E-ISSN: 2278–179X

JECET; December 12- February 2013; Vol.2.No.1, 46-51.

Journal of Environmental Science, Computer Science and Engineering & Technology

Available online at www.jecet.org

Engineering & Technology

Research Notes

India: A Report on Non-Conventional Energy Sources

M.I.Khan[1], Abhinav Kumar[2], Amit Sharma[2], Pushpendra Vikram Singh[2]

[1] Indian Institute of Technology (BHU)-Varanasi, India

[2] Bhagwant University, Ajmer, India

Received: 12 November 2012; **Revised**: 6 December 2012; **Accepted:** 8 December 2012

Abstract: Energy security has an important bearing on achieving national economic development goals and improving the quality of life of the people. The level of per capita energy consumption has for long been considered as one of the key indicator of economic growth. In this paper an attempt has been made to present potential of non-conventional renewable energy sources in India. Different renewable energy technologies (RET) and their advantages are also discussed.

Keywords: Solar energy, wind energy, biomass, ocean thermal energy, tidal energy, geo thermal energy.

INTRODUCTION

The development of infrastructure is an important factor to sustain economic growth. The power sector is one of the most important constituents of infrastructure. The achievement of energy security necessitates diversification of our energy resources and the sources of their supply, as well as measures for conservation of energy. So far, we were dependent on conventional sources of energy like thermal, hydro (large hydro) and nuclear. Fortunately, India is blessed with the third largest coal supplies in the world, although not of the best quality but we cannot use them indefinitely. The increasing prices for petroleum products, projection that petroleum resources would be exhausted in a relatively short period of time and the use of fossil fuel resources for political purposes will adversely affecting worldwide economic and social development. The impact of the energy crisis is particularly felt in developing countries like India, where an ever-increasing percentage of national budgets earmarked for development must be diverted to

the purchase of petroleum products. After independence large hydroelectric projects have been executed, some of them are still under construction and some have been planned for future. The inherent drawbacks associated with large hydro are; large gestation period, large area along with vegetation has to be submerged, shifting of people etc. from the sites. Political and environmental implications have made planners to think for some other alternative to the large hydro. For nuclear power plants also there is a problem of getting proper fuel, processing and safety from radiations. In addition, global warming caused largely by green house gas emission from fossil fuel generating systems is also a major concern. To overcome the problems associated with conventional sources of energy, most countries including India have shifted their focus to develop non-conventional renewable sources of energy. Among these resources are solar energy, wind, geo thermal energy, biomass and small hydropower. 263 districts in 16 states and one Union Territory have so far been covered under the Integrated Rural Energy Program of government of India, which aims at providing a cost effective energy mix of non conventional sources to meet the energy need of the rural areas. With the various initiatives taken by the government, a healthy power sector would emerge in the country which would pave the way for fast industrialization, growth in agricultural production, rural development and a better quality of life through non-conventional renewable energy sources[1-3].

2. RENEWABLE ENERGY SCENARIO

In India the potential of renewable energy source is about 81.200 MW out of which only 5594 MW i.e. 6.9% has been harnessed so far. The potential and capacity harnessed so far is given in **Table 1**[1]. India's need for power is growing at a prodigious rate, annual electricity generation and consumption in India have both nearly doubled since 1990, and it's projected 2.6% (low end) to 4.5 % (high end). Annual rate of increase for electricity consumption (through 2020) is the highest for any major country. India is currently the seventh greatest electricity consuming country (accounting for about 3.5% of the world total annual electricity consumption) but will soon overtake both Germany and Canada in that regard. India now faces an electricity shortages conservatively estimated at 11% and as high as 18% during peak demand periods[4].

Table-1: Potential and Installation of Renewable Energy Systems

SI. No.	**Renewable Energy Sources**	**Potential (MW)**	**Potential harnessed so for (MW)**
1	Wind	45000	2980
2	Small Hydro	15000	1693
3	Biomass	3500	727
4	Gasifiers	16000	62
5	Urban and Industrial waste	1700	46.5
6	Solar Photo Voltaic	20/SQ KM	86
	TOTAL	**81200**	**5594**

RENEWABLE ENERGY TECHNOLOGIES

3.1- Solar Energy: Solar energy has the greatest potential of all the sources of renewable energy and if only a small amount of this form of energy could be used, it will be one of the most important supplies of energy specially when other sources in the country have depleted energy comes to the earth from the sun. This energy keeps the temperature of the earth above than in colder space, causes current in the atmosphere and in ocean, causes the water cycle and generate photosynthesis in plants. The solar power where sun hits atmosphere is 10^{17} watts, where as the solar power on earth's surface is 10^{16} watts. The total worldwide power demand of all needs of civilization is 10^{13} watts. Therefore the sun gives us 1000 times more power than we need. If we can use 5% of this energy, it will be 50 times what the world will require[3]. Electricity can be produced from the solar energy by photovoltaic solar cells, which convert the solar energy directly to electricity. The most significant applications of photovoltaic cell in India are the energisation of pump sets for irrigation, drinking water supply and rural electrification covering street lights, community TV sets, medical refrigerators and other small power loads.

3.2 -Wind Energy: Wind energy, which is an indirect source of solar energy conversion, can be utilized to run windmill, which in turn drives a generator to produce electricity. Wind can also be used to provide mechanical power such as for water pumping. In India generally wind speeds obtainable are in the lower ranges. Attempts are, therefore, on the development of low cost, low speed mills for irrigation of small and marginal farms for providing drinking water in rural area. The developments are being mainly concentrated on water pumping wind mill suitable for operation in a wind speed range of 8 to 36 km per hour. In India high wind speeds are obtainable in coastal areas of saurashtra, western Rajasthan and some parts of central india[5]. Among the different renewable energy sources, wind energy is currently making a significant contribution to the installed capacity of power generation, and is emerging as a competitive option. India with an installed capacity of 3000 mw ranks fifth in the world after Germany, USA, Spain and Denmark in wind power generation. Energy of wind can be economically used for the generation of electrical energy. wind energy equipment are modular in nature and the investment requirement for these equipments as compared to conventional energy equipments is not large and the industry is able to attract private investment thereby reducing the burden on the encourages such investment.

3.3. Biomass & Biogas Energy: the potential for application of biomass, as an alternative source of energy in India is large. We have plenty of agricultural and forest resources for production of biomass. Biomass is produced in nature through photosynthesis achieved by solar energy conversion. As the word clearly signifies biomass means organic matter. in simplest form, the process of photosynthesis is in the presence of solar radiation. Biomass energy co-generation programme is being implemented with the main objective of promoting technologies for optimum use of country's biomass resources and for exploitation of the biomass power generation potential, estimated at 19500 mw. The technologies being promoted include combustion, gasification and cogeneration, either for power in captive or grid connected modes, or for heat applications.

3.4. Ocean Thermal Energy Conversion: This is also an indirect method of utilizing solar energy. A large amount of solar energy is collected and stored in tropical oceans. The surface of the water acts as the collector for solar heat, while the upper layer of the sea constitutes infinite heat storage reservoir. Thus the heat contained in the oceans, could be converted into electricity by utilizing the fact that the temperature difference between the warm surface waters of the tropical oceans and the colder waters in the depth is about $20 - 25^{0}$ k. Utilization of this energy, with its associated temperature difference and its conversion into work, forms the basis of ocean thermal energy conversion (OTEC) systems. The surface water, which is at higher temperature, could be used to heat some low boiling organic fluid and the vapours of which would run a heat engine. The exit vapour would be conducted by pumping cold water from the deeper regions. The amount of energy available for ocean is replenished continuously. all the systems of OTEC

method work on a closed routine cycle and use low boiling organic fluids like ammonia, propane, r – 12, r – 22 etc.

3.5. Tidal Energy: The tides in the sea are the result of the universal gravitational effect of heavenly bodies like sun and moon on the earth. Due to fluidity of water mass, the effect of this force becomes apparent in the motion of water, which shows a periodic rise and fall in levels which is in synthesis with the daily cycle of rising and setting of sun and moon. This periodic rise and fall of the water level of sea is called tide. These tides can be used to produce electrical power which is known as tidal power. When the water is above the mean sea level, it is called flood tide and when the level is below the mean sea level, it is called ebb tide. To harness the tides, a dam is to be built across the mouth of the bay. It will have large gates in it and also low head hydraulic reversible turbines are installed in it. A tidal basin is formed, which gets separated from the sea by dam. The difference in water level is obtained between the basin and sea. By using reversible water turbines, turbines can be run continuously, both during high tide and low tide. The turbine is coupled to generator, potential energy of the water stored in the basin as well as energy during high tides used to drive turbine, which is coupled to generator, generating electricity.

3.6. Geo Thermal Energy: This is the energy, which lies embedded within the earth. According to various theories the earth has a molten core. The steam and the hot water come naturally to the surface of the earth in some locations of the earth. Two ways of electric power production from geothermal energy has been suggested. In one of this heat energy is transferred to a working fluid which operates the power cycle. This may be particularly useful at places of fresh volcanic activity, where the molten interior mass of earth vents to the surface through fissures and substantially high temperatures, such as between 450 to 5500C can be found. By embedding coil of pipes and sending water through them can be raised. In the other, the hot geothermal water and or steam is used to operate the turbines directly. At present only steam coming out of the ground is used to generate electricity, the hot water is discarded because it contains as much as 30% dissolved salts and minerals and these cause serious rust damage to the turbine.

3.7. Small Hydropower: Energy from small hydro is probably the oldest and yet, the most reliable of all renewable energy sources. The term 'small hydro' has a wide range in usage, covering schemes having installed capacities from a few kW to 25 MW. In India small hydro schemes are further classified as micro hydro up to 100 kW plant capacity, mini hydro from 101 kW to 2000 kW and small hydro up to 25000 kW plant capacities. The advantage of this resource is that it can be harnessed almost everywhere in India from any nearby stream or canal – in the most environmentally benign manner, and without encountering any submergence, deforestation or resettlement problems which are generally encountered in the development of large hydro power development.

Small hydropower development can reduce the load on conventional sources of energy. Small hydro technology is mature and proven. Civil works and installation of equipment involve simple processes, which offer ample employment opportunities to local people and use locally available material. Gestation period is also short. Simple and proven design concepts suit local conditions. The development of small-scale hydropower in India started almost in the pace with the world's first hydroelectric installation in 1882 at Appleton USA. The 130 KW installations in Sidrapong (Darjeeling) in the year 1897 was the first installation in India. The other installations were Shivasamundram at Mysore (2000 kW), and Bhoorisingh in Chamba (40 kW) in 1902, Galogi at Mussoorie (3000 kW) in 1907, Jubbal (50 kW) in 1911 and Chhaba (1750 kW) at Shimla in 1913. These plants were used primarily for lighting in important towns and are still working. The country has an estimated SHP potential of about 15000 MW. So far 514 SHP projects with an aggregated installed capacity of 1693 MW have been installed [1, 6-7].

3.8. Hydrogen Energy and Fuel Cells: In recent years hydrogen has been receiving worldwide attention as a clean and efficient energy carrier with a potential to replace liquid fossil fuels. Significant progress has been reported by several countries including India in the development of hydrogen energy as an energy carrier and an alternative to fossil fuels. Serious concerns relating to energy security, depleting fossil fuel

reserves, green house gas emissions and air quality are driving this global transformation effort towards a hydrogen-based economy. Hydrogen has high-energy content, when burnt, it produces only water as a by-product and is, therefore, environmentally benign. At present hydrogen is available as a by-product from several chemical processes, plants or industries.

4. Cost of RET Systems: The capital and generation cost of RET systems is given in **Table 2** below[8].

Table 2: Capital and Generation Cost of RET Systems.

SI. NO.	Sources	Capital Cost (Rs Crores/MW)	Cost of Generation (Rs / kWh)
1	SHP	3.00-6.00	1.00-2.50
2	Wind	4.00-4.50	2.25-2.75
3	Biomass / Cogeneration	2.50	1.75-2.00
4	Biomass / Gasification	2.50-3.00	1.75-2.00
5	S.P.V	20.00-25.00	9.00-12.00

5. Advantages of Renewable Energy Technologies: To augment the energy needs renewable energy options may be used to supply all substantial amount of energy as they do have the following advantages.

I. Renewable energy is an indigenous source available in considerable quantities to al developing nations and capable, in principle of having a significant local, regional or national economic impact.
II. Several renewable options are financially and economically competitive for certain applications, such as in remote locations, where the costs of transmitting electrical power or transporting conventional fuels are high.
III. Rapid scientific and technological advantages are expected to expand the economic range of renewable energy applications over the next 8-10 years making it imperative for international decision makers and planners to keep abreast of these developments.
IV. Renewable are free for the taking. The power plants based on renewable do not have any fuel cost and hence negligible running cost.
V. Renewable have low energy density and more or less there is no pollution or ecological balance problem.
VI. The use of renewable energy could help to conserve foreign exchange and generate local employment if conservation technologies are designed, manufactured, assembled and installed locally.
VII. Provide energy in environmentally benign manner.
VIII. Short gestation period and low investment.
IX. With the help of State/ Union Govt. incentives, these schemes have become more attractive for private sector participation.

6. CONCLUSION

The demand of energy is growing owing to the development. Due to the problems associated with the development of conventional sources of energy, the focus is now being shifted to renewable energy sources. India has potential of renewable energy source in abundance, which if developed properly can

augment the growing demand of the energy. There is a need to make full use of renewable energy technologies to harness the untapped potential in cost effective manner and fulfill the energy demand.

7. REFERENCES

1. Annual Report, 2004-2005, Ministry of Non-Conventional Energy Sources, Govt. of India, New Delhi, 2005.
2. Debajit Palit, Renewable Energy in North East India; Issues and prospects, International Conference on Energy and Environmental Technologies for Sustainable Development, Oct. 8-10, 2003. pp. 85- 93.
3. G.D.Rai, Non-Conventional energy sources, Khanna Publishers, New Delhi, 2nd Edition, 2002.
4. World Bank, India country brief at http://www.worldbank.org/html/extdr/regions,htm
5. TERI, "TERI Energy Data Directory and year book', The Energy Research Institute, New Delhi, 2000. pp. 118.
6. Study on Design and Development of Model SHP Based Self Sustained Projects, Alternate Hydro Energy Center, Indian Institute of Technology, Roorkee, 2002.
7. G.S.Dhillon, V.V. Sastry, "Appropriate Technology for SHP (Low head plants)", Indian journal of Power and River Valley Development, Oct.-Nov. 1992.
8. M.P.Sharma,R.P. Saini, "SPV based electrification of remote rural area", National Symposium on recent advances in RET's, Shivaji University

*Correspondence Author: **M.I.Khan;** Indian Institute of Technology (BHU)-Varanasi, India