

A Study on Renewable Power Generation in India

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To Cite this Article

Krithiga L and Dhenakaran S S, "A Study on Renewable Power Generation in India", *International Journal for Modern Trends in Science and Technology*, Vol. 03, Issue 08, July 2017, pp.-50-54.

ABSTRACT

Renewable energy is any energy source that is naturally replenished. Now a day's electricity is more important in day to day life. As you all know power production over 29.9% only through Renewable energy all other are from Non- Renewable energy. The major Renewable energy used in India is Solar, Wind, Hydropower, and Biomass power. Around 42,849.38 MW are generated by Renewable energy in India. Solar power generation is reaching all over India and other major power production is from Darjeeling and Shivanasamudram for Hydropower, Tamilnadu, Maharashtra, Gujarat, Rajasthan and Karnataka for wind power and Gujarat, Jharkhand and peninsular in India for Biomass power. The process of data collection over Renewable energy production in India, to assess the data collected and to interpret and compare it to the partner states or districts. And also listed the data on the basis of state and district with the comparison of minimum and maximum to distribute the energy from maximum to minimum. This paper is aimed at to study the amount of Renewable energy power generation in various places of India and how the resources are shared by the Indian government.

Keywords: India, Power Generation, Renewable , Energy

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I. INTRODUCTION

1.1 Indian energy status

The utility electricity sector in India had an installed capacity of 315.42 GW as on 28 February 2017. Renewable power plants constituted 30% of total installed capacity. During the fiscal year 2015-16, the gross electricity generated by utilities in India was 1,116.84 TWh (Terawatts) and the total electricity generated (utilities and non-utilities) in the country was 1,352 TWh (Terawatts) or 1,075.64 kWh (kilowatts) per capacity. India is the world's third largest producer and the fourth largest consumer of electricity. Electric energy consumption in agriculture was recorded highest (17.89%) in 2015-16 among all countries. The per capita electricity

consumption is low compared to many countries, despite cheaper electricity tariff in India.

In the aspect of total installed renewable power generation, India occupies the fifth position in the world today. While the governmental policies have steadily encouraged the adoption of renewable power generation, there are need and potential for more vigorous encouragement in the pursuit of achieving power for all citizens along with economic development.

Renewable energy in India

India's renewable energy sector is amongst the world's most active players in renewable energy utilization, especially solar and wind electricity generation. As of June 2016, India had grid connected installed capacity of about 42.85 GW

(Gigawatts) non-conventional renewable technologies-based electricity capacity, about 14.15% of its total; exceeding the capacity of major hydroelectric power for the first time in history.

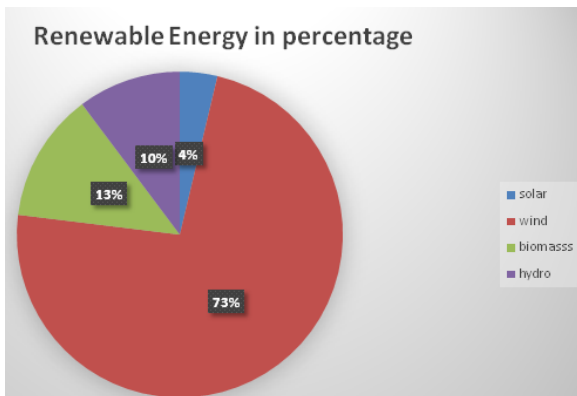


Fig 1: Renewable Energy sources(%) in India

II. ANALYSIS OF VARIOUS SOURCES OF RENEWABLE ENERGY

2.1 Solar energy

India's installed solar capacity increased from 17.8 MW to over 500 MW. It was during that period when solar energy prices dropped to as low as Rs. 7.49/kWh, or \$0.15 USD/kWh. On 11 January 2010, JNNSM was launched. The mission targeted at generating 20,000 MW of solar power by the end of the thirteenth Five-Year Plan (2022). The mission also aimed at deploying 20 million solar lighting systems in rural areas, thus reaching 15 million square meters by 2017 and 20 million by 2022. The other aim was also to take manufacturing into consideration and reaching an installed capacity of 4-5GW by 2020. With respect to off-grid solar projects, JNNSM set a target of 1000MW of 2017.

According to the mission, plans were made to increase the capacity of grid connected (33 Kilowatts and above) solar power generation to 1,000 MW within three years of 2013 and an additional 3,000 to 9,000 MW by 2017.

Solar System In Some Of The Indian states Gujarat

Gujarat has been a leader in solar power generation. Here, solar power is available at 5.5 kWh/Sq. Mt./day. The state contributes to two third of the 900 MW of PV in the country with one the largest solar park in Asia commissioned at Charanka village. Charanka is among the regions that receives the highest solar radiation per unit area in the country. It houses Asia's largest solar

park, the 214 megawatts (MW) Gujarat Solar Park, beating China's 200MW Golmud Solar Park.

Karnataka

Karnataka has tremendous potential for solar energy. The solar policy in Karnataka has set a target of 350MW by 2016 . The Karnataka Electricity Regulatory Commission (KEREC) issued regulations for getting 0.25% of total power from solar resources.

Madhya Pradesh

The state is closer to both Rajasthan and Gujarat with its nodal agency being Madhya Pradesh UrjaVikas Nigam (MPUVN) Ltd. The Government of Madhya Pradesh sets a target of total capacity of 500MW during the operative period of the policy. The state also planned solar cities under the MNRE. The cities included places like Bhopal, Jabalpur.

Rajasthan

Rajasthan is one of the leaders in solar energy production in India. The state gets solar radiation for 6-7 kWh/m²/day. The maximum number of sunny days in the state is about 325 days. In the first phase of the solar mission project, the state received an allocation of generating 873 MW, which is 80% of the total allocation of the national mission.

Table 1: State-wise Installed Capacity of Solar System

S.No	State	2012 (MW)	2013 (MW)	2014 (MW)	2015 (MW)	2016 (MW)
1	Andhra Pradesh	21.75	23.5	131.84	357.34	572.96
2	Gujarat	604.89	824	916	1024.15	1119.17
3	Karnataka	9.00	14	31.00	104.22	145.46
4	Kerala	0.84	0	0.03	12.03	12.025
5	Madhya Pradesh	2.10	11.75	347.17	678.58	678.58
6	Maharashtra	20.00	34	249.25	378.70	378.7
7	Rajasthan	197.65	442.45	730.10	1264.35	1264.35
8	Tamilnadu	15.05	17.06	98.36	418.95	635.87
9	Punjab	9.33	9.33	16.35	200.32	342.32
10	Telangana	-	-	-	91.45	392.39

2.2 Wind energy

India has the fourth largest wind power installed capacity in the world. Highest capacity of wind power 3300 MW in 2015-2016. Tamilnadu is the leader in renewable energy, Total capacity of about 32,730 MW installed all over India. Tamilnadu alone has about 8326.86 MW. 25.44% of the total installed capacity. An important sector of wind energy 34.31% of the total wind energy installed in india.

Wind Energy Technology (C-WET) as technical focal point for development of wind energy in India.

The C-WET has established country – wide network of 790 wind monitoring stations in 31 states and union territories for wind resource mapping. According to C-WET estimation, Gujarat, Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra are leading states in wind energy potential.

Tamil Nadu is pioneer of wind energy in India. Tamil Nadu is the leading producer of wind energy with a total installed capacity of 7,276 MW, accounting 34% of India’s total wind capacity. Maharashtra is having the largest installed capacity of wind energy after Tamil Nadu with 4098 MW, covering about 19% of India’s total wind capacity. Satara, Sangli, Dhule and Panchgani are places in Maharashtra those have a good number of wind power generating facilities.

The state of Gujarat is blessed with a long coastline of 1600 KM where the wind speeds are adequate for conversion into electrical energy. Rajasthan is emerging as the most favored destinations for setting up wind power projects. This state has reached to installation of 2,820 MW on March 2014 from just 16.1 MW in 2002. Andhra Pradesh is having second highest potential for wind energy with 14.5 GW of generation potential at 80 meter hub height. In 2013 also, 305.35 MW wind energy has been established.

On October 31, 2016 cumulative capacity of 46.33 GW renewable energy capacities has been installed in India. Which constitutes 15% of the total installed energy generation capacity of 307.69 GW .

Table 2: State-wise Installed Capacity of Wind Power

S.NO	State	2012 (MW)	2013 (MW)	2014 (MW)	2015 (MW)	2016 (MW)
1	Andhra Pradesh	245.55	448	746.20	1155.12	1431.45
2	Gujarat	2966.28	3175	3454.30	3876.50	3948.61
3	Karnataka	1933.50	2135	2318.20	2871.53	2869.15
4	Kerala	35.10	35	35.20	35.10	43.5
5	Madhya Pradesh	376.40	386	423.40	1126.19	2141.1
6	Maharashtra	2733.30	3022	4100.40	4638.35	4653.83
7	Rajasthan	2070.65	2685	2784.90	3866.34	3993.95
8	Tamilnadu	6987.58	7162	7269.50	7514.76	7613.86

2.3 Biomass energy

Biomass power is the largest source of renewable energy as well as a vital part of the waste management infrastructure. Major place power production is from Gujarat, Jharkhand and peninsular in India for Biomass power. The process of data collection over Renewable energy production in India

An increasing global awareness about environmental issues is acting as the driving force behind the use of alternative and renewable sources of energy. State-wise overall Production of biomass power in megawatts details shown in table 3. Highest biomass power generation installed states are Maharashtra, Karnataka, Uttar Pradesh. Least power production state is Madhya Pradesh. 4621 MW installed in 2016.

Table 3: State-wise Installed Capacity of Biomass Power

S.No	State	2012 (MW)	2013 (MW)	2014 (MW)	2015 (MW)	2016 (MW)
1	Andhra Pradesh	363.25	380	578	389.75	380.75
2	Chattisgarh	249.90	250	264.90	264.90	279.90
3	Gujarat	20.50	30.50	43.42	55.90	56.30
4	Karnataka	441.18	491.38	603.28	664.28	872.18
5	Madhya Pradesh	8.50	16.00	26.00	36.00	35.00
6	Maharashtra	603.70	756.90	940.40	1033.40	1220.78
7	Rajasthan	83.30	91.30	101.30	11.30	108.30
8	Tamilnadu	532.70	538.70	571.30	662.32	641.90
9	Punjab	90.50	124.50	140.50	140.50	155.50
10	Uttar Pradesh	644.50	776.50	776.50	888.50	870

2.4 Hydro power

Hydro power is considered as one of the most economic and non polluting sources of energy. Power generated from water is termed as Hydroelectricity. Hydro electricity means electricity generated by hydro power from the use of the gravitational force of falling or flowing water. Major power production is from Darjeeling and Shivanasamudram for Hydropower. State-wise total hydro power installation capacity (MW) in Megawatts details shown in table 4.

The potential for hydroelectric potential in terms of installed capacity in India is estimated to be about 148,700 MW out of which a capacity of 30,164 MW (20.3%) has been developed so far and 13,616 MW (9.2 %) of capacity is under construction. In 2 hydro power generated 16.6% of the world's total electricity and 70% of all renewable electricity and was expected to increase about 3.1% each year for the next 25 years.

Table 4: State-wise Installed Capacity of Hydro Power

S.No	State	2012 (MW)	2013 (MW)	2014 (MW)	2015 (MW)	2016 (MW)
1	Arunachal Pradesh	79.33	103.91	104	104.61	104.64
2	Chhattisgarh	20.25	50.00	52	52.00	236
3	Himachal Pradesh	527.66	587.91	638.91	754.80	793.31
4	Karnataka	882.45	963.76	1032	1177.85	1217.73
5	Jammu & Kashmir	130.53	130.53	147.53	156.53	156.53
6	Uttaranchal	134.62	174.82	174.82	209	209.33
7	Andhra Pradesh	217.83	219.30	221.03	232.23	232.98
8	Maharashtra	281.33	299.93	327.43	86.56	339.88
9	Kerala	150	150	158.42	199	198.92

III. RESULT AND DISCUSSION

The development and deployment of renewable energy, products, and services in India is driven by the need to decrease dependence on energy imports sustain accelerated deployment of renewable energy system and devices expand cost-effective energy supply augment energy supply to remote and deficient areas to provide normative consumption levels to all sections of the population across the country. And finally, switch fuels through new and renewable energy system/ device deployment.

In the below table to explain the energy production of different energy like Solar, Wind, Biomass and hydro. Relevant year from 2012 to 2016 in megawatts. The chart shows the overall energy production in India.

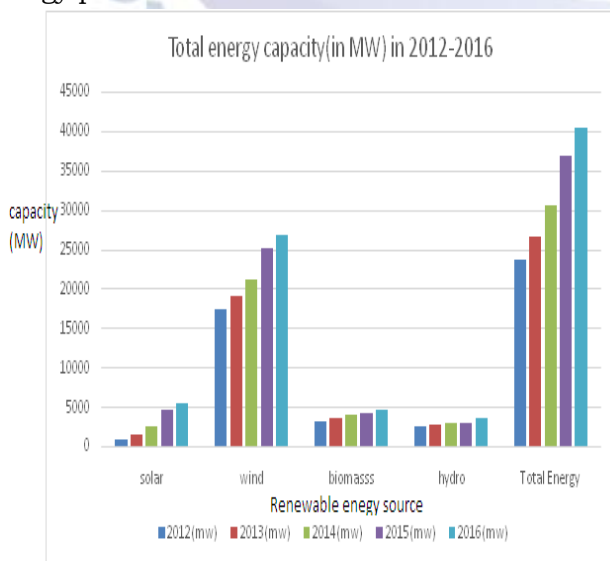


Fig 2: Total Energy Capacity 2016-2017

Table 5: Year-wise Energy Production Capacity in Megawatts

Energy	2012(mw)	2013(mw)	2014(mw)	2015(mw)	2016(mw)
Solar	881	1376	2519	4530	5542
Wind	17348	19048	21132	25084	26695
Biomass	3038	3456	4046	4147	4621
Hydro	2424	2688	2856	2973	3489
Total energy	23691	26568	30553	36734	40347

IV. CONCLUSION

In this paper Energy consumption over four Energy services, namely Solar, Wind, Biomass and Hydro energy over India. Cluster and sort the data through State wise, and District wise and also transfer data from maximum to minimum with power production. The experimental result shows the data collection over energies in India. The implementation stage involves careful planning, investigation of the existing system and its constraints on the implementation, designing of methods to achieve changeover and evaluation of changeover methods.

ACKNOWLEDGMENT

I would like to thank Dr.S.S.Dhenakaran for his guidance and support for preparing this paper.

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