

## An evaluation of present status and challenges of renewable energy in India

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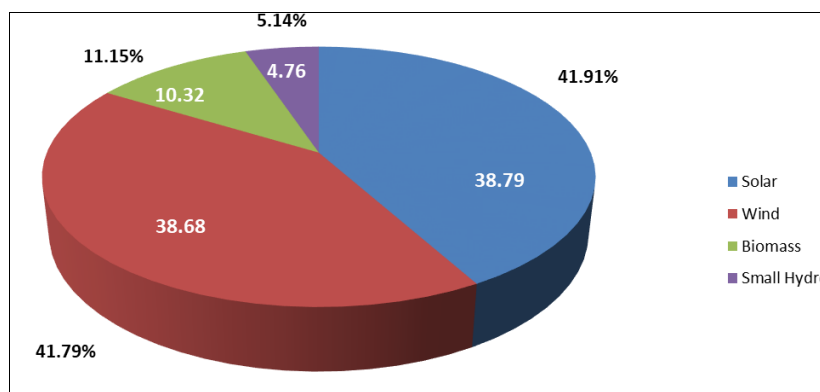
### Abstract

In developing countries like India, energy sources play a decisive role in economic development; energy sectors depend upon renewable sources to meet the flourishing demand for energy, such as solar, wind, biomass, and hydropower. Since for many decades, India facing several problems and challenges in developing renewable energy. And now India has improved with lots of undertakings like public awareness, human resources development, and technical training programs in renewable field. However, up-gradation of the labor force, technology imports, policy-related issues, installation & initial cost, and competition are the long-time barriers in renewable energy sectors. But now India is moving to step up the global market, foreign direct investments policy, and cooperation with the worlds' financial institutions are helping to gain outside funds and other skilled elements to contribute towards the sustainability of energy. In this review, the researcher summed up the challenges facing the renewable energy sector in India. This paper shows the overall scenario of status, installment, target, achievements, and challenges of renewable energy.

**Keywords:** installed capacity, barriers, challenges, bagassee, co-generation and economic growth

### Introduction

Energy is one of the most imperious elements of building a pedestal for human development and economic advancement. In developing countries like India; Energy plays a vital aspect in infrastructural development due to the rapid increase in the population simultaneously increases the energy demand. To meet the energy demands of any developing nation, energy sectors of the country have to bolster the energy sources to renewable production. And the immense difficulties in today's world are putting an end to poorness and embracing a sustainable lifestyle. Energy is the answer to both problems. Energy in the form of electricity has become a critical component of the country's economic development. Accessibility to electricity is restricted, causing obstacles in the growth such as livelihoods, employment, healthcare, industry, and education. And also, detrimental influence on economic growth and living standards. In the present scenario, India is one of the largest consumers of fossil fuels such as crude oil, coal, and others sources. This uncontrollable increase in the use of Non-renewable energies such as fossil fuel, oil, natural gas has led to the fluctuation of demand & supply. And this will lead us to the uncertainty of the future of Non-renewable energies. Having a negative Energy Balance for decades, had to purchase energy sources from other countries to fulfill the demand. The advancement of renewable energy resources will accelerate the development of the energy sector in the country so that it can meet its growth aspirations. The power demand has risen dramatically in recent years.



(Source: MNRE Annual report 2020/21)

Fig 1: Installed capacity of RE in India as on 31.01.2021(GW)

The fig. 1 presents the source-wise installed capacity of renewable energy as end of 2021 march. In the total of capacity install the solar energy is about 42%, wind energy installed is about 39%, Biomass is about 11%, and small hydro is 5% with a capacity of 38.79 GW, 38.68 GW, 10.32 GW, and 4.76 GW Respectively. Consider all kinds of renewable energy like Solar, Wind, Biomass, Hydropower, etc. As of May 2021, India has moved to a position of 3rd in the 57th EY Renewable Energy Country Attractiveness Index (RECAI) released by EY. The total installed capacity of current is more than 220% compared to the last five years also Renewable energy is targeted to achieve 175 GW by December 2022 and 450 GW to achieve before 2030.

The study consists of the status and challenges of renewable energy in India and focuses on challenges faced by Industries / Manufacturers in generating renewable energy. This paper study is a Descriptive or Conceptual study through Secondary data. Based on the literature survey on the status and challenges of renewable energy in India, to complete the object of this research study that is 1. To give a complete review of renewable energy status in India. 2. To know the challenges and obstacles for renewable energy development in India, the researcher collected the data from secondary sources like research articles, journals, books, thesis, and online sources to complete the study.

### Review of Literature

The literature review is the basis of a systematic review of research articles on the Status, Challenges, and Barriers of renewable energy in India. The literature review is through the secondary sources collected from research articles, journals, thesis, books, reports, and other online sources.

Accessing renewable energy sources is crucial for human growth. An effort to build a foundation for sustainable energy distributions is more nowadays. Many elements contribute to renewable energy access. However, most of them fall under financing, institutional strengthening, infrastructures, technologies, and policy decisions. All of them are required for power accessibility peculiarly in rural areas. (Akash Kumar Shukla, 2017)<sup>[8]</sup> Discussed the energy scenario and challenges mainly in the South Asian Countries; India, Pakistan, Sri Lanka, Bhutan, Nepal, Afghanistan, and the Maldives. And the researcher concluded that these countries have to utilize the available potentials and work with coordination for social and technical benefits, research & development activities to minimize the cost factors, implementation of policies to avoid uncertainties. And suggest the project implementation to contribute the GHG emission reduction and become a green developing country. (Sanjay Kumar Kar, 2015)<sup>[6]</sup> the causes are the low performance of renewable plants are low efficiency, lack of long-term financing, high initial CAPEX, high-interest rate, low return, grid connectivity, and land availability. And suggest the Government has to initiate some investment models through the innovation of projects with better fiscal and monetary incentives, higher subsidies to attract producers, and promote the green product theme among the consumers. (K.C. Surendra, 2014)<sup>[4]</sup> The diffusion of biomass energy is due to high installation expenses and maintenance costs. The biogas plants need to implement a Clean Development Mechanism (CDM) project to promote the education & awareness of biogas technology among the developing nations to gain economic, health, social, and environmental merits of Biogas technologies. (Painuly, 2004)<sup>[2]</sup> Examined the Stakeholders' perspectives regarding barriers in the diffusion of renewable energy technologies in the state of Maharashtra. To identify each Barrier, the researcher considered four groups of samples such as households, commercial establishments, Industry, and policy experts. And found the perception-based results through the weighted average method and concluded that most barriers happened in technical, economic, and institutional conducts. (Srivastava, 2019)<sup>[10]</sup> Explained the present status and future opportunities of renewable energy in India; concluded that India has potentials and opportunities to expand renewable energy to fill the demand; due to the increase in the population from decades to decades. And to reach that energy demand, Research and developments activities are to be done to enhance technological advancement, policies formation, tax rebates, and efficiency improvement. The fundamental problem is now facing in the absence of a stable platform of numerous variables and actions that enables the operation and gives long-term solutions. Similarly, hence the need to investigate the elements and entities that aid in providing the answers for enhancing energy availability in rural areas. (Muralidhar Nayak Bhukya, 2021)<sup>[14]</sup> The state of Rajasthan has a target and potential is up to 22000 MW of energy in solar and wind by the year 2022. And researcher reported the main reason for facing the difficulties in reaching the target is the high temperature, high penetration level in the market, and waste of materials. (Anil, 2018) Renewable energy technologies (RETs) are essential to meet the energy demand in India. While coming to the adoption of wind energy technologies, the researcher focused on barriers in achieving potentials, rural energy & employment services. And conducted a survey and found that most challenges to wind energy technologies are due to the Financial, Institutional, and Policy sectors and suggest new policy approaches and stakeholders-focused analysis. (Gupta, 2013)<sup>[3]</sup> The Researcher surveyed rural and urban localities about the understandability of Renewable sources, Installation, and Awareness of renewable energy schemes. And found that the government schemes for the renewable energy sector are getting fiscal benefits only after the Installation, which is difficult for the low-income group. Hence this poor maintenance would be the main barrier of this study, and the rural areas have fewer installations than urban localities. (Pratiyuksha V.N, 2021) building a large power plant requires more finance; maintaining long-term finance would be the main barrier in this study. And to enhance this finance requirement, the manufacturer needs international financial organizations' support such as the World Bank, UNIDO, UDAY, DISCOMs, and other organizations with a large number of capital investments. (Rao, 2020) Explained the opportunities, potentials, and challenges of Smart grid implementations in India and concluded that there are many challenges like policy issues, cyber security issues, technical skills,

time-limited projects, lack of awareness, and others not solved to implement Smart grid projects. And suggest the Smart city mission, Digitalization, Energy access in rural areas, Decentralized electrification systems, and other programs to develop Smart grid projects.

### Installed capacity, target and achievements

Due to the high expense of substitutes, India has set a goal to increase large-scale conventional power capacity. Now, with solar and wind energy becoming economically viable concerning marginal mainstream outlets (particularly imported coal and nuclear-based generation), legislators have more options when it comes to the scientific, economic, and natural factors of an upcoming power system that can keep up with the economic expansion. In light of the preceding, India's Intended Nationally Determined Contribution (INDC) seeks to base 40% of total installed power production capacity on non-fossil fuel resources by 2030, with international technical assistance and funding assistance. And this incorporates the Indian government's lofty goal of attaining 175 GW of renewable energy by 2022, the 75th anniversary of our sovereignty.

**Table 1:** State-wise installed capacity of Grid Interactive renewable power as on 31.03.2021(Cumulative)

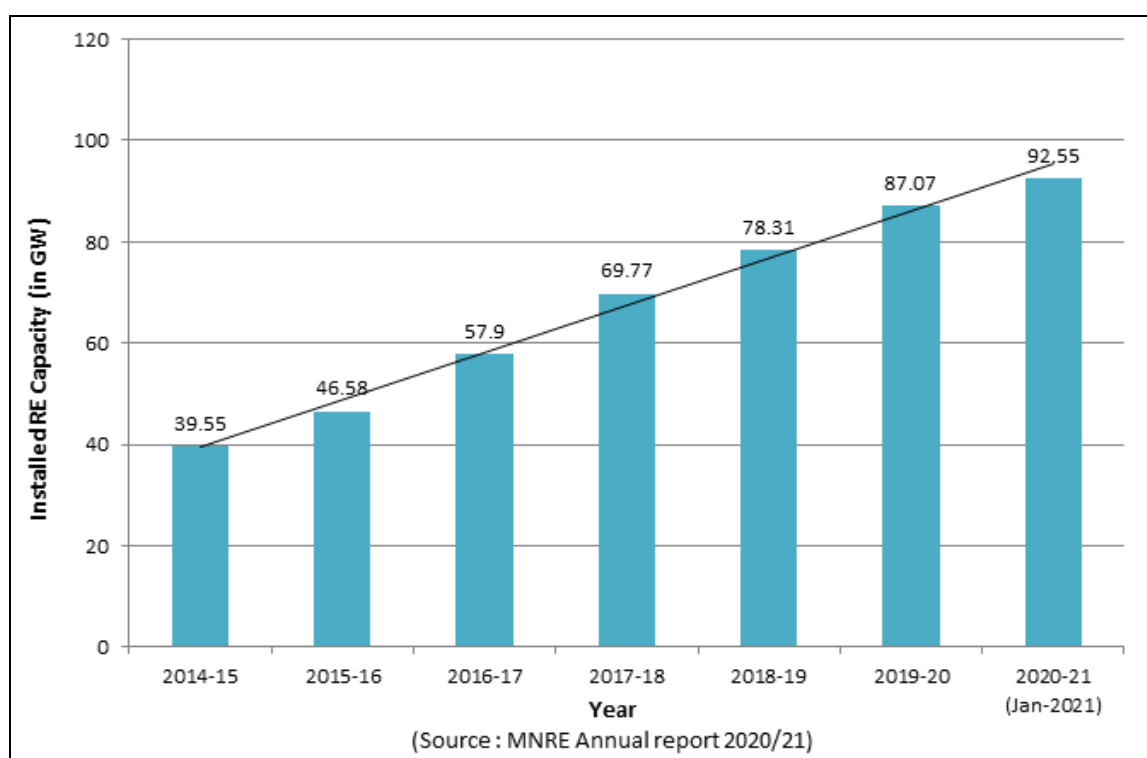
SL. No	States/UT's	Solar power (MW)	Wind power (MW)	Bio power (MW)	Hydro power (MW)	Total capacity (MW)
01	Andhra Pradesh	4203.00	4096.65	506.83	162.11	8968.59
02	Arunachal Pradesh	5.61	-	-	131.11	136.72
03	Assam	42.99	-	2.00	34.11	79.10
04	Bihar	159.51	-	124.70	70.70	354.91
05	Chhattisgarh	252.48	-	244.90	76.00	573.38
06	Goa	7.44	-	0.34	0.05	7.38
07	Gujarat	4430.82	8561.82	77.30	82.69	13152.63
08	Haryana	470.83	-	211.86	73.50	693.19
09	Himachal Pradesh	42.73	-	9.20	936.11	988.04
10	Jammu and Kashmir	20.73	-	-	185.98	206.71
11	Jharkhand	52.06	-	4.30	4.05	60.41
12	Karnataka	7355.17	4938.60	1888.30	1280.73	15462.80
13	Kerala	257.00	62.50	2.27	230.02	551.79
14	Madhya Pradesh	2460.22	2519.89	122.75	99.71	5205.57
15	Maharashtra	2289.97	5000.33	2596.99	379.58	10226.87
16	Manipur	6.36	-	-	5.45	11.81
17	Meghalaya	0.12	-	13.80	32.53	46.45
18	Mizoram	1.53	-	-	36.47	38.00
19	Nagaland	1.00	-	-	30.67	31.67
20	Odisha	401.72	-	59.22	88.63	549.57
21	Punjab	959.50	-	484.20	173.55	1617.25
22	Rajasthan	5732.58	4326.82	121.25	23.85	10204.50
23	Sikkim	0.07	-	-	52.11	52.18
24	Tamil Nadu	4475.21	9608.04	1019.05	123.05	15225.35
25	Telangana	3953.12	128.10	205.90	90.87	4377.99
26	Tripura	9.41	-	-	16.01	25.42
27	Uttar Pradesh	1712.50	-	2117.26	49.10	3878.86
28	Uttar Khand	368.41	-	130.22	214.32	712.95
29	West Bengal	149.84	-	319.92	98.50	586.26
30	Andaman & Nicobar	29.22	-	-	5.25	34.47
31	Chandigarh	45.16	-	-	-	45.16
32	Dadra & Nagar Haveli	5.46	-	-	-	5.46
33	Daman & Diu	40.55	-	-	-	40.55
34	Delhi	192.97	-	52.00	-	244.97
35	Lakshadweep	0.75	-	-	-	0.75
36	Pondicherry	9.33	-	-	-	9.33
37	Others	-	4.30	-	-	4.30
	Total (MW)	40085.37	39247.05	10314.56	4786.81	94433.79

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

**Table 2:** Programs / Scheme-wise physical progress in 2020/21

Sectors	FY – 2021/21	
	Target	Achievement (Apr./mar.21)
1. Grid-Interactive Power (Capacity In MWP)		
▪ Wind Power	3000.00	1503.30
▪ Solar Power – Ground Mounted	9000.00	3533.14
▪ Solar Power – Roof Top	2000.00	1924.44
▪ Small Hydropower	100.00	103.64
▪ Biomass (Bagassee)(Cogeneration)	200.00	173.37
▪ Biomass (Non-Bagassee) (Cogeneration/captive power)	50.00	97.24
▪ Waste to power	30.00	21.00
Total	14380.00	7356.13
2. OFF-Grid/Captive Power (Capacities in MWEQ)		
▪ Waste to energy	10.00	20.76
▪ SPV systems	500.00	171.11
Total	510.00	197.87
3. Other Renewable Technology (Capacity in NOS)		
▪ Biogas plants (in lakhs)	0.60	0.11

(Source: Ministry of New and Renewable Energy – Annual report 2020/21)

**Fig 2:** Installed Renewable Energy Capacity in India as on 31.01.2021(GW)

The above bar chart and tables give information about India's Renewable energy status as of 2021 and the total installed capacity from 2014 to 2021. And it is noticeable that installation in all the years increased over the period shown. In 2014/15, the renewable installation is 39.55 GW grow up to 40.58 GW in 2015/16 and about 17.7% more than the previous level. And the remaining years orderly 2015/16 to 2016/17, 2016/17 to 2017/18, 2017/18 to 2018/19, 2019/20 to 2020/21; about 24.3%, 20.5%, 12.2%, and 11.2% respectively. And it's almost 134% increase in the capacity during the years from 2014 to 2021. During the previous several years, solar energy has had a noticeable influence on the Indian energy landscape. Millions of people in Indian communities have profited from solar energy-based decentralized and distributed technologies that satisfy their cooking, lighting, and other energy demands in an environmentally benign manner. The socio-economic advantages include a reduction in drudgery among rural women and girls who collect fuelwood over vast distances and cook in smoky kitchens, a lower incidence of outsourcing lung and eye diseases, the creation of jobs at the local levels. And, eventually, an improvement of the quality of livelihood and the wealth formation prospects at the village level. In addition, India's solar energy sector has grown to become a prominent participant in grid-connected power generating capacity throughout the years. It promotes the government's objective of long-term

prosperity while also establishing itself as an important contributor to meeting the country's energy demands and a key role in ensuring energy security.

### **Major challenges in renewable energy sectors**

Some of the Challenges / Barriers after reviewing the article study have discussed below:

Renewable sources are high-budget compared to conventional sources, particularly cost associated or incurred with Buildings, Infrastructures, and Installing facilities mainly in solar and wind technologies. Hence this influences the higher borrowings rates and affects the investment decisions. The main problem is the renewable manufacturer is facing today is the storage of energy; due to the more storage in fossil fuel and provided according to needs; renewable storage batteries are not availed to stored accordingly to maintain demand and supply. Behavioral changes: Perceptual changes in the minds of the consumers regarding adoption and expenses of modern technologies in the Renewable sources and consumer takes advice from the conventional users rather than/from Renewable energy experts, due to the technology up-gradation in renewable energy technologies (RETs) might disappoint the consumer minds. The oil (petrol, diesel, fuels) imports are increasing nowadays due to the consumptions, presently about 65% of petroleum were importing, it would rise to 85% by the year 2025. The technical up-gradation in Renewable energy technologies (RETs) leads to the requirement of technical experts. The organization must focus on the training and development programs for their existing man powers; hence the skill up-gradation requires cost plus-off the job training; this would be the main problem is nowadays facing by renewable manufacturers.

India is an agriculture-based nation, generating renewable energy requires a large amount of land for installing and operating renewable plants; hence converting agricultural land into the commercial area will destroy the cultivation culture. Tax and Tariffs: Due to the fluctuations in the Indian government with different parties, different Regulations in the tax and tariffs on renewable and non-renewable changes customers' preferences due to price changes and tax benefits. Lack of standard technology: The unconditional changes in the technology world, energy technologies changes year by year, for maintaining & changing or shifting to update; require more cost. Thus, the manufacturer remains within his availability. Limited availability of infrastructure and sources leads to thinking within a limited area/focus. If the project experts always work in a limited source might lead to low project development.

Installing Renewable Energy Technologies (RETs) and power plants need a large amount of capital for the long term and require financial institutions' support. So, maintaining long-term finance is a tough job for the producers. The subsidies which the government provided on conventional energy are more than subsidies given to Renewable energy sources. Hence this would be the most impacting drawback for the renewable energy manufacturer / industries. Transition from fossil fuels to renewable energy plants requires skilled employees, mainly in the top-level management and technical expert to involve in the professional study and technical courses because it is mandatory for designing the project, build the plant, operate with technology, and main the activities of the renewable plants.

Consumer feels paying more cost for renewable sources, even after installation is better to pay for fossil-fuels. A report by EIAs (International Energy Outlook) (2016) suggests that fossil fuels are expected to supply 78% of overall global used in 2040. Focusing on Research & Development activities for Renewable today requires a capital investment and technical cost. The government and R&D sections are not complied with spending lots of money because the results may differ due to the technology risks and conventional sources advantages.

### **Recommendation**

Maintaining the equilibrium in the Demand-Supply of energy makes sufficient progress in sustainability; the manufacturer or industry makes sure that how much to generate and how to supply accordingly to create a demand-supply chain effectively. Government has to reduce fossil-fuel subsidy through policy implications in LPG schemes to adopt renewable sources and providing more to renewable source manufacturers & industries to build high-capacity plants and encourage them to produce/use maximum availability. Due to technological advancement, the manual applications using in fixing prices don't reach out all the time. Hence adopting modern pricing methodologies for renewable sources and modern methods for monitoring technologies and plants might help the easier maintenance.

The proper measurements are needed to reduce barriers to renewable energy sources and increase the potentials & consumption level of renewable energy reduces the economic and financial crisis of a country to maintain long-run equilibrium. Long-term finance from international financial organizations such as the World Bank, UNIDO, UDAY, DISCOMs, and other organizations with lesser interest rates of capital investments helps long-term financial assistance (Pratiyuksha V.N, 2021). The rules and policies set for reducing the drawbacks and must focus on the potentials of Renewable energies with initiating new projects with higher research work for utilization of potentials. Set an annual target for generating energy by each plant and immediate action to the variables, if any. And auto-correction leads to the highest usage of resources and reduces inefficiency among both technicians and power plants. Universities and institutions must provide more technical education on Renewable energy to develop in further years to make technological advancements. Energy audit has become essential to maintain the gap between demand and supply of energy; through networking of power sectors, more investment, and research & development processes. Land requirement for installing power-plants in solar and

wind sources is higher compared to other forms of renewable. Hence the government has to look up land facilities through different schemes/programs and support renewable generation.

### Conclusion

Renewable energy is and would be playing a vital role in the sustainability of future standard living, employment opportunities, and technological & economic advancement. Obtaining consistent and high-quality electricity remains a prime obstacle, and connecting it to the grid requires additional time and effort on the ground. Even though enforcement of several rules, individuals continue to have problems with unpredictable power supplies, resulting in monotony, pollutants, security, and medical issues. However, it is not possible to eradicate obstacles, but can avoid as much as possible because India is a developing country also a populated country; the government has to look up to balance every progress of the country. And the government has taken many steps (policy and initiatives) to increase the awareness of renewable energy sources instead of depending on conventional energy sources.

An examination of the supply of new renewable technologies, such as wind, biomass, geothermal energy, tidal and marine energy, hydropower, and solar photovoltaic energy, obviously demonstrates a change in preferences for these advanced technologies as a form of energy. Despite the economic downturn and economic collapse, green technologies have continued to create prominence. The widespread adoption and usage of sustainable energy would aid in addressing concerns such as energy shortages, fluctuating fuel prices, also assisting India in becoming self-sufficient. India is already experiencing an energy crisis, with many regions yet without power. Thus, renewable energy might be the answer to its issues. The major limitation of this study is covering area and multi analysis of each challenge to their particular that is industrial or manufacturers. So, according to the researchers' knowledge, covering each area like Solar, Wind, Hydropower, and Biomass and interacting with potential and challenges and on the other hand; multistage analysis of each challenge-control measurements could results investigator with proved evidence. The researcher believes that this piece of review paper would help for further research work.

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