

Environment Friendly Generation Technologies

Prof.Prasannati.A.Kulkarni

(Asst.Prof.) K.C.college of Engg.Thane(E),Mumbai,India

ABSTRACT: Electricity generation is the process of generating electric power from other sources of primary energy. The fundamental principles of electricity generation were discovered during the 1820s and early 1830s by the British scientist Michael Faraday. His basic method is still used today. Global environmental concerns are leading electric power researchers around the world to develop advanced processes and technologies for a sustainable & reliable power supply. Furthermore, growing awareness of the impact of greenhouse gas emissions on global climate has necessitated a reassessment of conventional approaches to achieve a sustainable power supply. Using more environmentally friendly and renewable energy sources would bring big reduction of greenhouse gas (GHG) emissions and subsequently would improve the climate. Increasing negative effects of fossil fuel combustion on the environment in addition to limited stock have forced many countries to explore and change to environmentally friendly alternatives that are renewable to sustain the increasing energy demand^[1]

KEYWORDS: PV-photovoltaic; GHG-greenhouse gas; tidal power; natural gas; geothermal energy

I.INTRODUCTION

The electricity supply industry is undergoing major changes worldwide. In the evolving industry environment, the challenges are to produce, transmit, and use energy in an environmentally friendly manner, to reduce costs by improving operating efficiency and business practices, and to enhance the reliability of and quality of power supply. Research, development and application of new technologies plays a major role in shaping future directions of electric power systems.^[2]

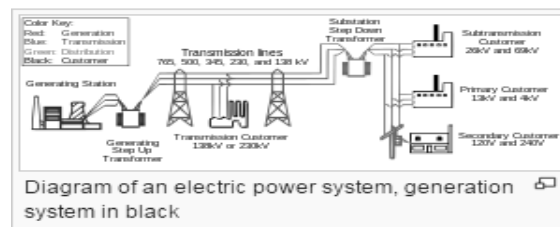


Fig.1 Electricity Generation

Central power stations became economically practical with the development of alternating current power transmission, using power transformers to transmit power at high voltage and with low loss. Electricity has been generated at central stations since 1882. The first power plants were run on water power or coal, and today we rely mainly on coal, nuclear, natural gas, hydroelectric, wind generators, and petroleum, with a small amount from solar energy, tidal power, and geothermal sources. Almost all electrical power on Earth is generated with a turbine of some type. Turbines are commonly driven by wind, water, steam or burning gas. The turbine drives an electric generator.

Main Power sources include: (first generation technologies)

1) Steam: Water is boiled by coal burned in a thermal power plant, about 40% of all electricity is generated this way. Either steam under pressure emerges from the ground and drives a turbine or hot water evaporates a low boiling liquid to create vapor to drive a turbine.

2) Gas/diesel: Natural gas is burned in a gas turbine, turbines are driven directly by gases produced by combustion. Combined cycle are driven by both steam and natural gas. They generate power by burning natural gas in a gas turbine and use residual heat to generate steam. At least 20% of the world's electricity is generated by natural gas.

3) Water: Energy is captured from the movement of water. From falling water (dam), the rise and fall of tides or ocean thermal currents. Each driving a water turbine to produce approximately 16% of the world's electricity.

4)Nuclear:- energy generated using nuclear material like uranium and thorium in a reactor by making use of chain reaction. High speed electrons are bombarded on uranium rods to generate electricity.

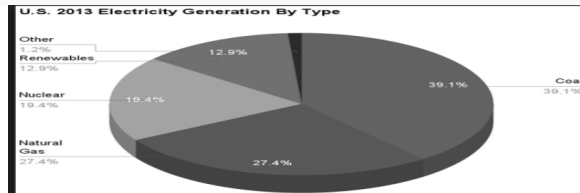


Fig2.Electricity generation by type

A] Day by day the conventional sources are getting depleted so one has to rely compulsory on renewable/nonconventional sources. These are not only eco friendly but also cost effective as compared to the above said sources. So in coming future we have to rely on these sources of energy for the generation as well as utilization purposes.

B] The environmental impact of electricity generation is significant because modern society uses large amounts of electrical power. this power is normally generated at power plants that convert some other kind of energy into electrical power. It is true to the fact that the conventional sources like nuclear, thermal, diesel are getting replaced by following renewable

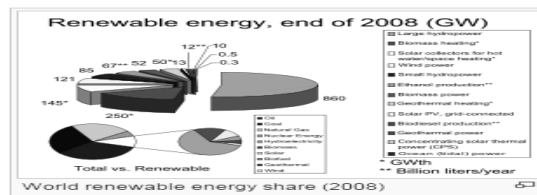


Fig.3 Renewable energy share

Renewable energy: Renewable power technologies can have significant environmental benefits. Unlike coal and natural gas, they can generate electricity and fuels without releasing significant quantities of CO₂ and other greenhouse gases that contribute to climate change, however the greenhouse gas savings from a number of bio fuels have been found to be much less than originally anticipated, as discussed in the article Indirect land use change impacts of bio fuels. Renewable intensive bulk power system planning and operation considerations are getting high importance due to huge pressure imposed by environment-friendly policies and uncertainties in the fossil-fuel based investments[3].Some of the natural and eco friendly resources which are called second generation technologies,1) Water 2) Tidal 3) Biogas 4) Biomass 5) Geothermal 6) Wind 7) Solar

C] Energy and environmental issues ^[4]

Energy scenario:-energy has been a life blood of continual progress of human civilization. Since the beginning of Industrial Revolution the around two centuries ago the global energy consumption is increased by leaps and bounds to accelerate the human living standard. Particularly in industrialized areas of world. Per capita energy consumption is the main factor in the Prosperity of the nation’s economy. USA has highest living standard in the world. It consumes 25% of total energy having only 5% of world’s population. Japan also consumes 5% of total energy for 2% of world’s population. And India and china together consumes 1/10th of that USA for 38% of world’s population. Until now the energy generation was by fossil fuels, which is going to deplete in coming years so the usage of renewable has to be compulsorily increased.

Environmental issues:-Environmental pollution and safety problems contributed by increased energy consumption are recently becoming dominant issues in our society. Eg. Nuclear power plant has safety issues, radioactive creation and its waste disposal are the major issues. Burning of fossils generates harmful gases like CO₂, SO₂,NO₂,CO etc. along with ash fly, acid rain and urban pollution. this all causes global warming. This affects the vegetation and agriculture sector. So how can this be mitigated? By using the natural resources which help in producing clean and sustainable energy.

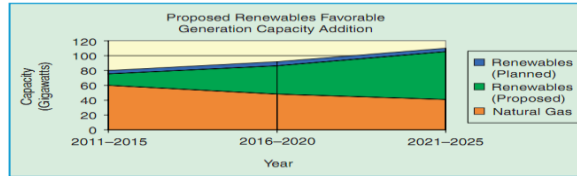


Fig.4 Proposed renewable for favorable generation capacity addition.

Long term growth of renewable energy sources should be market driven by providing an alternative clean energy source for consumers and through aggressive technical and market development.^[8]

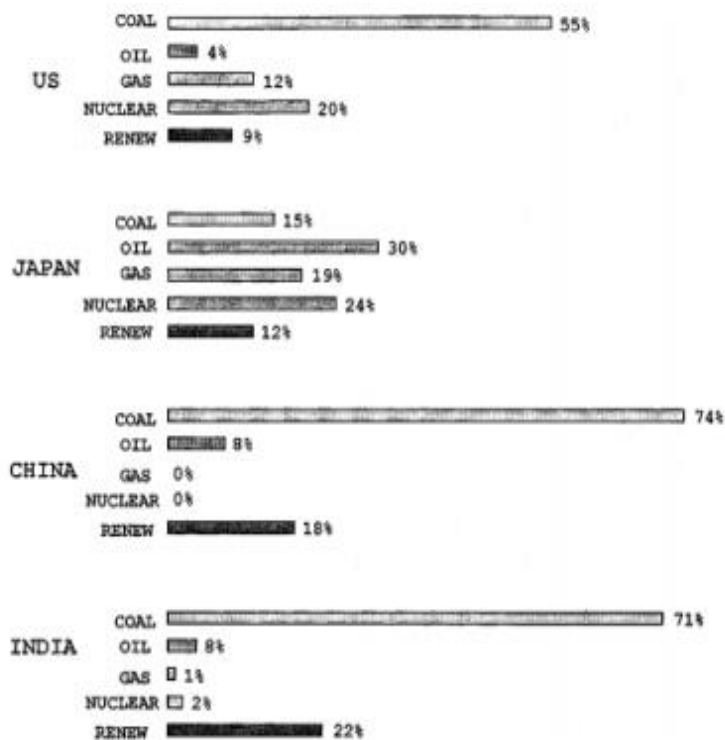


Fig.5 Generation by fuel type

II.RENEWABLE SOURCES

A] Hydroelectricity:-The major advantage of hydroelectric systems is the elimination of the cost of fuel. Other advantages include longer life than fuel-fired generation, low operating costs, and the provision of facilities for water sports. Overall, hydroelectric power can be far less expensive than electricity generated from fossil fuels or nuclear energy, and areas with abundant hydroelectric power attract industry. butl disadvantages of hydroelectricity systems. are dislocation of people living where the reservoirs are planned, release of significant amounts of carbon dioxide at construction and flooding of the reservoir, disruption of aquatic ecosystems and birdlife, adverse impacts on the river environment, Hydrogen based electric systems can be used as a substitute for large battery banks in distribution systems, especially in applications where there is a big concern for environmental safety^[5]

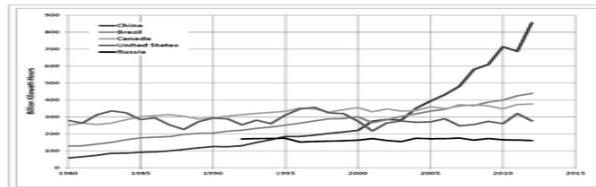


Fig.6 Trends in top 5 hydroelectricity countries

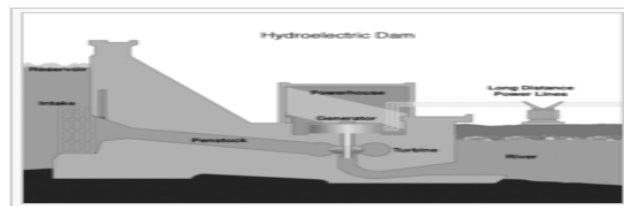


Fig.7 Cross sectional view of dam

B] Tidal energy

Tidal power, also called tidal energy, is a form of hydropower that converts the energy of 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. However, many recent 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. The world's first large-scale tidal power plant is the Rance Tidal Power Station in France, which became operational in 1966.

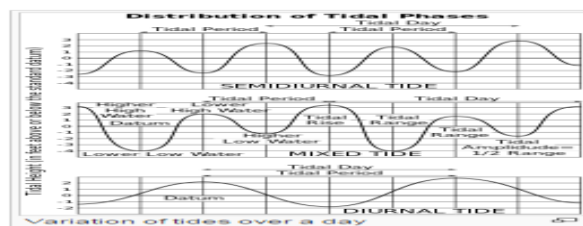


Fig.8 Tidal variation over a day

The main environmental concern with tidal energy is associated with blade strike and entanglement of marine organisms as high speed water increases the risk of organisms being pushed near or through these devices. Depending on the frequency and amplitude of sound generated by the tidal energy devices, this acoustic output can have varying effects on marine mammals.

C] Biomass:-Electrical power can be generated by burning anything which will combust. Some electrical power is generated by burning crops which are grown specifically for the purpose. Usually this is done by fermenting plant matter to produce ethanol, which is then burned. This may also be done by allowing organic matter to decay, producing biogas, which is then burned. Also, when burned, wood is a form of biomass fuel. Burning biomass produces many of the same emissions as burning fossil fuels. However, growing biomass captures carbon dioxide out of the air, so that the net contribution to global atmospheric carbon dioxide levels is small. The process of growing biomass is subject to the same environmental concerns as any kind of agriculture. It uses a large amount of land, and fertilizers and pesticides may be necessary for cost-effective growth. Biomass that is produced as a by-product of agriculture shows some promise, but most such biomass is currently being used, for plowing back into the soil as fertilizer if nothing else.

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 2, Issue 7, July 2015

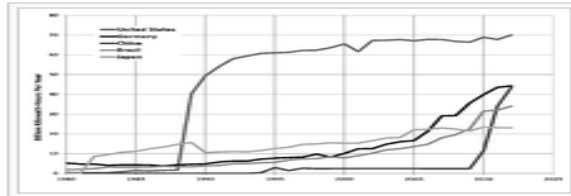


Fig.9 Trends top 5 countries generating electricity from biomass

D] Wind:- Wind power harnesses mechanical energy from the constant flow of air over the surface of the earth. Wind power stations generally consist of wind farms, fields of turbines in locations with relatively high winds. Older, smaller, wind turbines are rather noisy and densely located, making them very unattractive to the local population. The downwind side of the turbine does disrupt local low-level winds. Modern large wind turbines have mitigated these concerns, and have become a commercially important energy source. Many homeowners in areas with high winds and expensive electricity set up small windmills to reduce their electric bills. A modern wind farm, when installed on agricultural land, has one of the lowest environmental impacts of all energy sources:

1. It occupies less land area per kilowatt-hour (kWh) of electricity generated than any other renewable energy conversion system, and is compatible with grazing and crops.
2. It generates the energy used in its construction within just months of operation.
3. Greenhouse gas emissions and air pollution produced by its construction are small and declining. There are no emissions or pollution produced by its operation.
4. Modern wind turbines rotate so slowly (in terms of revolutions per minute) that they are rarely a hazard to birds. Landscape and heritage issues may be a significant issue for certain wind farms.

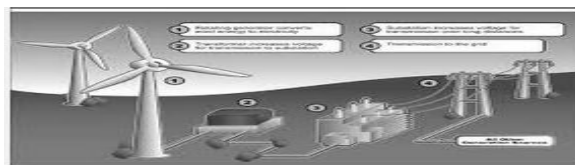


Fig.10 Wind energy generation

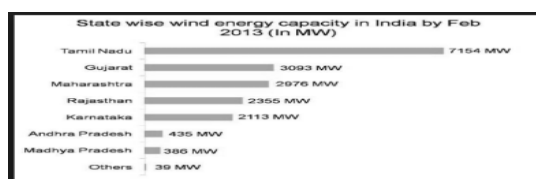


Fig.11 State wise wind energy capacity

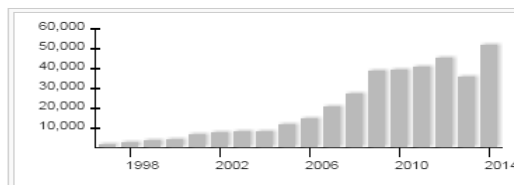


Fig.12 Global annual installed wind capacity 1997-2014

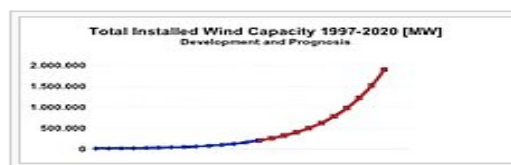


Fig.13 Worldwide installed wind capacity (1997-2020)

E] Geothermal power:-Geothermal energy is the heat of the Earth, which can be tapped into to produce electricity in power plants. Warm water produced from geothermal sources can be used for industry, agriculture, bathing and cleansing. Where underground steam sources can be tapped, the steam is used to run a steam turbine. Geothermal steam sources have a finite life as underground water is depleted. While a geothermal power plant does not burn any fuel, it will still have emissions due to substances other than steam which come up from the geothermal wells. These may include hydrogen sulfide, and carbon dioxide. Some geothermal steam sources entrain non-soluble minerals that must be removed from the steam before it is used for generation; this material must be properly disposed. Any (closed cycle) steam power plant requires cooling water for condensers; diversion of cooling water from natural sources, and its increased temperature when returned to streams or lakes, may have a significant impact on local ecosystems.

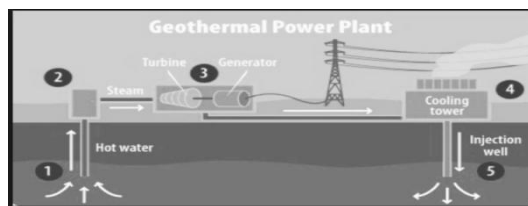


Fig.14 Geothermal power plant

F] Solar power:- In view of the current energy shortage, global economic growth and environmental pollution, the search for a substitute to replace fossil fuels has increased the importance of photovoltaic system as a long-term, inexhaustible, environmentally friendly and reliable energy technology^[6]. It works by converting the sun's radiation into direct current (DC) power by use of photovoltaic cells. This power can then be converted into the more common AC power and fed to the power grid. Solar photovoltaic power offers a viable alternative to fossil fuels for its cleanliness and supply, although at a high production cost. Future technology improvements are expected to bring this cost down to a more competitive range. Its negative impact on the environment lies in the creation of the solar cells which are made primarily of silica and the extraction of silicon from silica may require the use of fossil fuels, although newer manufacturing processes have eliminated CO₂ production. Solar power carries an upfront cost to the environment via production, but offers clean energy throughout the lifespan of the solar cell. Large scale electricity generation using photovoltaic power requires a large amount of land, due to the low power density of photovoltaic power. Land use can be reduced by installing on buildings and other built up areas, though this reduces efficiency.

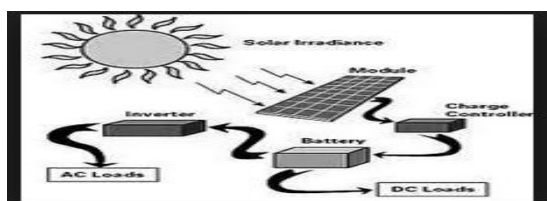


Fig.15 Solar power works

Solar	3,850,000	[8]
Wind	2,250	[9]
Biomass potential	~200	[10]
Primary energy use ²	539	[11]
Electricity ²	~67	[12]

Fig.16 Human energy consumption in EJ

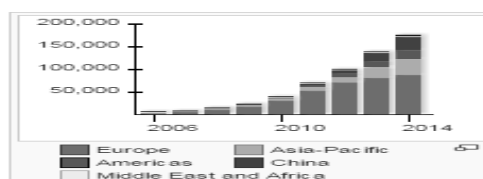


Fig.17 Global growth of PV capacity MW



International Journal of Advanced Research in Science, Engineering and Technology

Vol. 2, Issue 7 , July 2015

In recent years, because of the characteristics of environmentally friendly mature technology and cheap operation cost, new energy power generation technology is developing fast. Wind-Photovoltaic-hydro-gas power generation system is proposed to achieve energy conservation and emissions reduction, taking minimum hydroelectric power flow and minimum gas turbine fuel consumption as two objectives. The proposed model is solved by improved multi-objective differential evolution (MODE) based on parameter adaptive adjustment.[7]

III.CONCLUSION

Finally the concluding lines for the energy area is that to eliminate the carbon emissions ,to reduce the pollution, to mitigate the global warming effects and for many more factors human being has to rely on nature for the energy generation which will be clean sustainable, and eco friendly. Also there is no fear of depletion of resources as they are totally natural and available in ample amount.

REFERENCES

- [1]Zahedi, A.“Technical analysis of an electric power system consisting of solar PV energy, wind power, and hydrogen fuel cell” Power Engineering Conference, 2007.
- [2]Kundur, P.S. “Research and technology shaping the future of electric power systems” Power Engineering Society General Meeting, 2006. IEEE
- [3] Queensland Geothermal Energy Centre of Excellence QGECE Saha, T.K. ,Eghbal, M, “Tradeoffs in planning renewable power generation entry to the electricity market”, Power and Energy Society General Meeting, 2011 IEEE
- [4] Bimal .K. Bose. “Energy, environment and advances in power electronics”,IEEE transactions on power electronics,vol.15 no 4 ,2000
- [5]Aguirre,M. CIDEI,“An environmental friendly alternative for hydrogen production and electric energy generation” IECON 2011 - 37th Annual Conference on IEEE Industrial Electronics Society
- [6]Cucchiella, F. D'Adamo, I. Gastaldi, M. Koh, S.C.L.,”A photovoltaic system in a residential building: Environmental and economic optimization analysis” at Supply Chain Management and Information Systems (SCMIS), 2010 8th International Conference.
- [7]Chen Tian-qiong , “A short-term joint optimal dispatching method of wind farms, photovoltaic generations, hydropower stations and gas power plants”,Power System Technology (POWERCON), 2014 International Conference)
- [8]Said Al Hallaj “More than enviro-friendly renewable energy is also good for a bottom line” IEEE power and energy magazine May/June 2004
- [9]M. Shahidehpour, “Don't let the sun go down on PV”,IEEE power energy Mag. Vol.2, no.3, May/June 2003
- [10]J.G.slootweg,and W.L.King, “Is the answer blowing in the wind?”, IEEE Power energy Mag.vol.1 , no.6.Nev/Dec 2003
- [A][http://en.wikipedia.org/wiki/Electricity generation](http://en.wikipedia.org/wiki/Electricity_generation)
- [B][http://en.wikipedia.org/wiki/Hydroelectricity Advantages and disadvantages](http://en.wikipedia.org/wiki/Hydroelectricity_Advantages_and_disadvantages)
- [C] [http://en.wikipedia.org/wiki/Wind power](http://en.wikipedia.org/wiki/Wind_power)
- [D] [http://en.wikipedia.org/wiki/Solar energy](http://en.wikipedia.org/wiki/Solar_energy)