A Brief Study of Alternative Sources of Energy

Mrs. M. Santhi & Dr. A. Mukunthan
Bharath Institute of Higher Education and Research
Chennai – 600073

Abstract :

The Electric energy and natural energy sources play a vital role for domestic purpose and industrial needs in every country. The economic growth of a country mainly depends on the production of electrical energy and other types of energies available from different sources in nature and their usage in different sectors.

The present study briefly analyses the different sources of energy available in nature and their conversion in different fields successfully.

Keywords :

Fossil fuel, wind power, Nuclear power, Hydro power, Solar Power, Biomass

Discussion:

Types of non-renewable resources:

Fossil fuel – produced by burning petroleum products such as oil, coal and natural gas
Uranium – used in nuclear fission to fuel nuclear power plants

Fossil fuel:

What is a fossil fuel?

Fossil fuels are hydrocarbons such as coal, oil and natural gas sourced from the organic remains of prehistoric organisms. When these fuels are burnt, the energy released can be harnessed to produce electricity, power vehicles, heat homes, cook food and much more. They are also used in the production of important materials such as plastics.

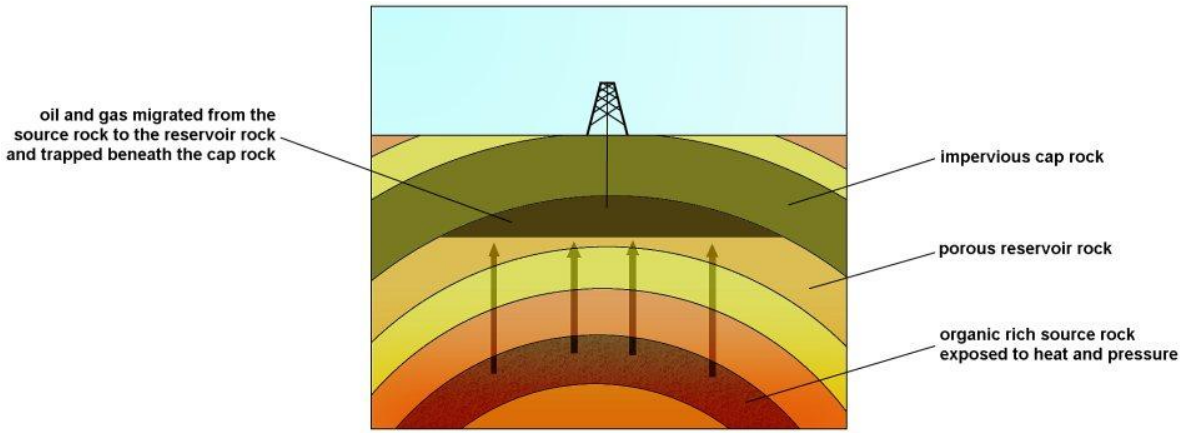
Lump of coal

Liquid petroleum

Gas flame

How do fossil fuels form?

Oil and gas are formed by organic remains of marine organisms. Coal typically forms on land from vegetation in low land, swampy, mire environments.



Will fossil fuel run out ?

Fossil fuels are essentially a non-renewable energy source. The geological processes which create them take millions of years, so they cannot be replaced within human timescales once they have gone. It is impossible to estimate when fossil fuels will disappear, but within the next 100 years it is widely believed that the cost of finding and extracting new deposits will render them too expensive for every use.

What are the advantages and disadvantages of fossil fuel ?

• Straightforward combustion process • Relatively inexpensive • Easily transported	• Thought to be a major cause of global warming • Cause of acid rains • Not sustainable in the long-term. • Politics and economics can cause major price increase • Extraction can be very damaging to the landscape

Can human civilization continue to have comfortable living conditions without fossil fuel?

The answer is changing from NO to YES due to the latest advancement of science and results of research about alternative fuel.

Nuclear Power:

How it works?

Nuclear power generations is to control the nuclear reaction by preventing it lead to an explosion and use its heat to generate electricity. There are two types of nuclear reaction that can be used, which are nuclear fission and nuclear fusion. The most common type that can be found in current applications is nuclear fission. It generates power by spliting Uranium 235. Nuclear fusion generates power using Hydrogen isotopes same as the way which sun generates its heat. There is no proper mechanism to control nuclear fusion yet. Therefore its practical usages are limited.

Advantages and disadvantages of nuclear power:

- The main application of nuclear power is fission and its fuel is Uranium
- Most of the developed countries use this technology to generate electricity. The process can be controlled using reactors.
- The power generating process is safe, yet in the case of malfunction the consequence can be severe.
- Costly to dispose radioactive byproducts.
- No Stable hydrogen isotopes to continue the fusion reaction in a controlled manner.
- However there are no radioactive fuels used, due to that once the reaction is stabilized, it can be used to power up automobiles as well as domestic off grid power generation.
- The fuel can be included in the automobile and will be sufficient for its whole life time.

Different sources of power generation in India:

Source	**Electricity production (MW)**
Thermal power (Solar Energy)	70,200
Hydel power	23,800
Nuclear power	2,700
Wind power	1,150
Biomass power	256

Types of renewable resources – pollution free:

- Wind power
- Hydel power
- Biomass
- Solar radiation

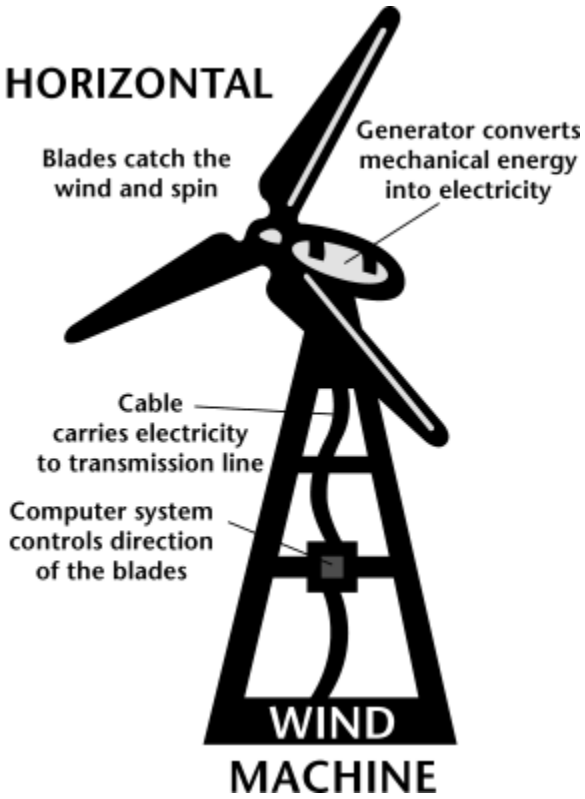
What is wind power?

We can covert the power of the wind, physical energy, to more useful types of energy. The most common type of energy is converted to electricity.

A wind farm is a large area of land in which there are a number of wind turbines to generate electricity, as a power plant does. While creating a wind farm, one must make sure that the spacing between the turbines is sufficient as not to cause energy/wind loss.

How does it work?

The most common type of energy generated from wind is electrical energy. This is by making the use of an electrical generator which is turned by turbine blades which are turned by the wind and thereby turning the turbine, creating electricity.



Is it renewable?

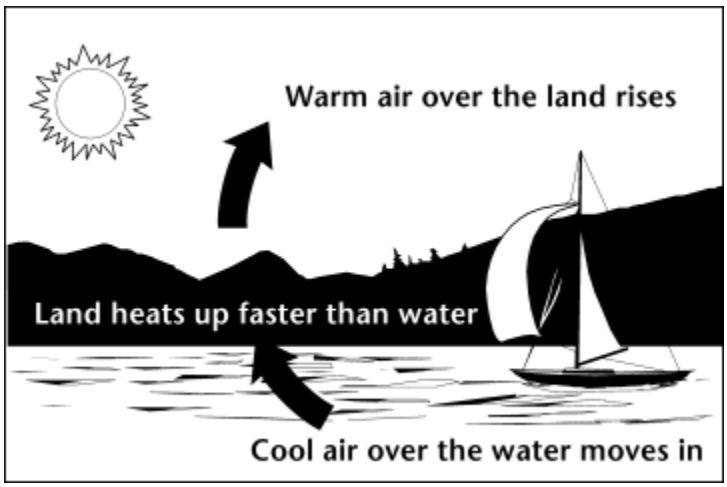
Yes, as we find wind throughout the world and the minimum wind speed needed is from 16km/h upwards. The wind needs to have a constant speed, should be non-turbulent and must not be subject to strong bursts of air. The wind also blows faster the higher into the atmosphere you go. That is why most wind farms are found quite high up.

Applications of wind energy:

There are three types of wind farms:
On Shore
Near Shore
Off Shore

On Shore:

If a wind farm is about 3 Km away from the nearest shoreline it is regarded as an on shore wind farm. They are normally installed in the mountainous areas as the higher you go the faster the wind blows. The cliffs and mountains also contribute to speeding up the wind. Before setting up a wind farm much research has to be done because the smallest difference of placement could even double the turbines' output.



Near Shore:

If a wind farm lies on land within 3 Km to the nearest shore line or lying on the water within 10 Km from the shore it is considered a near shore wind farm. Sea shores tend to be very windy as the land and sea heat up and cool down at different rates, creating strong winds. The wind from the sea is also more denser and therefore carries more energy than the same speed wind in mountainous terrain.

Off Shore:

If a wind farm is more than 10 Km into the sea form a shore then it is considered to be off-shore. Off-shore turbines are found in deep sea waters and are usually much larger than their land-based siblings. The wind over the open sea is considerably faster and stronger than that of land because they have no obstacles in their way such as trees and buildings to affect the wind speed. Their distance from land allows companies to create larger ones and they do not need to worry about any noise factors as they are a considerable distance from the shore. The off-shore wind farms are the most expensive to build as they need to be set in the open ocean where they are subjected to all the earths's elements, therefore raising the maintence cost of off shore wind farms. The cost involved in transferring the electricity from the turbine to the land could be large as there is a large distance to be covered. Off shore wind farms are much larger than the on shore counterparts as there is much more space in the open sea as opposed to land and there are no worries of people complaining about them in the sea.

Airborne:

This is a new concept with no product available as yet but there are companies busy in developing an airborne wind turbine which is suspended high in the atmosphere thereby obtaining the fastest and strongest winds available.

Advantages:

Wind is free and in abundance and we have the technology to capture the power of wind

efficiently. The costs for wind turbines are only initial costs; once the turbine is built there are minimal maintenance costs which are involved. In the rural areas which are not connected to a country's power grid it can be used to generate its own power. The space which a wind turbine takes up on land is very small as the moving parts are quite a distance above the ground. Wind turbines produce energy with minimal damage to the world's environment and produces "clean power".

Disadvantages:

Some pollutants are given off into the atmosphere in the creation of a wind turbine. Wind turbines can be quite noisy. The wind speed is not constant and therefore there will not always be a definite supply of electricity from wind turbine. Large numbers of wind turbines are needed to power towns, as the largest turbine is able to produce electricity to sustain only +/- 500 homes. Many people feel that wind turbines are unsightly and that they should not disrupt the natural beauty of landscapes.

Wind Power in South Africa:

Currently, South Africa does not have any wind farms which supply the national grid, but there are numerous projects to get them up and running. Two pilot projects which involve the use of wind farms to supply the national grid are located at Klipheuwel and Darling both of which lie in the Western Cape. The project at Darling is set to be up and running this year while the wind farm at Klipheuwel is in its first year of its three year experimental stage. The farm at Kilpheuwel which costs R42 million to set up consists of only three wind turbines with the biggest being 60 metres in height and having a blade length of 33 metres. South Africa is regarded as having the potential to become a worldwide wind powerhouse, and with Eskom, South Africa's largest electricity company spending millions on research and setting up wind farms, South Africa's wind power future is looking bright.

Interesting Information:

The wind farm at Klipheuwel in the Western Cape is the biggest wind farm in sub-Saharan Africa. The cost of wind generators has dropped substantially since they were commercially brought into use in the 1990s. The price continues to drop as companies develop better and cheaper ways of creating the wind turbine. The greatest part of the cost involved in setting up wind turbines is the initial capital needed, the wind turbine has zero cost for fuel and the maintenance cost is low when compared to other forms of renewable sources of energy.

Hydro power:

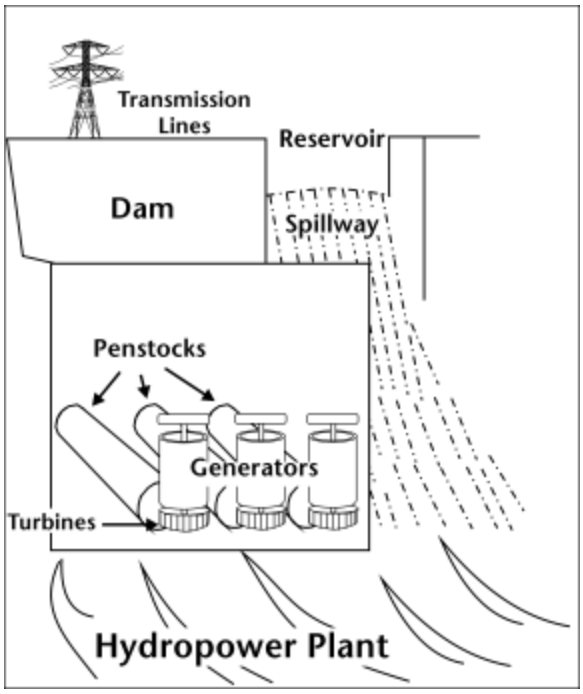
Hydro power is the generation of electricity by using the natural force of water.

The generation of electricity is possible in 3 different ways: hydroelectric power, tidal power, and wave power.

Hydroelectric Power
Tide Power
Wave Power

Hydroelectric Power:

This is the most common form of hydro-power, making up the majority of all renewable energy produced. Electricity is produced by hydroelectric dams in which the force of falling water drives massive turbines. Hydro power is one of the best, cheapest, and cleanest sources of energy with big or small dams. Big dams may have many environmental and social problems as has been seen in the case of the Tehri and the Narmada Projects. Small dams are, however, free from these problems. Small hydropower plants can serve the energy needs of remote rural areas independently.



The dams are built in a place where there is a natural lake or a big river in a valley. Hydroelectric power is produced when water passes through a dam. If more water passes through a dam, more energy is produced. Once a dam is built, an artificial man-made lake is created behind the dam. Electricity is produced by a device called a turbine. Turbines contain metal coils surrounded by magnets. When the magnets spin over the metal coils, electricity is produced. Turbines are located inside dams. The falling water spins the magnets. Turbine is attached to the electrical generator. The generator contains 2 main parts: the rotor and the stator. The rotator is the part which rotates and the wire has a huge magnet inside of it; and the stator is the part which is covered in copper. The electrical current is created when the rotor spins around the copper wire on the stator. This is the charge which is then used as electricity.

Note: Hydro power generation works well in mountainous countries as the water can be stored at very high pressures. The dam wall increases with width as you go down towards the base, this is because the water pressure gets greater as depth increases.

Applications of Hydro power:

Hydro power is also utilized by large scale companies as a private use. Many large mining companies or aluminum manufacturers use vast amounts of electrical so rather than buying from the state they can generate their own power by using hydro power generation.

Advantages:

There is no pollution or waste produced. It's a reliable energy source. It's not expensive to maintain if once the dam is built. It can increase the plant's production or decrease it whenever there is high or low demand. Water can be stored.

Disadvantages:

Building the dam is an expensive and time taking task. The dam changes the habitat and landscape upstream, as much more land will be submersed. The land below the dam is also affected as the flow of water is reduced. Silt can build up in the dam as the water slows down it does not have enough energy to carry the sand .

Tidal Power:

The second most popular type of hydro power, tidal energy is produced by currents caused from the natural ebb and flow of the tide.

Wave Power:

This is the youngest of the three hydropower solutions. The system harnesses the power from ocean surface wave motion, where air displaced by waves is driven through a generator than spins a turbine. The end result is electricity. These

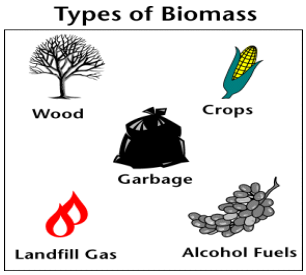
generators can either be coupled to floating devices On the Sea, or fixed along the shore where seas are rough. Although this technology is relatively new, it has been estimated that there is enough energy in ocean waves to produce up to 2000 Megawatts of power.

Biomass:

It's a renewable energy resource derived from the carbonaceous waste of various human and natural activities. It is derived from various sources, including the by-products from the timber industry, agricultural crops, raw material from the forest, major parts of household waste and wood. Biomass is on organic matter that is renewable over time. Biomass is a stored energy for example , during photosynthesis, plants use light from the sun's energy (light energy) to convert carbon dioxide and water into simple sugars and oxygen. It plays a vital part of the waste management infrastructure. It has dual applications such as heat and power generation.

The biomass energy is extracted from three distinct sources:

- Wood
- Waste
- Alcohol fuels
- Crops
- Landfill gases



Wood is the largest energy source of biomass: contributors include the timber industry, agricultural crops and raw materials from the forest.

Waste energy is the second largest source of biomass energy. The main contributors are: municipal solid waste and manufacturing waste.

Alcohol fuels is the third largest contributor and is derived mainly from corn.

Any source can be used to fuel biomass energy production. We can use rubbish, animal manure, woodchips, seaweed, corn stalks and other wastes. Biomass is matter usually thought of as garbage. Some of the sources are just lying around: dead trees, left-over crops, woodchips, sawdust from lumber mills, even used tires and livestock manure will do.

What is the difference between biomass and fossil fuel ?

Fossil fuels are hydrocarbon deposits, such as petroleum, coal, or natural gas, derived from organic matter from a previous geologic time. They are essentially fossilized biomass and differ from present-day biomass in that they come from organic matter created millions of years ago, which has been stored below ground. In other words, the key difference between biomass and fossil fuels is age! Fossil fuels contain carbon that was removed from the atmosphere, under different environmental conditions, millions of years ago. When burnt , this carbon is released back into the atmosphere. Since the carbon being released is from ancient deposits, and new fossil fuels take millions of years to form, burning fossil fuels adds more carbon to the atmosphere than is being removed. Biomass, on the other hand, absorbs atmospheric carbon while it grows and returns it into the atmosphere when it is consumed, all in a relatively short amount of time.

Advantages:

Biomass can be used for fuels, power production & etc. It can be used to generate electricity with the same equipment or power plants that are now burning fossil fuels. It is sensible to use waste products where we can. Biofuels have demonstrated significant benefits. They improve vehicle performance, reduce harmful greenhouse gas emissions, ensure greater energy independence, enhance rural economic development, and protect ecosystems and soils. Biomass fuel generally tends to be cheap. The use of biomass energy has the potential to greatly reduce greenhouse gas emissions.

Disadvantages:

Collecting sufficient quantities of waste can be difficult. Burning the fuel creates greenhouse gases, although only a very little.

Solar Radiation:

Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP).

A solar cell, or photovoltaic cell (PV), is a device that converts light into electric current using the photoelectric effect. The phenomenon of emission of electrons from matter like metals and non-metallic solids, when an electromagnetic radiation of very short wavelength and high frequency, such as ultraviolet radiation is incident on it. Electrons emitted in this manner may be referred to as photoelectrons.

Solar Cells

Solar cells are devices which convert solar energy directly into electricity, either directly via the photovoltaic effect, or indirectly by first converting the solar energy to heat or chemical energy.

The most common form of solar cells are based on the photovoltaic (PV) effect in which light falling on a two layer semi-conductor device produces a photo voltage or potential difference between the layers. This voltage is capable of driving a current through an external circuit and thereby producing useful work.

A typical Solar cell

The Need for Solar Cells

The development of solar cell use in Australia has been stimulated by.The need for low maintenance, long lasting sources of electricity suitable for places remote from both the main electricity grid and from people. The need for cost effective power supplies for people remote from the main electricity grid. The need for non polluting and silent sources of electricity. There is a need for a convenient and flexible source of small amounts of power. The need for renewable and sustainable power, as a means of reducing global warming. Together, these needs have produced a growing market for photovoltaic's which has stimulated innovation.

Advantages:

The sun's energy is free to use, which makes the process cheaper. The process is completely non-polluting. It can be used in a wide variety of locations around the world over.

Disadvantages:

The cost of the panels and equipment is expensive. They can only work when the sun is available; therefore this source is a weather dependant & intermittent.

Conclusion:

In this paper we have discussed briefly about the alternative sources of different types of energies. If we boost up the production of these energies in future and use the different sources of energies available in nature we can reach the goal of self sufficiency in energy required for our country.

Acknowledgement :

The authors are very thankful to Ho. Chairman, Chancellor, Vice-Chancellor and Registrar, Dean (R&D) and Dean (Engg.) for their continuous support and encouragement given to bring out this research paper.

References:

1. Solar Energy by G.D. Rai,S.Chand & Co-publishers
2. Renewable Energy Resources by John Twidell
3. Alternative energy sources by Efstathios E. (Stathis) Michaelides