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Green Energy - A Global Analysis

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Abstract
The Future is Green, if Today is Renewable", with the entire world's cynosure is on green, renewable and a sustainable future, it's importance is now the trending headlines. Almost all the countries are now on the primary mission in achieving Net Zero, lowering the Carbon emissions, adopting cleaner energy techniques. Thus, there is a need to analyse the viable options available to achieve these objectives. This article focuses on the growing needs of green energy, with an outlook on green energy, its importance, merits and demerits, and the investment in the green energy sources.

Keywords: Green energy, Hydroelectric energy, Wind energy, Solar energy, Biomass, Investment

INTRODUCTION

Green energy is a current concern of many nations throughout the world as a means of addressing the challenge of depleting non-renewable resources and the effects this has on the environment and human resources. Coal, petroleum, oil, kerosene, and other non-renewable resources are examples. Natural renewable resources like the sun, wind, water, etc. are used to generate green energy, which helps to reduce problems like pollution, climate change, and carbon footprint. The entire amount of greenhouse gas emissions brought on by human activity is known as the "carbon footprint." Every nation can implement green energy since it is economically viable to do so. It can be put into practise through technological advancements such as reducing energy consumption on the demand side, or by the population, increasing the efficiency of energy production, decarbonizing, and switching to renewable energy sources like the sun and water.

Types Of Green Energy

There are few significant types of green energy such as Solar Energy, Wind energy, Biomass, Hydroelectric Energy etc.

Solar Energy is the energy extracted from the sun, the greatest source of renewable energy, with the least cost. The most abundant and least expensive kind of renewable energy is solar energy, which is one of the few important sources of green energy. Nuclear fusion is the process by which lighter, heavier atoms are created by the fusing of smaller, lighter atoms under heat and pressure. The solar radiation is then used to create electricity from this energy. Solar energy is mostly obtained from photovoltaic cells found in sun panels that collect solar radiation. Here's the data revealing solar energy generation of India over the years:

Table 1. State-wise installed capacity of solar power generation units in India (In MW).

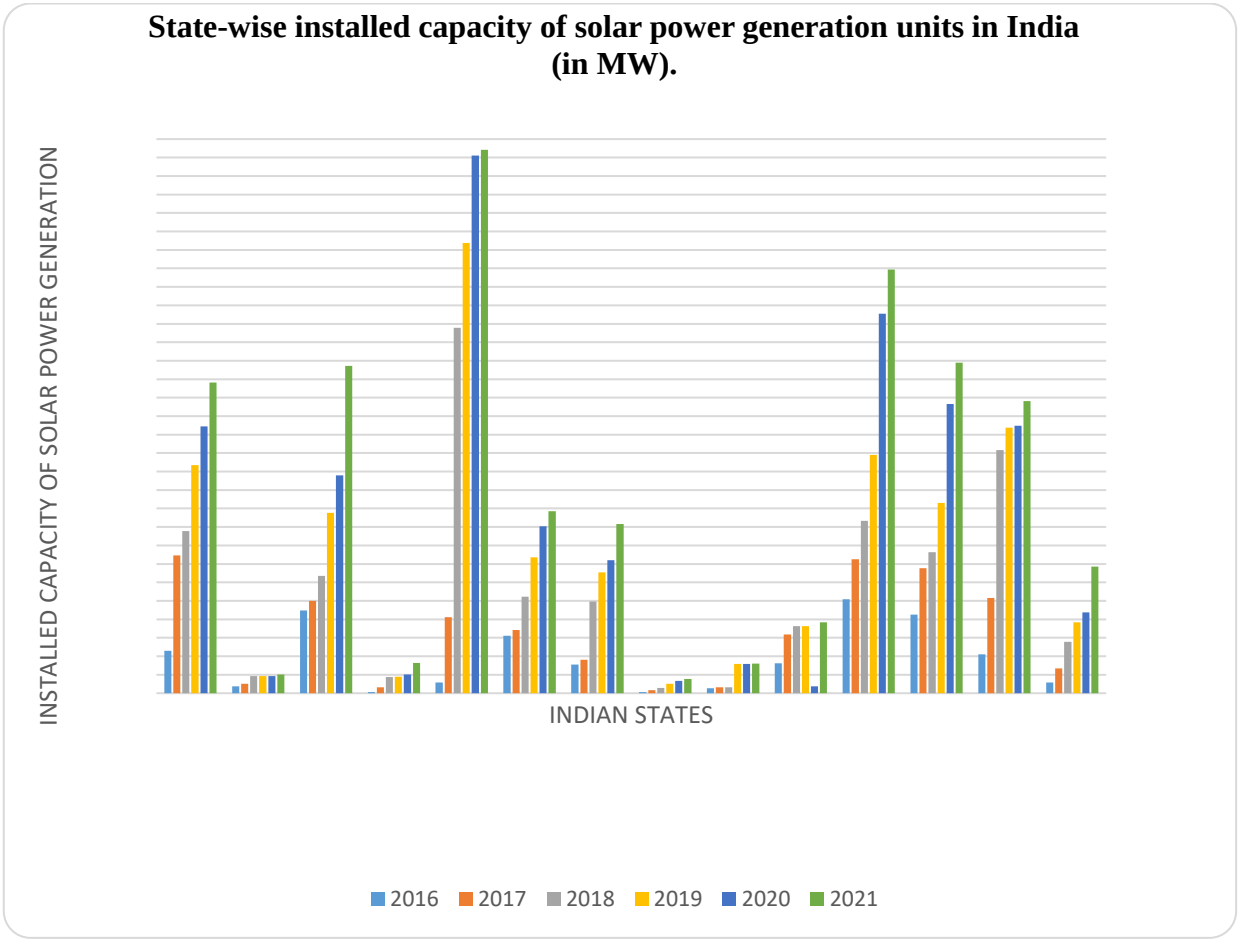
State/Union Territory	2016	2017	2018	2019	2020	2021
Andhra Pradesh	572.96	1867.23	2195.46	3085.68	3610.02	4203
Arunachal Pradesh	0.27	0.27	5.39	5.39	5.61	5.61
Assam	0	11.78	12.45	22.4	41.23	42.99
Bihar	5.1	108.54	142.45	142.45	151.57	159.51
Chhattisgarh	93.58	128.86	231.35	231.35	231.35	252.48
Goa	0	0.71	0.91	3.92	4.78	7.44
Gujarat	1119.17	1249.37	1588	2440.13	2948.37	4430.82
Haryana	15.39	81.4	216.85	224.52	252.14	407.83
Himachal Pradesh	0.2	0.73	0.75	22.68	32.93	42.73
Jharkhand	16.19	23.27	25.67	34.95	38.4	52.06
Karnataka	145.46	1027.84	4944.12	6095.56	7277.93	7355.17
Kerala	13.04	74.2	107.94	138.59	142.23	257
Madhya Pradesh	776.37	857.04	1305.55	1840.16	2258.46	2463.22
Maharashtra	385.76	452.37	1239.18	1633.54	1801.8	2289.97
Manipur	0	0.03	0.06	3.44	5.16	6.36
Meghalaya	0	0.01	0.02	0.12	0.12	0.12
Mizoram	0.1	0.1	0.2	0.5	1.52	1.53
Nagaland	0	0.5	1	1	1	1
Daman and Diu	4	10.46	10.61	14.47	19.86	40.55
Delhi	14.28	40.27	69.57	126.89	165.16	192.97
Odisha	66.92	79.42	79.57	394.73	397.84	401.72
Punjab	405.06	793.95	905.62	905.62	94.1	959.5
Rajasthan	1269.93	1812.93	2332.77	3226.79	5137.91	5732.58
Sikkim	0	0	0	0.01	0.07	0.07
Tamil Nadu	1061.82	1691.83	1908.57	2575.22	3915.88	4475.21
Telangana	527.84	1286.98	3291.25	3592.09	3620.75	3953.12

State/Union Territory	2016	2017	2018	2019	2020	2021
Tripura	5	5.09	5.09	5.09	9.41	941.
Uttarakhand	0	0	0	0	0	0
Uttar Pradesh	143.5	336.73	694.41	960.1	1095.1	1712.5
West Bengal	7.77	26.14	37.32	75.95	114.46	149.84
Jammu and Kashmir	1	1.36	1.36	14.83	19.3	20.73
Dadra and Nagar Haveli	0	2.97	5.46	5.46	5.46	5.46
Total (in GW)	**6.8**	**12.3**	**21.7**	**28.2**	**34.6**	**40.1**

Source: Ministry of New and Renewable Energy (MNRE), Government of India.

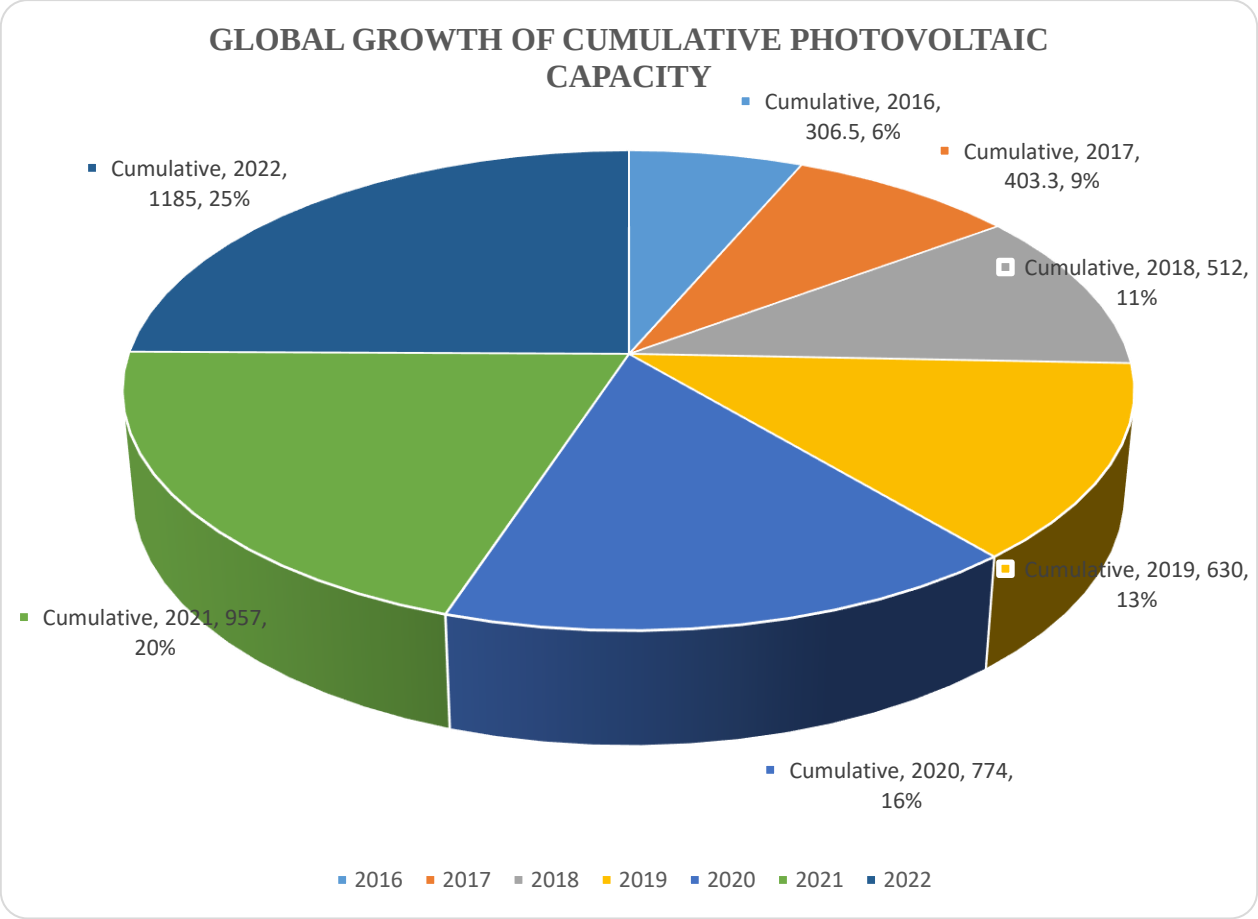
The below data reveals the installed capacity of solar energy generation in significant states of India over the years. It depicts that there has been a significant improvement in solar energy generation from 2016-2021, the march of the nation towards renewable energy sources, increasing the green corridor of the nation. Here's also a display of the world's improvement in solar energy generation.

Fig.1 State-wise installed capacity of solar power generation units in India (in MW)



Source: Computed by Researcher based on data from Ministry of New and Renewable Energy (MNRE), Government of India

ig. 2 Global Growth of Cumulative Photovoltaic Capacity



Source: Computed by Researcher based on data from International Renewable Energy Agency (IRENA)

WIND ENERGY is derived from the winds produced by the planet's topography. Utilizing a turbine, windmills are used to extract energy and produce electricity. However, large-scale wind farms must be built in order to have a significant influence. Here's the data revealing the utilization of wind energy over the years compared to the other out doing countries and the interstate development of India.

Table 2. Wind power potential at 50 m, 80 m and 100 m for major states of India (NIWE, 2019–20).

Potential States	**Generating potential (MW)**		
	@ 50 m	**@ 80 m**	**@ 100 m**
Maharashtra	5439	5961	45394
Gujarat	10609	35071	84431
Tamil Nadu	5374	14152	33800
Andhra Pradesh	5394	14497	44229

Potential States	Generating potential (MW)		
	@ 50 m	@ 80 m	@ 100 m
Madhya Pradesh	920	2931	10484
Karnataka	8591	13593	55857
Rajasthan	5005	5050	18770
Orissa	910	1384	3093
West Bengal	638	22	2
Kerala	450	–	1700
North East States	406	600	–

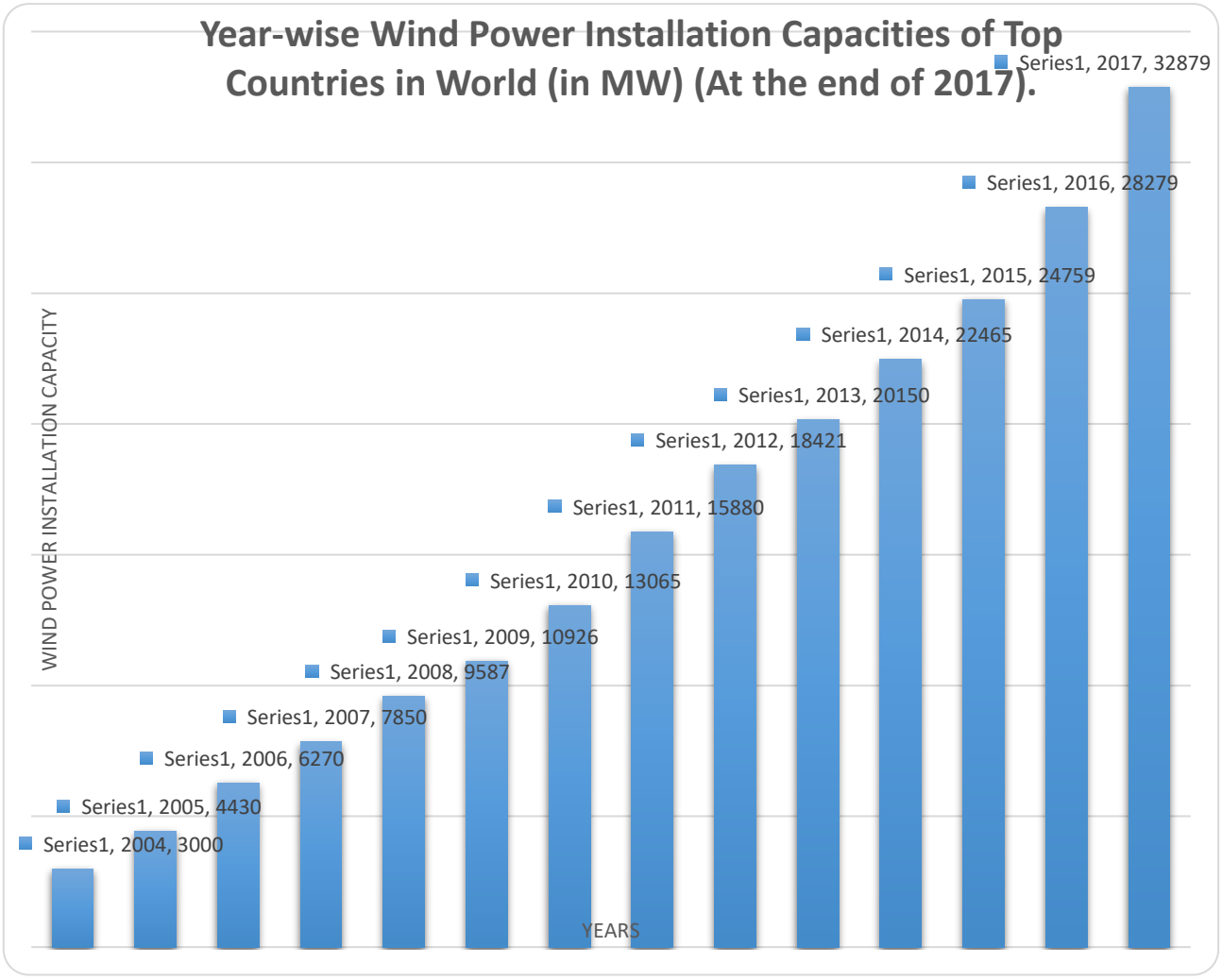
Source: Ministry of New and Renewable Energy (MNRE), Government of India.

Table 3. Year-wise Wind Power Installation Capacities of Top Countries in the World (in MW) (At the end of 2017).

Rank	1	2	3	4	5
Country	China	USA	Germany	India	Spain
2004	764	6725	16629	**3000**	8263
2005	1266	9149	18428	**4430**	10028
2006	2599	11603	20621	**6270**	11630
2007	5912	16819	22247	**7850**	15145
2008	12210	25170	23903	**9587**	16740
2009	25104	35159	25777	**10926**	19149
2010	41800	40200	27190	**13065**	20623
2011	62364	46919	29060	**15880**	21673
2012	75324	60007	31308	**18421**	22796
2013	91324	61108	34660	**20150**	22959
2014	114763	65754	40468	**22465**	22987
2015	147362	74347	45192	**24759**	22987
2016	168730	82033	50019	**28279**	23075
2017	187730	88927	56132	**32879**	23170

Source: The Wind Power: Wind Turbines and Wind-firms Database

Fig.3 Year-wise Wind Power Installation Capacities of Top Countries in World (in MW)



Source: Computed by Researcher based on data from International Renewable Energy Agency (IRENA)

Hydroelectric Energy is one of the most popular forms of green energy is the energy extracted from flowing water. Turbines are set up in the narrow fast flow of water, enabling the turbines to run generating electricity. Sometimes water is stored in reservoirs like dams and the release from those reservoirs makes the turbine run generating electricity.

The data given below reveals India's position in developing and utilising hydroelectric energy in comparison with various financial years.

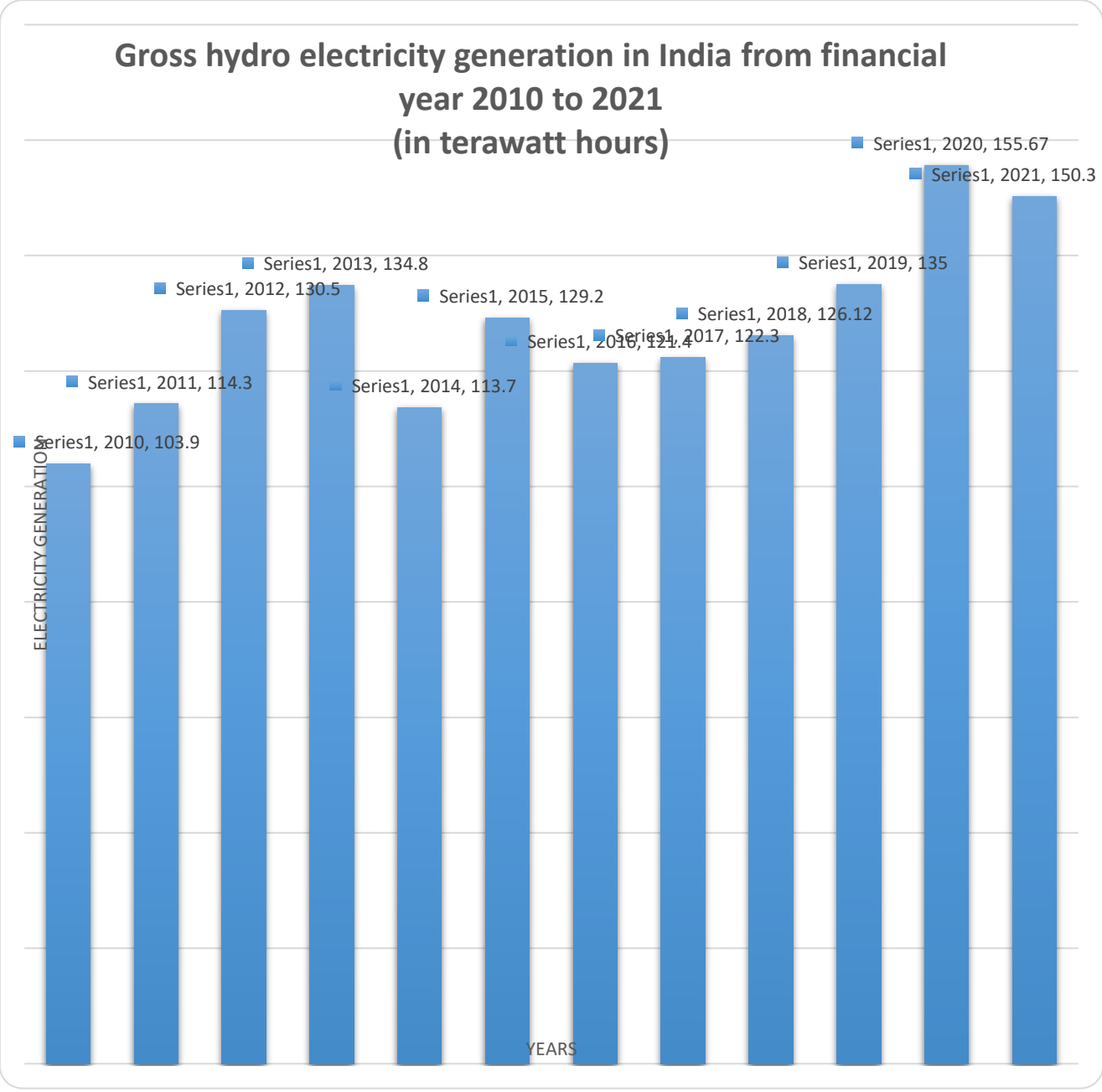
Table 4. India's Electricity Generation over the Years

YEAR	INDIA'S ELECTRICITY GENERATION WITH HYDRO ENERGY
2010	103.9
2011	114.3
2012	130.5
2013	134.8

2014	113.7
2015	129.2
2016	121.4
2017	122.3
2018	126.12
2019	135
2020	155.67
2021	150.3

Source: Ministry of New and Renewable Energy (MNRE), Government of India.

Fig.4 Gross hydro electricity generation in India from financial year 2010 to 2021 (In terawatt hours)



Source: Computed by Researcher based on data from Ministry of New and Renewable Energy (MNRE), Government of India

Biogas is the by-product generated from the waste products like sewage, household waste, agricultural waste, manure etc. The most popular green energy is also known for its effectiveness to generate electricity from waste materials.

Biomass is a source of energy generated from the cellulose and sugar in the plants and animals, which they store from the sun.

Importance Of Green Energy

As was already indicated, the current issue of non-renewable resources like coal, petroleum, and other oils can be greatly reduced by using green energy. Environmental risks from the manipulation of these resources include pollution, climate change, carbon emissions, etc. The goal of the Net-Zero effort is to reduce greenhouse gas emissions as much as possible.

Through the use of renewable sources like solar and wind energy, green energy is introduced as a combat tactic to lessen the pollution created by the utilisation of non-renewable resources. This lessens pollution because the methods used to extract these non-renewable resources are also harmful, and burning these fossil fuels in homes and businesses creates significant pollution that threatens people's overall health and releases energy that contributes to climate change, about which the world is now more concerned and for which committees and conventions have been established to mitigate. Utilizing the sun, water, and wind contributes to the reduction of pollution. Additionally, because these resources are finite and rare, excessive use of these fuels results in a lack of them, which in turn causes a crisis and contributes to inflation in various nations, a problem that many nations face as a result of geopolitical circumstances.

Merits And Demerits Of Green Energy

The following factors make green energy, which is essentially energy derived from renewable sources, more beneficial:

Typically, the energy produced won't deplete more quickly than other energy sources. When compared to other energy sources that drain your wallet, the energy's maintenance requirements are very minimal. The money saved by this energy is substantial. It has many environmental advantages, including no pollution, reducing the effects of climate change, and promoting clean water and air. The nation's Air Quality Index (AQI) rises, and this energy promotes better waste generation and management within the limits of the earth's carrying capacity. There is little dependence on foreign nations because this energy is produced from natural, renewable resources. There are numerous opportunities for gainful employment because it is produced locally.

Green energy also has some drawbacks, including a high setup and implementation cost despite low maintenance costs. Due to this energy's restricted use and significance in the modern world, storage facilities are few and limited. Due to the fact that carbon is volatile and is present in all materials in the world, this energy typically has geographical restrictions and is not always completely carbon-free.

Investment In Renewable Energy

Now the solicitude is on the investment in renewable resources, post knowing the significance of green energy and the crisis of non-renewables. Many countries are opening gambit in investing in renewable sources.

One such initiative in Spain is the "Bike Bus" programme, which started in Sarria in March 2021 and spread to Barcelona, the country's second-largest city, where hundreds of children cycle to school every day. 80 parents have volunteered to help with this programme, which allows the students to travel on the cleanest, most environmentally friendly bicycles while also ensuring their safety on the busy streets. It begins at 8:30 AM and currently operates on 15 routes. In the 2020–21 school year, over 700 people joined a route, accounting for 15,000 school commutes. According to reports, the riders' improved cycling skills improve families' quality of life. Glasgow and Portland have been inspired to start similar programmes. Rouen launched the pedal-powered school bus in France in 2016. All of these initiatives pave the way for pollution-free nations, enhancing their demographics and impeding a healthy way of life. As these initiatives are carried out with the utmost concern for the safety of the populace, the countries also deal with the minimal drawbacks.

The demand for deliveries has grown as the world moves toward a virtual and more technological way of life. Trucks, bicycles, and other private modes of transportation are also responsible for pollution, energy emissions, and climate change. Therefore, to avoid such pitfalls Micro Mobility options like e-bikes, cargo bikes, cycles, etc. are used as alternatives. In 2020, when Covid-19 was introduced, there were more than one-third of delivery vehicles on the road and 2 billion people who relied on online shopping. Therefore, the most environmentally friendly method of moving goods is micro mobility. Reducing the delivery industry's carbon footprint. The use of micro mobile modes of transportation resulted in a 90% reduction in carbon emissions.

Conclusion

In order to combat the crisis of unfavourable climate change and other geopolitical events, various countries, especially developing economies, have recently given the importance of energy transition and investment in renewable means top priority. Prime Minister Narendra Modi's initiative to achieve net zero emissions in India by 2070 demonstrates the concern of developing nations regarding the energy transition, and this investment requires a $10 trillion investment. However, putting this into practice is difficult due to a number of obstacles, including the need for investment capital, insufficient flexibility, credit risk, and a lack of transparency. There is a need for accommodative climate infrastructure policies, reliable data, risk management, and transparent performance measures in order to attract investment in unlisted renewables in developing economies.

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