Growing Renewable Energy in the Future of India Opportunities over Challenges

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Abstract— As the demand is going to increase the generations have to be increased. So as the time is going to pass the conventional energy sources are going to be decreased and it might happen that after some years these sources are going to be exhausted. The best alternative of conventional energy sources are the non-conventional energy sources, which are never going to become exhausted because they are the natural sources and they are permanently available for use. The challenges required for the conventional energy for increasing population demand with the use of renewable energy the future of India get good opportunities to full fill it. Among the various non-conventional energy sources such as solar energy, wind energy, Hydro energy, tidal energy, wave energy, Ocean Thermal energy, geothermal energy, Biomass energy, fuel cell energy, Hydrogen etc. are never going to become exhausted because they are natural sources and they are permanently available for use. The sharp increase in energy consumption particularly in the past several decades has raised fears of exhausting the globe's reserves of fossil fuels in the near future. Approximately, 90% of our energy consumption comes from fossil fuels. Energy and development are inter-related. Energy sector is the backbone of any country's growth and economy. India is one of the largest growing economies in the world and today not just India, but the whole world is looking for alternate sources of energy like wind, solar, hydro, biomass, biofuel etc. known as renewable energy sources for Sustainable energy development.

Keywords: Biomass gasification, Energy scenario, Renewable energy, Sustainable energy

I. INTRODUCTION

Currently, India is the sixth largest energy consumer in the world and the country's energy consumption is expected to increase in the near future. In the past, India has derived most of its energy from coal, but recently the country has been making efforts to extract energy form other sources. However, fossil fuels still remain the largest energy sources. About 76 % of India's electricity is produced in power plants using coal or petroleum products. Of the remainder 22% is hydroelectric and 2% is nuclear. According to data from India's Ministry of Statistics and Programme Implementation, the nation's total energy consumption has increased approximately fourfold over the last three decades.

The energy sources which are available can be divided into three types According to its availability:

(a) Conventional: The energy from fossil fuels and wood is considered as the conventional sources of energy.

(b) Non-Conventional: This includes energy from solar radiations (Solar Energy), wind (Wind Energy), energy from biomass such as domestic and agriculture wastes (biogas) energy from sea (Tidal Energy) and geothermal energy. They are also known as sustainable energy sources.

(c) According to replenishment: Fossil fuels are formed from organic resources which after million years have been transformed into coal, petroleum and natural gas. As this formation takes a very long time, these sources are considered as non-renewable.

Total percentage use of various energy sources for the total energy consumption in the world is given in the table-1 below, which will show that we use the commercial energy sources more then non-commercial energy sources. Solid waste generated at domestic level is the single largest component of all wastes generated in our country. A number of research studies have shown that somewhere 300 to 600 gms of solid waste is generated per person per day in our country.

Sr. No.	Type of Source	Percentage (Individual)	Type of Energy	Percentage
1	Coal	32.5	Commercial or Conventional Energy Sources	92
2	Oil	38.3		
3	Gas	19.0		
4	Uranium	0.13		
5	Hydro	2.0		
6	Wood	6.6	Non-Commercial Energy Sources	8
7	Dung	1.2		
8	Waste	0.3		

Table. 1: Energy consumption in the world

Eventually, Municipalities everywhere face the problems of waste collection, processing and disposal or treatment of voluminous solid waste produced by the cities. Moreover, the rains and humidity on the garbage promotes the bacterial multiplication and enhances the spread of infectious diseases. Due to their rich organic contents, the solid waste can be a good resource to produce manure & energy. It has been estimated that about 70 MW equivalent power could be generated from urban & municipal waste alone. This potential is likely to increase further with our economic growth. India is a fast developing country and have huge gap in demand & supply of electricity generated by conventional sources. To reduce the gap partly non-conventional energy sources should be taped. India has 17% of the world's population growing at a rate of 1.5%. The average energy consumption growth is 9% per annum and the demand will get doubled by 2020. All India generating installed capacity as on date is 1,23,668 MW.

II. SUSTAINABLE ENERGY CHOICES "THE FUTURE"

The energy problem in our country can be described in simple terms as a dilemma between the need to make available increased quantities of energy for development and the need to reduce the expenditure on import of oil,

expenditure on infrastructure for coal and electricity and the impending need to put a brake on deforestation. The problem is further compounded by the variety of needs and the multifarious energy requirements of rural and urban levels. Since renewable energy technologies make use of resources available locally, they are better adaptable to small scale production, can be designed for decentralized usage patterns, have minimal fuel costs and can be assembled with local lab our, and hence they are ideally suited to Indian conditions and rural needs. The decentralized renewable energy concept has been recognized as a major answer to energy needs both in the household as well as agro-industrial sector, particularly in rural areas. In view of the continued demand pressure on conventional sources of energy and its limitations to serve growing energy needs it is now generally accepted that renewable Energy Sources have to play a major role.

India has the world's largest programme for renewable energy. Ministry of New and Renewable Energy (MNRE) is the nodal ministry of Govt. of India for all matters relating to the development of Renewable Energy. Table 2 below shows the total potential vs. achievement of RE in various sectors: micro, mini and small hydro power plants. India has a huge potential in renewable sources. A decentralized energy system with focus on rural electrification is the core of energy planning in India. The national goal is "Energy for All" by 2012 in which, 10% of grid capacity has to come from Renewable Energy.

Sr.No.	Sources	Potential(MW)	Achievement(MW)
1	Wind	45,000	2,980
2	Hydro	15,000	1,700
3	Biomass	19,500	750
4	Solar Panel	20MW/sq.km	2MW/sq.km
5	Waste to energy	1,700	50

Table. 2: Potential vs. achievement in MW of different fuel

A. Solar energy

India has strong potential for harness 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 especially when other sources in the country have depleted. India is one of the few countries with long days and plenty of sunshine, especially in the Thar Desert region. This zone, having abundant solar energy available, is suitable for harnessing solar energy for a number of applications. In areas with similar intensity of solar radiation, solar energy could be easily harnessed. Solar thermal energy is being used in India for heating water for both industrial and domestic purposes. A 140 MW integrated solar power plant is to be set up in Jodhpur but the initial expense incurred is still very high.

The basic research in solar energy is being carried in universities and educational and research institutions, public sector institution, Bharat Heavy Electricals Limited and Central Electronic Limited are carrying out a co-coordinated programmed of research in solar energy. The application of solar energy which are enjoying most success today are Heating and cooling of residential building, Solar water heating, Solar drying of agricultural and animal products, Solar distillation on a small community scale, solar cookers, Solar engines for water pumping. Food refrigeration, Solar Furnaces, Solar electric power generation, etc.

B. Biomass energy

At present, biogas technology provides an alternative source of energy in rural India for cooking. It is particularly useful for village households that have their own cattle. Through a simple process cattle dung is used to produce a gas, which serves as fuel for cooking. The residual dung is used as manure.

The demand for mobility and automobiles in India has also been growing along with the economic progress world carbon emission is expected to increase in the coming years due to the rapid pace of urbanization, use of older and more inefficient coal power plants. India also faces the problem of poverty and under development. An alternative to the natural resource of fossil fuel that could be produced by mankind and that too on waste land or lands that cannot be cultivated. In the field of Jatropha plantations and production of Bio-diesel, as a search for an alternative source of energy. The sample of Bio-diesel was taken from one of the Jatropha plantation firm which was located at Gorakhpur, UP.

C. Hydro energy

Hydropower & Dams World Atlas 2001 reports that a total of some 15 GW of hydro capacity is under construction and a further 25 GW is planned. There are at least 17 plants of over 300 MW capacity being built, of which the largest are Nathpa Jhakri (1500 MW), Sardar Sarovar (1200 MW), Tehri Stage I (1000 MW) and Narmada Sagar (1000 MW). Over 1500 small-scale hydro plants are in operation, with an aggregate installed capacity of about 400 MW; a further 365 MW of small-scale capacity is under construction in more than 80 schemes. Over 1 000 schemes, totalling around 500 MW in capacity, are at the planning stage.

India's gross theoretical hydropower potential (2638 TWh/yr) and theoretically feasible potential (660 TWh/yr) are amongst the highest in the world. The public utilities' total installed hydro-electric capacity exceeded 22 000 MW by the end of 1999 and rose by 1 100 MW during 2000. Hydro output in 1999 was 82.2 TWh, equivalent to 17.5% of India's public sector electricity generation. According to the 1997 Energy Statistics Yearbook published by the United Nations Statistics Division, non-utility (self-producers) generation of hydro-electricity has so far been on a very small scale; however, several IPP hydro plants are now under construction.

D. Wind energy

Wind energy is contained in the force of the winds blowing across the earths's surface. It is created due to the pressure difference that in turn is created due to the warming of heated land and raising of warm air thereby creating a vacuum in the space it occupied. Rushing of cool air to fill the vacant space constitutes wind. They have three sources of variation direction, velocity, and turbulence work output of wind energy consists of pumping water, grinding grain, milling lumber electrical conversion by connection rotor to a generator.

1) Components of Wind Farm: Tower, Rotor, Nacelle, and Wind turbine size

	Small	Medium	Large
Power(Kw)	50-60	50-1500	2000-3000
Rotor dia.(m)	1-15	15-60	60-100
Features	Remote Areas	Commercial Purpose	Less Reliable & Economical

Table. 3: The Classification of wind farm

2) Economics of Wind Farm:

Apart from the non- conventional energy system such as solar thermal, photovoltaic, bio-gas etc. the economics of wind electric generators look to be most promising. A look at the following figures would substantiate this statement:
Cost of Generation:

E. Ocean thermal energy

Conceptual studies on OTEC plants for Kavaratti (Lakshadweep islands), in the Andaman-Nicobar Islands and off the Tamil Nadu coast at Kulasekharapatnam were initiated in 1980. In 1984 a preliminary design for a 1 MW (gross) closed Rankine Cycle floating plant was prepared by the Indian Institute of Technology in Madras at the request of the Ministry of Non-Conventional Energy Resources. The National Institute of Ocean Technology (NIOT) was formed by the governmental Department of Ocean Development in 1993 and in 1997 the Government proposed the establishment of the 1 MW plant of earlier studies. NIOT signed a memorandum of understanding with Saga University in Japan for the joint development of the plant near the port of Tuticorin (TamilNadu).

F. Tidal energy

The Tidal phenomenon is the periodic motion of the ocean water, caused by celestial bodies, principally the moon and the sun, on the different parts of the rotating earth. Tidal energy works from the power of changing tides. Tidal changes in sea level can be used to generate electricity by building a dam across a costal bay or estuary the large defenses between low high tides. The high tides allow immense amounts of water to flash into the bay. The gates of the dam then shutter water level is at its maximum height. Holes in the bottom of the dam let water to rush past turbines. The flow of later generates enough power to turn the turbines, which creates electric, the entire process repeats with each high tide.

The main potential sites for tidal power generation are the Gulf of Kutch and the Gulf of Khambat (Cambay), both in the western state of Gujarat, and the Gangetic delta in the Sunderbans area of West Bengal, in eastern India. The tidal ranges of the Gulf of Kutch and the Gulf of Khambat are 5 m and 7 m respectively, the theoretical capacities 900 MW and 7 000 MW respectively and the estimated annual output approximately 1.6 TWh and 15.0 TWh respectively.

G. Wave energy

Waves are caused by the transfer of energy from wind to sea. The rate of transfer depends on wind speed and the distance over which it interacts with the water. The Indian wave energy programme started in 1983 at the Institute of Technology (IIT) under the sponsorship of the Department of Ocean Development, Government of India. Initial research was conducted on three types of device: double float system, single float vertical system and the oscillating water column (OWC) but it was found that the OWC was the most suitable for Indian conditions: development activities have thus since concentrated on this type.

150 kW pilot OWC was built onto the breakwater of the Vizhinjam Fisheries Harbour, near Trivandrum (Kerala), with commissioning in October 1991. The scheme operated successfully, producing data that were used for the design of a superior generator and turbine. An improved power module was installed at Vizhinjam in April 1996 that in turn led to the production of new designs for a breakwater comprised of 10 caissons with a total capacity of 1.1 MWe. The caissons are designed to be spaced at an optimum distance apart, in order to increase their overall capture efficiency to above that of a single caisson.

III. OPPORTUNITIES

Tamil Nadu ranks first in the country in Wind Power. National goal of meeting 10% of grid capacity from renewable energy by 2012 has been achieved by Tamil Nadu (12.5%) even as on 31.03.02. India ranks 4th in the world in Wind Power. India is predominantly an agricultural country and a huge quantity of biomass is available throughout the year. Approximately, 350 million tons of agricultural waste is produced every year which has a potential of 17,000 MW of power and can eventually save 20,000 crores of rupees every year.

India has 300 full sunny days and a huge potential exists in the field of solar Energy. India has world's two largest solar cooking systems; one at Tirupati in Andhra Pradesh that cooks for 15,000 persons daily. Another is at Brahmkumari ashram in Mount Abu, set up with German Govt. Aid that cooks for 10,000 people per day. Many solar devices like solar cookers, solar water heaters, solar stills, solar lanterns are hugely popular in rural, semi-urban and urban areas of the country.

IV. CHALLENGES

Lack of adequate technology is the major challenge that the country is Facing today. Though the potential is huge, cost of setting up plants is very High. Geo-thermal energy, another non-conventional source of energy has not been tapped in India so far, although potential sites have been identified in Central and northern regions of the country. India has a huge coastline of 30,000 km and the estimated energy density is 65 MW/mile of coast line. But again, lack of infrastructure and huge capital investments involved have not encouraged the Govt. To go ahead for Ocean thermal and tidal energy yet. Biofuels is another promising area and the field has gained momentum in the country as well. A lot of R&D work is going on, especially on Jatropha curcas, to produce biodiesel. Already, Govt. of India has allowed the use of 5% ethanol blended petrol; ethanol being produced from molasses/cane juice.

V. DISCUSSIONS

Over 70% of the population of India lives in villages but it is these villages, which receive neither electricity nor a steady supply of water- crucial to survival and economic and social development and growth. Still, 63%

of India's villages are unelectrified. Decentralized energy is the solution to this problem and is achievable through renewable energy. Biomass exists in these villages and needs to be tapped intelligently to provide electricity and water. An added bonus is the availability of biomass round the year and also, waste biomass from gasifier plant is an excellent fertilizer.

VI. CONCLUSION

Prospects for renewable energy are steadily improving in India. Large-scale implementation of renewable energy resources need to have motivating govt policies and well established standards. It would be only through integration of energy conservation efforts with renewable energy programs that India would be able to achieve a smooth transition from fossil fuel economy to sustainable renewable energy based economy. India is a fast developing country and have huge gap in demand & supply of electricity generated by conventional sources. To reduce the gap partly non- conventional energy sources should be taped. The Department of Energy has shown great enthusiasm regarding renewable energy as s future energy source. With the sincere efforts taken by the government, there is increasing public interest in renewable energy for domestic as well as industrial applications. Our philosophy regarding energy will change drastically from the present into the future, in a society with increasing energy demands and decreasing conventional supplies, we must look to the future and develop our best potential renewable energy.

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