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Renewable Energy in India

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Abstract: **In the energy sector the Green Energy resources are most demanded resources because of the shortage of energy supply or due to environmental issues. The green energy share is very less in the total installed capacity of the energy in India due to high cost of Green Energy technologies as compared to fossil fuel based power generation. This paper discusses various techniques of power generation from Renewable Energy sources. This paper has main influence on solar, wind, small hydro and biomass. This paper elaborates the Renewable Energy scenario of India, technical and economical aspects of various RE sources. The RE scenario of each state has been shown in the paper and it has been observed that many states are encouraging the use of RE by providing tax benefits, government subsidies and government policies which support the RE.**

1. INTRODUCTION

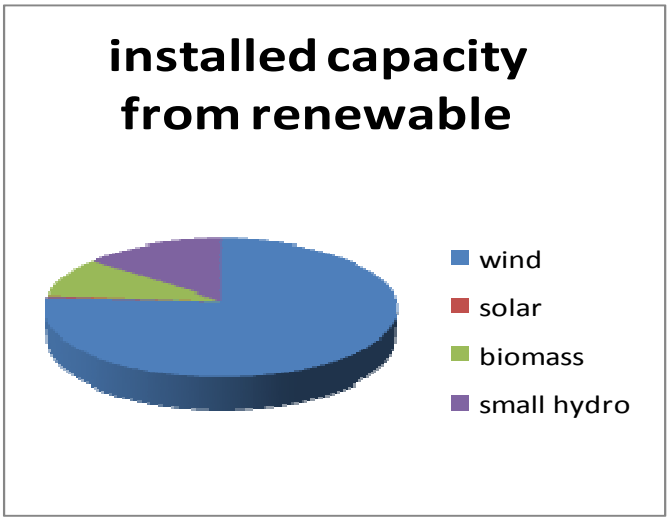
India has renewable resources in abundant. Energy is capability to produce motion, force, work, or any change.

The need for renewable energy has risen because of following facts:

1) The demand-supply gap, especially as population increases
2) A large untapped potential
3) Concern for the environment
4) Need to strengthen India's energy security
5) Solution for rural electrification
6) Rising prices for oils and gases
7) Government incentives.[2]

Renewable energy is energy generated from natural resources which are replenished such as wind, wave, solar, biomass and tidal power. Government and companies around the world are investing heavily in developing technologies to harness the power of clean renewable energy sources because of their potential to produce large quantities of energy without generating greenhouse gases which can contribute to climate change.[9]

Fig. 1 shows installed capacity of power from various renewable energy sources.[8]



In this paper following renewable energy forms will be discussed:

2. SOLAR ENERGY

Solar radiations present in abundant in nature at every place on the earth. Sun's warm energy can be used in two ways:

a) Solar thermal energy: solar energy directly used to heat water and buildings.
b) Solar PV cell: sunlight is directly converted into electrical energy using PV cells. Solar cell is a semi conducting device made up silicon, which when exposed to sunlight generates Electricity.

2.1.1. Advantages of solar energy:-

- Unlimited supply,
- Clean, pollution free,

2.1.2 Disadvantages of solar energy:-

- Large area required
- Not reliable in night and non-sunny days
- Storage and back-up required
- Not cost effective

State wise installed capacity of solar power in India has been shown in the Table.1. [2].

Table.1. State-wise installed solar capacity in India

S. no.	State	Solar photovoltaic capacity (MW)	Solar Thermal capacity(MW)
1	Rajasthan	43	400
2	Gujarat	722	45
3	Maharashtra	133	-
4	Karnataka	10	-
5	Andhra Pradesh	20.5	-
6	Uttarakhand	4	-
7	Punjab	5	-
8	Haryana	7.8	-
9	Uttar Pradesh	11	-
10	Jharkhand	16	-
11	Chhattisgarh	4	-
12	Madhya Pradesh	7.25	-
13	Odisha	11	-
14	Tamil Nadu	12	-
	Total	**1006.55**	**445**

3. WIND ENERGY

Wind turbines are used to generate energy utilizing wind as energy resource. Wind turbine converts kinetic energy present in wind into mechanical energy and that mechanical energy is converted into mechanical energy.

3.1.1. Advantages of wind energy:-

- Available free of cost
- Available in many off-shore, and on-shore remote areas
- Clean and pollution free
- Low operating cost

3.1.2. Disadvantages of wind energy:-

- Constant wind is required
- Kills birds and bats
- Large land is required.

State wise wind power capacity of India has been represented in the table 2. [2]

Table.2. State-wise estimate of installed wind energy capacity in India

S. no.	States	Gross potential (in MW)	Total capacity (in MW)
1	Andhra Pradesh	8968	200.2
2	Gujarat	10,645	2175.6
3	Karnataka	11,531	1730.1
4	Kerala	1171	32.8
5	Madhya Pradesh	1019	275.5
6	Maharashtra	4584	2310.7
7	Orissa	255	-
8	Rajasthan	4858	1524.7
9	Tamil Nadu	5530	5904.4
10	Others	-	4
	Total	**48,561**	**14,158**

4. SMALL HYDRO POWER

Dams are built on rivers as water reservoirs. The water through dam falls on the wheel of turbine, and converts that falling energy into mechanical energy which is given as input to the generator.

4.1.1 Advantages

- Abundant, clean and safe
- Easy to store in reservoirs
- Offers recreational benefits like boating, fishing etc.

4.1.2 Disadvantages

- People can lose their homes
- Used only at places where water is in abundant

The total installed capacity of India is 36878MW. State wise hydro power capacity of India has been shown in the table.3. [2]

Table .3.State-wise installed small hydro energy capacity in India

S. no.	States	Installed capacity (in MW)
1	Himachal Pradesh	2457
2	Jammu & Kashmir	3923
3	Uttarakhand	6858
4	Punjab	243
5	Madhya Pradesh	166
6	Andhra Pradesh	1560
7	Kerala	373
8	Karnataka	400
9	West Bengal	186
10	Sikkim	2455

11	Arunachal Pradesh	9579
12	Assam	150
13	Manipur	1566
14	Tamil Nadu	500
15	Meghalaya	504

5. BIOMASS ENERGY

The second Biomass is the oldest renewable energy sources. Municipal solid waste and sewage sludge break down to produce methane. This methane can be collected in tanks and burned to produce heat. Various processes performed on different-different types of biomasses to convert them in energy forms are:-

1. Combustion
2. Pyrolysis
3. Hydrolysis and Distillation
4. Anerobic digestion
5. Fermentation and distillation
6. Photochemical process
7. Photobiological process and
8. Catalytic process.

5.1.1 Advantages

- Abundant and renewable
- Used for burning of waste products

5.1.2. Disadvantages

- Pollution increases due to burning of biomass
- Government Incentives

Wherever Incentives provided by the state and central government to encourage individuals and firms for renewable energy are shown in table .4. [3]

Table .4. Government incentives

Technology	Subsidies
Biogas Plant	Rs.10,000 per plant (general category states) Rs. 16,700 per plant for north eastern states
Biomass Gasifier	Rs. 5 lakh per village
Solar PV(NSM) Decentralized SPV systems	Rs. 150/Wp & an average10kWp system/village subsidy of benchmark capital cost (Rs. 270/Wp)to FIs for refinancing @5% interest rate
Micro hydro/Water mills	Rs. 1 lakh per water mill
Remote Village Electrification	90% of project cost

6. CONCLUSION

Thus, the sources of renewable energy helps a lot in getting rid of increasing power crisis and increasing prices of fossil fuels. Renewable sources present in abundant in nature and are free of cost. Also, the cost of transportation related them is zero. Energy generated from RE sources is clean and pollution free (except for biomass waste gases).

Now-a-days, government and individuals are giving more and more emphasis on generating electricity using RE sources to overcome the problem of power shortage. Government is also encouraging people in this regard by giving various subsidies and tax benefits. Rural electrification is one of the best outcomes of generating electric power using RE sources. From all, renewable energies wind energy is the most reliable and efficient, as its installation cost and generation cost not much high; also its payback time is short. Researches are going on to make solar power more efficient because of its abundant presence.

Fig. 2 shows installed capacity of power from various renewable energy sources in different states.

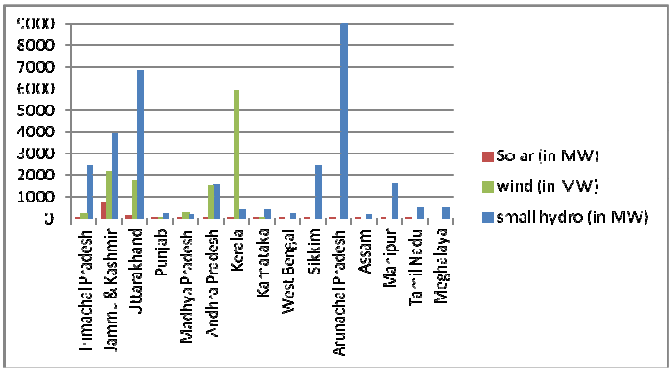


Fig. 2.

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