A Review on Alternate Energy Resources for Pollution Free Smart Environment

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Abstract— The base of human life is energy. It is the capacity to do any kind of work. There is hardly any moment in a day that is independent of energy. Without giving an input energy form, no any machine will operate that cause's production rate to fall down. Therefore, for economic development and production growth of any nation proper security of energy is very necessary. The available energy sources are non-renewable and renewable. Although non-renewable sources cover a huge part of the world electricity demand but due to continuous increment in energy requirements some extra sources are also required. In future, Renewable resources of energy will play very important role to meet all such demands.

Key words: Renewable sources, Availability, Demand, Energy scenario

I. INTRODUCTION

Energy may be accessible in many forms for their usage. The very common energy forms are electrical, mechanical, nuclear, heat and chemical. Depending upon the accessibility of the energy sources to split into following three categories:-

- Conventional and Non-Conventional Energy sources
- Commercial and Non-Commercial Energy Sources
- Renewable and Non-Renewable Energy Sources

Conventional Energy sources include energy from fossil fuels (mainly coal), liquid and gaseous fuel (petroleum and its derivatives) and wood. Non-Conventional Energy sources include energy from sun, wind, tides, biomass, geothermal etc.

Easily functional energy sources in the market with a low account payable price are known as Commercial energy sources while Non- Commercial Energy Sources know those energy sources, which are not easily functional in the market for commercial purpose. Commercial sources form the foundation of economic development of any nation. Some examples of Commercial and Non-Commercial sources are coal, oil, natural gas etc and firewood, agro waste, solar energy etc.

Renewable energy sources are inexhaustible energy sources, which include energy from sun, wind, tides, biomass, hydroelectric etc. These are pollution free sources of energy. Non-Renewable sources are conventional fossil fuels (coal, oil and gas) which will exhaust with time in future.

Following figure shows the different non-renewable and renewable sources of energy and their classification:

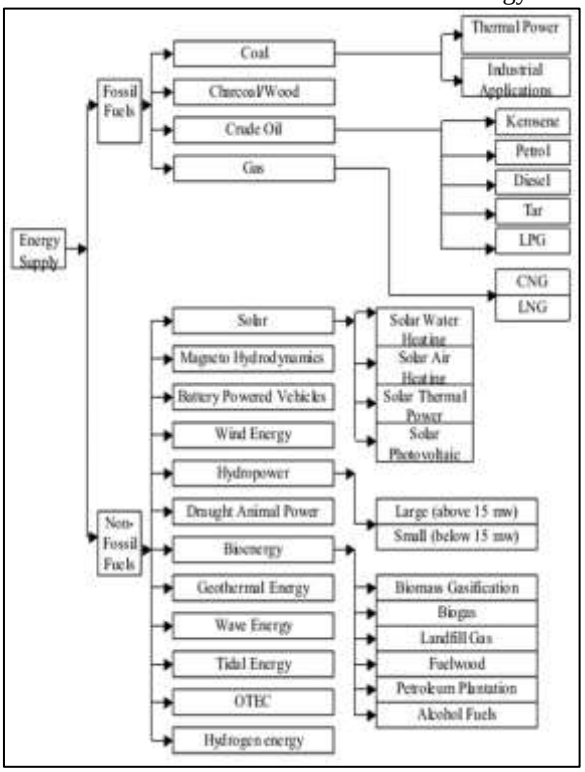


Fig. 1.1: Energy sources and their classification

II. RENEWABLE ENERGY SOURCES

There are following renewable energy sources commonly pre owned in the world:-

- Solar Energy Source
- Wind Energy Source
- Tidal Energy Source
- Biomass Energy Source
- Geothermal Energy Source
- Energy from fuel cells
- Nuclear fusion Energy Source

A. Solar Energy Source

Solar energy makes the consumption of sun's radiation energy. The Earth receives a enormous amount of sun's radiation. It receives about 1.6×10^{19} Units of energy annually, which is more than sufficient for human beings but due to inadequacy of energy storage devices we can't save it properly. If 10% of the total land area is used the available solar power would be 8 million MW which is equivalent to 5,909mtoe per year. India has 2.12 MW of grid connected solar power generation power capacity. India is currently ranked Number one along with United States in terms of installed solar power generation capacity. The mediocre intensity of solar radiations received in India is 200MW/Km square having area of 3.287 million square Km amounting solar potential 657.4 million MW. Whereas 87.5% for agricultural purposes and forest area, 6.7%for housing, industry etc., 5.8% is barren, snow bound or inhabitable. Thus only 12.5% of land owing to 0.413 million Km. square can be practically used for harnessing solar power. There are following two ways of conversion of solar radiation energy into electrical energy:-

- Direct energy conversion from solar to electrical by photo-voltaic cells (PV cells / Solar cells)
- Indirect energy conversion from solar to steam / thermal to electrical by **Drive Turbine generator** units

A Solar cell converts solar radiation energy directly to electrical energy. It is a semiconductor PN junction fabricated with silicone and gallium arsenide or cadmium sulphite etc. When sun's radiation falls on P-type surface, and the pond N terminals are connected to external electric circuit, current flows and electrical energy is generated. These cells are wafer-thin circles or rectangles and have about 3 to 4 inches cross-section.

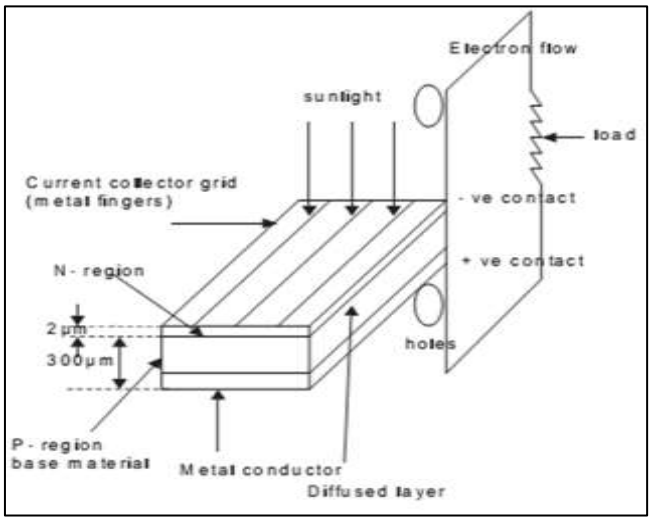


Fig. 2.1: Typical view of a PV cell

A single solar cell exposed to solar irradiance of 1 kW/m^2 has open circuit voltage of about 0.5 V, Short circuit current of about 0.004 A/ cm^2. Several solar cells are connected in series and parallel to get desired output DC voltage and current respectively. The output of a typical PV panel is about 160 W/m^2.

In this conversion process, solar radiation energy is utilize to generate first heat or steam then useful electricity. Solar-thermal turbine-generator units are used for such purpose. Some commonly used configurations of solar-thermal power plant are as follows:-

- Distributed collector type solar thermal power plant
- Binary cycle solar thermal power plant
- Concentrating sun-tracking reflectors with central steam boiler power plant
- Concentrating parabolic reflectors with central steam boiler power plant

B. Wind Energy Source

Wind is caused by motion in air due to pressure gradient. Main reason of this and flow of wind is solar radiation heating of the atmosphere. For electricity generation from wind, wind turbines are used. The concept of kinetics is used in this conversion. A wind turbine converts the kinetic energy of wind motion into mechanical energy transmitted by shaft and a mechanical coupled

generator further converts into electrical energy. A wind turbine operates on the principle of converting kinetic energy of the wind into mechanical energy.

Power available from wind mill = ½ ρA V^3

Where,

ρ– Air density = 1.225 Kg. / m^3 at sea level. (Changes by 10-15% due to temperature and pressure variations)

A – Area swept by windmill rotor = ΠD^2 sq-m. (D – Diameter)

V – Wind speed m/sec

Air density, which linearly affects the power output at a given speed, is a function of altitude, temperature and barometric pressure. Variation in temperature and pressure can strike air density up to 10 % in either direction. Warm climate cut down air density. The main requirement of this energy production is flow of wind. Although the wind is the largest job producer, it is reliant on strong winds, wind turbines are large. They are also very noisy to operate. They also threaten the wild bird population.

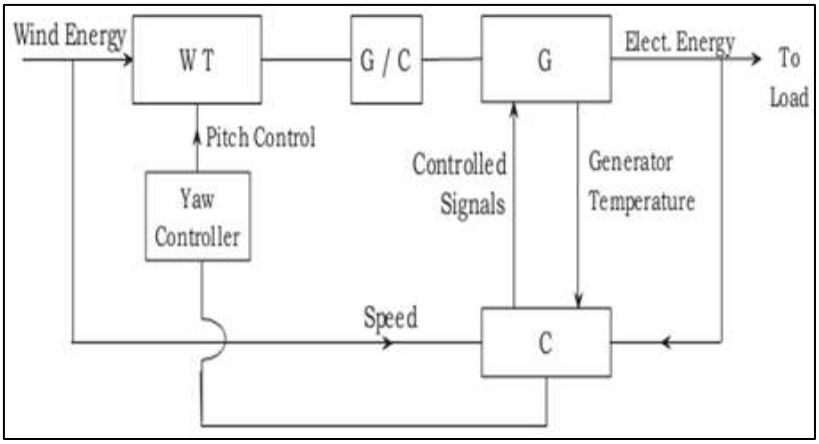


Fig. 2.2: Block diagram of a wind energy conversion system

WT is Wind Turbine that is used to Convert wind energy into mechanical energy

G/C is gear coupling which changes the speed

G is generator, which Converts mechanical energy into electrical energy.

C is Controller which Senses wind direction, wind speed generator output and temperature and initiates appropriate control signals to take control action. Yaw control rotates wind turbine about the vertical axis to get proper output is fifth largest installed wind power capacity in the entire world. India has wind power installed capacity of 157,899MW. Samana wind farm at Gujarat is the largest wind power project by RULON.CLP India.

C. Tidal Energy Source

Tides are caused by gravitational forces of Sun and Moon on the water of revolving Earth. During high tide, the water level of ocean increases and during low tide, this level drops. Moon rotates around earth in 24 hour, 50 minutes. During this rotation, tide rises and falls twice resulting in tidal cycle of 12 hour 25 minutes. Approximately 705 full tidal cycles are obtained annually. Energy generation can be done by tides by constructing a reservoir or basin behind a barrage and then passing the tidal water through turbine in the barrage for electricity production. In this generation schema, mean tidal difference of 5 meters or more is required. There are two types of tidal power plants (i.e. single pool and double pool type). Tidal energy is a clean and abundant energy form. It has higher cost. In addition, Construction and lying pipes can cause damage to the ecosystem.

D. Biomass Enrgy Source

Biomass is an organic matter, produced by plants and their derivatives. It is mainly derived from numerous sources, including the by-products from the timber industry, agricultural crops, raw material from the forest, major parts of household waste and wood. Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as a fuel. It also includes forest crops and residues. As the life of plants renews and adds to itself every year so biomass can be, consider as a renewable energy source. It is an important source of energy and the most important fuel after coal, oil and natural gas. It is very commonly used by the rural people as a major source of energy, mainly in cooking food, which constitutes almost 50% of the total energy consumption. Biomass electricity helps save on landfill waste but transportation can be expensive. In addition, its process needs to be simpler. India has a potential of 16,881 MW (agro-residues and plantations), 5050MW (biogas) and 2700MW (energy recovery from wastes). There are 40 lakh bio gas plants in India. Biomass attracts investments of over INR 600 crores every year generating almost 5000 million units of electricity and yearly employment of 10 million person-days in rural areas.

E. Geothermal Energy Source

Earth's interior is made of hot fluid called as 'magma'. A huge amount of thermal energy is available in the planet earth in the form of magma. The outer crust of the earth has an average thickness of 32 kilometers and below that is the magma. The molten magma contains water, which it releases in the form of steam, which is utilized for electric power generation. Geothermal energy can also be used directly to heat and cool the buildings and it has agriculture application as well. Thus geothermal energy

uses Steam from Earth is interior to generate power. It uses small land areas than other power plants. They can operate every time of the day. Disadvantages are that it is very site specific and along with the heat from the Earth, it can bring up toxic chemicals and gases when obtaining the steam. Drilling of geothermal reservoirs may be an expensive task. India is ranked 15th in world in geothermal power generation. India possesses a potential of 10,600MWof geothermal power.

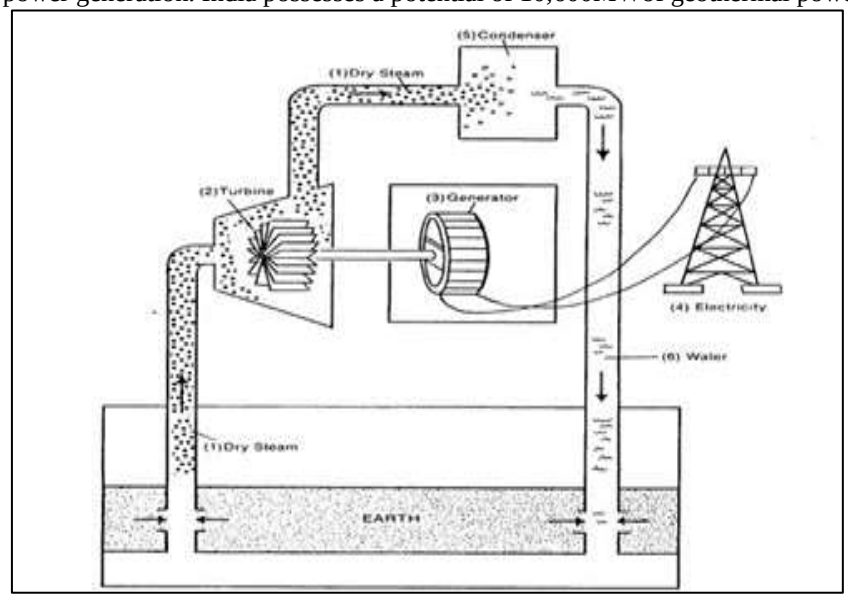


Fig. 2.3: Layout of grid connected geothermal power plant

F. Energy from fuel cells

Fuel cells are electromechanical devices that are capable to convert chemical energy of a fuel directly into DC electrical energy and consist of electrolyte switched between two electrodes. The most common fuel for such cells is hydrogen. Some common applications of hydrogen fuel cells are power generation, in transport etc.

Hydrogen is preferred as a fuel due to following reasons:-

- It is pollution free source.
- It can be produced from any kind of energy sources.

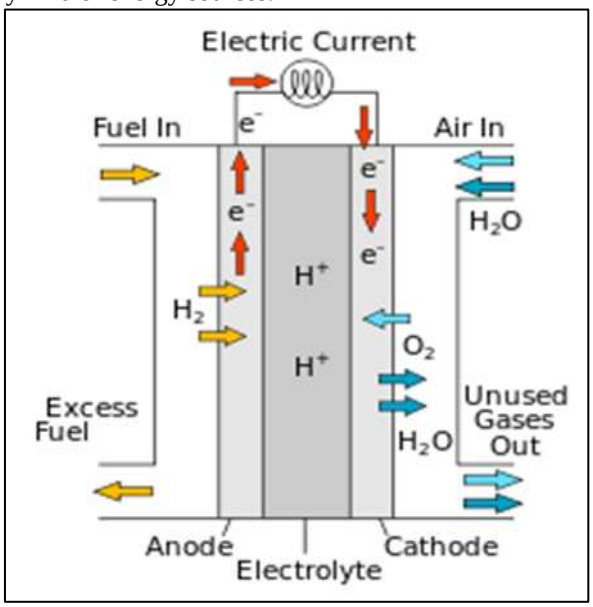


Fig. 2.4: Layout of fuel (Hydrogen) cell

As shown in figure 5 a fuel cell consists of two thin porous electrodes, an anode and a cathode. These are separated by a catalyst coated polymer electrolyte that passes only protons. When hydrogen fuel is applied to flow channel the anode splits into electrons and protons. The electrons travel off via external circuit to power a drive any electrical circuit. The protons migrate through the membrane to the cathode where it combines with returning electrons and oxygen from the air to form water.

G. Nuclear Fusion Energy Source

Fusion energy is a form of nuclear energy, which is released by the combination of two light nuclei to produce heavier nucleolus. Energy produced in the Sun and Stars is a type of fusion reaction in which four nuclei of hydrogen fuse to get one nucleolus of helium and two positrons. It causes very less pollution as compare to nuclear fission energy. In nuclear fusion energy generation,

the basic fuel is Deuterium, which is present in hydrogen in proportion of Deuterium 1 atom in 50 atoms of hydrogen. Thus nuclear fusion fuel would be available in inexhaustible quantities for future energy production. Deuterium, Tritium, Lithium cycle is considered for nuclear fusion power plants. It involves following two reactions:-

$D + T = {}^4He + n$

It gives 4 helium particles with energy of 3.5 MeV and a neutron with energy of 14.1 MeV.

${}^6Li + n = T + {}^4He$; ${}^7Li + n = {}^4He + n$

Tritium generated in the second reaction can be reused in first reaction. For above both reactions kinetic temperature of plasma should be about 15 Kev

III. ENERGY SCENARIO

Type of Sources	% Consumption	Total
Oil	38.3	91.9
Coal	32.5	
Gas	19.0	
Uranium	0.1	
Hydro	2.0	
Wood	6.6	8.1
Dung	1.2	
Waste	0.3	

Table 3.1: consumption of various energy sources in the world

Therefore total percentage energy consumption in the world is approximately 92% from the commercial conventional energy sources and 8% from Non-commercial Non-conventional energy sources. A very huge part of electricity demand is covered by non-renewable sources of energy.

S.No.	Year	Requirements	Availability	Difference
1.	1997-98	323	298	25
2.	2001-02	400	360	40
3.	2006-07	576	484	92
4.	2011-12	872	652	220

Table 3.2: shows the requirements and availability of coal in India (million tonnes)

S.No.	Year	Crude production	Crude import	Petroleum product demands	Self-reliance (%)
1.	1997-98	0.69	0.62	1.68	39
2.	2001-02	0.74	1.57	2.1	33
3.	2006-07	0.8	2.2	2.89	26
4.	2011-12	0.9	3.31	4.06	21

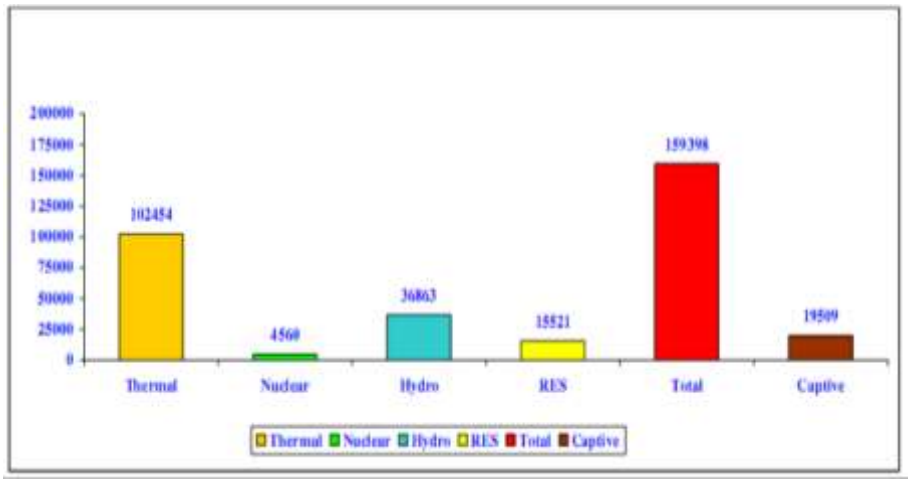
Table 3.3: shows the requirements and availability of oil in India (million barrels per day)

S.No.	Year	Requirements	Production	Difference
1.	1997-98	52.1	49.3	2.8
2.	2001-02	117.8	71.2	46.6
3.	2006-07	167.1	57.5	109.6
4.	2011-12	216.4	43.8	172.6

Table 3.4: shows the requirements and availability of natural gas in India (million meter^3 per day) Above three tables present that the demand rate is increasing continuously whereas production rate is falling down. In near future it will become a big problem for Indian economy. Therefore, renewable sources must be developed.

S.No.	REGION	THERMAL				Nuclear	HYDRO	R.E.S.	TOTAL
		Coal	Gas	Diesel	Total		(Renewable)	(NRE)	
1	North	21275.00	3563.26	12.99	24851.25	1620.00	13310.75	2407.33	42189.33
2	West	28145.00	8143.81	17.48	36306.79	1840.00	7447.50	4630.74	50225.03
3	South	17822.00	4392.78	939.32	23154.60	1100.00	11107.03	7938.87	43300.50
4	East	16895.00	190.00	17.20	17102.58	0.00	3882.12	334.76	21319.46
5	North east	60.00	766.00	142.74	968.74	0.00	1116.00	204.16	2288.90
6	Islands	0.00	0.00	70.02	70.02	0.00	0.00	5.25	75.27
7	All India	84198.38	17055.85	1199.75	102453.98	4560.00	36863.40	15521.11	159398.49

Table 3.5: shows region wise installed MW power capacity of India



Graph 1: shows all India generating MW installed capacity

Country	Gas	Nuclear	Coal	Hydro	Total
USA	566.8	181.9	573.9	60.9	2297.8
Canada	78.7	16.8	31.0	68.6	291.4
France	39.4	99.8	12.4	14.8	260.6
Russia	365.2	34.0	111.3	35.6	670.8
UK	85.7	20.1	39.1	1.3	223.2
China	29.5	9.8	799.7	64.0	1178.3
India	27.1	4.1	185.3	15.6	345.3
Japan	68.9	52.2	112.2	22.8	504.8
Malaysia	25.6	-	3.2	1.7	54.4
Pakistan	19.0	0.4	2.7	5.6	44.8
Singapore	4.8	-	-	-	38.9

Table 3.6: shows the Total energy Consumption in some countries (Million tones oil equivalent)

IV. CONCLUSION

The most common merit of Non- Conventional energy sources is that they are renewable and Coming to the power generation in the country, India has increased installed power capacity from 1362 MW to over 112,058 MW since independence and electrified more than 500,000 villages. This achievement is impressive but not sufficient. It is a matter of concern that 44% of households do not have access to the electricity and as many as 80,000 villages are yet to be electrified.

The electricity supply is not even sufficient for those who have been connected. The country still encounters peak and energy shortage of 7.7% and 12.3% respectively. The anticipated demand as per 16th Electric Power Survey requires an addition of cannot be exhausted. They are a clean energy, as they do not pollute air, do not contribute to global warming or greenhouse effects. Their sources are natural so the cost of operation is reduced and they also require less maintenance on their plant. A common disadvantage to all is that it is difficult to produce the large amount of electricity. The cost of initiating them is also high.

Economic growth of any nation requires proper energy generation and consumption. Conventional and Non-Conventional sources of energy have their own advantages as well as disadvantages. Non-conventional sources are clean and future resources whereas conventional sources will be exhausted in near future. Proper energy saving and management is the best source of energy which will cause use of energy as long as possible.

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