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Overview of Renewable Energy in Maharashtra

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Abstract: Maharashtra has been one of the most industrialized and urbanized states in the country. India has a vast supply of renewable energy resources. In this context, the main objective of this study is to critically examine the state's renewable energy landscape. The state also has set targets for capacity installation for four different renewable based power generations. Keeping this in view, it is critical that Maharashtra should implement a comprehensive renewable energy policy with a focus on promoting large scale solar projects in both urban and rural areas of the state. In this paper we focus on renewable energy sources available in Maharashtra.

Keywords: Solar, Hydro, Biomass, Wind.

I. INTRODUCTION

Maharashtra is one of the most urbanized states there is an scope for urban services quality, reliability improvement and delivery to people. Renewable energy alternatives have potential to satisfy both the challenges of inclusive and low carbon growth. There is a wide disparity in electricity consumption in urban districts like Mumbai, Thane, Raigad, versus the rural districts like Nandurbar, and Gadchiroli. Typically poor consumer from rural areas can't sustain paying for electricity for a duration in which they can see its return in terms of better life style. However the average load shedding for rural areas in case of Irrigation feeders is around 8 hours.

There are around 4 million pump sets in the state which are energized. With poor quality of electricity supply, a vicious circle is formed between the farmer who is unwilling to pay for the poor supply and the utility for which there is no incentive to upgrade the service quality and provide electricity at very low to negligible commercial profit. In presence of such poor supply quality, farmers adopt diesel pump sets, which can be very inefficient as compared to the electric motors, resulting not only in huge increment in input cost for farmers but also increased carbon footprint of the agriculture sector.

RE options such as solar/wind pumps can easily help to solve this twin problem. RE applications such as solar water heater for domestic purposes, specifically in the urban areas, can similarly help in reduction of peak load during the morning hours. Shifting to RE at a large power generation scale however have many dimensions such as maturity of technology, life cycle cost etc. on which its penetration depends however with current financial situation of state utilities across the country, it is difficult to imagine such uptake. There is a huge scope and need for better service e.g. agricultural pumping, cooking energy, and domestic water heating where renewable options can be appropriately promoted. [1]

II. RENEWABLE ENERGY LANDSCAPE OF MAHARASHTRA

The estimated potential and achievement of grid connected renewable energy systems in the state are shown in Table.

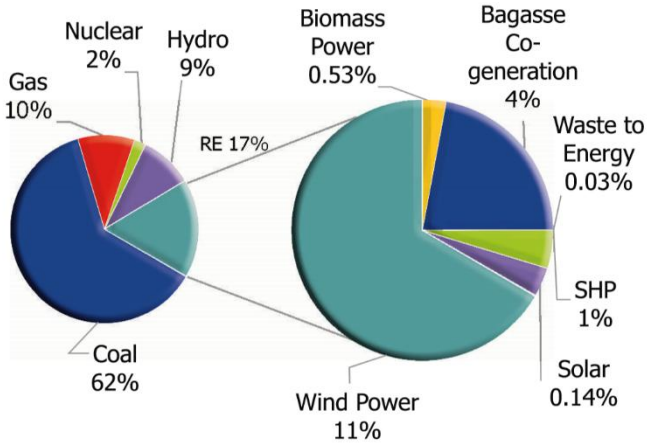

Fig.1: Resource wise installed capacity in Maharashtra

Table: The overall supply of energy from renewable energy sources can be divided into various categories based on the end user demand and scale of energy generation e.g. [1]

Table I

Sr. No.	RE Technology	Potential	Achievement
1	Wind	5,4391 MW	4,079.6 MW
2	Waste to energy	287 MW	11.7 MW
3	Biogases cogeneration	1,250 MW	1,362.7 MW
4	Biomass Power	1,887 MW	182 MW
5	Small Hydro Power	733 MW	278.6 MW
6	Solar PV	4-7 MW	230.25 MW

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Maharashtra has the second highest installed capacity of the renewable based power options, among all the states in India. The combined renewable power generation capacity of the four leading states Maharashtra.

Each of these states has relied on the renewable resource which is abundantly available there, for e.g. Gujarat massively developed solar power whereas Tamil Nadu has developed its wind resource. Maharashtra has a large potential for wind and biomass followed by solar.

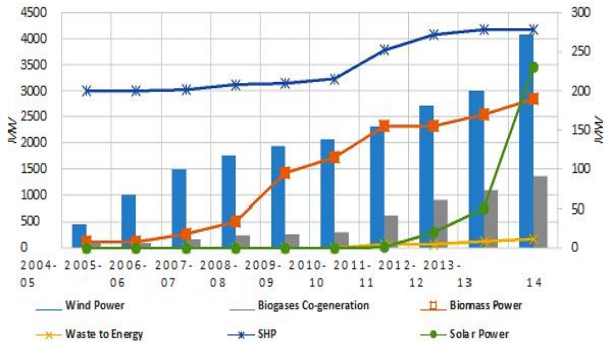

Fig.2: Renewable Power Capacity Addition in State of Maharashtra [2]

III. OVERALL TARGET

The Grid connected renewable projects as per the following capacities:

Table II

Type of power	Capacity
Wind	5000 MW
Biogas	1000 MW
Small hydro	400 MW
Biomass	300 MW
Industrial waste Based	200 MW
Solar	7500 MW

Table: Grid connected renewable projects Capacity

A. Hydro power

Although capacity of hydro power has steadily increased, from close to 40% in 1980 to 12% in 2013. In addition, there are issues specific to hydropower, notably the high levels of sediment in the rivers coming down from the North side of Indian Mountains, which can reduce reservoir storage capacity and, if not removed, cause heavy damage to turbine blades and other steel structures in a hydropower plant.

The result is a rise in installed capacity for huge hydropower from 42.56 GW in 2014 to just under 100 GW in 2040. Small projects up to 10 MW10, also plays a growing role, particularly in meeting the power requirements of remote, mountainous areas. Their capacity increases from 2.8 GW to over 10 GW by 2040. Similar arrangements are in place with Nepal, including the approval of projects with a combined capacity of 1.8 GW in 2014.

Ministry of Non-conventional Energy Sources is focused on:

1. Nation-wide resource assessment
2. Setting up of commercial projects
3. Industry based research and development

B. Solar energy

Solar energy based electricity can be generated through photovoltaic effect in solar cells and Solar thermal which uses the infrared component of radiation spectrum to heat the fluid which can be further used to rotate turbines. Maharashtra has a potential of over 64 GW for solar power generation. Such assessments and their accuracy have a direct impact on the project viability. Therefore that should to be carried out by the state nodal agencies in partnership with other organizations and the results must be shared with the developers to promote investment in the solar sector. In order to provide a favourable environment for solar energy technologies i.e. both SPV and thermal, Government of India has constituted Jawaharlal Nehru National Solar Mission (JNNSM), with set targets for three years 2013, 2017 and 2022. [3]

C. Solar Rooftop

Status: 358MW Projects sanctioned and 41 MW installed
Target: 40,000MW by 2022 of which 10 GW during 2015-16 to 2017-18.

Fig.3: Solar Rooftop

Advantages of Solar Rooftop:

- Savings in transmission and distribution losses.
- No requirement of additional land.
- Local employment generation.
- Reduction of power bill

Major routes for getting returns on investment which are possible under various schemes, policies and mechanisms:

i) The JNNSM route - incentives and schemes are available but the tariff is determined through a competitive bidding process.
ii) The Average Power Purchase Cost (APPC) and REC combination route in which tariff is negotiated between utility and developer with maximum tariff capped by average pooled power purchase in the state.
iii) The Feed-in-Tariff route in which the MERC determines the tariff for various renewable power projects, which is levelized tariff for a long period. Till now, total projects commissioned of grid interactive SPV in the state are of 230 MW capacities. [3]

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D. Wind Based Generation Power

Fig.4: Wind Based Plants

Wind turbines can be used as stand-alone applications independently or in combination with solar PV, or they can be connected to a utility power grid. For utility-scale development of wind energy. The total in-land wind power generation potential is estimated to be around 5439 MW in Maharashtra. Although the off-shore wind generation potential can be much more than in-land, it is not yet estimated. Total installed capacity of wind power in Maharashtra up to 2013-14 is 4079 MW, which is 75% of the estimated potential.

E. Bio energy for Power Generation

Bio Energy is derived from biomass through various conversion processes such as direct burning of biomass or conversion into liquid or gaseous fuels. Biomass power is the use of biomass for electricity generation. There are five major types of biomass power systems: burning of biomass or direct fired (biomass as primary fuel), co-firing (biomass as partial substitution of primary fuel), gasification (partial combustion), anaerobic digestion (through bacterial organisms), and pyrolysis (distilling organic matter without air supply). Most of the biomass based grid connected power plants at MW scale use direct-fired system to generate steam required to run the turbine. Many coal fired power or heat generation units can use co-firing systems to reduce emissions, especially sulphur dioxide emissions as well as reduce fuel costs. Gasification systems use high temperatures and an oxygen-starved environment to convert solid biomass into a gas (a mixture of hydrogen, carbon monoxide, and methane), which then can be used to run gas turbine or engines. The Decay of biomass produces a gas (a mixture of methane and carbon dioxide), that can be used as an energy source. Methane can be generated from biomass through the process called anaerobic digestion, which involves using bacteria to decompose organic matter in the absence of oxygen. Methane can be directly burnt in a boiler to generate steam or it can used be in a gas engine to generate motive power. [4]

F. Biogases Co-Generation Based Power Generation

Cogeneration is essentially the generation of heat and power, where already steam is being generated for existing industrial process purpose. Typically, there is a component of waste heat in power generation which can be used for the process as useful heat in case of co-generation resulting in thermodynamically efficient use of the fuel. The relatively better growth of Biogases based cogeneration in the state can be attributed to organized nature of fuel supply chains as well as financial support provided through state policy i.e. role of energy fund called Urjankur Nidhi.

Cogeneration projects can utilize either biogases or any other biomass as fuel. Cogeneration plants get the added advantage of established and organized fuel supply chain. The total installed capacity up to year 2013-14 was 1,354 MW, which is second largest contributor after wind power to the current renewable energy portfolio of the state. The installed capacity exceeds the potential estimated in year 2011 i.e. 1,250 MW. In order to promote cogeneration based power development, there are incentives and subsidies available from both state policy as well as central level. [4]

G. Biomass Based Power Generation

Biomass energy based power generation has a huge scope in the state. According to IISc study on estimating the potential for biomass based power, there is a potential for around 1800 MW capacity in the state.

Fig.5: Biomass power generation

However, this depends upon the cropping pattern and calorific value of various crop wastes. However, due to many hurdles such as fuel quality, dependence upon rainfall and cropping pattern, the actual installed capacity in the state is around 10% of the potential. There are a total 182MW biomass based power generation projects commissioned till 2014, as against the total estimated potential of 1,887 MW. Total 17 projects have been installed so far, out of which 14 are in Vidarbha and Marathwada region and remaining 3 are in north Maharashtra. Particularly in rural Maharashtra gasifier projects can not only address electricity shortage but also the most energy intensive and vital household process, cooking while utilizing charcoal (a by-product of the gasifier). [4]

H. Waste to Energy

Generation of electricity from waste, it is a form of energy recovery. Most of the processes produce electricity and produce combustible fuels, such as methane, methanol, ethanol or synthetic fuels. Although the potential estimated for waste to energy is 287 MW, but only 11.7 MW projects have been realized till now. Mumbai generates 8,000 metric tons of garbage every day,

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and had announced to set up 10 power plants based on waste-to-energy technology. For promoting the waste-to-energy based power generation in the country, a capital subsidy for the promoter is available for different types of processes such as Biomethanation at sewage treatment plants and bio-CNG production. [5]

I. Hydro-Power

Hydro power projects are generally categorized in two segments i.e. SHP. In India, hydro projects up to 26 MW station capacities have been categorized as Small Hydro Power (SHP) projects. The Small Hydro-Power (SHP) growth has been steady in the state throughout the last decade. The current installed capacity is 278.6 MW. [6]

J. Wind Solar Hybrid

A hybrid renewable energy system is the reliability of the system is enhanced. Total 193 wind solar hybrid systems have been installed, most of which are for institutional set ups. Total installed capacity up to the year 2012 is 1,352 kW. A capital subsidy to the tune of 1-1.5 Lakh per kW is available for aero generators/wind solar hybrid systems through central finance assistance of MNRE. [6]

IV. CONCLUSION

Growth of renewable energy in Maharashtra was dependent on only two resources i.e. wind and biogases, out of which over 75% of the wind potential and 100% of the cogeneration potential is already tapped. This growth in these two sectors can be mainly attributed to the financial incentives such as accelerated depreciation, state energy fund, as well as other key factors such as organized nature of fuel supply chain for cogeneration projects and categorization of wind potential sites in the state. However other sectors such as solar didn't grow with such rate in absence of clear policy signals among other reasons. The small hydro sector has also been growing steadily. To continue the same growth trend, it is essential for the state to equally stress on other renewable resources such as bio energy, solar PV and waste- to-energy, which are abundantly available in the state. All of the bio energy options depend upon an assured supply of biomass fuels for its operation. Development of solar PV has been sluggish in the past and it can be promoted with a clear policy direction and time bound targets. Given the high urbanization in the state, waste-to-energy offers a dual advantage of energy generation as well as waste disposal. [7]

Fig.6: Use Renewable energy sources

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BIOGRAPHIES

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