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A Review on Renewable Energy Sources, Usages & Future Scope in India

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Abstract : This paper explains about the different sources of renewable energy; Solar, Biomass, Tidal, Geothermal and Hydro Energy. The review has been taken to know the current statistics about sector wise energy consumption in India. As the renewable energy usage is globally increasing, the scope and target can be achieved from the different data provided in this paper. This study is focused to develop or modify the renewable energy sources in India. As India has a very convenient geographical location to collect solar energy, the target is to increase the usage of solar energy and wind energy for alternating conventional sources of energy. The data provided in this paper gives clear idea to focus or update in the usage throughout the India.

Keywords **– Renewable Energy Sources, Renewable Usages in India, Statistical data of renewable energy in India**

1 Introduction

Energy that is sustainable is defined as something that never runs out or is limitless, like the sun. Renewable energy sources are frequently included when the term "alternative energy" is used. It refers to energy sources that are an alternative to the most popular non-sustainable sources, such as coal.

One of the most plentiful and freely available energy sources on our planet is sunlight. The amount of solar energy that reaches the surface of the earth in a single hour exceeds the planet's entire annual energy needs. The amount of solar energy we can use varies depending on the time of day, the season of the year, as well as our geographic location, despite the fact that it may seem like the ideal renewable energy source. Solar energy is becoming a more and more common way to supplement your energy use in the India

The main renewable energy sources currently in India are:

- Solar energy
- Biomass energy
- Wind energy
- Tidal energy
- Geothermal energy
- Hydro energy

I. Solar Energy

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Fig.1 Solar Energy

II. BIOMASS ENERGY

Biomass is a renewable source of energy because it allows us to grow more trees and crops and always produces waste. Examples of biomass fuels include wood, crops, manure, and garbage. During combustion, the chemical energy of biomass is released as heat.

Fig.2 Biomass Energy

III. WIND ENERGY

A plentiful source of clean energy is wind. With wind power contributing more and more to the National Grid, wind farms are becoming a more common sight in the India. In order to generate electricity from wind energy, turbines power generators, which then supply power to the National Grid. Even though there are systems for "off-grid" or domestic generation, not every property can accommodate a domestic wind turbine.

Fig.3 Wind Energy

IV. TIDAL ENERGY

Tidal energy is produced by the movement of tides and oceans, and the strength of water caused by the ebb and flow of tides is a form of kinetic energy. Tidal power encompasses gravity hydropower, which uses the movement of water to drive turbines and generate electricity.

Fig.4 Tidal Energy

V. GEOTHERMAL ENERGY

Geothermal energy is a type of renewable energy extracted from the earth's core. It comes from the heat generated during the early formation of the planet and the radioactive decay of matter. This thermal energy is stored in rocks and liquids inside the Earth.

Fig.5 Geothermal Energy

VI. HYDRO ENERGY

Hydro power is one of the most commercially developed sources of renewable energy. A large reservoir can be used to create a controlled flow of water that will drive a turbine, producing electricity, by erecting a dam or barrier. The ability to store electricity for use at times of peak demand makes this energy source often more reliable than solar or wind power (especially if it's tidal rather than river-based). Similar to wind energy, hydro can occasionally be more cost-effective as a commercial energy source (depending on the type and compared to other sources of energy), but it can also be used for domestic, "off-grid," generation.

Fig.6 Hydraulic Energy

2 Literature Review

Phebe Asantewaa et al.[1] shown the different energy sources available with their uses and application as shown in Table 1.

Table 1 RENEWABLE ENERGY SOURCES AND THEIR USE[1]

Energy sources	Energy conversion and usage options
Hydropower	Power generation
Morden biomass	Heat and power generation, pyrolysis, gasification, digestion
Geothermal	Urban heating, power generation, hydrothermal, hot dry rock
Solar	Solar home systems, solar dryers, solar cookers
Direct solar	Photovoltaic, thermal power generation, water heaters
Wind	Power generation, wind generators, windmills, water pump
Wave and tide	Numerous design, barrage, tidal stream

The country's RE capacity stood at 104.88 GW as of December 31st, 2021, with 56.31 GW under implementation and 26.82 GW tenders issued. Table 2 provides a sector-wise breakdown of the capacities achieved.

Table 2 SECTOR-WISE TARGETS AND CUMULATIVE ACHIEVEMENTS (AS ON 31.12.2021) [2]

Sector	Target by 2022 (GW)	Installed capacity (GW)	Under Implementation (GW)	Tendered (GW)	Total Installed/ or in the Pipeline (GW)
Solar Power	100	49.35	40.86	20.52	110.73
Wind Power	60	40.08	9.65	1.50	51.23
Bio energy	10	10.61	0.00	0.00	10.61
Small Hydro	5	4.84	0.36	0.00	5.20
Hybrid/Round the clock (RTC)/ Peaking Power/ Thermal + RE Bundling	0	0	5.44	4.80	10.24
Total	175	104.88	56.31	26.82	188.01

By 2040, India's energy consumption growth will be the fastest among major economies. Coal supplies most of this demand, followed by renewables. By 2020, renewables will overtake gas and oil to become the second most important source of domestic electricity generation. Demand for renewable energy in India will rise by 256 Mtoe. Table 3 shows the projected primary energy consumption of India (including renewable energy) from 2016 to 2040

TABLE 3 PROJECTED PRIMARY ENERGY CONSUMPTION OF INDIA (INCLUDING RENEWABLE ENERGY) FROM 2016 TO 2040[3]

Level (Mtoe)													
	1990	**1995**	**2000**	**2005**	**2010**	**2016**	**2020**	**2025**	**2030**	**2035**	**2040**	**1990–2016**	**2016–2040**
Total	195	251	316	394	537	724	880	1118	1365	1624	1921	5.2%	4.2%
Oil (Mb/dl)	58	75	106	122	155	212	251	308	359	419	485	5.1%	3.5%
Gas (Bcf/dl)	11	17	24	32	54	45	57	72	89	106	128	5.6%	4.5%
Coal	110	140	164	211	290	412	485	593	710	824	955	5.2%	3.6%
Nuclear	1	2	4	4	5	9	11	16	27	35	44	7.1%	7.0%
Hydro	15	17	17	22	25	29	36	43	47	50	52	2.6%	2.5%
Renewables	0	0	1	2	7	17	41	86	133	191	256	35.1%	12.0%

Based on the availability of earth and solar radiation, the India's potential solar energy is estimated at about 750 GWp. Details of country's projected solar energy potential and cumulative installed capacity by state (as of December 31, 2021) are provided in Table 3.1

Table 4 STATE-WISE ESTIMATED SOLAR ENERGY POTENTIAL IN THE COUNTRY[2]

Sl. No.	State/UT	Solar Potential (GWp)
1	Andhra Pradesh	38.44
2	Arunachal Pradesh	8.65
3	Assam	13.76
4	Bihar	11.20
5	Chhattisgarh	18.27
6	Delhi	2.05
7	Goa	0.88
8	Gujarat	35.77
9	Haryana	4.56
10	Himachal Pradesh	33.84
11	Jammu & Kashmir	111.05
12	Jharkhand	18. 18
13	Karnataka	24.70
14	Kerala	6.11
15	Madhya Pradesh	61.66
16	Maharashtra	64.32
17	Manipur	10.63
18	Meghalaya	5.86
19	Mizoram	9.09
20	Nagaland	7.29
21	Odisha	25.78
22	Punjab	2.81
23	Rajasthan	142.31
24	Sikkim	4.94
25	Tamil Nadu	17.67
26	Telangana	20.41
27	Tripura	2.08
28	Uttar Pradesh	22.83
29	Uttarakhand	16.80
30	West Bengal	6.26
31	UTs	0.79

CONCLUSION: India is the country in which scope of renewable energy is always in demand. As per the climate condition as well as geographical location, India always increases the usage of renewable energy especially in solar and wind energy. So among the all renewable energy, solar energy is the maximum use. Jammu Kashmir & Rajasthan have potential of 111 and 142 GW respectively.

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