An Overview of Renewable Energy in Present Scenario

Prof. (Dr.) Ashok Dhariwal
Director, (Academic)
Vyas Institute of Engineering & Technology, Jodhpur

Anshul Bhati
Assistant Professor
Vyas Institute of Engineering & Technology, Jodhpur

Naveen Choudhary
Assistant Professor
Vyas College of Engineering & Technology, Jodhpur

Manish Gahlot
Assistant Professor
Vyas College of Engineering & Technology, Jodhpur

Abstract: - Renewable energy sources refer to hydropower, biomass energy, solar energy, wind energy, geothermal energy, and ocean energy. The term 'new' renewable suggests a greater focus on modern and sustainable forms of renewable energy, in particular: modern biomass energy, geothermal heat and electricity, small-scale hydropower, low-temperature solar heat, wind electricity, solar photovoltaic and thermal electricity, and marine energy. Electricity consumption will comprise an increasing share of global energy demand during the next two decades. In recent years, the increasing prices of fossil fuels and concerns about the environmental consequences of greenhouse gas emissions have renewed the interest in the development of alternative energy resources. Renewable energy is now considered a more desirable source of fuel than nuclear power due to the absence of risk and disasters. Considering that the major component of greenhouse gases is carbon dioxide, there is a global concern about reducing carbon emissions. In this regard, different policies could be applied to reducing carbon emissions, such as enhancing renewable energy deployment and encouraging technological innovations. Two main solutions may be implemented to reduce CO2 emissions and overcome the problem of climate change: replacing fossil fuels with renewable energy sources as much as possible and enhancing energy efficiency. In this paper, an attempt has been made for discussing alternative technologies for enhancing renewable energy deployment and energy use efficiency.

Keywords— energy resources, renewable energy, generation technology, carbon emission.

I. Introduction

The renewable energy is fostered by the fact that fossil fuels are becoming scarce and that their combustion produces CO_2 which contributes to climate change. Renewable energy sources may be highly responsive to environmental, social and economic goals. Presently, renewable energy provides about 14 percent of global primary energy consumption, mostly traditional biomass, and about 20 percent of electricity, mostly large-scale hydropower. However, 'new' renewable contribute only 2 percent of the world's primary energy use. Such renewable energy sources that use indigenous resources have the potential to provide energy services with zero or almost zero emissions of both air pollutants and greenhouse gases. Natural flows of renewable resources are immense in comparison with global energy use. This holds both from a theoretical and technical perspective, however the level of their future use will primarily depend on the economic performance of technologies utilising these flows. Policies promoting the development and use of renewable energy sources and technologies can make a significant difference. Clearly, the long-term use of energy resources will likely become more an issue of the degree to which present and future societies have to balance environmental and economic trade-offs, and control greenhouse gas emissions rather than a question of resource and technology existence. Furthermore, the growing problem of the availability of (cheap) fossil fuels will amplify energy security concerns. A rapid expansion of energy systems based on renewable energy sources will require actions to stimulate the market in this direction. This expansion can be achieved by finding ways to drive down the relative cost of new renewable in their early stages of development and commercialisation, while still taking advantage of the economic efficiencies of the marketplace. Pricing based on the full costs of conventional energy sources (including phasing out subsidies and internalising externalities) will make new renewable more competitive. However, such measures remain controversial. In any case, significant barriers stand in the way of the accelerated development of renewable technologies, which can only be overcome by appropriate frameworks and policies. So far renewable natural energy resources are, however, not generally recorded as assets on the national balance sheet. This seems to be a serious omission since their share in total energy production is increasing. Fostering the exploitation of renewable energy resources is undoubtedly an important part of sustainable development policy strategies around the world. Balance sheets that are restricted to non-renewable energy resources only could lead to a serious underestimation of a country's available energy resources. In this paper we present the different renewable energy supply technologies including solar, wind and hydro power, geothermal and other sources.

II. Renewable Energy Resources and Technologies

The natural energy flows through the earth's ecosystem, and the geographical and technical potential of what they can produce for human needs, exceeds current energy use by many times. The renewable energy supply is continuously increasing. A large amount of investment has been made during recent years and the advancement of technology has enabled countries to produce renewable energy more cost effectively. It is forecasted that the number of countries producing above 100 megawatts (MW) of renewable energy will increase significantly by 2018. Due to some negative and irreversible externalities coming with conventional energy production, it is necessary to promote and develop renewable energy supply technologies. These technologies may not be comparable with conventional fuels in terms of production cost, but they could be comparable if we consider their associated externalities, such as their environmental and social effects. Also, it should be noted that economies of scale could play a key role in reducing the unit production cost. Transmission and distribution costs, as well as technologies, do not differ much among the conventional and renewable energies. Below we present facts about the development of the main renewable energy supply technologies. Climate change due to emissions of GHGs, particularly CO2, becomes an issue when stored solar energy is converted to useable forms of energy (heat, electricity, fuels, chemicals) at a rate far exceeding the rate of formation. For coal, oil, and natural gas, the ratio of time between formation and use is on the order of 1 million to one: that is, the world uses in one year what took natural processes one million years to create. Only biomass among these stored forms has a time ratio that is within a human time frame of years or decades. Renewable energy can now be defined as forms of solar energy that are available and replenished in time scales no longer than human lifetimes. Below we present facts about the development of the main renewable energy supply technologies.

III. Hydro power

Hydropower facilities exploit the kinetic energy in flowing or falling water to generate electricity. Hydro power is currently the largest renewable energy source for power generation around the world. Hydro electricity generation has had a strong increase over the past 50 years. We can compare this to the global consumption of 15,000 TWh of electricity with a global production of 18,306 TWh in 2006. Currently, hydro power development is difficult due to a large initial fixed investment cost and environmental concerns. Additionally, hydro power has caused problems for local residents associated with the need to relocate large populations, as well as the construction of dams is permanent with a sunk cost of utilities which cannot be removed. The environment is also influenced by hydro power construction because of large engineering works. On the other hand, hydro power is attractive due to a pre-existing supply of water for agriculture, household and industrial use and hydro power is clean and enables the storage of both water and energy. Also, the stored energy can be used for the application of both base-load and peak time power generation. Conventional hydropower facilities use water from a river, stream, canal, or reservoir to continually produce electrical energy, and water releases from single-purpose reservoirs (i.e., dedicated to power production) can be quickly adjusted to match electricity loads. Hydropower technology is currently mature and widely available. Almost 15% of the world's electrical energy comes from hydroelectric facilities operating in over 80 countries. Only a fraction of the available resource has been exploited to date, in large part because of sitting constraints, environmental pressures against large-scale systems, and competition with other interests for water resource use. The increased development and use of micro-hydro technologies may permit additional resources to be accessed without encountering the barriers that have traditionally constrained conventional hydropower development. In Nepal, for example, the Agricultural Development Bank has financed the purchase of more than 650 small hydro systems by farmers, who use income from milling operations and electricity sales to pay back the loans.

IV. WIND POWER

A region's mean wind speed and its frequency distribution have to be taken into account to calculate the amount of electricity that can be produced by wind turbines. Technical advances are expected to open new areas to development. The installed capacity of wind power has increased from 4.8 MW in 1995 to more than 400 GW in 2017. Today, each wind turbine could generate as much electricity as a conventional power plant. Wind energy has made its most significant contributions in China, the US and India. Figure (2) shows the worldwide wind installation capacity trend based on the BP (2016) report. Wind power generation grew by 15.6% in 2016 to reach 960 TWh, or 4% of total world electricity generation. That is almost equivalent to the total power generation of Japan, the world's fifth largest power generator. China replaced the US as the largest wind power producer last year, growing by 29% and contributing more than 40% of global growth in wind power. Wind has become an important contributor to European electricity generation. In Denmark wind power provided more than 40% of power generation in 2016: and wind power now provides 15% or more of power generated in Spain, Portugal, Ireland, in Lithuania. Germany, the largest wind power producer in Europe, obtained 12% of its power from wind last year. Wind has a much smaller share in The US, where it contributed just over 5% of power generation in 2016; and in China, where wind provided just under 4% of power.

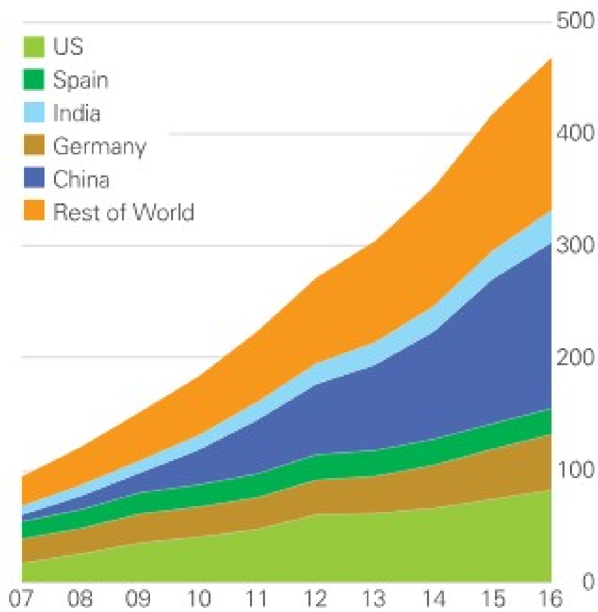

Figure 1 Installed wind generation capacity (giga watts, cumulative installed capacity)

The European Wind Energy Technology Platform envisions that "in 2030, wind energy will be a major modern energy source, reliable and cost competitive in terms of cost per kWh." In addition, they foresee that wind energy will contribute 21% to 28% of the European Union (EU) electricity demand, which is similar to the scenario described previously for the United States. The European Wind Energy Technology Platform describes a long series of research and development improvements that will be necessary to make wind cost competitive by 2030. The reader interested in this challenging multi-disciplinary research program. There is no "big technology breakthrough" envisioned for wind technology in the United States or in Europe. However, many evolutionary steps executed with technical skill can cumulatively bring about a 30% to 40% improvement in the cost effectiveness of wind technology over the next two decades.

V. SOLAR POWER

During the two last decades, the economic feasibility of solar power for residential, commercial and industrial consumption has been investigated by researchers. Industrial countries like Japan and Germany are looking for alternative sources of energy such as solar power due to the limited availability of natural primary energy sources. In early 1990s, Japan started to take advantage of large-scale electricity generation by solar photovoltaic (PV), and was soon followed by Germany. Currently, both countries have taken the lead in the manufacture and production of solar power technologies. More recently, China has developed an extensive solar power capacity due to cheap labour and government subsidies, in turn, decreasing the cost of solar power generation. Solar energy has immense theoretical potential. The amount of solar radiation intercepted by the Earth is much higher than annual global energy use. Large-scale availability of solar energy depends on a region's geographic position, typical weather conditions, and land availability. The assessment here is made in terms of primary energy. In other words, the energy before the conversion to secondary or final energy is estimated. The amount of final energy will depend on the efficiency of the conversion device used (such as the photovoltaic cell applied). Solar energy is versatile and can be used to generate electricity, heat, cold, steam, light, ventilation, or hydrogen. It appears that several factors will determine the extent to which solar is utilised. These include the availability of efficient and low cost technologies, effective energy storage technologies, and high-efficiency end-use technologies. Solar thermal systems that produce high temperature heat can be used to generate electricity. Examples of solar thermal electricity (STE) technologies are parabolic trough systems, parabolic dish systems, and solar power towers surrounded by a large array of two-axis tracking mirrors reflecting direct solar radiation onto a receiver on top of the tower.

The solar photovoltaic market has experienced extraordinary growth over the last five years. The market has increased from 70182 MW in 2011 to 301473 MW in 2016.

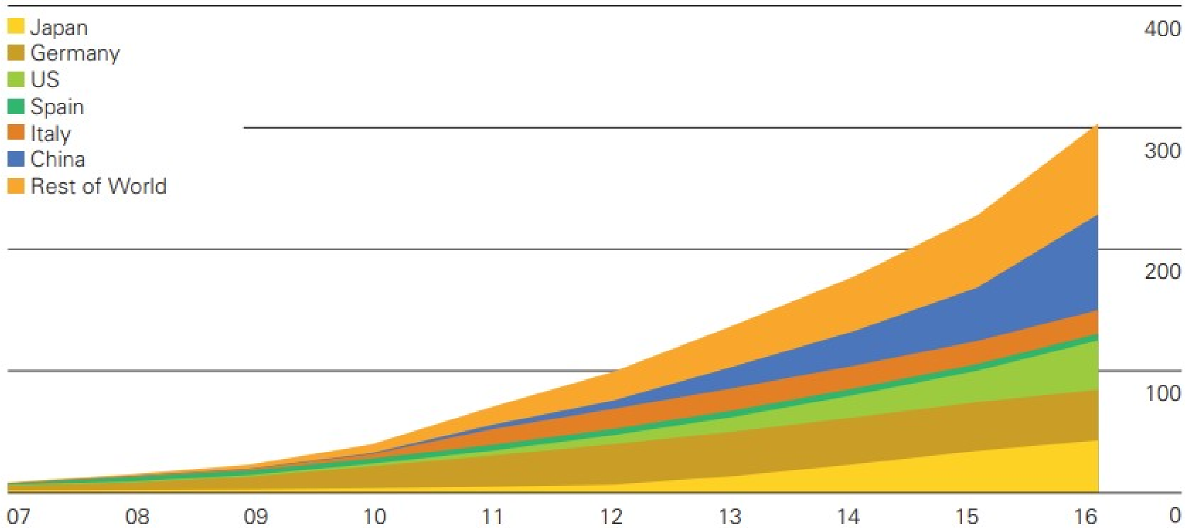

Figure2:-Cumulative installed solar PV capacity, 2007-2016 (in MW)

Figure 2 shows the trend since 2007 to 2016 based on the BP (2016) report. Almost 75 GW of new capacity was installed worldwide in 2016, leading to an increase in the total world capacity to 300 GW. A major part of this new capacity has been due to tariff support policies, the expiration date of some policies and price reductions, all towards the end of the year.

Similar to wind energy, solar energy is dependent on weather conditions. Variation in weather, including clouds and pollution, could affect solar power generation. There is a major difference between wind and solar power, as solar power has time limitations. Therefore, solar power generation varies by season, location and daytime. Many technologies are used to deploy solar radiation including thermal solar energy, concentrated solar power plants (CSP), solar chimneys or towers and photovoltaic systems Photovoltaic technology allows the integration of PV collectors into the building and can turn external walls, windows and roofs into PV collectors. However, some environmental and health concerns can arise from the use of materials in the PV systems.

VI. GEOTHERMAL

Geothermal is a type of thermal energy generated and stored within the Earth. It has been used throughout history for bathing, heating and cooking. Geothermal energy is created by radioactive decay, with temperatures reaching 4,000˚C at the core of the Earth. While geothermal energy is available worldwide, there is an important factor called the geothermal gradient that indicates whether a region is a favored place for enactment. It measures the rate at which the temperature increases as the depth of the Earth increases. For example, the average geothermal gradient in France is 4˚C/100m with a range of 10˚C/100m in the Alsace region to 2˚C/100m in the Pyrenees Mountains. In Iceland and the volcanic regions, the gradient can reach as high as 30˚C/100m. Geothermal energy is generally defined as heat coming from the Earth. It has large theoretical potential but only a much smaller amount can be classified as resources and reserves still, even the most accessible part, classified as reserves, exceeds current annual consumption of primary energy. But like other renewable resources, geothermal energy is widely dispersed. Thus the technological ability to use geothermal energy, not its quantity, will determine its future share. High-temperature fields used for conventional power production are largely confined to areas with young volcanism, seismic, and magmatic activity. But low-temperature resources suitable for direct use can be found in most countries. Figure 3 shows the cumulative installed geothermal power capacity worldwide, based on the report by BP (2016). Geothermal capacity grew by 3.4% (440 MW) in 2016, to reach 13.4 GW. The largest additions to capacity were in Indonesia (190 MW) and Turkey (150 MW). The US has the largest geothermal capacity with 3.6 GW (27% of the world total), followed by the Philippines (1.9 GW), Indonesia (1.6 GW) and New Zealand (1.0 GW). Geothermal power runs at a much higher load factor than wind or solar (its energy source is continuous rather than intermittent), so geothermal produces significantly more electricity per MW of capacity. However the geological conditions required for geothermal power mean that development has been concentrated in a relatively small number of countries. Geothermal power generation grew by 3.6% in 2016. Overall the geothermal share of global power generation remains very small (0.3%), but in certain countries it plays a significant role, for example, Kenya (44% of power), Iceland (27%), El Salvador (26%), and New Zealand (18%).

Renewable energy – geothermal

Cumulative installed geothermal power capacity*

Megawatts	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Growth rate per annum 2016	Growth rate per annum 2005-15	Share 2016
Australia	†	†	†	1	1	1	1	2	2	2	**2**	–	30.2%	♦
Austria	1	1	1	1	1	1	1	1	1	1	**1**	–	1.6%	♦
China	28	28	24	24	24	24	24	27	27	27	**27**	–	-0.3%	0.2%
Costa Rica	163	163	163	166	166	208	208	208	208	208	**208**	–	2.5%	1.5%
El Salvador	195	195	204	204	204	204	204	204	204	204	**204**	–	3.1%	1.5%
Ethiopia	7	7	7	7	7	7	7	7	7	7	**7**	–	–	0.1%
France (Guadeloupe)	15	15	16	16	16	16	16	17	17	17	**17**	–	1.5%	0.1%
Germany	†	3	3	8	8	8	12	17	27	27	**27**	–	63.1%	0.2%
Guatemala	33	52	52	52	52	52	52	48	48	48	**48**	–	3.8%	0.4%
Iceland	312	485	576	576	575	665	665	665	665	665	**665**	–	12.6%	4.9%
Indonesia	850	980	1052	1189	1193	1209	1339	1339	1401	1401	**1590**	13.5%	5.1%	11.8%
Italy	811	811	811	843	883	883	875	876	916	916	**916**	–	1.5%	6.8%
Japan	534	532	536	536	536	536	536	537	539	544	**544**	–	0.2%	4.1%
Kenya	167	170	174	174	209	212	217	253	450	605	**676**	11.7%	13.7%	5.0%
Mexico	960	960	965	965	965	887	812	834	834	887	**907**	2.3%	-0.8%	6.7%
New Zealand	425	443	585	625	723	723	723	971	971	971	**971**	–	8.6%	7.2%
Nicaragua	78	88	88	88	88	88	160	160	160	160	**160**	–	7.5%	1.2%
Papua New Guinea	36	56	56	56	56	56	56	56	56	56	**56**	–	26.1%	0.4%
Philippines	1978	1958	1958	1953	1966	1783	1848	1868	1917	1917	**1929**	0.6%	-0.3%	14.4%
Portugal (The Azores)	16	29	29	29	29	29	29	29	29	29	**29**	–	6.1%	0.2%
Russia (Kamchatka)	79	82	82	82	82	82	82	82	82	82	**82**	–	0.4%	0.6%
Thailand	†	†	†	†	†	†	†	†	†	†	**†**	–	–	♦
Turkey	28	28	35	82	94	114	114	226	405	624	**775**	24.2%	40.8%	5.8%
US	2940	3037	3163	3289	3308	3318	3450	3524	3525	3596	**3596**	–	2.2%	26.8%
Total World	**9655**	**10121**	**10575**	**10928**	**11152**	**11071**	**11397**	**11917**	**12492**	**12995**	**13438**	**3.4%**	**3.3%**	**100.0%**

Figure 3 Cumulative installed geothermal capacity, 2006-2016 (in MW)

Geothermal use is commonly divided into two categories: electricity production and direct application. The technology to use geothermal energy is relatively mature. The conversion efficiency of geothermal power plants is rather low, about 5 to 20 percent. Geothermal energy for electricity production previously had considerable economic potential only in areas where thermal water or steam is found concentrated at depths of less than 3 kilometers. This has changed recently with developments in the application of ground source heat pumps using the Earth as a heat source for heating or as a heat source sink for cooling, depending on the season. These pumps can be used basically everywhere. Important applications can be found in amongst others Switzerland and the United States of America.

VII. Conclusion

Over the past few decades energy is the backbone of technology & economic development. Rapid increase in use of energy has created problems of demand & supply. According to current SITUATION, 80,000 villages are yet to be electrified. Also India has had a negative Energy Balance for decades. Even though, The Ministry of Power has set an agenda of providing Power to All. Could India meet all energy needs, was the problem statement of this paper. The answer found is Yes, India can meet all energy needs with Renewable Energy Sources. Solution to long-term energy problems will come only through research, development & implementation of such developments & recherché in the field of renewable energy sources. The total estimated potential of renewable Energy is around 152,000 MW, which is much greater than the current total installed energy generating capacity of India. To overcome energy crises, Government has developed many projects & programs for proper utilization of renewable energy resources.

REFERENCES

[1] Asif, M., & Muneer, T. (201). Energy supply, its demand and security issues for developed and emerging economies. Renewable and Sustainable Energy Reviews, 11(7), 1388-1413.

[2] Russell, M., Jantzen, D. and Z. Shen. 1992. Electricity From Biomass: Two Potential Chinese Projects, Energy, Environment, and Resources Center, University of Tennessee, Knoxville, 1992.

[3] Blanco, M I. (2009). The economics of wind energy. Renewable and Sustainable Energy Reviews, 13(6), 1372-1382.

[4] Hall, D.O., et al. 1993: "Biomass for Energy: Supply Prospects", in Johansson, et al., 1993.

[5] Perlack, R.D., Ranney, J.W. and M. Russell. 1991. Biomass Energy Development in Yunnan Province, China, Oak Ridge National Laboratory, ORNL/TM-11791, Oak Ridge Tennessee, June 1991.

[6] Branker, K., Pathak, M., & Pearce, J. (2011). A review of solar photovoltaic levelized cost of electricity. Renewable and Sustainable Energy Reviews, 15(9), 4470-448.

[7] Moreira, J.R. and A.D. Poole. 1993: "Hydropower and Its Constraints", in Johansson, et al. 1993.

[8] BP Statistical Review of World Energy.

[9] Depuru, S.S.S.R., Wang, L., & Devabhaktuni, V. (2016). Smart meters for power grid: Challenges, issues, advantages and status. Renewable and Sustainable Energy Reviews, 15(6), 2736-2742.

[10] Kahn, Z.K. and E. Sable. 1988: APlanning a Program to Determine Physical and Chemical Characteristics of Municipal Solid Waste,@ Resource Recovery/Cogeneration World, 1:15-18.

[11] Gagnon, L., & van de Vate, J.F. (1999). Greenhouse gas emissions from hydropower: the state of research in 1996. Energy Policy, 25(1), 7-13.