

Renewable Energy and Self-Reliance in India: An Overview

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Abstract

Since 2000, India has been responsible for more than 10% of the increase in global energy demand. On a per capita basis, energy demand in India has grown by more than 60%. By 2030, India's reliance on energy imports is predicted to exceed 53 percent of total energy consumption. An increasing proportion of domestic generation of green energy in India's energy mix will lessen the country's reliance on fossil fuels and also lowers the country's import bill. The country must switch from non-renewable energy to renewable energy.

The main objective of this paper is to present the status of renewable energy in India and also the covers the various initiatives of the Government in promoting Renewable Energy. The paper mainly focused on Solar energy, Hydrogen energy and Wind energy.

In compliance of the Atmanirbhar Bharath Abhiyan, several schemes were taken to enhance solar electricity generation and consumption. Roof-top Solar Energy, PM KUSUM, Solar City, Solar Park, Green Energy Corridors, Renewable Energy Obligation (RPO) and AJAY are some such schemes.

Continuous focus and expanded use of renewable energy may help India move towards self-sufficiency and energy independence by reducing the country's reliance on imported fossil fuels. As a result, renewable energy sources such as wind, solar, biomass, hydropower, waste to energy, and others must be expanded and utilised. India's energy choices have direct and far-reaching effects on the lives of growing population and major indirect effects on the rest of the world through their impact on energy markets, emissions and flows of technology and capital.

Keywords: Green energy, Solar energy, Hydrogen energy, wind energy

Introduction

India is the world's third-largest energy consuming country. Energy use has doubled since 2000, **due to increased income, improved standard of living, industrialization and urbanisation.** Since 2000, India has been responsible for more than 10% of the increase in global energy demand. Energy demand in India has increased by more than 60% per capita since 2000, yet there are significant disparities between different sections of the country and socioeconomic groups.

At present, India generates about 79 percent of its energy from fossil fuels, and it is heavily reliant on fossil fuel imports to meet its energy needs; by 2030, India's reliance on energy imports is predicted to exceed 53 percent of total energy consumption. Supply is constrained and imports are expensive due to high commodity price cycles and geopolitical concerns. An increasing proportion of domestic generation of green energy in India's energy mix will lessen the country's reliance on fossil fuels and also lowers the country's import bill. Shifting to renewable sources of energy will also help to combat the harmful environmental effects of conventional sources of energy. The country must switch from non-renewable energy to renewable energy.

Keeping up with the global trend, India has also shifted towards renewable sources of energy to meet its energy demands. Continued focus on and expanded usage of renewable energy sources may reduce the nation's reliance on imported fossil fuels and move India closer to self-sufficiency and energy autonomy. Consequently, it is essential to increase and use renewable energy sources such as wind, solar, biomass, and hydro energy from garbage, etc. As an emerging economy, Indian government is exploring ways to increase solar and wind energy with urgent need to reduce imports of fossils.

Concept of Renewable Energy

Renewable energy comes from natural sources that replace themselves more quickly than they are used up. The energy that is gathered from resources that can be naturally replenished on a human timeline is referred to as "renewable energy". The elements of the sun, wind, rain, tides, waves, and geothermal heat are a few examples of renewable energy sources. Generation of renewable energy, contributes to lessening the dependency on coal and other forms of fossil fuels. Renewable resources are considered especially important for their potential to replace non-renewable, or finite, resources in the production of energy. Additionally, renewable resources can offer cleaner energy solutions than those provided by non-renewable resources such as coal and fossil fuels.

Review of Literature

Rajesh, Charles & Majid, Mohammed (2020), the plans for economic expansion that are currently being implemented in India require an ever-increasing amount of energy. The production of ever-increasing amounts of energy is a crucial prerequisite for the growth of a country's economy.

Subhashish Dey & etc. (2022), in several regions of India, the production of renewable energy is becoming increasingly significant. The implementation of renewable energy still confronts significant obstacles. Others are brought on by the current market, societal norms, and infrastructure realities. Some are related to different renewable energy technology.

Objectives

To analyse the status and development of renewables in India with a special focus on solar, wind and hydrogen energy.

To know the major government initiatives to promote solar, hydrogen and wind energy in the country.

To explore the challenges to the development of renewable energy generation in the power sector.

Methodology

The study is based on secondary sources. The required data has been gathered from the annual reports of Ministry of Power, Government of India, Special reports by India Energy Outlook and Newsletter of Ministry of New and Renewable Energy, Government of India.

Analysis

Trend of solar energy

To ensure reliable, sustainable and affordable energy to an expanding economy, the Government of India along with state governments have implemented various schemes to promote massive expansion in the generation of green energy to boost the energy sector. Fortunately, India has a diverse range of renewable energy sources, including biomass, solar, wind, geothermal, and minor hydropower, and is developing one of the world's largest renewable energy initiatives. With the ongoing 'Azadi Ka Amrit Mahotsav: India at 75 years of Independence' Government has introduced wide range policies and schemes designed to make India, a global leader in green and clean energy.

The fundamental goal of renewable energy deployment in India is to promote self-reliance in energy, economic development, improve energy security, increase energy access and reduce climate change. Sustainable development can be achieved through the use of renewable energy. The government has created regulations, programmes and a welcoming atmosphere in order to attract international investment and rapidly expand the country's renewable energy market. As a result, India has risen to become one of the world's most attractive renewable energy markets.

Table 1

<i>India's renewable energy sector at a glance</i>					
Year	Installed RE capacity (in GW)	% Share of RE in total installed capacity	Generation from renewable sources (in BU)	Total generation from all sources in BU	% share of RE in Generation
2014-15	39.55	14.36	61.78	1110.18	5.56
2015-16	46.58	15.23	65.78	1172.98	5.6
2016-17	57.9	17.68	81.54	1241.38	6.56
2017-18	69.77	20.24	101.83	1303.37	7.81
2018-19	78.31	21.95	126.76	1375.96	9.21
2019-20	87.07	23.52	138.32	1390.93	9.95
2020-21	92.54	24.53	111.92	1017.81	11
UPTO	01/2021	01/2021	12/2020	12/2020	12/2020

Source: Annual report of Ministry of New and Renewable Energy 2020-21

India has a total installed renewable energy capacity of 92.54 GW (excluding large hydro), of which 5.47 GW was added between 2020 and 2021. During the period from 2014 to 2021, the installed renewable energy capacity of India has increased by two-and-half times, and in the same period, the installed solar energy capacity has increased 15 times. Generation of renewable energy has increased from 61.78 BU in 2014-15 to 111.92 BU in 2020-21. Percentage share of renewable energy has increased from 5.56 to 11 percentage in the same period. India is now ranked fourth in the world in terms of renewable energy power capacity, fourth in

wind power, and fifth in solar power capacity. India has one of the highest rates of renewable energy growth in the world. Currently, the renewable energy capacity in India is 136 GW, which is 36% of the total energy capacity in India.

To promote India’s renewable energy production and consumption the central government has taken various initiatives especially for the development of solar energy. The enormous solar energy potential in India offers a safe and practical alternative to the severely destructive, polluting, and quickly running out traditional sources of electricity. India may become a global leader by creating schemes for the generation and practical use of solar energy.

In compliance of the Atmanirbhar Bharath Abhiyan, several schemes were taken to enhance solar electricity generation and consumption. The National Solar Mission launched in 2010, has the target of development of solar power to 100 GW. Roof-top Solar Energy, PM KUSUM, Solar City, Solar Park, Green Energy Corridors, Renewable Energy Obligation (RPO) and AJAY are some such schemes.

Table 2
Top ten states in solar installation capacity in MW

Sl.No.	States	Cumulative capacity till 31.12.2020 mw
1	Rajasthan	7737.95
2	Karnataka	7469.01
3	Gujarath	57085
4	Tamilnadu	4675
5	Andhra Pradesh	4380
6	Telagana	3992
7	Maharashtra	2444
8	Madhya Pradesh	2440.14
9	Uttara Pradesh	1292.85
10	Punjab	947.1

Source: Annual report 2020-2021, Ministry of power, Government of India

Rajasthan leads solar installed capacity in India with 7737.95 MW, Karnataka comes second with 7469.01MW as per the reports of Ministry of Power. As of 2020, the cumulative capacity of Gujarath is 57085 MW. Tamilnadu, Andhra Pradesh, Uttara Pradesh are the other states performing well in the installation and generation of solar energy.

Pradhan Mantri Kisan Urja Suraksha evem Utthan Mahabhiyan (PM KUSUM) scheme is one of the largest initiatives in the world to provide clean energy to more than 3.5 million farmers by solarizing their agricultural pumps. All components of the scheme combined would support installation of additional solar capacity of 30.80 GW. Scheme was launched in 2019 to help farmers access reliable daytime solar power for irrigation, reduce power subsidies, and decarbonize agriculture. With solarization, while the electricity to farmers would be available free of cost/at a very low cost during the day time, savings would accrue to the State Government on account of subsidy being paid to the DISCOMs for electricity supply to farmers at subsidized tariff. India has witnessed a significant rise in production of electricity from solar energy i.e. 50.10 billion units in 2019-20 from 1.65 billion in 2012-13.

Table- 3

Selected statewise and component wise performance under PM KUSUM scheme

Sl.No	States	component a (mw)	component b (numbers)	Component c (numbers)	
				Individual pumps solarization	Feeder level solarisation
1	Karnataka	500	10500	1000	50000
2	Rajasthan	1200	75000	37500	0
3	Tamilnadu	75	6500	20000	0
4	Telangana	500	0	0	30000
5	Gujarath	500	2199	7000	0
6	Haryana	65	37000	468	0
7	Madhya Pradesh	300	60000	0	25000
8	Maharashtra	500	100000	0	50000
9	Uttara Pradesh	225	23000	0	0
10	Punjab	220	9500	0	12500

Source: Annual report 2020-2021, Ministry of power, Government of India

Roof Top Solar energy is another scheme introduced with a target of achieving cumulative capacity of 40000 MW by 2022. Over 3.7 GW of RTS capacity has been built throughout the country under this scheme, with 2.6 GW capacity under construction in the residential segment. As a part of solar energy promotion, Government intends to develop at least one Solar City per state, the electricity needs of which will be fully met from renewable energy sources, primarily from solar energy. The Ministry of Renewable Energy also took steps to enhance domestic manufacture of renewable energy machinery, components and equipments.

International Solar Alliance: Established by Prime Minister Narendra Modi and President of France Francois Hollande on November 2015, ISA has the objective to scale up solar energy, reduce the cost of solar energy generation through aggregation of demand for solar finance, technologies, innovation, research and development, and capacity building.

Hydrogen Energy in India

Hydrocarbons currently account for the majority of world energy usage. In India, hydrogen is still in its early stages of adoption in the energy sector. Government as well as non-government funding agencies are engaged in R&D projects pertaining to hydrogen production, storage, utilisation, power generation and for transport applications. As early as in 2003, National Hydrogen Energy Board was formed and in 2006 the Ministry of New and Renewable Energy laid out the National Hydrogen Energy Road Map identifying transport and power generation as two major green energy initiatives. India is participating in Mission Innovation Challenge for clean hydrogen and shares the objective to accelerate the development of a global hydrogen market by identifying and overcoming key technology barriers to the production, distribution, storage and use of hydrogen at gigawatt scale. The Government of India has allotted Rs 25 crore in the Union Budget 2021–22 for the research and development in hydrogen energy and intends to produce three-fourths of its hydrogen from renewable resources by 2050.

The National Hydrogen Mission was established in August 2021 with the goal of producing carbon-free fuels from renewable resources and making India a global powerhouse for green hydrogen production and export. The mission's ultimate goal is to achieve energy self-sufficiency by 2047, in time to

commemorate the country's 100th year of independence. The mission will have a significant impact on the energy sector and will contribute to a cleaner, gas-based economy.

Wind Energy

Wind power is one of the fastest-growing renewable energy technologies. Wind energy has enormous promise as a source of energy as India has vast coastal line. The Ministry of New and Renewable Energy along with the National Institute of Wind Energy (NIWE) has announced India's Offshore Wind Policy. India's wind energy sector is led by indigenous wind power industry and has shown consistent progress.

The wind industry's growth has resulted in a strong ecosystem, project operating capabilities, and a manufacturing base of roughly 10,000 megawatts per year. The country currently has the fourth highest wind installed capacity in the world with total installed capacity of 39.25 GW (as on 31st March 2021) and has generated around 60.149 Billion Units during 2020-21. Among all the renewables, wind energy contributes 40.8% as per MNRE report 2021.

The government is encouraging private sector investment in wind power projects across the country by offering tax and financial benefits such as Accelerated Depreciation and concessionary custom duty exemption on specific components of wind energy generators. Besides, Generation Based Incentive (GBI) Scheme was available for the wind projects commissioned before 31 March 2017. Wind-Solar hybrid policy of MNRE has the objective of providing a framework for promotion of large grid connected wind solar PV system.

Table 4

Wind potentiality status of the country as on 31.03.2021

Sl.No.	State	Wind potential at 100m (GW)	Wind potential at 120m (GW)
1	Gujarat	84.43	142.56
2	Rajasthan	18.77	127.75
3	Maharashtra	45.39	98.21
4	Tamil Nadu	33.79	68.75
5	Madhya Pradesh	10.48	15.4
6	Karnataka	55.85	124.15
7	Andhra Pradesh	44.22	74.9
	Total 7 windy states	292.97	651.72
8	Others	9.28	43.78
	Total	302.25	695.5

Source: Ministry of New and Renewable Energy, Government of India

The Government, through National Institute of Wind Energy (NIWE), has installed over 800 wind-monitoring stations all over country and issued wind potential maps at 50m, 80m, 100m and 120m above ground level. The recent assessment indicates a gross wind power potential of 302 GW in the country at 100 meter and 695.50 GW at 120 meter above ground level. Most of this potential exists in seven windy States. Nearly 97 per cent of this potential is concentrated in seven states -Gujarat, Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu, Rajasthan and Madhya Pradesh.

Challenges

The country's renewable energy sector is expanding swiftly as a direct result of government policies, initiatives, and the general positive environment. In addition to having one of the greatest initiatives in

the world for the adoption of renewable energy systems and goods, India also has a huge amount of renewable resources. India is the only country in the world with a ministry solely dedicated to the development of renewable energy sources. The sector of renewable energy still faces several challenges. All renewable energy sources face some of these challenges, while others are specifically caused by an uneven market and regulatory environment.

The implementation of renewable technology is hampered by inadequate legislative and regulatory frameworks. To attract more financial backing, the market for renewable energy must first establish clear regulations and codified legal processes. Because there are no set rules in place, the approval procedure for projects in the private sector moves slowly. To encourage private investment, the government of the country must take action. Research and development should be used to overcome inadequate technology and the lack of infrastructure needed to build renewable technologies. The government must make it possible for more money to be allotted for research and innovation initiatives in this sector.

Conclusion

It is expected that the share of renewable energy in the total generation capacity will increase in future. However, significant structural, legislative, and institutional barriers remain, and progress has been inconsistent across renewable technologies. Continuous focus and expanded use of renewable energy may help India move towards self-sufficiency and energy independence by reducing the country's reliance on imported fossil fuels. As a result, renewable energy sources such as wind, solar, biomass, hydropower, waste to energy, and others must be expanded and utilised. India's energy choices have direct and far-reaching effects on the lives of growing population and major indirect effects on the rest of the world through their impact on energy markets, emissions and flows of technology and capital. So India has a key role to play in the world's transition to a green energy economy.

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