Prospective of Sustainable Energy Source in India

Ravindra Mourya[1]

[1]*M.Tech in Construction management from MIT ADT University, Pune, Maharashtra*

Abstract:- *Renewable energy sources and technologies have the potential to provide solutions to the long-standing energy problems faced by developing countries. Renewable energy sources such as wind energy, solar energy, hydropower, geothermal energy, tidal energy, biomass energy and fuel cell technology can be used to overcome the energy shortage in India. As India is a developing country, the energy needs will increase up to 3-4 times the current needs in the future and the needs can be met with renewable energy resources. India is increasingly adopting responsible renewable energy techniques and is taking positive steps towards carbon emissions, cleaning the air and ensuring a more sustainable future. India is home to the world's largest smallest gasification program and the second largest biogas program. After many years of slow growth, it seems that the demand for solar water heaters is gaining ground. The small hydro grew in India at a slow but steady pace. In this paper, efforts have been made to summarize the availability, current status, main achievements and future potential of renewable energy options in India. This document also evaluates specific strategic interventions and governmental efforts to overcome obstacles and improve the development of renewable sources for the future.*

1. Introduction

The World Energy Forum has predicted that the reserves of oil, coal and fossil gas will be exhausted in less than 10 decades. Fossil fuels account for over 79% of the primary energy consumed in the world and 57.7% of this amount is used in the transport sector and is rapidly declining. The exhaustion of natural resources and the accelerated demand for conventional energy has forced planners and policymakers to look for alternative sources. Renewable energy is energy derived from resources that are regenerative and do not run out over time. Renewable energy offers our planet the opportunity to reduce carbon emissions, clean the air and put our civilization in a more sustainable position. It also offers countries all over the world the opportunity to improve their energy security and stimulate economic development.

Renewable energy provides 16.7% of the world's final energy consumption (Figure 1), counting traditional biomass, large hydropower and "new" renewable energies (small hydropower, modern biomass, wind, solar, geothermal biofuels). Traditional biomass, mainly for cooking and heating, is about 11.44% and is growing slowly in some regions, since biomass is used more efficiently or replaced by more modern forms of energy. The large hydropower represents 3.34% and is growing moderately, mainly in developing countries. The new renewable energies represent 2.4% and are growing very rapidly in developed and in some developing countries.

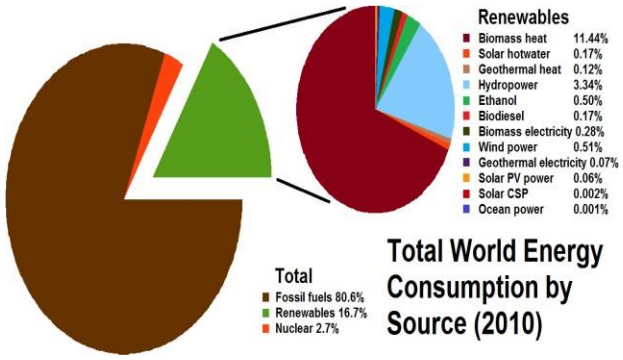

Fig.1. World Total energy consumption [2]

The use of renewable energy resources is a promising prospect for the future as an alternative to conventional energy. Therefore, through this document an attempt was made to examine the availability of renewable energy options in India and provide information on the current state of renewable, the potential future of their uses, the main results and current governmental policies, delivery and dissemination in the context India. It presents a remarkable overview of renewable energy resources and India's position on the global map when using these resources.

2. Renewable Energy in India

Energy is a fundamental requirement for economic development and in all sectors of the Indian economy. Therefore, India needs to rapidly seek new and emerging renewable energy and energy efficiency technologies as well as energy saving laws for execution. In this context, the country urgently needs to develop a sustainable path of energy development.

The promotion of energy conservation and the increased use of renewable energy sources are the twin tables of a sustainable energy supply. Fortunately, India has been blessed with a variety of renewable energy sources, such as biomass, solar, wind, geothermal and small energy and the implementation of one of the largest programs in the world Renewable energy. India is determined to become one of the world's leading producers of clean energy. The Indian government has already adopted several provisions and set up many agencies that will

help it achieve its goal. Renewable energies, excluding large hydroelectric projects, already represent 9% of the total installed energy capacity, equal to 12.610 MW of energy. In combination with large hydroelectric plants, capacity is more than 34%, or 48,643 MW, with a total installed capacity of 144,980 MW. Fig. 2 shows the installed power capacity (MW) in India.

The country has an estimated renewable energy potential of approximately 85,000 MW from commercially exploitable sources, that is, wind energy, 45,000 MW; Small hydropower plant, 15,000 MW and biomass / bio energy, 30,000 MW. Furthermore, India has the potential to generate 35 MW per square kilometer using solar photovoltaic and solar thermal energy. There has been phenomenal progress in wind energy and with an installed capacity of over 15700 MW; India is in fifth place worldwide.

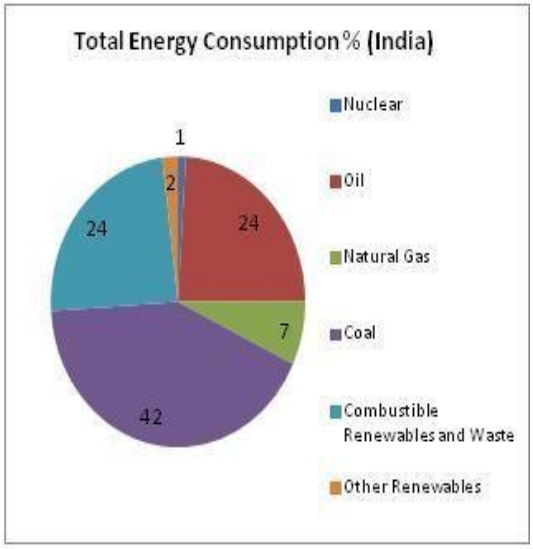

Fig2. Total energy consumption in India[2]

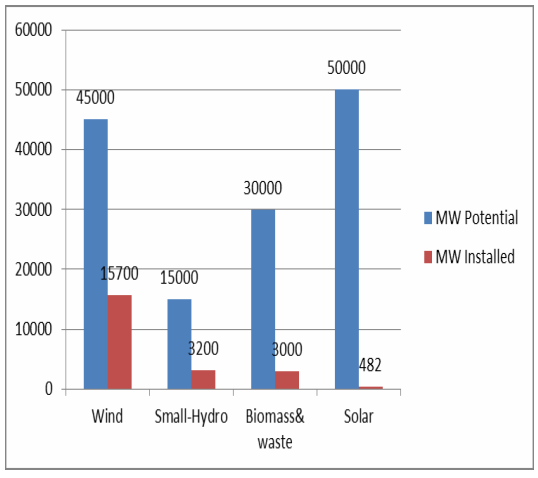

Fig3. Potential of renewable energy in India [22]

2.1 Biomass energy

Biomass includes solid biomass (organic material, non-fossil biological origin), biogas (mainly methane and carbon dioxide produced by anaerobic digestion of biomass and burned to produce heat and / or power), liquid bio fuels (bio based liquid fuel biomass transformation),mainly used in transport applications) and urban waste (waste produced by the residential, commercial and utility sectors in specific plants and incinerated to produce heat and / or energy). The most successful forms of biomass are biogases cane agriculture, cellulose and paper waste in forestry and manure in livestock waste. It is stated that biomass can directly replace fossil fuel because it is more effective at reducing atmospheric carbon sequestration C02 in trees. The Kyoto Protocol encourages greater use of biomass energy. Biomass can be used in various ways to produce energy. The most common methods are:

- Combustion
- Gasification
- Fermentation
- Anaerobic digestion

India is very rich in biomass. It has a potential of 19,500 MW (biogas based cogeneration 3,500 MW and 16,000 MW of biomass surplus). Currently, India has 537 MW in service and 536 MW under construction. The facts support the idea of India's commitment to develop these resources for energy production. Below is a list of some states with the greatest potential for biomass production:

- Andhra Pradesh - 200 MW
- Bihar - 200 MW
- Gujarat - 200 MW
- Karnataka - 300 MW
- Maharashtra -1,000 MW
- Punjab- 150 MW
- Tamil Nadu - 350 MW
- Uttar Pradesh - 1,000 MW

2.2 Hydropower

India has enormous potential for hydropower, of which around 20% has been made so far. The new hydroelectric projects must face serious resistance from environmentalists. Resettlement of displaced persons with their lands becomes a serious problem.

In the national electricity policy of 2005, the objectives were

set as follows: provision of access to electricity for all households; Demand will be met in 2015 without energy shortages and at peak times, and adequate reserves will be available and reliable and quality energy supplies at reasonable prices. The Indian government considers hydropower as a renewable, ecological and non-polluting source of energy. The exploitable hydropower potential in terms of installed capacity is estimated at around 148,700 MW of which one capacity to date, 30,164 MW have been developed and 13,616 MW of capacity under construction. In addition, 15,000 MW were assessed in terms of installed capacity of small, mini and micro hydroelectric plants. Furthermore, 56 sites for pumping storage systems with a total installed capacity of 94,000 MW were identified. The government expects to fully exploit its hydropower potential by 2027 with a huge investment of 5,000 trillion rupees.

Some key figures on small hydropower plants in India

- Less than 25 MW is in the "small hydropower" designation
- 4096 potential sites have been identified
- There is a potential of 15,000 MW
- Technology is mature and reliable.
- The installation is 1520 MW up to today. Two types of technology are used.

(i) High-head systems

(ii) Low prevalence systems

2.3 Wind Energy

Wind energy is one of the most efficient alternative energy sources. There has been a great development in wind turbine technology over the past decade with many new companies joining the fray. Wind turbines have become bigger, efficiency and availability have improved and the concept of wind farm has become popular. It could be combined with solar energy, especially for a project of total self-sustainability.

The wind energy economy is already solid, despite the relative immaturity of the industry. The downward trend in wind energy costs is expected to continue. As the global wind turbine market continues to grow, wind turbine prices will continue to decline. India is now classed as a "wind superpower" with a net potential of around 45,000 MW from just 13 states identified. Wind resources can be exploited primarily in areas where wind energy density is at least 400 W / m2 to 30 m above the ground. An average annual wind energy density of more than 200 W / m2 (watts per square meter) at 50 m height was recorded in 211 wind monitoring stations, which cover 13 states and territories of the union.

The wind potential of India has been valued at 45,000 MW. A capacity of 15700 MW has been installed.

Advantages of wind power:

- It is one of the most environmentally friendly, clean and safe energy resources.
- It has the lowest gestation period compared to conventional energy.
- Assembly and commissioning of the equipment only take a few months.
- There is no fuel consumption, so low operating costs.
- Maintenance costs are low.
- The cost of capital is comparable to conventional power plants. For a wind farm, the cost of capital varies between 4.5 Crores up to 5.5 million rupees, depending on the site and the wind power generator (WEG) selected for installation.

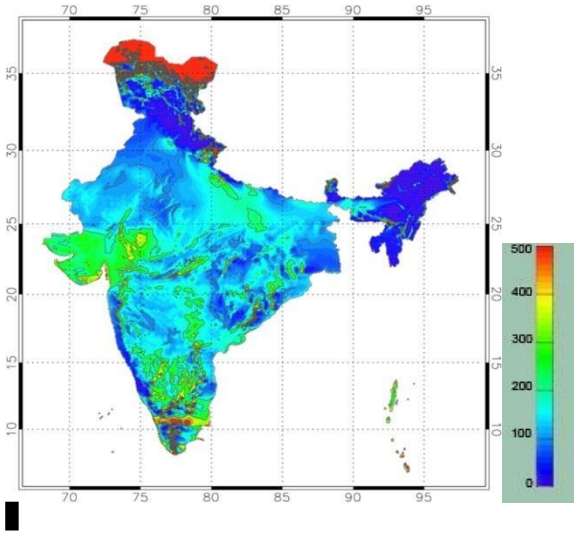

Fig 3. Wind power density map at 80 m level[21]

2.4 Solar Energy

So far, solar energy has played an almost non-existent role in the Indian energy mix. The capacity connected to the grid in the country is now 481.48 MW, while the total potential of solar energy is estimated at 50,000 MW. Most of India has between 300 and 330 days of sunshine a year, equivalent to more than 5000 billion kWh per year. The average solar incidence is between 4 and 7 kWh / m^2 / day. Approximately 66 MW of aggregate capacity are installed for various applications including one million industrial photovoltaic plants.

- 80 percent of which are solar lanterns, street lighting and solar pumps, among other things India is densely populated and has a great solar insulation, which provides an ideal combination for solar energy in India. Much of the country does not have an electricity grid, so one of the first applications of solar energy was pumping water; to start replacing India's four and five million diesel water pumps, each of which consumes around 3.5 kilowatts and off-grid lighting. Some big projects have been proposed and an area of 35,000 km2 of the Thar desert has been reserved for solar projects, enough to generate 700 to 2,100 gigawatts.

Photovoltaic cells (PV) have a low efficiency factor, but power generation systems that use photovoltaic materials have the advantage of not having moving parts. Photovoltaic cells find applications in single-house roof systems, community public lighting, and community water pumping areas where land makes access to the electricity grid difficult. The efficiency of photovoltaic solar cells with mono crystalline silicon is between 13% and 17%. High efficiency cells are produced with concentrators that can operate with low light intensity.

2.5 Geothermal Energy

Geothermal energy is the energy generated by the heat stored in the earth or the collection of absorbed heat derived from the subsoil. Currently, geothermal energy contributes to around 10,000 MW worldwide and India's small resources can increase the previous percentage. Studies conducted by the geological study of India have observed the existence of about 340 hot springs in the country. These are distributed in 7 geothermal provinces. The provinces, even if they are located along the west coast of Gujarat and Rajasthan and along a south-east-north-east west line that goes from the west coast to the western border of Bangladesh (known as SONATA), a section of 1500 km of the Himalayas.

3. Shortage of electricity

India suffers from a severe lack of electrical capacity. According to the World Bank, about 40% of the residences in India have no electricity. Furthermore, blackouts are common in the main cities of the country. The World Bank also reports that one-third of Indian companies believe that unreliable electricity is one of the main barriers to trade. To further complicate the situation, total electricity demand in the country continues to rise and is exceeding capacity increases. Adequate additional capacity did not materialize in India in light of market regulations, insufficient investments in the sector and the difficulty of obtaining environmental approval and funding for hydroelectric projects. Furthermore, the scarcity of coal is even more difficult

4. The future of renewable energy in India

In India, renewable energy is taking off. It is expected that India with large sources of renewable energy (solar photovoltaic, wind, solar thermal, small hydroelectric and biomass) will have a large-scale development and renewable energy projects. India should also seek international cooperation in renewable energy through well-defined R & D projects. The report on integrated energy policy recognized the need to develop domestic supply options as much as possible, as well as the need to diversify energy sources. The contribution of renewable energy only in the generation of energy is expected to be 60,000 MW in the year 2031-2032. A modest evaluation of investments in this sector will concern Rs. 300,000 crores in the next 25 years. MNRE included in its mission: energy security; Increase in the share of clean energy; availability of energy and access; energy convenience; and energetic equity. Several governmental and private organizations, such as MNRE, Wind Energy Technology Center, University, IIT, NIT, Indian Oil Corporation Ltd. (IOCL) and The Energy Resource Institute (TERI) participate in RES research and development.

5. Current energy policies

- **National electricity policy, 2005.**

The national electricity policy aims to achieve the following objectives; access to electricity, availability of energy demand (which will be covered in full by 2012), energy shortages and the peak to be overcome and availability of the rotation reserve, reliable power supply and quality of specific standards in an efficient and reasonably priced manner availability of electricity per inhabitant will increase to more than 1,000 units by 2012, the financial breakthrough and commercial profitability of the electricity sector and the protection of consumer interests.

- **Tariff policy, 2006.**

The pricing policy announced in January 2006 has the following provisions:

1. In accordance with the provisions of section 86 (1) (e) of the Act, the Appropriate Commission will establish a minimum percentage for the purchase of energy from these sources, taking into account the availability of these resources in the region and the impact on retail rates.

2. It will take some time before unconventional technologies can compete with conventional sources in terms of electricity cost. Therefore, the procurement of distribution companies will be carried out at preferential rates established by the corresponding Commission.

3. This acquisition by distribution licensees for future needs will be carried out, as far as possible, through a competitive tender procedure pursuant to Article 63 of the law within

suppliers that offer energy of the same type. unconventional sources.

4. The Central Commission shall establish guidelines within three months to determine the price of non-binding power, in particular from unconventional sources, which will be followed in cases where such bargaining is not carried out through public bids.

- **The Electricity Act 2003**

The Electricity Act contains the following provisions concerning non-conventional energy sources.

In points 3 (1) and 3 (2), it has been said that the central government will periodically prepare and publish the national electricity policy, and tariff policy, in consultation with state governments and the authority for the development of the energy system based on the optimal use of resources such as coal, natural gas, nuclear or material substances, hydropower and renewable energy sources. Section 4 establishes that the central government, after consultation with state governments, will prepare and notify a national policy, allowing independent systems for rural areas. Sections 61, 61 (h) and 61 (i) stipulate that the corresponding commission, subject to the provisions of this law, specifies the terms and conditions for determining the rate and, in doing so, must be guided by the following: That is, the promotion of cogeneration and the generation of electricity from renewable energy sources. and national electricity policy and tariff policy. Sections 86 (1) and 86 (1) (e) state that the state commissions will perform the following functions, i.e., promote cogeneration and production of electricity from renewable energy sources, providing adequate connectivity measures for the network and the sale of electricity to any person, and also specifies, for the purchase of electricity from such sources, a percentage of total electricity consumption in the area of a distribution license.

- **National policies for rural electrification, 2006.**

1. The objectives include the provision of access to electricity for all households for the year 2009, the quality and reliable supply of energy at reasonable prices and a minimum consumption of 1 unit / family unit / day as meritorious good for the year 2012.

2. For villages / houses where network connectivity would not be feasible or would not be economically advantageous, off-network solutions based on independent systems may be used for the supply of electricity.

3. The government must, within 6 months, prepare and notify a rural electrification plan, which should map and detail the electrification supply mechanism.

4. The Gram Panchayat will certify and confirm the electrified state of the village on March 31 of each year.

• Report on Integrated Energy Policy (Planning Commission) 2006

Suggest a way to meet the country's energy needs in an integrated way up to 2031-2032. A special approach is recommended in the development of renewable energy.

6. Main results

• Over 4200 MW of grid power from wind, small hydro, biomass and solar energy.

• 3600 remote villages / villages, including those of Sunderbans, Bastar, Ladakh and Northeast, electrified by solar energy.

The largest solar steam cooking system for 15,000 people / day established in Tirupati Tirumala Devasthanam.

• Area of 7 square meters of water heating systems for installed solar collectors.

• 3.5 million biogas plants installed for cooking and lighting applications.

• 35 million improved wood stoves in rural households.

• Integrated rural energy program implemented in 860 blocks.

• Solar photovoltaic products with a capacity of 30 MW exported to various developed and developing countries.

• 280 energy parks set up in schools to demonstrate renewable energy systems and devices.

• Rs.25, 000 million direct grants awarded to beneficiaries / users of renewable energy systems and devices, including grants for renewable energy projects connected to the grid.

• Rs. 32,000 million loans granted so far by the Indian Renewable Energy Development Agency for 1,600 renewable energy projects.

• CWET was founded as an organization of scientific and industrial research for the assessment of wind resources, equipment certification and research and development in Chennai in Tamil Nadu.

• Solar energy center established for the development of solar energy systems and devices in Gurgaon in Haryana.

7. Conclusions

Energy security, economic growth and environment protection are the national energy policy drivers of any country of the world. The need to boost the efforts for further development and promotion of renewable energy sources has been felt world over in light of high prices of crude oil. A critical part of the solution will lie in promoting renewable energy technologies as a way to address concerns about energy security, economic growth in the face of rising energy prices, competitiveness, health costs and environmental degradation. Specific action points that have been mentioned include promoting deployment, innovation and basic research in renewable energy technologies, resolving the barriers to development and commercial deployment of biomass, hydropower, solar and wind technologies, promoting direct (direct) biomass combustion and biomass gasification technologies, promoting the development and production of small wind turbines and improving the regulatory / tariff regime for the main flow of renewable energy sources in the national electricity system. As a result, more emphasis is placed on the use of renewable energy which in 2032 will account for around 5% of the electricity mix. It is proposed that alternative fuels, essentially biofuels, be used progressively to mix with diesel and petrol. , mainly for transport applications.

Finally, renewable energy offers enormous benefits and can contribute significantly to the national energy mix, at least to economic, social and environmental costs, and it is expected that the share of renewable energy in total generation capacity will increase in the future.

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