BASIC ENERGY RESOURCES

Presentation · September 2008

DOI: 10.13140/RG.2.2.10619.72488

1 author:

A. Balasubramanian
University of Mysore
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by
Prof.A. Balasubramanian
University of Mysore

24-9-2008

Introduction:

Planet Earth has enormous amounts of energy resources. The usage of energy by human beings dates back to several centuries. Energy is the capacity to perform work. We use various forms of energy to do work. The total quantity of usable energy available to people is called as Energy supply. Energy is of many kinds as electrical energy, kinetic energy, mechanical energy and chemical energy. Electrical energy operates on several appliances like pump sets, fans, grinders, vacuum cleaners, washing machines and other industrial equipment. Heat energy is used to cook food on stoves, shape metals, make bricks and for several industrial processes requiring heat as a major factor or as a catalytic factor. Similarly, mechanical energy is used for many activities like moving vehicles, lifting and breaking materials, handling and aligning objects. Energy may be obtained directly from an energy source or it may be obtained indirectly. Energy is derived from one or more than one source. The chief sources of energy are

a) fossil fuels,
b) flowing water,
c) Biomass and
d) Atomic minerals.

In addition, solar energy, wind power, tidal energy, chemical and geothermal power also provide some amounts of energy. The sources and use of energy by the population, differ from a developed country to a developing country. It depends on the energy resources available with them.

Not all continents have all the needed energy resources.

These sources are classified into two major groups as renewable and non-renewable energy sources.

1. Renewable sources are those which will be available for our human consumption again and again. The energy derived from water as hydro-electric power, Sun as solar energy and wind energy are renewable energy resources.

2. Non-renewable energy sources are those which are permanently consumed for generating the energy and needs further supply. Fossil fuels like coal, oil and gas, fissionable materials for nuclear power generation and geothermal sources come under this category.

In this episode, the energy resources are discussed under the following modules:

1. Energy from Fossil Fuels
2. Energy from Sun And Wind
3. Energy from Water
4. Energy from Biomass
5. Energy from Nuclear & Other Sources.

1. ENERGY FROM FOSSIL FUELS

About 85 per cent of the world's commercial energy comes from coal, oil, and natural gas. These are called as fossil fuels since they have been developed from the fossilized remains of prehistoric plants and animals.

The use of these sources depend on their availability in a country.

Coal is made up of organic material which has escaped from oxidation in the carbon cycle. It is an altered residue of plants and trees of older forests, which have been buried under sediments, and they were subjected to a set of geological processes and transformations.

Coal is burned to create heat to turn water into steam. The steam is then used to rotate turbines which will rotate the dynamos to generate electricity.

It is also converted into another useable form called coke. It is a charcoal –like solid which is an essential raw material used in the production of iron and steel.

Coal occurs in sedimentary basins as coal seams or layers. There are four types of coal occurring in the order of decreasing carbon content, volatiles and moisture, as
a. Anthracite
b. Bituminous coal
c. Sub-bituminous coal and
d. Lignite.

Peat is partially decayed plant matter found in recent swamp deposits. Peat and wood are the basic materials before the formation of lignite.

Anthracite is a rare form but the hardest variety of coal. It also contains more carbon and produces more heat than the other varieties. Bituminous coal is the most commonly used coal by industries. It contains more carbon and produces more heat than either lignite or sub-bituminous coal. It is also suitable for making coke.

Coal contains some sulphur compounds. The sulphur content may be very low (< 1%) or medium (1-3%) and high (> 3 %).

Coal is mainly used in thermal power plants. While using it, the one having low sulphur will cause less air pollution. The production of thermal power depends on the ash-content of the coal used. Higher the ash content, lower the efficiency of the boiler and furnaces.

Use of coal also generates solid wastes and ashes. For every megawatt of energy produced by a thermal plant, about one acre of land is needed to dump the wastes (ash).

Coal-based thermal plant pollutes the atmosphere by gaseous emissions of sulphur-dioxide and nitrogen oxide, and produce tremendous amount of solid wastes, fly ash and bottom ash.

Coal mining, transport, washing, processing, shipping, combustion and final disposal of ash may lead to potentially adverse environmental effects like
a. aesthetic degradation,
b. noise pollution,
c. dust pollution and the
d. release of trace elements into water, soil and air.

Coal is a non-renewable form of energy, the use of which is to be done very economically.

The next major source of energy comes from oil.

The oil that is derived from rocks, is called as Petroleum. (Petro means rock, oleum means oil). Petroleum furnishes about 40 per cent of the commercial energy used in the world. It provides most of the energy used for transportation and other activities of the population.

In general, Petroleum and natural gas (methane) are hydrocarbons. They are fossil fuels formed from organic material, escaped from complete decomposition after burial. Petroleum is a complex mixture of hydrocarbons containing N, S and O.

The major source for oil and gas is the fine grained, organic rich sediments that are buried to a depth of 500 m or below stagnant oceanic waters. These might have experienced a thrust due to an increase in pressure and heat. The water is deficient in oxygen. Various geological and biological (bacteria) processes have promoted the chemical transformation of these organic materials into hydrocarbons. They tend to migrate through the porous sediments called reservoir rocks.

Like coal, oil also contains some impurities that can cause air pollution. But refineries can remove many of these pollutants when they process the petroleum.

Natural gas is the most convenient fossil fuel. It causes little no air pollution. Natural gas is a clean source of energy because it is refined naturally during its formation within the earth and does not require further refining. In addition, it can be compressed into a liquid and transported long distances through pipelines.

Natural gas accounts for about 21 per cent of the commercial energy used in the world. Millions of people use natural gas to heat their homes, cook their meals, and dry their laundry.
Typical gas consists of hydrocarbons, having a very low boiling point. Methane, the first member of the paraffin series makes up 85 % of the typical gas.

The following types of gas have been recognised based on their composition:
l. Dry or Lean gas comprising mostly methane
2. Wet Gas – is the higher hydrocarbons
3. Sour Gas – when containing more hydrogen sulphide
4. Sweet Gas – containing little H2S.
5. Residue Gas – containing higher paraffins for extraction
6. Casing head Gas - derived from an oil-wells by extraction at the surface.

Natural gas is used for domestic and industrial applications.

The consumption rating for different sectors are :
For manufacturing fertilizers about 36 % ,
For power generation about 27 % ,
For industrial sectors about 8 % ,
And for the extraction of liquefied Petroleum Gas or cooking gas the rest are used.

2. SOLAR AND WIND ENERGY

The energy received .from the sun's electromagnetic radiation is called as the solar energy. It is also used to produce electric power. This is a non-conventional and renewable energy source.

There are two methods through which sunlight can be converted into electric power. They are:
(1) photovoltaic conversion, or
(2) solar thermal conversion.

It is reported that the solar energy falling on the earth every 29 seconds, is equivalent to the human energy requirement of a day.

It comes from the Sun and is plentiful. The distribution is sparse. It must be collected and concentrated to produce usable power. This requires some special devices. Hence, harnessing of solar energy is an expensive affair.

A typical solar water heater consists of a coil of copper pipe brazed to a blackened metal base. This assembly is covered by a transparent glass plate or a plastic sheet. The water which is passed through coil gets heated up by the radiation. Very high amount of heat is trapped in this process during summer months.

Solar energy is also caught to provide power using solar cells. Solar cells are the devices made from crystals of silicon to produce electricity from sunlight. They are the Photovoltic cells.

Research continues on the applications of solar energy for pumping up water, refrigeration, solar ponds and temperature control in buildings.

Consumption by Solar energy has more advantages, like the
1. Unlimited supply,
2. No way of producing air, water, thermal, and noise pollution,
3. No possibilities of large scale disasters,
4. Conserves earth's resources and
5. the technology is available for immediate usage.

The major disadvantage is the expenditure involved in establishing the plants.
Solar cells are more expensive. They can not completely replace the conventional fuels.

WIND ENERGY

The rapid depletion of fossil fuels and the increase in environmental pollution call for an efficient use of other energy sources and to identify alternate sources also.

Wind is a powerful agent for providing power. It is the best renewable energy source available on earth.

Wind energy can be harnessed very easily. The blow of wind is allowed to rotate the blades of a windmill, which is coupled to a turbine. This drives a power generator.

There are some merits and demerits.
1. The generation period is low (5 months). This is because of the seasonal availability of a reasonably useful wind.
2. Power generation starts immediately after commissioning the plant.
3. Power is cost free, generation is cheaper and recurring cost is less.
4. Installation cost is heavy, and the maintenance of machinery is also expensive.
5. This is a pollution free and environment friendly generation of power.

A wind power plant is also a source of income. A wind power generator of 200 kw/250 kw, generates at an average of six to seven lakh units every year.

3. ENERGY FROM BIOGAS

Biogas is the methane gas produced or released from the organic wastes like sewage, garbage, manure or crop residues. These are decomposed substances in the absence of air. This is similar to the natural gas in origin.

Biogas can be collected using a container filled with the wastes and closed at the top with a tap for trapping the gas. The wastes are mostly animal excreta or dungs which are allowed to decay and decompose naturally inside the container. After producing the gas, the used up materials can be used as a high quality organic manure in crop lands.

Community biogas plants, industrial biogas plants, night soil biogas plants, family size biogas plants and improved chulhas are some of the bio-energy sources employed and are under operational conditions in several parts of the world.

BIOMASS

Biomass fuel is the common name given to all forms of fuel-generating organic remains. These organic matter can be burned directly or indirectly as a fuel. A well known popular biomass is the fuel wood.

Wood was used as a major source of energy in several parts of the world. Firewood is the best known biomass fuel. Cow dung or cattle dung is burnt for cooking purposes. The distillation of biomass is done to produce alcohol for fuel.

There are three major sources as
1. Forest products,
2. Unused agricultural products and
3. Urban wastes.

The main advantage is that the biomass, under several conditions, can be recycled. The main disadvantage is the requirment of an energy for processing the biomass into a convenient form of energy. Biomass energy is available locally (Eg. Sugar cane farms and sugar production plants –the straw and dusts). The main disadvantage is that the consumption of biomass fuel can produce air pollution, smokes, ashes and sometimes degrade the land.

4. ENERGY FROM WATER

Hydroelectric power generation is a major source of enerhy over the globe for several decades. Water power furnishes about 7 per cent of the world's commercial energy. Water costs nothing and cannot be used up, and it supplies energy without pollution. However, water power projects require a dam or a reservoir which are expensive.

A hydroelectric power plant can operate only where water flows from a higher altitude to a lower one. In several hilly and mountainous terrain establishment of hydroelectric power plants on perennial rivers has contributed the major electricity usage in many countries.

Hydropower is a renewable energy source. Historically, water wheels were used to generate mechanical energy to run mills and machineries.

Water power is clean power. It requires no burning of any fuel. These power generators do not pollute the atmosphere or the hydrosphere.

Hydroelectric power is also combined with thermal power plants. With this combination, the thermal plant can supply power if the hydroelectric plant is affected by drought.

TIDAL POWER

Tides and Waves can generate enormous energy for consumption. The tides, which are dashing against the shores continuously, can generate the tidal power. This can be obtained by using a tidal dam built with a turbine. This is more expensive when compared to the hydroelectric power installations.

In high tide zones such provisions help in harnessing this power. There is also a limitation that it can produce electricity only at certain times of a year.

5. ENERGY FROM NUCLEAR AND OTHER SOURCES:

Many of the environmentally conscious countries in the world depend on nuclear power for their electricity generation. At present about 17 % of the worlds electricity is generated through nuclear sources.

Nuclear source is clean, compact and concentrated. Nuclear power plants are similar to coal plants in that heat is used to produce steam to drive a turbine. But the basic difference between them is the atomic fission instead of chemical combustion.

A nuclear reactor requires a fuel substance whose nuclei can undergo fission. Such substances are called fissionable substances. U235 and plutonium 239 are the widely used fuels. In addition to the fuel, reactors require neutrons. These are the stimulators for chain reaction. Safety, design and operation of reactors depend on the way by which these neutrons are managed.

Nuclear reactors are classified based on the fuel, coolant and moderator used to support the nuclear chain reaction.

The natural concentration of uranium in the earth's crust is about 2 ppm. Uranium originates in magma. It is concentrated to about 4ppm in granitic rocks, pegmatites, etc. They occur in a large number of minerals. They are called rare-earth minerals (or) radio-active minerals. They contain Uranium or Thorium as an essential part of their chemical composition. Some of them are Oxides and complex oxides.

The disposal of nuclear wastes, some radio-active liquids, gases will affect the environment severely.

Sources are available in the form of fuel bundles, which once loaded in to the reactor
Core can provide energy for 1 to 2 years at a stretch before discharge. One kg of Uranium gives an energy equivalent to 25,000 kg of coal.

GEOTHERMAL ENERGY

This refers to the heat energy emanating from the earth's interior which could be used for heating or for generating electricity. The production of geothermal energy can occur only in areas where hot rocks lie near the earth's surface.
Iceland, Italy, Japan, the Philippines, New Zealand, and the United States have developed geothermal power plants. The method is simple by installing a pipe into the wells drilled over the regions of geothermal sources and connect them to a turbine.

Conclusion:

Energy is needed for the present and future generations. Earth has various sources of energy. The Non-renewable energy depletes very quickly due to the pressure of population. Harnessing renewable energy is the pre-requisite for our future survival. Energy saved is the energy produced is a common sloga of the modern society. Let us save energy and use it appropriately.