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A COMPREHENSIVE STUDY ON SOURCES OF ENERGY FOR FUTURE DEVELOPMENT

P. V. Ramana
Associate Professor, Mechanical Engineering Department, CVR College of Engineering- Hyderabad, Telangana

Abstract:

Every living organism on the planet earth needs Input of energy .Energy is the basic requirement for economic development of any country. Energy is an important input to every sector of the nation for its development. Agriculture, Industry, Transport, commercial and domestic fields needs energy. Thus energy is the life line and driving force of civilization and out most care should be taken for its efficient production and utilization. The production of electrical energy and its consumption is directly related to the level of living standards of the people of the country can be directly related to per capita energy consumption.

Due to increased population, urbanization and transportation day to day consumption of fossil fuels increased drastically in the recent years and also causing environmental damage. At present 70% of Energy production in the world is from fossil fuels (coal, oil and gas). Since the deposits of fossil fuels are depleting day by day in faster rate, due to burning of fossil fuels, emission of CO_2 increased and caused for the green house effect by the owing the earth's temperature is increasing and as a result many low lying areas near the sea will be drowned owing to melting of glaciers, if the earth's temperature increased by 4^0 C due to global warming.

Efficient use of energy could be achieved on the basis of a genuine energy strategy and the future of energy should be linked to the more efficiency less vulnerable and environmentally sustainable source of energy. Scientists and engineers are engaged in searching out new energy resources, especially non-conventional sources like solar energy, wind energy, geothermal and tidal energy and also renewable sources, energy converting devices as new resources for development.

Key Words: Solar Energy, Wind Energy, Renewable Sources, Biomass, Geothermal & Tidal Energy

Introduction:

Energy is the back bone of modern civilization. The gap between energy demand and supply is widening. In order to reduce the gap one of the Novel way is to conserve energy. Energy conservation increases the production from the given amount of energy in put by reducing losses or wastage and maximizing the efficiency .December 14^{th} is National Energy conservation day (world's Energy day)

As per the known reserve of fossil fuels, coal will decline after 250 years, oil and gas will decline after 50 years and 70 years. The conventional source of energy such as coal, oil, uranium etc., are depleting very fast and the demand of energy is increasing rapidly, there is an acute shortage of energy in near future

Example: energy consumed in 1990 is around 41.65 x 10^{12} KWh as compared with energy consumed in 1960 which is 13.17 x 10^{12} KWh. so year to year energy need is exceeding the energy generation. The demand for energy and electricity increases steadily. The international energy agency (IEA) has predicted that the energy and electricity demand in the world will increased by 1.7% to 2.4% per every year respectively from year 2000.if this trend continue the expected availability of fossil fuels are not more than 200 years.

All the resources available for energy are used with maximum possible efficiency and high standard of conversion is to be achieved in short time. It is responsibility of scientists and power engineers to develop new resources of energy and new methods of energy conservation. Energy conservation can be defined as the substitution of energy with convenience. The conservation of energy involves s rational and scientific use of energy. It implies suppression of wastage in the use of energy to have more products with the same input energy. i.e curbing wastage and increasing efficiency of a given amount of fuel.

So this is the period to explore the usage of other sources to increase the available span of fossil fuel reserves and to control the consumption. So the increased awareness in the public on the exponential growth of energy consumption and the rapid depletion of our Natural resources, the lagging development of new energy resources and Technological advancements and the growing public and institutional demands for energy and environmental protection have forced the various countries to look forward to a more rational plan for energy economy and conservation of energy sources. Therefore all the resources available for energy generation are to be used with maximum possible extent to meet the demand raised by the consumers, so renewable energy is source without depleting, to meet the acute shortage in future. And also worldwide there is a great concern for environmental pollution due to the ever increasing use of fossil fuels and rapid depletion of these resources. This led to the development of alternative sources of energy, which are renewable and environmental friendly.

Now there is a need of sustainable energy which ensures constant supply of energy without or very less environmental pollution because of following merits

- ✓ Plenty Availability
- ✓ No Pollution
- ✓ In Exhaustible
- ✓ Low Gestation Period

As a result many government and private agencies have initiated broad studies of projected energy consumption and the possibility of conserving energy while enhancing the quality of environment.

1. Energy Resources:

Energy sources categorized as

1.1 Non- Renewable Energy Sources: Which are finite and cannot be renewed after their consumption is known as non renewable energy sources

Examples: fossil fuels, uranium

1.2 Renewable Energy Sources: Which are renewed by nature again and again and their supply is not affected by their rate of consumption known as renewable

Example: solar, wind, biomass, ocean (thermal, tidal and wave), geothermal, Hydro etc., They don't pollute the atmosphere.

1.3 Based on Traditional Application: Power plants can be classified under the groups of conventional and non- conventional categories of energy

A) Conventional Energy: energy resources which have been traditionally in use before and around oil crises (1973) known as conventional energy resources.

Conventional Power Plants:

- ✓ Steam power plants
- ✓ Gas power plants
- ✓ Hydro electric power plants
- ✓ Nuclear power plants

- ✓ Gas/steam combined cycle power plants
- ✓ Binary vapor power plants

B) Non-Conventional Energy Sources: Energy resources which are considered for large scale use after the oil crisis 1973 known as non-conventional energy sources. Non-conventional energy sources being located in tropical region. India is blessed with abundance of renewable energy resources such as solar, wind, biomass, Hydro, geothermal, etc. As mentioned earlier, the main focus world over is towards renewable energy for energy security, so India is also striving hard to harness these energy through its various programmers. It is worthy to note that India has potential to generate more than 10^5 MW from Non –conventional energy sources. At the end of 1999 the total contribution of renewable energy was 2414 MW that reached to 13,876.46 MW in 2003 March 2009 with 4% contribution on non- conventional energy to grid.

Non-Conventional Power Plants:

i) Direct Energy Conversion System-Plants

- ✓ Thermoelectric energy -plants
- ✓ Thermionic energy -plants
- ✓ Fuel cell energy -plants
- ✓ MHD (magneto hydro dynamic) energy –plants

ii) Indirect Energy Conversion System-Plants

- ✓ Photo voltaic cell (solar cell)-plants
- ✓ Bio mass-plants
- ✓ Hydrogen energy-plants
- ✓ Electric storage Batteries-plants
- ✓ Geo thermal energy-plants
- ✓ Wind energy –plants
- ✓ Tidal wave-plants

2. Solar Energy:

Solar energy is a renewable form of inexhaustible energy for all living creatures on earth planet. This energy can be utilized by using thermal and photovoltaic conversion system solar radiation known as solar constant is about is 1367 W/m^2 expressed by NASA (national aeronautics and space administration) outside the atmosphere but the average energy received on the earth is 800 W/m^2. It is worth to note that the earth continuously intercepts solar power of 178 billion MW daily which is about 10,000 times the world demand of electricity. So we have a scope to study /use the solar energy for the increased demand of electric energy. So far it has been harnessed in a very small percentage. It is estimated that if all the buildings of the world are covered with solar PV panels, the whole requirement of world's energy will be met. But, the solar PV power is till date very expensive.

India being a tropical country receives enough solar energy which can be harnessed. As per estimate India receives solar energy equivalent to 5000 trillion KWh per year which is more than the total energy consumption.

The daily global radiation is around 5 KWh/m^2 per day and the bright aspect with India is that sun shine during 2,300 to 3,200 hours per year in its most parts. As a result government of India has embarked upon to harness solar energy at a rapid rate. There are three methods to harness solar energy as given below;

- ✓ Solar photovoltaic system program
- ✓ Solar thermal energy system program
- ✓ Space based solar power (new concept)

a) Solar Photovoltaic System Program: solar photovoltaic system is a highly developed commercialized one and now it is so common that in remote villages also, the system has been installed. Indian government is promoting solar energy in the form of solar lanterns. Home lighting systems, street lighting systems, solar water pumps and power plants. The total SPV installed ill India is around 160 MW and as a result India ranks fourth in the world in harnessing SPV system after Japan, USA and Germany. 100 KW and 200KW SPV systems have been installed in some parts of country.

b) Solar Thermal System Program: solar thermal power plant is harnessed by three methods namely solar concentrated system, distributed system and solar pond. In India, now use of solar energy for water heating, cooking, drying and space heating through various schemes are in common use .In order to promote the solar water heating system, Bangalore has declared as a solar thermal city. It is worth to note that a project of 140 MW is under consideration under integrated solar combined cycle (ISCC) in Jodhpur district in Rajasthan. 35 MW will be generating by solar energy while rest 105 MW is to be generated by fossil fuel (regasified liquefied, natural gas) .A 100 MW solar power plants using solar concentrated system is under development. Reliance ADAG is going to install 500 MW of solar energy plants (PV and thermal systems) in India. At present, the capital cost of solar PV system is Rs.10 crore/ MW as compared to Rs. 6 crore/ MW for coal based power plant. It is expected that with further research in PV system, the cost will come down .solar energy is already being used economically in many advanced countries both for domestic and commercial purposes such as water heating ,water distillation, refrigeration, dying ,etc

3. Studies on Solar Power:

3.1 Solar Power Panels

The solar panels are erected on the Top of the college Building. The solar panels categorized as

- ✓ Mono crystalline solar panel
- ✓ Poly crystalline solar panels
- ✓ Thin film technology panels:

As i) amorphous silicon ii) cadmium Telluride (C_dT_e)
these panels are having photo voltaic cell(Solar cells).photovoltaic cell is a device which converts solar energy in to direct electric energy

Figure 1: Details of Solar panels

Solar Cell (Silicon Cell):

Modern solar cells make use of semiconductor based silicon. The general configuration of solar cell is to make p-n junction. p-n junction is obtained by diffusing n-type S_i (0.2µm thick)with p-type S_i of about 300µm thick. Metal electrode made of (T_i

–A_g) alloy are attached to the top and bottom of the cell. The bottom is completely covered with metal electrodes while the top side electrode is made in the form of fine grid of narrow metal fingers which permits the sun light to go through an anti-reflection coating of 0.1 µm thick is applied on the top of the cell. The sun light strikes the upper surface of the cell; some photons are absorbed near the junction of two layers. This generates e.m.f and if the two electrodes are connected through the external circuit a current flow. Photo voltaic cell generates DC supply. However it can be converted to AC of required voltage by power conditioning unit (PCU).

The details of solar panel as follows:

Solar semi-conductors SSI-S6_230
Tested at STC (1000 W/m^2 AM 1.5, 25^0 C)
Rated power: 230 Wp(Tolerance ± 3%)
Vmp; 29.04 VImp: 7.94 A
Voc: 36.5 VIsc: 8.54 A
Series fuse ratio: 15 ADiode rating: 15 A
The approximate life of solar panel is 25 years.
The cost of solar panel is Rs. 11000 /-

3.2 Power Conditioning Unit:

Details of power conditioning unit as follows
Product type: 3P-OD-25K-230-50-240-23KW
Model number: GSC 25 KVA (900569-01)
Output power: 25 KVA
Output AC voltage: 415V, 3Ø, 50 HZ
Battery voltage: 240 V DC
Series number: 1563

Figure 2: Power controlling unit details

Name Plate Details of Power Controlling Unit:

Mfd. By optimal power synergy India Pvt.ltd
#197,12th Main,3rd phase, peenya Industrial Area
Bangalore-560058(India)

3.3 Solar Batteries:

There are many companies are supplying solar batteries but the institute using" AMARAJA BATTERIES LTD (AMRON) Made in India "company batteries.
The unit cost of battery =15000/-

Figure 3: Solar Batteries

4. Wind Energy:

The air movement on the earth surface is caused by the unequal heating of the land and water by the sun. The temperature gradient induce the circulation of air from high pressure zone to low pressure zone .this movement of air is referred as wind. Wind energy is replenishable source of energy and can be used for irrigation and lighting. Wind mill involves the conversion of kinetic energy of the wind in to mechanical energy that can be utilized to perform useful work or to generate electricity. Many types of wind mills have been designed and developed. They are classified as

- ✓ **Horizontal Axis Wind Mills**
  - Multi blade type wind mill
  - Sail type wind mill
  - Propeller type wind mill
- ✓ **Vertical Axis Wind Mills**
  - Savonius type wind mill
  - Darrieus type wind mill

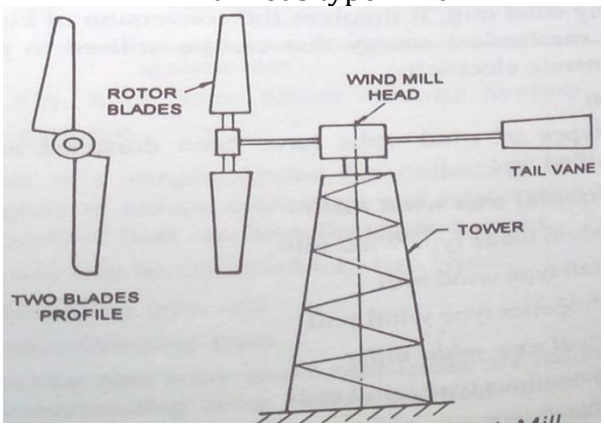

Figure 4: Horizontal Axis Wind Mill

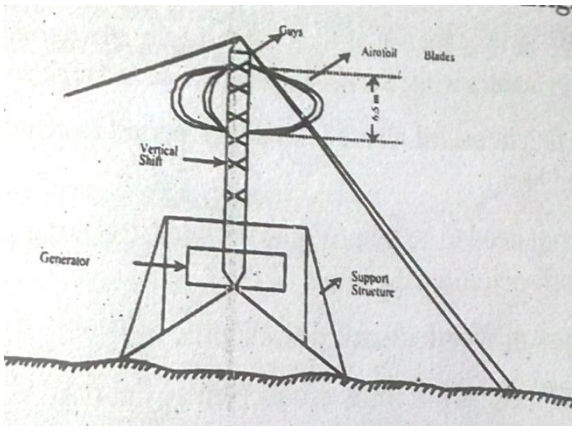

Figure 5: Vertical Axis Wind Mill

Surface wind data on a national or regional basis is usually presented in the form

1. Isovents: contours of constant average wind velocity in m/s. this data is presented in the form of wind map in which the mean annual velocity zones are marked.

2. Isodynes: contours of constant wind power, in watts/m^2 . This data is represented in the form of maps showing available yearly average wind power.

Government has a very big dream to harness wing energy on a very large scale. The program was started in 1983-84. India has achieved a milestone by acquiring 5th rank in the world among countries having large installed capacity wind generator after

Denmark, USA, Spain and Germany. The leading company of wind generation in India is suzlon and she is providing expertise to other countries such as Turkey, Egypt, Phillippines and Vietnam, etc., by 2008.India could be able to generate just 9755 MW most of the wind generators are located in coastal areas such as Tamil Nadu, Gujarat and Maharashtra.

Wind power has been used in many centuries to sail vessels, pump water, and grind wheat and corn. At the turn of the present century nearly 30,000 house mills capable of producing a total of 100 MW and 3000 industrial wind mills generating an another 100 MW will be in operation in Denmark.

Table 1: Wind power Generation Countries

S.No	Country	Generation Capacity (MW)
1	Germany	10,650
2	USA	1,329
3	Spain	4,039
4	Denmark	2,515
5	India	1,507
6	Italy	755

About 2% of the solar power in the form of radiation reaching to the earth is converted in to wind .Every year the winds provide 26,000 TKWh, of which at least on-third is recoverable . A mere 1% of the worlds wind resources could meet the entire energy needs of the world but its harnessing is a costly affair.

5. Biomass Energy:

Bio gas is produced from organic matter by the process of Photosynthesis (biological conversion of solar energy in to chemical energy which produces biomass. Biogas contains methane (CH4=55.65%, carbon dioxide (CO_2=30-40%) with the traces of hydrogen sulphide (H_2S).The bio mass produced for cow dung from which the biogas is produced can be used as fertilizer.

Energy resources available from animals and vegetation fall under the category of biomass energy. These are renewable energy sources and it is supposed that biomass energy resources don't produce any pollution as CO_2 released due to combustion of plants will be absorbed by plants which are renewable in nature. These are very important source of energy developing countries like India and it can be mixed with fossil diesel from 10% to 20% India, being an agricultural country, has a large quantity of biomass in the form of dry waste agro-residues, fuel wood, twigs, etc. and wet waste like cattle dung, organic effluents, sugarcane bagasse, banana steam etc. it is worth to note that potential for generation of electric power from agro residue and plantation is 16,881 MW while potential through cogeneration using bagasse is 5000 MW and that from waste is 2700 MW. Energy farming has a great potential in India through which bio-diesel are extracted from some plants (Jatropha). A large quantity of bio-diesel are being produced .It is worth to note that plants and trees grow absorbing solar energy through photo synthesis process which is estimated to be around 2x1018 KJ. Further, biomass resources may be used to produce bio fuels such as biogas (methane), producer gas, ethanol, biodiesel, etc. World over there are millions of biogas plants especially in China and India

The biomass energy resources include the following.

- ✓ Trees (wood leaves and forest industry waste)
- ✓ Plants (stem leaves and roots)
- ✓ Algae and other vegetation from ocean and lake
- ✓ Urban waste (municipal and industrial waste)
- ✓ Rural waste (agricultural and animal waste crop residues)

6. Geothermal Energy:

Geo thermal energy is primarily energy from the earth's own interior in the form of internal energy. Vast natural heat stores lie beneath the earth's crust. It is recoverable in the form of steam or hot water. These are used for electric generation, space heating, cooking and medicinal purposes. The main locations of geothermal energy are USA, Italy, Japan and New Zealand. By 2008 worlds total installed power generating capacity from geothermal resources is about 8100 MW and direct thermal use installed capacity is around 17000 MW. The growth rate of geothermal power is around 7%. It is worth to note that island of Hawaii generates 25% of its electricity from geothermal resource. The oldest geothermal eclectic power station, located at Lordasello, in Italy and commissioned in 1904 is presently producing 460 MW. In EI-Salvador is producing 30% of total electric requirement by geothermal energy. It is estimated that if the earth's crust is cooled by 1^0C, the whole world will be getting energy for 20,000 to 50,000 years but nobody knows about the ecological imbalance due to this.

7. Tidal Energy:

Tide is a period of rise and fall of the water level of sea. Tides are caused by the interacting forces of the gravitational pulls of the moon and sun. The moon is approximately twice as effective as the sun in causing tides. The difference between the high and low water level is called the range of the tide.

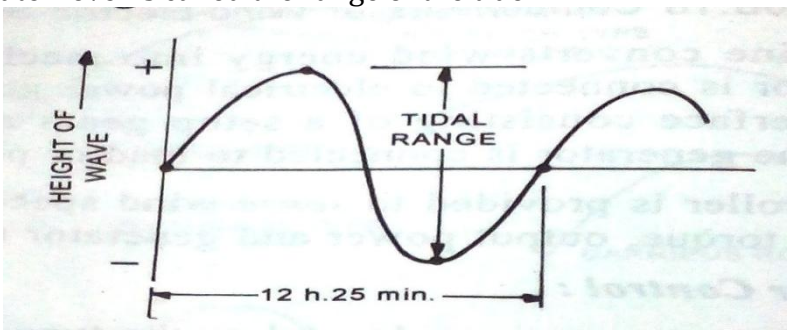

Figure 6: Tidal Wave

The power generation from tides involves flow between basins on sea. Two or more basins are provided in order to generate continuous power. The basic scheme arrangements for generating power are

- Single basin arrangement
- Double basin arrangement

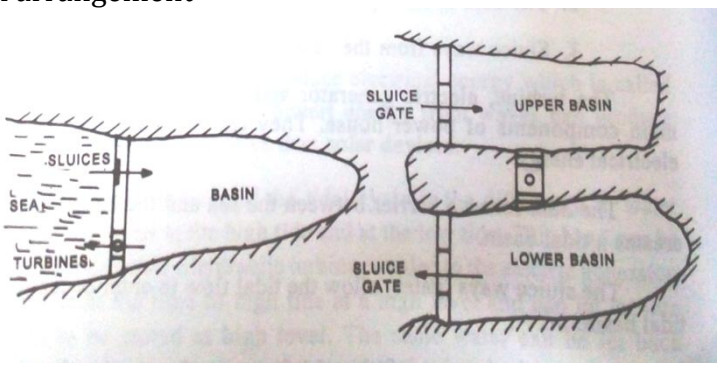

Figure 7: Basin Arrangement

Tides are the joint action of sun and moon on the earth. The potential is estimated to be very high and of the order or 1.2 x10^3 MW. There are only a few working plants world over. The first and the largest tidal built in 1996 by France at the mouth of La Rance river near St Malo on Brittany coast produces 240 MW. A 400 MW plant is located at Kislaya, Cuba. In Canada, there is a 20 MW plant at Nova Scotio.

8. Precautionary Measures and Suggestions:

Avoid the wastage of energy both at institution and Industrial level by suitable conservations methods, conducting energy audits to find out energy losses.

- ✓ Rooms must be constructed with good ventilation of sun light to save power by avoiding usage of lights during day time.
- ✓ Avoid ideal running of fans and lights
- ✓ Adopt latest technologies to save power by use incandescent bulbs filled with krypton. Replace conventional GLS bulbs by CFL bulbs which save 80% of energy for the same light output at the same time CO_2 emissions reduce by 80%.
- ✓ Remote controlling devices /sensors to be provided for better control of power usage.

9. Conclusions of Solar Plant:

At present the capital cost of solar PV system is more as compared to coal based power plant. Solar power unit production cost is much higher than the production cost unit power by other sources. So it is not at all economical at present stage but in near future cost of conventional fuels will be raised due to non-availability of fuel because of increasing cost of petrol year to year. this is due to increasing the demand year to year and also due to faster rate of depleting conventional fuel sources .so in near future there is no way to get power other than renewable sources. Renewable sources may be considered as a major source of power after depletion of the conventional (non-renewable) energy sources. Meanwhile latest technologies must be applied for further improvements by R&D to bring down the cost of solar production for common use. Now it is a challenge to our scientists to bring down the manufacturing costs of solar panels and batteries to the acceptable level .we may expect in near future this cost may equal to hydroelectric cost and common man may also use solar power because of increasing the cost of conventional power and reducing the cost of non-conventional sources. Solar energy is already being used economically in many advanced countries for both domestic and commercial purpose such as water heating, water, distillation refrigeration, dying etc, At present lot of improvements are going on by research and development by adopting new technologies to bring down the cost to a reasonable level for the usage of common men.

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