers and associated groundwater reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity (terracing, water storage or drainage structures, roads, buildings, etc.)."

Resources that are obtained from the land are called land resources. Almost every man-made product is composed of products of land resources. Land is the most important resource existing. It is the major source of important energy resources like fossil fuels. Agriculture is not possible without land resources. Land also harbors all crucial minerals.

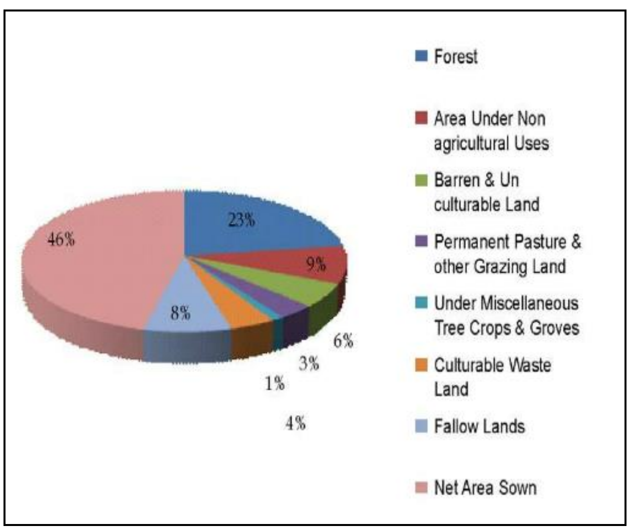
LAND USE WORLD WIDE

The use of land worldwide can be represented as;



LAND RESOURCES IN INDIA:

Land Resources in India enclose approximately 1.3 million sq miles and is a cape, protruding into the Indian Ocean, in between the Bay of Bengal on the east and Arabian Sea on the west. Indian land resources are segmented into varied relief features, 43% of land area is plain region; Indian mountain region constitutes 30% of the area, where as plateaus account for 27 % of the total surface area on the nation. The use of land resources in India is represented graphically below;



Use of land resources

FOREST:

Role in Hydrologic Cycle

Food source

Commercial use

Soil conservation

Pollution moderator

Wildlife habitat

O_2 producer

CO_2 sink

MINERALS:

Minerals can be obtained by the mining process. Mining is the extraction of valuable minerals or other geological materials from the earth. Materials recovered by mining include base metals, precious metals, iron, uranium coal, diamonds, limestone, oil shale, rock salt and potash. Any material that cannot be grown through agricultural processes, or created artificially in a laboratory or factory, is usually mined.

Process of mining:

A large area of forest cleaned out Removal of upper layer of land for surface mining Use of heavy machinery for digging tunnels or shafts into the earth to reach buried ore deposits for underground mining.

AGRICULTURAL LANDS:

Agricultural lands feed our increasing population .Approximately 12% of total land area is used as agricultural lands. India rank second worldwide in farm output Agriculture output purely depends on land resource. Thus, lack of access to land, increases incidence of poverty in rural areas. Quality of land has a direct bearing on the productivity of agriculture, which is not true for other activities.

LAND DEGRADATION;

Lowering of the quality of land is referred to as land degradation. The causes are

- Mining
- Urbanization
- Deforestation
- Overgrazing
- Construction of dams and canals
- Excessive use of fertilizers
- Dumping of industrial and domestic waste

SOIL EROSION

The detachment and transportation of the top fertile layer of the soil is termed soil erosion. The causes are;

- Deforestation
- Heavy floods
- Overgrazing
- Dry violent winds
- Improper agricultural techniques

Effects of soil erosion

- Decrease in productivity of land
- Desertification of land
- Reduction in agricultural lands along the banks of rivers
- Deposition of soil in river beds and canals causing diversion of their natural flow leading to natural disasters

Methods of controlling soil erosion

- Reduced tillage
- Contour bunding
- Vegetative bunds

- Strip cropping
- Terracing
- Afforestation on barren land
- Control of overgrazing
- Construction of small check dams
- Prevention of excavation of lands
- Promotion of equitable use of water resources

DESERTIFICATION

Conversion of fertile land in to infertile desert land is termed as desertification. The causes are natural as well as anthropogenic. The natural causes include very low rainfall, increased difference in diurnal temperatures, excessive evaporation, and high temperatures. The other factors incude deforestation, overgrazing, over irrigation, excessive ploughing, excessive use of fertilizers and conversion of pastures to arable lands.

Effects of desertification;

- Poor soil quality
- Rapid soil erosion
- Unfavorable climate
- Low water table
- Huge economic loss

Control of desertification

- Afforestation
- Changing agricultural practices and promoting dry land farming
- Development of pasture lands and control of overgrazing
- Promoting equitable use of water resources

- Development of catchment areas

LAND RESOURCE MANAGEMENT IN INDIA:

The Ministry of Rural Development, Government of India, has created a Department of Land Resources Management. At the conceptual level it has been realized that the management rather than the mere use of land is the central theme. There is no dearth of land; the real issue is management which should include: dynamic conservation, sustainable development and equitable access to the benefits of intervention.

The concept of sustainable development focuses on help for the very poor because they are left with no option but to destroy their own environment. It also includes the idea of cost-effective development using differing economic criteria to the traditional approach; that is to say development should not degrade environment quality, or reduce productivity in the long run. The greater issues of health control, appropriate technologies, food self-reliance, clean water and shelter for all are to be addressed. Equitable access to the benefits of development could be achieved either through land reforms or a dedicated and institutionalised mode of people's participation.

Case study

JHARIA COAL FIELD, JHARKHAND have been posing a big problem to the local residents due to underground fires and they are asked to vacant the area. The proposal of large scale evacuation of about 0.3 million population of Jharia immediately raises the question of their relocation and rehabilitation for which proper planning is required. Some 115 crores of rupees have been spent to put out the fire since 1976, still the problem persists. The people of Jharia are being asked to evacuate the area, but till now there is no alternative land and rehabilitation package prepared, as the result local people formed "Jharia coalfield bachao samiti " According to the latest estimate 18,000 crores will be spent to shift Jharia population and around 8,000 crores for extinguishing the fire.

RENEWABLE ENERGY RESOURCES

Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves, and geothermal heat.

Renewable energy flows involve natural phenomena such as sunlight, wind, tides, plant growth, and geothermal heat. Renewable energy is derived from natural processes that are replenished constantly.

Climate change and global warming concerns, coupled with high oil prices, peak oil, and increasing government support, are driving increasing renewable energy legislation, incentives and commercialization. According to a 2011 projection by the International Energy Agency, solar power generators may produce most of the world's electricity within 50 years, reducing the emissions of greenhouse gases that harm the environment.

Renewable energy replaces conventional fuels in four distinct areas: electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services:

- **Power generation**

  Renewable hydroelectric energy provides 16.3% the world’s electricity. When hydroelectric is combined with other renewable such as wind, geothermal, solar, biomass and waste: together they make the "renewable" total, 21.7% of electricity generation worldwide as of 2013. Renewable power generators are spread across many countries, and wind power alone already provides a significant share of electricity in some areas: for example, 14% in the U.S. state of Iowa, 40% in the northern German state of Schleswig-Holstein, and 49% in Denmark. Some countries get most of their power from renewable, including Iceland (100%), Norway (98%), Brazil (86%), Austria (62%), New Zealand (65%), and Sweden (54%).

- **Heating**

  Solar water heating makes an important contribution to renewable heat in many countries, most notably in China, which now has 70% of the global total (180 GWth). Most of these systems are installed on multi-family apartment buildings and meet a portion of the hot water needs of an estimated 50–60 million households in China. Worldwide, total installed solar water heating systems meet a portion of the water heating needs of over 70 million households. The use of biomass for heating continues to grow as well. In Sweden, national use of biomass energy has surpassed that of oil. Direct geothermal for heating is also growing rapidly.

- **Transport fuels**

  Renewable biofuels have contributed to a significant decline in oil consumption in the United States since 2006. U.S. oil use fell 8.5% from 2005 to 2014. The 93 billion liters of biofuels produced worldwide in 2009 displaced the equivalent of an estimated 68 billion liters of gasoline, equal to about 5% of world gasoline production.

There are many forms of renewable energy

Most of these renewable energies depend in one way or another on sunlight. Wind and hydroelectric power are the direct result of differential heating of the Earth's surface which leads to air moving about (wind) and precipitation forming as the air is lifted. Solar energy is the direct conversion of sunlight using panels or collectors. Biomass energy is stored sunlight contained in plants. Other renewable energies that do not depend on sunlight are geothermal energy, which is a result of radioactive decay in the crust combined with the original heat of accreting the Earth, and tidal energy, which is a conversion of gravitational energy.

Solar

This form of energy relies on the nuclear fusion power from the core of the Sun. This energy can be collected and converted in a few different ways. The range is from solar water heating with solar collectors or attic cooling with solar attic fans for domestic use to the complex technologies of direct conversion of sunlight to electrical energy using mirrors and boilers or photovoltaic cells. Unfortunately these are currently insufficient to fully power our modern society.

Solar energy is radiant light and heat from the sun harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture and artificial photosynthesis.

The sun's energy can be captured to generate electricity or heat through a system of panels or mirrors.

- Solar, or photovoltaic, cells convert sunlight directly into electricity. Most photovoltaic cells are made primarily of silicon, the material used in computer semiconductor chips, and arranged on rectangular panels. When sunlight hits a cell, the energy knocks electrons free of their atoms, allowing them to flow through the material. The resulting DC (direct current) electricity is then sent to a power inverter for conversion to AC (alternating current), which is the form in which electric power is delivered to homes and businesses.
- Solar thermal collectors use heat-absorbing panels and a series of attached circulation tubes to heat water or buildings.
- Solar concentration systems use mirrors - usually arranged in a series of long, parabolic troughs, a large round dish, or a circle surrounding a 'power tower' - to focus the sun's reflected rays on a heat-collecting element. The concentrated sunlight heats water or a heat-transferring fluid such as molten salt to generate steam, which is then used conventionally to spin turbines and generate electricity.

Wind Power

The movement of the atmosphere is driven by differences of temperature at the Earth's surface due to varying temperatures of the Earth's surface when lit by sunlight. Wind energy can be used to pump water or generate electricity, but requires extensive areal coverage to produce significant amounts of energy.

Wind turbines work much like windmills, but they are used specifically to generate electricity. A wind turbine usually has fewer blades and is made of lighter materials, such as plastics, which allow the blades to turn more quickly and with less wind. The blades of the wind turbine capture the energy of the wind and send it down a shaft inside the nacelle. This shaft spins the turbines of a generator. Inside the generator is a large pole with metal wires wrapped around it. On the inside walls of the generator are magnets. As the turbine poles spin, the magnets draw electrons from the wire and produce electricity. A wind turbine can produce enough electricity to satisfy the needs of a home. In some cases, a single turbine may also produce excess energy that can be stored in batteries or sold to a local utility company.

Wind turbines can also be grouped together to create large quantities of electricity. This is referred to as a wind farm. Wind farms are becoming more widespread throughout the world.

Advantages of Harnessing

The Wind Energy:

1. Wind energy is cleaner, cheaper and more renewable than many of the current sources of energy used in this country.
2. Not only is wind power a renewable energy, but like other renewable energies it gives off no harmful greenhouse gases while being operated - no methane, no carbon dioxide.
3. Wind energy is one of the cleanest and most effective forms of harnessing a renewable form of energy.

Reasons for Harnessing Wind Energy:

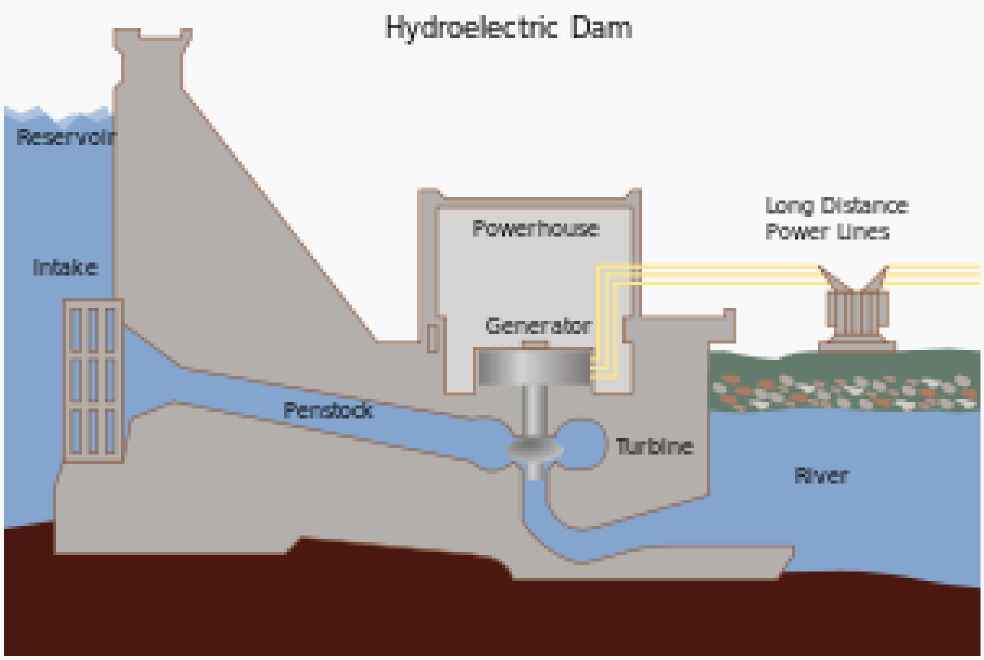
1. First, it produces no pollution or greenhouse gases.

2. Fourth, wind power produces more jobs per watt produced than all other energy platforms, including oil and coal.
3. Second, it is renewable and will last for as long as our son about another four billion years.

Hydroelectric energy**.** This form uses the gravitational potential of elevated water that was lifted from the oceans by sunlight. It is not strictly speaking renewable since all reservoirs eventually fill up and require very expensive excavation to become useful again. At this time, most of the available locations for hydroelectric dams are already used in the developed world.

Hydroelectricity is the term referring to electricity generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water. It is the most widely used form of renewable energy.

Generating methods



Cross section of a conventional hydroelectric dam.

Conventional (dams)

Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on the volume and on the difference in height between the source and the water's outflow. This height difference is called the head. The amount of potential energy in water is proportional to the head. A large pipe (the "penstock") delivers water to the turbine.

Pumped-storage

This method produces electricity to supply high peak demands by moving water between reservoirs at different elevations. At times of low electrical demand, the excess generation capacity is used to pump water into the higher reservoir. When the demand becomes greater, water is released back into the lower reservoir through a turbine. Pumped-storage schemes currently provide the most commercially important means of large-scale grid energy storage and improve the daily capacity factor of the generation system. Pumped storage is not an energy source, and appears as a negative number in listings.

Run-of-the-river

Run-of-the-river hydroelectric stations are those with small or no reservoir capacity, so that the water coming from upstream must be used for generation at that moment, or must be allowed to bypass the dam. In the United States, run of the river hydropower could potentially provide 60,000 megawatts (80,000,000 hp) (about 13.7% of total use in 2011 if continuously available).

Tide

A tidal power station makes use of the daily rise and fall of ocean water due to tides; such sources are highly predictable, and if conditions permit construction of reservoirs, can also be dispatchable to generate power during high demand periods. Less common types of hydro schemes use water's kinetic energy or undammed sources such as undershot waterwheels. Tidal power is viable in a relatively small number of locations around the world. In Great Britain, there are eight sites that could be developed, which have the potential to generate 20% of the electricity used in 2012.

Biomass is the term for energy from plants. Energy in this form is very commonly used throughout the world. Unfortunately the most popular is the burning of trees for cooking and warmth. This process releases copious amounts of carbon dioxide gases into the atmosphere and is a major contributor to unhealthy air in many areas. Some of the more modern forms of biomass energy are methane generation and production of alcohol for automobile fuel and fueling electric power plants.

Biomass is biological material derived from living, or recently living organisms. It most often refers to plants or plant-based materials which is not used for food or feed, and are specifically called lignocellulosic biomass .As an energy source, biomass can either be used directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel. Conversion of biomass to biofuel can be achieved by different methods which are broadly classified into: *thermal*, *chemical*, and *biochemical* methods.

There are three sources of biomass: **1- Woody source of biomass'***(Lignocelluloses) such as:Forest residues, Landscaping residues, Energy wood plantations, Residues from food, Industrial wood residue, Waste wood residues* **2- Non Woody biomass** (Oil, sugar, starch) such as: Energy plants from agriculture, Straw and other harvesting residues from agriculture, Residues from food industry, Landscaping residues(grass etc.) **3- Animal/Men(Fats/Proteins)**, Farm slurry /excrements, Slaughter waste, Organic waste from households and industry

Wood remains the largest biomass energy source to date;examples include forest residues (such as dead trees, branches and tree stumps), yard clippings, wood chips and even municipal solid waste. In the second sense, biomass includes plant or animal matter that can be converted into fibers or other industrial chemicals, including biofuels.

Plant energy is produced by crops specifically grown for use as fuel that offer high biomass output per hectare with low input energy. Some examples of these plants are wheat, which typically yield 7.5–8 tonnes of grain per hectare, and straw, which typically yield 3.5–5 tonnes per hectare in the UK.The grain can be used for liquid transportation fuels while the straw can be burned to produce heat or electricity. Plant biomass can also be degraded from cellulose to glucose through a series of chemical treatments, and the resulting sugar can then be used as a first generation biofuel.

Biomass can be converted to other usable forms of energy like methane gas or transportation fuels like ethanol and biodiesel. Rotting garbage, and agricultural and human waste, all release methane gas—also called landfill gas or biogas. Crops, such as corn and sugar cane, can be fermented to produce the transportation fuel, ethanol. Biodiesel, another transportation fuel, can be produced from left-over food products like vegetable oils and animal fats.Also, biomass to liquids (BTLs) and cellulosic ethanol are still under research.

There is research involving algal, or algae-derived, biomass due to the fact that it is a non-food resource and can be produced at rates five to ten times faster than other types of land-based agriculture, such as corn and soy. Once harvested, it can be fermented to produce biofuels such as ethanol, butanol, and methane, as well as biodiesel and hydrogen.

The biomass used for electricity generation varies by region. Forest by-products, such as wood residues, are common in the United States. Agricultural waste is common in Mauritius (sugar cane residue) andSoutheast Asia (rice husks). Animal husbandry residues, such as poultry litter, are common in the UK.

Methods of generating energy from biomass:

The methods of generating energy can be split in two different groups. There are the dry processes and the wet processes.

The dry processes are:

Combustion and Pyrolysis
The wet processes are:

Anaerobic Digestion, Gasification and Fermentation.

Combustion

The most obvious way of extracting energy from biomass, the technology of direct combustion is well understood, straightforward and commercially available. Combustion systems come in a wide range of shapes and sizes burning virtually any kind of fuel, from chicken manure and straw bales to tree trunks, municipal refuse and scrap tyres. Some of the ways in which heat from burning wastes is currently used include space and water heating, industrial processing and electricity generation. One problem with this method is its very low efficiency. With an open fire most of the heat is wasted and is not used to cook or whatever. One method of improving this in developing countries is to build stoves out of mud and scrap iron.

Pyrolysis

A wide range of energy-rich fuels can be produced by roasting dry woody matter like straw and woodchips. The process has been used for centuries to produce charcoal. The material is pulverised or shredded then fed into a reactor vessel and heated in the absence of air. Pyrolysis can also be carried out in the presence of a small quantity of oxygen ('gasification'), water ('steam gasification') or hydrogen ('hydrogenation'). One of the most useful products is methane, which is a suilable fuel for electricity generation using high-efficiency gas turbines.

AnaerobicDigestion

Biogas is produced when wet sewage sludge, animal dung or green plants are allowed to decompose in a sealed tank under anaerobic (oxygen-free) conditions. Feedstocks like wood shavings, straw and refuse may be used, but digestion takes much longer. Each kilogram of organic material (dry weight) can be expected to yield 450-500 litres of biogas. The residue left after digestion is a potentially valuable fertilizer or compost. Fermentation: Ethanol (ethyl alcohol) is produced by the fermentation of sugar solution by natural yeasts. Suitable feedstocks include crushed sugar beet and fruit. Sugars can also be manufactured from vegetable starches and cellulose by pulping and cooking, or from cellulose by miling and treatment with hot acid. After about 30 hours of fermentation, the brew cantains 6-10 per cent alcohol, which can be removed by distillation as a fuel.

Gasification

This process, usually using wood produces a flammable gas mixture of hydrogen, carbon monoxide, methane and other non flammable by products. This is done by partially burning and partially heating the biomass (using the heat from the limited burning) in the presence of charcoal (a natural by-product of burning biomass). The gas can be used instead of petrol and reduces the power output of the car by 40%. It is also possible that in the future this fuel could be a major source of energy for power stations.

Fermentation

If the biomass used is (or can be converted into) mostly sugar, then yeast can be added. The fermentation that follows produces alcohol which is a very high energy fuel that makes it very practicle for use in cars. This has been tried succesfully in Brazil.

Hydrogen and fuel cells. These are also not strictly renewable energy resources but are very abundant in availability and are very low in pollution when utilized. Hydrogen can be burned as a fuel, typically in a vehicle, with only water as the combustion product. This clean burning fuel can mean a significant reduction of pollution in cities. Or the hydrogen can be used in fuel cells, which are similar to batteries, to power an electric motor. In either case significant production of hydrogen requires abundant power. Due to the need for energy to produce the initial hydrogen gas, the result is the relocation of pollution from the cities to the power plants. There are several promising methods to produce hydrogen, such as solar power, that may alter this picture drastically.

Geothermal power**.** Energy left over from the original accretion of the planet and augmented by heat from radioactive decay seeps out slowly everywhere, everyday. In certain areas the geothermal gradient (increase in temperature with depth) is high enough to exploit to generate electricity. This possibility is limited to a few locations on Earth and many technical problems exist that limit its utility. Another form of geothermal energy is Earth energy, a result of the heat storage in the Earth's surface. Soil everywhere tends to stay at a relatively constant temperature, the yearly average, and can be used with heat pumps to heat a building in winter and cool a building in summer. This form of energy can lessen the need for other power to maintain comfortable temperatures in buildings, but cannot be used to produce electricity.

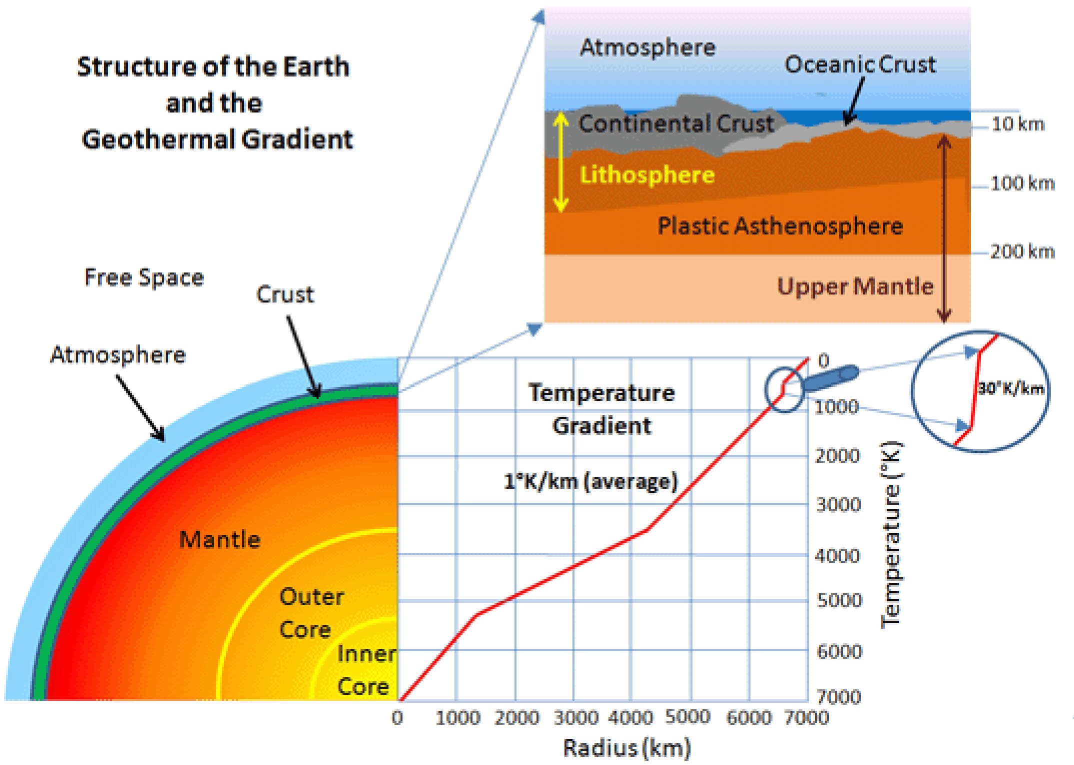
The Earth as an Energy Source

The geothermal energy available from the Earth is potentially enormous. A United States Government energy agency estimates that the total energy available from global geothermal resources is approximately 15,000 times the energy contained in all the known oil and gas reserves in the world. Unlike solar and wind energy, the supply of geothermal energy is constant and doesn't vary with the time of day or change with the weather. Although geothermal energy may always be available *when* it is needed, like the other two sources it is not always available *where* it is needed.

The Earth's core maintains temperatures in excess of 6000°K due to the heat generated by the gradual radioactive decay of the elements it contains. Modern estimates (Sclater 1981) for the total present rate of radioactive heat generation within the Earth are about 2×10^{13} W. This heat energy continuously flows outwards from the hot core due to conductive and convective flows of the molten mantle beneath the crust.

Estimates of the mean heat flux through the Earth's surface resulting from its radioactive core vary between 0.04 and 0.08 Watts per square meter. At the surface the heat dissipates into the atmosphere and space. This geothermal heat flow is trivial compared with the 1000 W/m^2 of solar energy impinging on the surface of the Earth in the other direction from the Sun (1367 W/m^2 at the outer surface of the atmosphere). Never the less it is sufficient to allow harvesting of geothermal energy on a commercial basis.

The diagram below shows the Earth's temperatures resulting from its internal heat generation and heat flows. The section on Solar Powerdescribes the solar energy flows coming from external sources.



The Earth's Layers

- **Inner Core** - The inner core is solid with a radius of about 1,220 km and consists of about 80% Iron and 5% to 10% Nickel, with a temperature of up to about 7,200°K.
- **Outer Core**- The outer core, also mainly Iron and Nickel, is in a liquid state and is about 2,260 km thick. Melted rock is also called **Magma**
- **Gutenberg Discontinuity** Marks the boundary between the outer core and the inner mantle.
- **Mantle** is about 2900 kms thick surrounding the core and contains 83% of the volume and most of the mass of the Earth.
  - **Lower (Inner) Mantle (semi-rigid)** - The deepest parts of the mantle, just above the core.
  - **Upper (Outer) Mantle** is about 670 kms thick with two distinct regions, the hotter innermost part is plastic (flowing) while the cooler outermost part is rigid.
    - **Upper Mantle (flowing) = Asthenosphere** - The innermost part of the upper mantle exhibits plastic (flowing) properties. It is located below the rigid lithosphere and is between about 100 and 250 km thick starting about

100-200 kms below the Earth's surface and possibly extending to a depth of 400 kms.

  - **Upper Mantle (rigid)** - The rocky uppermost part of the mantle is part of the lithosphere.

- **Lithosphere** - The lithosphere is defined as the solid rocky region about 100-200 km thick which spans the crust and the rigid upper mantle.
- **Mohorovicic (Moho) Discontinuity** - is the boundary between the Earth's crust and the upper mantle.
- **Crust** - The Earth's crust occupies just 1% of the Earth's volume with a thickness averaging just 15 km. In scale size, this is only one fifth of the thickness of a typical egg shell. The temperature at the Earth's surface is typically 25 °C (298°K)
  - **Continental Crust** - the exposed thick parts of the Earth's crust, (not located under the ocean). The average continental crust thickness is 35 km. The maximum thickness is 90 km below Himalayas and the minimum is 25 km at its thinnest in various places.
  - **Oceanic Crust** - The part of the Earth's crust located under the oceans is thinner, only about 5 to 11 km thick.
- **Ocean** - large bodies of water up to 3.7 km deep sitting on top of the oceanic crust. The water temperature at the surface is higher than the deep water temperature due to solar heating and thermal convection in the water which keeps it that way since the heavier cold water remains in the depths and the warmer, less dense water stays on the surface.
- **Atmosphere -** The thin layer of gases above the Earth extends to about 800 kilometres deep with a temperature of -273°C (absolute zero) at its outer limits. Most of the atmosphere (about 80%) is actually within 16 km of the surface of the Earth. In, scale this would be equivalent to a generous coat of varnish on a desktop globe.

Geothermal Gradient

The geothermal or temperature gradient is the rate of increase in temperature per unit depth in the Earth due to the outflow of heat from the centre..

The temperature gradient between the centre of the Earth and the outer limits of the atmosphere averages about 1°C per kilometre. The temperature gradient in the Earth's fluid layers, the magma, tend to be lower because the mobility of the molten rock tends to even out the temperature. This mobility however does not exist in the solid crust where temperature gradient is consequently much higher, typically between 25 °C and 30 °C per kilometre depending on the location and higher still in volcanic regions and along tectonic plate boundaries where seismic activity transports hot material to near the surface.

Other forms of energy**.** Energy from tides, the oceans and hot hydrogen fusion are other forms that can be used to generate electricity. Each of these is discussed in some detail with the final result being that each suffers from one or another significant drawback and cannot be relied upon at this time to solve the upcoming energy crunch.

What are Non-Renewable Sources of Energy?

Non-renewable energy sources are those sources that drain fossil reserves deposited over centuries. This results in depletion of these energy reserves. There are many countries, which have recorded significant reduction of these sources and are currently suffering from the side effects of drilling these energy reserves from deep underground. Examples of these countries include China and India. The environmental impact is so great that just by travelling to these two countries, you can get a firsthand experience on the case studies that are there to be seen by the naked eyes.

Non-renewable energy comes from sources that will run out or will not be replenished in our lifetimes—or even in many, many lifetimes.

Most non-renewable energy sources are fossil fuels: coal, petroleum, and natural gas. Carbon is the main element in fossil fuels. For this reason, the time period that fossil fuels formed (about 360-300 million years ago) is called the Carboniferous Period.

All fossil fuels formed in a similar way. Hundreds of millions of years ago, even before the dinosaurs, Earth had a different landscape. It was covered with wide, shallow seas and swampy forests.

Plants, algae, and plankton grew in these ancientwetlands. They absorbed sunlight and created energy through photosynthesis. When they died, the organisms drifted to the bottom of the sea or lake. There was energy stored in the plants and animals when they died.

Over time, the dead plants were crushed under the seabed. Rocks and other sediment piled on top of them, creating high heat and pressure underground. In this environment, the plant and animal remains eventually turned into fossil fuels (coal, natural gas, and petroleum). Today, there are huge underground pockets (calledreservoirs) of these non-renewable sources of energy all over the world.

Advantages and Disadvantages

Fossil fuels are a valuable source of energy. They are relatively inexpensive to extract. They can also be stored, piped, or shipped anywhere in the world.

However, burning fossil fuels is harmful for theenvironment. When coal and oil are burned, they release particles that can pollute the air, water, and land. Some of these particles are caught and set aside, but many of them are released into the air.

Burning fossil fuels also upsets Earth's "carbon budget," which balances the carbon in the ocean, earth, and air. When fossil fuels are combusted (heated), they release carbon dioxide into the atmosphere. Carbon dioxide is a gas that keeps heat in Earth's atmosphere, a process called the "greenhouse effect." The greenhouse effect is necessary to life on Earth, but relies on a balanced carbon budget.

The carbon in fossil fuels has been sequestered, or stored, underground for millions of years. By removing this sequestered carbon from the earth and releasing it into the atmosphere, Earth's carbon budget is out of balance. This contributes to temperatures rising faster than organisms can adapt.

There are many places in the world that are experiencing fast degradation of non-renewable sources in terms of fossil fuels. Soon there will be none left is appropriate measures are not take into consideration. This is a trend that has to be reversed if the world is to survive the degradation process that is going or happening at a much rapid pace. The main non-renewable energy sources are:-

1. Coal :

Coal is a black or brownish rock. We burn coal to create energy. Coal is ranked depending on how much "carbonization" it has gone through. Carbonization is the process that ancient organisms undergo to become coal. About 3 meters (10 feet) of solid vegetation crushed together into .3 meter (1 foot) of coal

Peat is the lowest rank of coal. It has gone through the least amount of carbonization. It is an important fuel in areas of the world including Scotland, Ireland, and Finland.

Anthracite is the highest rank of coal. Anthracite forms in regions of the world where there have been giant movements of the earth, such as the formation of mountain ranges. The Appalachian Mountains, in the eastern part of the United States, are rich in anthracite.

Coal is the most abundant form of fossil fuel available on earth. They were formed by the decay of old plants and animals several centuries ago. coal is mostly found below the earth and is major source of fuel for electricity generation as of today. Most power stations on earth require huge reserves of coal to produce electricity continuously without break. When coal is burnt, it produces heat that is used to convert the water into stream.

The steam is then used to move the turbines which in turns activate generators which produces electricity. Coal contains excessive amount of carbon. When it is burnt to produce power, it mixes up with oxygen to produce carbon dioxide. Carbon dioxide is one the gas responsible for global warming. The use of coal and other fossil fuels have only increased since they were discovered. Their excessive extraction and use has resulted in degradation of environment and ecological imbalance. Though coal is still available in big quantity on this earth but it is predicted that it won't last for more than 40-50 years if switch is not made to green or clean energy.

Advantages and Disadvantages

Coal is a reliable source of energy. We can rely on it day and night, summer and winter, sunshine or rain, to provide fuel and electricity.

Using coal is also harmful. Mining is one of the most dangerous jobs in the world. Coal miners are exposed totoxic dust and face the dangers of cave-ins and explosions at work.

When coal is burned, it releases many toxic gases andpollutants into the atmosphere. Mining for coal can also cause the ground to cave in and create underground fires that burn for decades at a time.

2. Oil : Oil is available in abundance in most of the middle east countries including Saudi Arabia, Kuwait, Iran, Iraq and UAE while some limited oil wells are present in North America and Canada. Most of the countries still have their huge dependency on these countries for their oil requirements. Like coal, it was also made out of dead plants and animals that had lived millions of years ago. When plants and animals died they were covered with thick layer of mud and sand which created huge pressure and temperature. These fossil fuels coal, oil and natural gas are result of those conditions only.

Wide usage of oil and oil related products has resulted in massive air pollution. It is a major source of fuel that is used in vehicles. Due to the process of combustion, harmful gases like carbon dioxide are released when oil is burnt. Everyday around 19.7 million barrels of oil is consumed in United States alone. Oil is transported to other nations using pipelines or ships. Leakage in ships leads to oil spill which affects animals and plants that live inside or around the sea. Just couple of years back, a ship containing oil of British Petroleum (BP) caused oil leakage which resulted in killing of many whales, fishes and small animals that live inside the sea.

Petroleum

Petroleum is a liquid fossil fuel. It is also called oil or crude oil.

Petroleum is trapped by underground rock formations. In some places, oil bubbles right out of the ground. At the LaBrea Tar Pits, in Los Angeles, California, big pools of thick oil bubble up through the ground. Remains of animals that got trapped there thousands of years ago are still preserved in the tar!

Most of the world's oil is still deep under the ground. We drill through the earth to access the oil. Some deposits are on land, and others are under the ocean floor.

Once oil companies begin drilling with a "drill rig," they can extract petroleum 24 hours a day, seven days a week, 365 days a year. Many successful oil sites produce oil for about 30 years. Sometimes they can produce oil for much longer.

When oil is under the ocean floor, companies drilloffshore. They must build an oil platform. Oil platforms are some of the biggest manmade structures in the world!

Once the oil has been drilled, it must be refined. Oil contains many chemicals besides carbon, and refining the oil takes some of these chemicals out.

We use oil for many things. About half of the world's petroleum is converted into gasoline. The rest can be processed and used in liquid products such as nail polish and rubbing alcohol, or solid products such as water pipes, shoes, crayons, roofing, vitamin capsules, and thousands of other items.

Advantages and Disadvantages

There are advantages to drilling for oil. It is relatively inexpensive to extract. It is also a reliable and dependable source of energy and money for the local community.

Oil provides us with thousands of conveniences. In the form of gasoline, it is a portable source of energy that gives us the power to drive places. Petroleum is also an ingredient in many items that we depend on.

However, burning gasoline is harmful to the environment. It releases hazardous gases and fumes into the air that we breathe. There is also the possibility of an oil spill. If there is a problem with the drilling machinery, the oil can explode out of the well and spill into the ocean or surrounding land. Oil spills are environmental disasters, especially offshore spills. Oil floats on water, so it can look like food to fish and ruin birds' feathers.

3. Natural Gas : Natural gas is a mixture of several gases including methane, ethane, propane and butane. It burns completely and leaves no ashes. It causes almost no pollution and is one the cleanest form of fossil fuel. Of these gases, methane is highly inflammable. It has no color, taste or odor. This is the reason that some chemicals are added to it before it can be supplied to individual homes so that a leakage can easily be detected. Middle Eastern countries particularly Iran and Iraq hold high reserves of natural gas. The beauty of this source of fuel is that it causes almost no pollution, cheap and environment friendly. Natural gas is another fossil fuel that is trapped underground in reservoirs. It is mostly made up of methane. You may have smelled methane before. The decomposing material in landfills also releases methane, which smells like rotten eggs.

There is so much natural gas underground that it is measured in million, billion, or trillion cubic meters.

Natural gas is found in deposits a few hundred meters underground. In order to get natural gas out of the ground, companies drill straight down. However, natural gas does not form in big open pockets. Natural gas is trapped in rock formations that can stretch for kilometers.

To reach natural gas, some companies use a process called “hydraulic fracturing,” or fracking. *Hydraulic* means they use water, and *fracturing* means to “split apart.” The process uses high-pressure water to split apart the rocks underground. This releases the natural gas that is trapped in rock formations. If the rock is too hard, they can send acid down the well to dissolve the rock. They can also use tiny grains of glass or sand to prop open the rock and let the gas escape.

We use natural gas for heating and cooking. Natural gas can also be burned to generate electricity. We rely on natural gas to give power to lights, televisions, air conditioners, and kitchen appliances in our homes.

Natural gas can also be turned into a liquid form, called liquid natural gas (LNG). LNG is much cleaner than any other fossil fuels.

Liquid natural gas takes up much less space than the gaseous form. The amount of natural gas that would fit into a big beach ball would fit into a ping-pong ball as a liquid! LNG can be easily stored and used for different purposes. LNG can even be a replacement for gasoline.

Advantages and Disadvantages

Natural gas is relatively inexpensive to extract, and is a “cleaner” fossil fuel than oil or coal. When natural gas is burned, it only releases carbon dioxide and water vapor (which are the exact same gases that we breathe out when we exhale!) This is healthier than burning coal.

However, extracting natural gas can cause environmental problems. Fracturing rocks can cause mini-earthquakes. The high-pressure water and chemicals that are forced underground can also leak to other sources of water. The water sources, used for drinking or bathing, can become contaminated and unsafe.

Other Non-renewable Energy Sources

Fossil fuels are the leading non-renewable energy sources around the world. There are others, however.

4. Nuclear Energy : Nuclear energy is has become a hot technology today. More and more countries are switching to nuclear energy to fulfill their future energy demands. Around 16% of world's electricity production comes through nuclear energy. Nuclear power plants use Uranium as a fuel to extract energy from it.

The energy can be released through either of the two processes: Nuclear Fission or Nuclear Fusion. Nuclear fission is the most common technique to harness nuclear energy. U-235 element is bombarded with slow moving neutrons which break the atom and releases energy. The atoms that got split are then again hit by neutrons to produce mass amount of energy. Like fossil fuels, nuclear does not produces any greenhouse emissions. Nuclear power plants produce some sort of nuclear waste called radioactive elements.

These elements emit strong radiations and must be buried deep underground so that they don't affect human life. Couple of nuclear disasters has already occurred in past including Chernobyl and Island Three Miles. In the recent past, there is the case of the disaster, which happened in Japan back in 2010. These disasters have again raised several questions on safety of nuclear power plants and people who work in these plants. Despite this, several power stations are coming up in different parts of the world. Another downside of nuclear energy is that it can be used to make nuclear bomb. Therefore, these remain targets for various terrorist organizations.

Nuclear energy is usually considered another non-renewable energy source. Although nuclear energy itself is a renewable energy source, the material used in nuclear power plants is not.

Nuclear energy harvests the powerful energy in the nucleus, or core, of an atom. Nuclear energy is released through nuclear fission, the process where the nucleus of an atom splits. Nuclear power plants are complex machines that can control nuclear fission to produce electricity.

The material most often used in nuclear power plants is the element uranium. Although uranium is found in rocks all over the world, nuclear power plants usually use a very rare type of uranium, U-235. Uranium is a non-renewable resource.

Nuclear energy is a popular way of generating electricity around the world. Nuclear power plants do not pollute the air or emit greenhouse gases. They can be built inrural or urban areas, and do not destroy the environment around them.

However, nuclear energy is difficult to harvest. Nuclear power plants are very complicated to build and run. Many communities do not have the scientists and engineers to develop a safe and reliable nuclear energy program.

Nuclear energy also produces radioactive material. Radioactive waste can be extremely toxic, causing burns and increasing the risk for cancers, blood diseases, and bone decay among people who are exposed to it.

Biomass Energy

Biomass energy, a renewable energy source, can also be a non-renewable energy source. Biomass energy uses the energy found in plants.

Biomass energy relies on biomass feedstocks—plants that are processed and burned to create electricity. Biomass feedstocks can include crops such as corn or soy, as well as wood. If people do not replant biomass feedstocks as fast as they use them, biomass energy becomes a non-renewable energy source.

QUESITIONS FOR PRACTICE

Part A

1. What are the objectives of Environmental studies?
2. "Humans have a special environmental responsibility to themselves and to other few living beings." Discuss.
3. Explain the multidisciplinary nature of Environmental studies.
4. Describe the factors composing environment.
5. Discuss the scope and importance of Environmental studies.
6. What is deforestation? Give main causes of deforestation.
7. What are renewable and non-renewable resources? Explain giving examples.
8. Write a short note on forest as a resource.
9. Write short note on alternative energy resources.
10. Briefly describe the role of an individual in the conservation of natural resources.
11. Justify the statement "it is essential to develop the non-conventional energy resources in the present day of technology".
12. Enumerate the main reasons of desertification with reference to the Thar Desert.
13. "The availability of fresh water is the biggest crisis that the world is facing today", discuss.

Part B

1. Ignorance regarding protection of environment will lead to detrimental consequences, comment with illustrations.

2. Explain methods to disseminate environmental information among people.

Write an extranatory note on importance of Environmental studies and public awareness.

3. Give an account of environmental effects of modern agriculture.

4. Describe world food problems. Enumerate the causes and possible ways to increase world food supply.

5. Describe the importance of land resources in the development of civilization. What do you mean by land degradation?

6. Discuss the environmental problems associated with land resources.

7. What are the environmental implications of conventional and non-conventional sources of energy?

8. Discuss the influence of following on agriculture:

(a) Tractor

(b) Tubewell

(c) Agricultural implements

(d) Chemical fertilizers

(e) Pesticides.