

# Renewable Energy Source: An Overview

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## ABSTRACT

Energy has been a vital input into the economic and social development. It is the gift of the nature to the mankind in various forms. The consumption of the energy is directly proportional to the progress of the mankind. However, one third of the world population, living in developing and threshold countries, has no access to electricity. These people mostly live in remote and rural areas with low population density, lacking even the basic infrastructure. Accordingly, utility grid extension is not a cost-effective option and sometimes technically not feasible. Therefore, it is imperative to look for sustainable (that is., cost-effective, environmentally benign and reliable) sources of energy for the development of these regions. The primary source of energy is fossil fuel, however the finiteness of fossil fuel reserves and large scale environmental degradation caused by their widespread use, particularly global warming, urban air pollution and acid rain, strongly suggests that harnessing of non-conventional, renewable and environment friendly energy resources is vital for steering the global energy supplies towards a sustainable path. This paper describes in brief the non-conventional energy sources and their usage in India.

**Keywords:** Renewable and Non-Renewable Energy, Solar Energy, Wind Energy.

## I. INTRODUCTION

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever-increasing energy needs requiring huge investments to meet them

Energy can be classified into several types based on the following criteria:

- Primary and Secondary energy
- Commercial and Noncommercial energy
- Renewable and Non-Renewable energy

### 1.1 Primary and Secondary energy

Primary energy sources are those that are either found or stored in nature. Common primary energy sources are coal, oil, natural gas, and biomass (such as wood). Other primary energy sources available include nuclear energy from radioactive substances, thermal energy stored in earth's interior, and potential energy due to earth's gravity Primary energy sources are mostly converted in industrial utilities into secondary energy sources; for example coal, oil or gas converted into steam and electricity. Primary energy can also be used directly. Some energy sources have non-energy uses, for example coal or natural gas can be used as a feedstock in fertilizer plants.

### 1.2 Commercial Energy and Non Commercial Energy

#### Commercial Energy

The energy sources that are available in the market for a definite price are known as commercial energy. By far the most important forms of commercial energy are electricity, coal and refined petroleum products. Commercial energy forms the basis of industrial, agricultural, transport and commercial development in the modern world. In the industrialized countries, commercialized fuels are predominant source not only for economic production, but also for many household tasks of general population.

Examples: Electricity, lignite, coal, oil, natural gas etc.

**Non-Commercial Energy**

The energy sources that are not available in the commercial market for a price are classified as non-commercial energy. Non-commercial energy sources include fuels such as firewood, cattle dung and agricultural wastes, which are traditionally gathered, and not bought at a price used especially in rural households. These are also called traditional fuels. Non-commercial energy is often ignored in energy accounting.

**1.3 Renewable and Non-Renewable Energy**

Renewable energy is generally defined as energy that is collected from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat as shown in Figure 1.1.

The most important feature of renewable energy is that it can be harnessed without the release of harmful pollutants. Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time. Figure 1.2 shows different sources of renewable and nonrenewable energy respectively

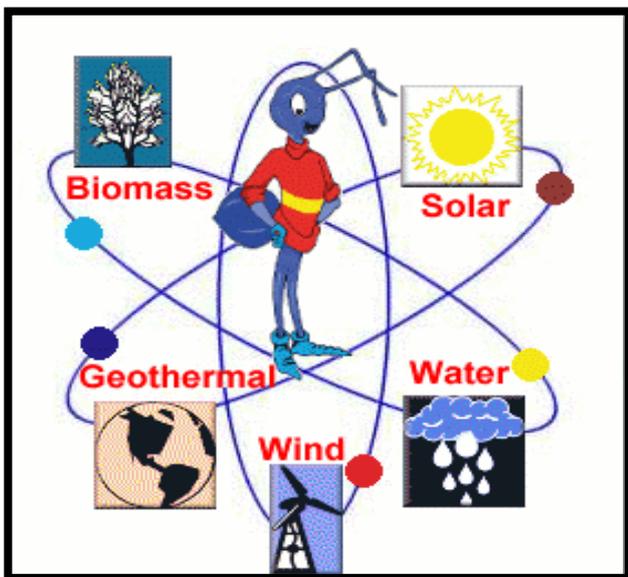


Figure No 1.1 (a) Renewable

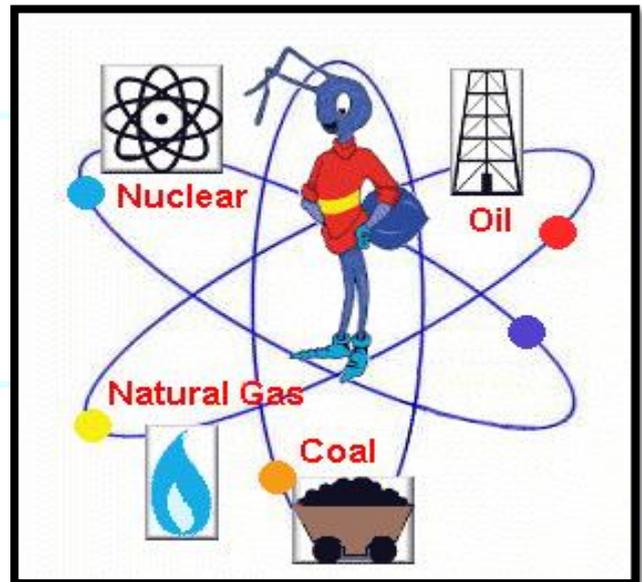


Figure No 1.1 (b) Non Renewable

**II. SOLAR ENERGY**

Solar energy is radiant light and heat from the Sun harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic, solar thermal energy, solar architecture and artificial photosynthesis. It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on the way they capture and distribute solar energy or convert it into solar power. Active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Passive solar techniques include orienting a

building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

The large magnitude of solar energy available makes it a highly appealing source of electricity. The United Nations Development Programme in its 2000 World Energy Assessment found that the annual potential of solar energy was 1,575–49,837 exajoules (EJ). This is several times larger than the total world energy consumption, which was 559.8 EJ in 2012. In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating global warming, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared".



**Figure No 2.1:- Solar Energy**

### **III. WIND ENERGY**

Wind Energy is the use of air flow through wind turbines to mechanically power generators for electricity. Wind power, as an alternative to burning fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, and uses little land. The net effects on the environment are far less problematic than those of nonrenewable power sources. Wind farms consist of many individual wind turbines which are connected to the electric power transmission network. Onshore wind is an inexpensive source of electricity, competitive with or in many places cheaper than coal or gas plants. Offshore wind is steadier and stronger than on land, and offshore farms have less visual impact, but construction and maintenance costs are considerably higher. Small onshore wind farms can feed some energy into the grid or provide electricity to isolated off-grid locations. Wind power is very consistent from year to year but has significant variation over shorter time scales. It is therefore used in conjunction with other electric power sources to give a reliable supply. As the proportion of wind power in a region increases, a need to upgrade the grid and a lowered ability to supplant conventional production can occur.



. Figure No 3.1:- WIND ENERGY

Power management techniques such as having excess capacity, geographically distributed turbines, dispatch able backing sources, sufficient hydroelectric power, exporting and importing power to neighboring areas, using vehicle-to-grid strategies or reducing demand when wind production is low, can in many cases overcome these problems. In addition, weather forecasting permits the electricity network to be readied for the predictable variations in production that occur. As of 2015, Denmark generates 40% of its electricity from wind, and at least 83 other countries around the world are using wind power to supply their electricity grids. In 2014 global wind power capacity expanded 16% to 369,553 MW. Yearly wind energy production is also growing rapidly and has reached around 4% of worldwide electricity usage 11.4% in the EU.

#### IV. TIDAL ENERGY

Tidal power, also called tidal energy, is a form of hydropower that converts the energy obtained from tides into useful forms of power, mainly electricity. Although not yet widely used, tidal power has potential for future electricity generation. Tides are more predictable than wind energy and solar power. Among sources of renewable energy, tidal power has traditionally suffered from relatively high cost and limited availability of sites with sufficiently high tidal ranges or flow velocities, thus constricting its total availability. However, many recent[when? clarification needed] technological developments and improvements, both in design (e.g. dynamic tidal power, tidal lagoons) and turbine technology (e.g. new axial turbines, cross flow turbines), indicate that the total availability of tidal power may be much higher than previously assumed, and that economic and environmental costs may be brought down to competitive levels. Historically, tide mills have been used both in Europe and on the Atlantic coast of North America. The incoming water was contained in large storage ponds, and as the tide went out, it turned waterwheels that used the mechanical power it produced to mill grain. The earliest occurrences date from the Middle Ages, or even from Roman times. It was only in the 19th century that the process of using falling water and spinning turbines to create electricity was introduced in the U.S. and Europe. The world's first large-scale tidal power plant is the Rance Tidal Power Station in France, which became operational in 1966. It was the largest tidal power station in terms of power output, before Sihwa Lake Tidal Power Station surpassed it. Total harvestable energy from tidal areas close to the coast is estimated to be around 1 terawatt worldwide.

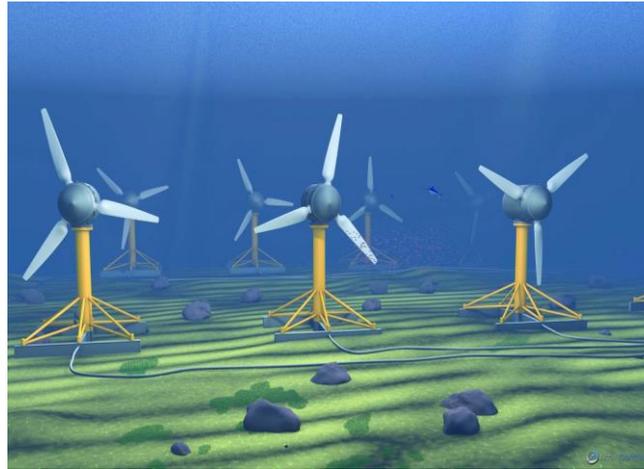


Figure No 4.1:- TIDLE ENERGY

## V. GEO-THERMAL ENERGY

Geothermal energy is thermal energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter. The geothermal energy of the Earth's crust originates from the original formation of the planet and from radioactive decay of materials. The geothermal gradient, which is the difference in temperature between the core of the planet and its surface, drives a continuous conduction of thermal energy in the form of heat from the core to the surface. The adjective geothermal originates from the Greek roots  $\gamma\eta$  (ge), meaning earth, and  $\theta\epsilon\rho\mu\omicron\varsigma$  (thermos), meaning hot.

Earth's internal heat is thermal energy generated from radioactive decay and continual heat loss from Earth's formation. Temperatures at the core–mantle boundary may reach over  $4000\text{ }^{\circ}\text{C}$  ( $7,200\text{ }^{\circ}\text{F}$ ). The high temperature and pressure in Earth's interior cause some rock to melt and solid mantle to behave plastically, resulting in portions of mantle convecting upward since it is lighter than the surrounding rock. Rock and water is heated in the crust, sometimes up to  $370\text{ }^{\circ}\text{C}$  ( $700\text{ }^{\circ}\text{F}$ ).

From hot springs, geothermal energy has been used for bathing since Paleolithic times and for space heating since ancient Roman times, but it is now better known for electricity generation. Worldwide, 11,700 megawatts (MW) of geothermal power is online in 2013. An additional 28 gigawatts of direct geothermal heating capacity is installed for district heating, space heating, spas, industrial processes, desalination and agricultural applications in 2010.

Geothermal power is cost effective, reliable, sustainable, and environmentally friendly, but has historically been limited to areas near tectonic plate boundaries. Recent technological advances have dramatically expanded the range and size of viable resources, especially for applications such as home heating, opening a potential for widespread exploitation. Geothermal wells release greenhouse gases trapped deep within the earth, but these emissions are much lower per energy unit than those of fossil fuels. As a result, geothermal power has the potential to help mitigate global warming if widely deployed in place of fossil fuels.

The Earth's geothermal resources are theoretically more than adequate to supply humanity's energy needs, but only a very small fraction may be profitably exploited. Drilling and exploration for deep resources is very expensive. Forecasts for the future of geothermal power depend on assumptions about technology, energy prices, subsidies, and interest rates. Pilot programs like EWEB's customer opt in Green Power Program show that customers would be willing to pay a little more for a renewable energy source like geothermal. But as a result of government assisted research and industry experience, the cost of

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generating geothermal power has decreased by 25% over the past two decades. In 2001, geothermal energy costs between two and ten US cents per kWh.

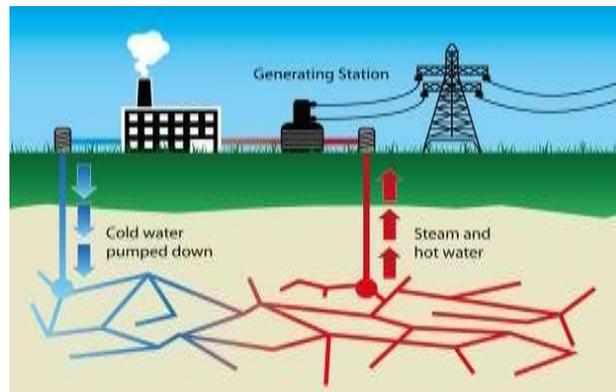


Figure No 5.1:-GEO-THERMAL ENERGY

VI. Energy from Biomass

Biomass refers to all plant material and animal excreta when considered as an energy source. Some important kinds of biomass are inferior wood, urban waste, biogases, farm animal and human waste. Biogas is based upon the use of dung to produce gas which is used as domestic fuel especially in the rural areas. This technique is based on the decomposition of organic matter in the absence of air to yield gas consisting of methane (55%) and carbon dioxide (45%) which can be used as a source of energy. This energy is piped for use as cooking and lighting fuel in specially designed stoves and lamps respectively. It can also be used for replacing diesel oil in dual fuel engines for generation of motive power and electricity. The left-over digested slurry serves as enriched manure. Biogas technology is taking deep roots in rural India because of certain inherent advantages. Biogas has higher thermal efficiency when compared with kerosene, firewood, dung and charcoal. It is observed that the thermal efficiency of gobar gas is 60 per cent while dung, which is commonly used in villages for cooking, has only 11 per cent thermal efficiency. Thus the use of gobar gas fuel is advantageous from the point of view of not only fuel efficiency but also fuel saving.

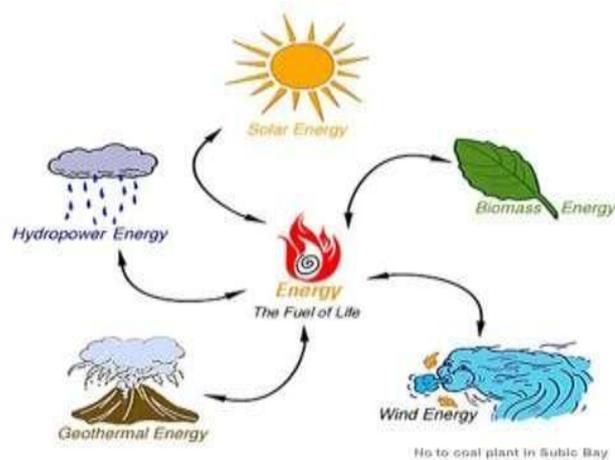


Figure No 6.1:- BIOMASS ENERGY

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