

## RENEWABLE ENERGY TRANSITION FOR SUSTAINABLE DEVELOPMENT IN INDIA: AN ANALYSIS

*Rajendra Kumar\**

### ABSTRACT

The main objective behind transition from non-renewable to renewable energy is to achieve a sustainable development that may be in the form of socio-economic development, energy security, environmental protection and mitigating the adverse impacts of climate change. Transition to renewable energy can save the earth from disastrous consequences of climate change. Sustainable development is feasible by the adoption of sustainable energy sources. Ambitious governmental commitments by formulating effective policies along with developing economic prospects have propelled India to be at 4<sup>th</sup> global position in the world's renewable energy markets. The Union and State governments along with private sector are taking initiatives to develop mega renewable energy projects to make India carbon neutral by 2070. India is deficient in conventional energy sources but is fortunate enough to be rich in renewable energy sources. It is proven that sustainable development cannot be achieved without taking recourse to renewable energy for overall development.

**Keywords:** Renewable energy; Sustainable development; Transition; Developers; Investment; Installed Capacity

- I. Introduction**
- II. Renewable Energy Potential in India**
- III. Current Status in Renewable Energy**
- IV. Legislative Framework for Renewable Energy in India**
- V. Governmental Policy Initiatives**
- VI. India's Global Position in Renewable Energy Capacity**
- VII. Challenges in Renewable Energy Transition**
- VIII. Suggestions to remove challenges**
- IX. Conclusion**

### I. Introduction

“The world's energy destiny lies with decisions and policies made by governments”

-Dr. Fatih Birol, Executive Director, IEA

---

\* Ph.D. Scholar, Faculty of Law, University of Delhi, New Delhi.

ENERGY IS the prerequisite and necessary requirement for humans to grow and develop. Fulfillment of energy demand has always been at the core of human progress and development. The Bruntland Commission in its report 'Our Common Future' (1987) emphasized on sustainable development and it observed that 'Energy is necessary for daily survival. Future development crucially depends on its long term availability in increasing quantities from sources that are dependable, safe and environmentally sound...'<sup>1</sup>The energy sector plays an important role in the economic progress and social development of a nation but the worldwide increase in the demand of energy consumption has led to the scarcity of fossil fuels and the use of the sources of energy production such as coal, natural gas, oil etc. has contributed to the global greenhouse gas emissions. For sustainable development which is defined as the ability to meet the demands of present generations without compromising the abilities of future generations to meet their own needs, it is essential to raise the standard of living by providing reliable and cleaner energy.<sup>2</sup>

India's requirement is to fulfill its energy demand for economic development. India is ranked the third largest country in the global carbon emissions after China and the USA. Due to high carbon emissions, climate change can disturb the ecological balance of the world. Intended Nationally Determined Contributions (INDCs) which have been undertaken and submitted to the United Nations Framework Convention on Climate Change (UNFCCC) after Paris Agreement (2015) might prove effective tools for transition to renewable energy provided these obligations are fulfilled. Paris Agreement has set the target of limiting global rise in temperature below 2 C.<sup>3</sup>

India is one of the largest coal producer and consumer in the world and also imports crude oil and natural gas to meet its increasing demand of energy.<sup>4</sup> Around 58% of the energy demand is met by non-renewable sources of energy and share of renewable energy in the total

---

<sup>1</sup> Usha Tandon (ed.), *Energy Law and Policy* 49 (Oxford University Press, New Delhi, 1<sup>st</sup> edn., 2018)

<sup>2</sup> United Nations World Commission on Environment and Development, "*Our Common Future*" 16 Oxford University Press (1987)

<sup>3</sup> Paris Climate Agreement, "*Key Outcomes from COP21*" Paris, available at: [www.https://unfccc.int/sites/default/files/english\\_parisagreement.pdf](https://unfccc.int/sites/default/files/english_parisagreement.pdf). (last visited on March 18, 2022)

<sup>4</sup> World Energy Council, "*World Energy Scenarios Composing Energy Futures to 2050*" available at: [www.worldenergy.org/wp-content/uploads/2014/09/World-Energy-Scenarios\\_composing-energy-futures-to-2050-Fullreport.pdf](http://www.worldenergy.org/wp-content/uploads/2014/09/World-Energy-Scenarios_composing-energy-futures-to-2050-Fullreport.pdf). (Last visited on March 18, 2022)

installed generation capacity is 42%.<sup>5</sup> India needs a rapid transition to renewable energy to achieve sustainable development and avoid disastrous impacts of climate change. Renewable energy sources can play a key role in achieving sustainable energy for sustainable development with lower carbon emissions.<sup>6</sup> It is already proved that renewable energy might fulfill energy demands sustainably and reduce carbon emissions. Recently India has been focusing on generating solar and wind energy so that it can develop a sustainable path for energy supply. Decentralization of generation of renewable energy is being promoted to increase the share of renewables. With the joint efforts of the Union and the States, over 64 GW solar energy capacity has been installed till February 02, 2023.<sup>7</sup>

There are five main reasons why increasing the transition to renewable energy is the way to a habitable planet today and for future generations. These five reasons are as follows- renewable energy sources are available everywhere, it is the cheaper source of energy, it is the healthier source, it creates jobs and it makes economic sense.<sup>8</sup> It is clear that renewable energy is cheaper and non-polluting to the environment and it can be accessed where grid connected energy supply is not possible. India had targeted 175 GW of renewable energy out of which 100 GW from solar energy, 60 from wind power, 10 from biomass power and 5 from small hydro-power by 2022.<sup>9</sup>

Though recently generation of renewable energy has progressed specially in solar and wind energy sector but it has encountered many barriers as well and we urgently need to remove these obstacles by discovering effective solutions so that India can achieve its target of 500 GW of generating renewable energy by 2030.<sup>10</sup> India has enormous potential of renewable energy and it can be utilized by adopting investor-friendly policy measures and effective legal steps so that India can become a global leader in renewable energy and fulfill its demand of energy by relying on renewable sources of energy.

---

<sup>5</sup> Ministry of New and Renewable Energy, “Initiatives and Achievements on Renewable Energy Status” available at: <https://mnre.gov.in/sites/default/files/uploads>. (Visited on August 8, 2023)

<sup>6</sup> Sanjay Kumar, *Renewable Energy*, 97-106, (Kalyani Publishers, New Delhi, 2017)

<sup>7</sup> Press Information Bureau, available at: <https://pib.gov.in>pressreleaseDetailm.aspx> (last visited on August 02, 2023)

<sup>8</sup> United Nations Organization, “Renewable energy-powering a safer future” available at <https://www.un.org/en/climatechange/raisingambition/renewable-eneergy> (last visited on February 27, 2023)

<sup>9</sup> Charles Rajesh Kumar, J. Paulraj, M. A. Bernard, Jenova Raju, M. Abdulmajid, “Sustainable Waste Management through Waste to Energy Technologies in India- Opportunities and Environmental Impacts” 09 *IJREER* 309 (2019)

<sup>10</sup> Press Information Bureau, available at: <www.pib.nic.in>pressrelease> (last visited on March 20, 2022)

For sustainable development a sustainable source of energy is an essential element. In the last few decades energy demand has increased exponentially and this trend is predicted to grow in future. An investigation for future energy consumption may determine investments in renewable energy sector for sustainable supply of energy for sustainable development. Sustainable energy supply and security are essential for human development and socio-economic progress.

Large population of India and rapid industrialization along with human development require high demand of energy. India is ranked second after China with more than 1.21 billion populations (2011) and is expected to have more than 1.512 billion population by 2030.<sup>11</sup> India's population is still increasing and adds more people to the world than any other country every year and some Indian States like UP, Maharashtra etc. have equal or more population than many countries. In India the demand for energy consumption will be the highest among all major economies by 2035-2040 and the most of this demand will be met by coal and oil followed by renewable energy. Today renewable energy has become the second source of domestic energy production replacing oil and gas. The demand of renewable energy in India has been increasing significantly and public as well as private investment is being increased. India consumed 41 mtoe (million tonnes of oil equivalent) of renewable energy in 2020 and it will be 86 mtoe in 2025, 133 mtoe in 2030 and 191 mtoe in 2035. India will be the largest consumer of energy by 2050.<sup>12</sup>

India is a fast-growing economy and this high economic growth in India is increasing the demand for energy and to meet this demand India requires more and sustainable energy sources. At the same time, India faces a challenge of growing population and environmental degradation in the way of sustainable development. The gap between demand and supply of energy in India is projected to increase in the coming time.<sup>13</sup> In 2021, the energy requirement was 12,75,534 MU and the availability was 12,70,663 MU, i.e., a deficit of 4,871 MU which

---

<sup>11</sup> World Meters, *available at*: <https://www.worldmeters.info/world-population/India-population> (last visited on April 15, 2022)

<sup>12</sup> BP Energy Outlook Report, "Country and Regional Insights- India" *available at*: <https://www.bp.com/content/dam/bp/in/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2020-country-insights-india.pdf>. (last visited on March 20, 2022)

<sup>13</sup> Inaki Arto, Inigo C- Perez, Rosa Lago, Gorka Bueno, Roberto Bermejo, "The Energy Requirements of the Developed World" 33 *ESD* 11-13 (2016)

is 0.4% even peak demand being as high as 1,90,198 MW.<sup>14</sup> Rising income and growing urbanization are also responsible for higher demand of energy for domestic purposes. The higher demand for transportation, infrastructure, capital goods, and industrial operations are the main driving forces for increased energy demand in industrial sector. In agriculture sector, wider scope for mechanization, enhanced use of groundwater for irrigation has pushed the demand of energy. The increased uses of electric vehicles and induction cook stoves have also enhanced the demand of energy.

## II. Renewable Energy Potential in India

India being a tropical country has high potential of renewable energy especially solar energy due to high solar radiation.<sup>15</sup> Solar energy is believed to be the most abundant of all renewables in India.<sup>16</sup> In India, the estimated total renewable energy potential amounts to 1,096GW.<sup>17</sup> Due to the advancement in technologies, waste to energy (WTE) also has enormous potential along with other forms of renewable energy. India has an estimated potential of WTE of 4.137 GW from industrial and urban wastes including municipal solid wastes.<sup>18</sup> India has good potential of some other untapped forms of renewable energy such as geothermal, tidal and wave energy. Geothermal energy potential is estimated to be 10,600 MW while tidal and wave energy potential ranges from 48 GW to 69 GW.<sup>19</sup>

Table 01, State-wise estimated renewable energy potential in India<sup>20</sup>

---

<sup>14</sup> Ministry of Power, “Power Sector at A Glance All India” available at: <https://powermin.nic.in/en/content/power-sector-glance-all-india>. (Visited on 20 April,2022)

<sup>15</sup> Nimish Kumar and Nitai Pal “The existence of barriers and proposed recommendations for the development of renewable energy in Indian perspective Environment Development and Sustainability: A Multidisciplinary Approach to the Practice and Theory of Sustainable Development” 22(03) *SLJ* 2188 (2020)

<sup>16</sup> Kashfina Kapadia, Aditya Agrawal, Hemant Sharma, Narayan Malviya, “India’s Renewable Energy Potential: A Review” *SSRN-Elsevier* 1553 (2019)

<sup>17</sup> Ministry of New and Renewable Energy, “Annual Report-2020-2021” available at: <http://mnre.gov.in/file-manager/annual-report/2020-2021/en/pdf>. (last visited on March 21, 2022)

<sup>18</sup> *Supra* note 08

<sup>19</sup> *Supra* note 16 at 1557

<sup>20</sup>Ministry of New and Renewable Energy, “Annual Report 2021-22” 7,8,9,33,44 (2022)

States/UTs	Solar Potential (GW)	Wind Energy Potential at 100 mtr(GW)	Wind Energy Potential at 120 mtr (GW)	Small Hydro Energy (GW)	Bio-energy (GW)	Total RE (GW)
<b>Andhra Pradesh</b>	38.44	44.23	74.90	0.409	1.001	84.648
<b>Gujarat</b>	35.77	84.43	142.56	0.202	1.683	122.087
<b>Karnataka</b>	24.07	55.86	124.15	3.726	1.581	86.278
<b>M.P.</b>	61.66	10.48	15.40	0.83	1.442	74.405
<b>Maharashtra</b>	64.32	45.39	98.21	0.78	3.424	113.931
<b>Rajasthan</b>	142.31	18.77	127.75	0.052	1.101	162.238
<b>Tamil Nadu</b>	17.67	33.08	68.75	0.604	1.671	53.801
<b>Others</b>	364.09	9.28	43.78	14.532	13.146	398.695
<b>Total</b>	748.98	302.25	695.50	21.133	25.049	1096.08

As depicted in the above table Rajasthan has the highest renewable energy potential in India especially in the solar energy sector and the main reason behind this high solar energy potential of Rajasthan is the vast desert area lying west to Aravali range covering 61% of the total geographical area of the State. Gujarat holds second place with 122GW renewable energy potential in India having high potential in wind energy sector especially in Kachchh and Kathiawar region of the State.<sup>21</sup> Union government, state governments and private sector play major role in harnessing high energy potential in renewable sector in India though the private sector leads in renewable energy investment. Private sector contributes 95% of the cumulative installed renewable energy, state governments generate 3% and Union government produces just 2%.<sup>22</sup> The major private companies in the field of renewable energy generation are Suzlon in wind energy, Tata power in solar energy, Renew power in solar and wind energy.<sup>23</sup>

<sup>21</sup> Author himself has visited in the western part of Rajasthan and Kachchh region of Gujarat observing solar and wind energy potential in the States.

<sup>22</sup> Central Electricity Authority (CEA), Ministry of Power, "All India Electricity Statistics, General Review" available at: <https://cea.nic.in/general-review-report/?lang=en/pdf>. (last visited on March 23, 2022)

<sup>23</sup> *Ibid.*

### III. Present Status in Renewable Energy

Renewable energy sector in India is one of the most attractive renewable energy-market in the world. India has taken several steps to increase the generation and use of renewable energy so that impacts of climate change can be alleviated and sustainable sources of energy can be utilized. Ministry of New and Renewable Energy (MNRE) at the highest level along with other financial and technical institutions have been established for the promotion of renewable energy and diversification of energy. India is increasing the use of renewable energy and has undertaken several mega renewable energy projects so that commitments related to renewable energy can be achieved.<sup>24</sup> India published transparent bidding guidelines for the generation of renewable energy and imposed lowest tariff and it resulted in decrease of per unit cost of renewable energy.<sup>25</sup> India has achieved a record low solar energy tariff of Rs 1.99 per unit from 6.47/kwh and similar trend was also noticed in other renewable forms of energy such as wind energy when procurement process changed from feed in tariff mechanism (assured price above market price for developers) to competitive bidding process.<sup>26</sup>

Year	Installed RE Capacity (GW)	% Share of RE in total Installed Capacity	Generation from Renewable Sources (BU)	Total Generation from All Sources(BU)	% Share of RE in Generation
2014-2015	39.55	14.36	61.78	1110.18	5.56
2015-2016	46.58	15.23	65.78	1172.98	5.60
2016-2017	57.90	17.68	81.54	1241.38	6.56
2017-2018	69.77	20.24	101.83	1303.37	7.81
2018-2019	78.31	21.95	126.76	1375.96	9.21
2019-2020	87.07	23.52	138.32	1390.93	9.95
2020-2021	92.54	24.53	111.92	1017.81	11.00

<sup>24</sup> National Institute of Transforming India (NITI) Aayog, "Report of the Expert Group on 175 GW Renewable Energy by 2022" available at: [http://niti.gov.in/writerdata/files/document\\_publication/report-175-GW-RE.pdf](http://niti.gov.in/writerdata/files/document_publication/report-175-GW-RE.pdf). (last visited on March 25, 2022)

<sup>25</sup> Ministry of New and Renewable Energy, "Preparation of Guidelines and Standard Bidding Documents for Power Projects based on Renewable Energy Sources" (2010)

<sup>26</sup> *Supra* 17 at 03

	(Up to January 2021)	(Up to January 2021)	(Up to Dec, 2020)	(Up to Dec, 2020)	(Up to Dec, 2020)
--	----------------------	----------------------	-------------------	-------------------	-------------------

Table 02, India’s Renewable energy Sector at a Glance from 2014-2021<sup>27</sup>

India has increased its renewable energy capacity exponentially. Renewable energy production capacity increased by 99.3% over 2014 levels.<sup>28</sup> The total installed renewable energy capacity has reached to 152 GW including hydro in 2022. Energy from renewable sources accounted for around 38.56% of total installed energy capacity on January 31, 2022 and the remaining 61.44 % came from non-renewable sources of energy such as coal, oil, gas etc. Excluding large hydro, India’s cumulative installed renewable energy capacity was 105GW up to January 2022.<sup>29</sup>

Globally India stands at fourth position in renewable energy cumulative installed capacity (including large hydro energy projects), holds fourth place in wind energy installed capacity and fourth in total installed solar energy as on October 31, 2022.<sup>30</sup> Southern and western States, including Karnataka, Tamil Nadu, Maharashtra, Gujarat and Rajasthan, are performing well in harnessing renewable energy because they have high solar radiation and wind velocity and investment is also concentrated in these regions especially in solar and wind sector.<sup>31</sup> In region-wise generation of renewable energy, the southern region generates around 50% of the total installed renewable energy capacity it is followed by Western region with around 30%, the Northern region with around 18%, the Eastern region with less than 2%, the North Eastern region with less than 1%.<sup>32</sup>

MNRRE launched Green Energy Corridor in March 2015.<sup>33</sup> Transmission and evacuation infrastructure is being set up under green energy corridor to evacuate energy generated from

<sup>27</sup>Supra note 17 at 02

<sup>28</sup> Ministry of Power, Government of India, “Annual Report 2021-22” 13 (2023)

<sup>29</sup> Supra note 24

<sup>30</sup> Ministry of New and Renewable Energy, “Year-End Review 2022” 01 (2022)

<sup>31</sup> Meng Gao, Yihui Ding, Shaojie Song, Xiao Lu, Michael B. McElroy, “Secular decrease of wind power in India associated with warming in the Indian Ocean” 4(12) *Science Advances* 01 (2018)

<sup>32</sup> Central Electricity Authority (CEA), Ministry of Power, available at: <http://www.cea.nic.in/reports/documents/executive-summary/2021/exe-summary-11.pdf>. (last visited on April 02, 2022)

<sup>33</sup> Press Information Bureau (PIB), Ministry of New and Renewable Energy, “Green Energy Corridor Project” available at: <https://pib.gov.in/newsite/PrintRelease.aspx?relid=116890>. (last visited on April 04, 2022)



renewable energy projects.<sup>34</sup> Inter-State Transmission System (ISTS) and Intra-State Transmission System (InSTS) are under construction in various phases. National Hydrogen Energy Mission was launched in 2020 to develop and deploy green hydrogen-based technologies with the vision of commercializing these technologies.<sup>35</sup> Inclusive development, energy transition and climate change have been as goals of Amrit Kaal in the Budget document of 2022-23.<sup>36</sup> Renewable energy sector along with other sectors has immense potential to propel sustainable development.

India under its Intended Nationally Determined Contributions (INDCs) has to reduce carbon emissions intensity of its Gross Domestic Product (GDP) by 45 percent by 2030 from 2005 level and to create additional carbon sink of 2.5 to 3 billion tonnes of CO<sub>2</sub> equivalent through forest and tree cover by 2030.<sup>37</sup> India had also pledged to achieve 40% cumulative electricity from renewable energy based sources.<sup>38</sup> Though these INDCs were recognized under Paris Climate Agreement (COP 21) in 2015 but are not legally binding. India has achieved the fastest growth in renewable energy in the world and has become the most attractive market for renewables, amounting to 64 Billion Dollars in five years.<sup>39</sup> It has been possible because India has focused on policies and programs on renewable energy, energy efficiency, green transportation and carbon sink. Thus, India has performed well under its INDC targets.

### **Solar Energy**

Solar energy sector has enormous growth potential in India. The cumulative installed solar energy has increased from 2.6 GW in 2013 to 22 GW in 2018 and it amounted to 50 GW (50,304 MG) on January 31, 2022.<sup>40</sup> Government is taking several steps to improve the status of solar energy such as “Solar City” to develop at least one city in each State of India where

---

<sup>34</sup> *Ibid.*

<sup>35</sup> Press Information Bureau (PIB), Ministry of Power, *available at:* <https://pib.gov.in/PressReleasePage.aspx?PRID=1799067>. (last visited on April 04, 2022)

<sup>36</sup> Budget 2022-2023, Ministry of Finance, *available at:* <https://www.indiabudget.gov.in/> (last visited on April 05, 2022).

<sup>37</sup> Ministry of New and Renewable Energy, Government of India, “Solar Energy- Overview” *available at:* <https://www.mnre.gov.in/sites/default/files/uploads/mnre-booklet.pdf>. (last visited on April 05, 2022)

<sup>38</sup> *Ibid.*

<sup>39</sup> *Supra* note 20

<sup>40</sup> Press Information Bureau, “India Embarks on a Solar Journey” *available at:* <https://static.pib.gov.in/WriteReadData/specificdocs/documents/2022> (visited on April 05, 2022)

all energy needs will be met using renewable energy sources primarily solar energy.<sup>41</sup> All houses will have solar roof tops and all streets will have solar street lights and waste to energy plants. Union government, State governments and private enterprises are setting up solar parks individually and within joint ventures.

Some of India's major solar parks are Dholera solar park in Gujarat with 4000 MW capacity, Pavagada solar park with 2000 MW capacity in Karnataka, Ananthpurmu solar park with 1500 Mw capacity in Andhra Pradesh, Jalaun solar park with 1200 MW capacity in Uttar Pradesh, Kurnul and Kadapa solar parks in Andhra Pradesh, Kaza solar park in Himachal Pradesh, Bhadla-III solar park in Rajasthan, Dholera-I solar park in Gujarat all with 1000 MW capacity.<sup>42</sup> Solar Roof Top Programme phase II was launched in 2019 with a target to achieve 40 GW solar energy by 2022. Central financial assistance of 40% is provided for plants up to 3 KW capacity and 20% for plants beyond 3 KW and up to 10 KW.<sup>43</sup> PM KUSUM is one of the world's largest initiatives to provide renewable energy to more than 3.5 million farmers. 15 Lakhs grid connected solar pumps and 20 Lakhs standalone solar pumps will be installed with aggregate capacity of 30.80 GW capacity.

A long-term vision of One Sun One World One Grid was conceptualized and a Memorandum of Understanding (MoU) was signed by Government of India, International Solar Alliance and World Bank on 8 September 2020. National Solar Mission had a target of 100GW solar energy by 2022.<sup>44</sup> This target was to be achieved through various policy initiatives, enabling decisions, effective mechanism etc. but as on December 2021, a total capacity of 48 GW of solar energy had been installed in the country and it was expected that 55 GW capacity solar energy projects will be commissioned by 2022.<sup>45</sup> But due to Covid-19 relaxation, India's total installed solar capacity was just 63 GW on October 31, 2022.<sup>46</sup>

Production Linked Incentive scheme is being provided to encourage the production of solar modules and Safeguard Duty is being imposed on imports of cheap solar modules to protect

---

<sup>41</sup> Press Information Bureau (PIB), MNRE, "Establishment of solar cities" available at: <https://pib.gov.in/newsite/PrintRelease.aspx?relid=113108>. (last visited on April 05, 2022)

<sup>42</sup> *Supra* note 17 at 23,24

<sup>43</sup> Press Information Bureau (PIB), Ministry of New Renewable Energy, "Rooftop Solar Programme Phase-II" available at: <https://www.pib.gov.in/PressReleasePage.aspx?PRID=1808352>. (last visited on April 20, 2022)

<sup>44</sup> Ministry of New and Renewable Energy, "Annual Report 2021-22" 07 (2022)

<sup>45</sup> *Ibid.*

<sup>46</sup> *Supra* note 30 at 07

local manufacturers. Under this Scheme, Government of India has made allocation of Rs 19,500 crore

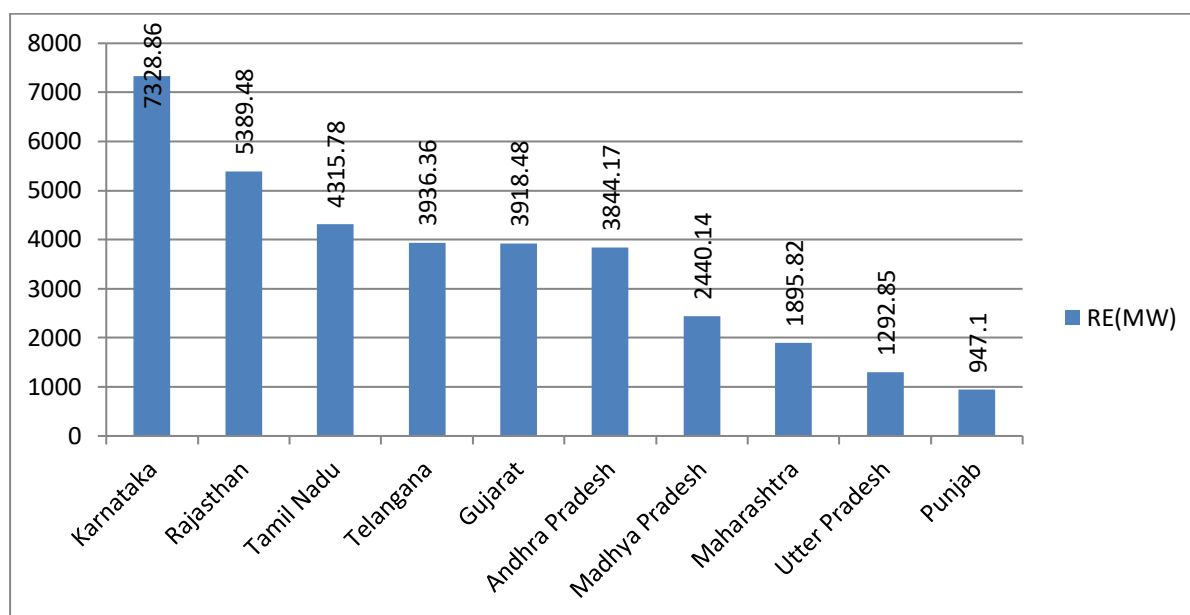


Fig.01, Solar installed capacity of top ten States in MW till 31 Dec, 2020.<sup>47</sup>

to encourage domestic manufacturing of high efficiency solar photovoltaic modules so that the ambitious target of 280 GW of installed solar energy capacity can be achieved by 2030.<sup>48</sup> There are three main factors behind India’s high solar energy progress, namely, favorable market, effective policy interventions and the fact India has more than 300 sunny days a year which provide ideal situation for solar energy to flourish.<sup>49</sup> During his visit to Bhadla solar power plant in Jodhpur district of Rajasthan, author noticed dust as a major challenge for solar power generation, every day because of the wind, the sand gets deposited on the solar panel modules but this challenge is overcome by using state of the art power efficient robotic cleaners without any requirement of water and damage to solar panels. The energy generated in this solar park is supplied to the national grid thus Bhadla solar power plant is not only providing environment friendly renewable energy to lakhs of houses but also reducing the power cost.

<sup>47</sup>Supra note 17 at 20

<sup>48</sup> Budget Speech 2022-23, Ministry of Finance, available at: <https://www.indiabudget.gov.in/> (last visited on April 08, 2022)

<sup>49</sup> Editorial, “Key to net zero strategy, India’s solar energy capacity grew by over 6,000 times in past 12 years” *The Print*, December 15, 2022

## Wind Energy

Wind energy is site specific and intermittent source of energy therefore a wind resource assessment map is required to be prepared before installation of wind energy plant. National Institute of Wind Energy under MNRE has established around 900 wind monitoring stations and prepared a wind energy resource map at different heights of 50 meter, 80 meter, 100 meter and 120 meter above ground.<sup>50</sup> Gujarat and Tamil Nadu are the major offshore wind energy potential states.<sup>51</sup> However, no project has been taken up to tap the potential. With respect to capacity utilization factor, offshore wind energy project has higher than onshore wind energy project and the cost also reduces with increase in capacity.<sup>52</sup> Government has a target to develop 5 GW offshore wind energy by 2022 and 30 GW by 2030.

The total installed generation capacity of wind energy was 21 GW in 2013-14 and it increased to 40 GW (40,101 MG) as on 31.01.2022.<sup>53</sup> The Parliamentary Standing Committee has made some recommendations on wind energy in India. The committee observed that the commercially exploitable wind energy potential in India is estimated to be more than 200GW but as of June 2022, the cumulative installed wind energy capacity was just about 20% of that potential. The committee recommended replacing less efficient wind energy turbines with more efficient advanced turbines and recycling the old turbines.

State	Installed Capacity (MW)
Andhra Pradesh	4092.45
Gujarat	8192.52
Karnataka	4868.80
Kerala	62.50
Madhya Pradesh	2519.89
Maharashtra	5000.33
Rajasthan	4326.82

<sup>50</sup> National Institute of Wind Energy, MNRE, “Annual Report 2020-2021 on Wind Energy for Cleaner India” available at: <https://www.niwe.res.in/downloads/annual-reports/2020-2021/pdf>. (last visited on April 08, 2022)

<sup>51</sup>J. Jeslin Drusila Nesamalar, P. Venkatesh, C. Raja “The Drive of Renewable Energy in Tamil Nadu: Status, Barriers and Future Prospects” 73 *RSER* 116-123 (2017).

<sup>52</sup> The Parliamentary Standing Committee, “Evaluation of Wind Energy in India” 29 (2022)

<sup>53</sup> Central Electricity Authority (CEA), Ministry of Power, available at: <https://cea.nic.in/reports/annual-reports/general-review-report/2021/pdf>. (last visited on April 08, 2022)

<b>Tamil Nadu</b>	9428.44
<b>Telangana</b>	128.10
<b>Others</b>	4.30
<b>Total</b>	38624.15

Table 03, State wise wind energy installed capacity on 31 Dec, 2020.<sup>54</sup>

### Small Hydro Energy

The Government of India approved some measures in March 2019 for the promotion of hydro energy including the declaration of large hydro power (more than 25 MW projects) as renewable source of energy and hydro purchase obligation (HPO) in non-solar renewable purchase obligations.<sup>55</sup> The Ministry of Power is responsible for the development of these large hydro energy projects but MNRE is responsible to develop small hydro energy projects (up to 25 MW projects).<sup>56</sup>

Small hydel energy projects (SHP) are developed into three categories small, micro and mini hydro energy projects. Small hydel energy projects are useful for overall development of isolated and remote areas by fulfilling their energy requirements and providing employment opportunities. Unlike wind energy; small hydro energy is predictable and reliable.

Large hydro energy projects are associated with multiple issues such as submergence of land; destruction to ecosystem, displacement and relocation of people etc. but these issues are not connected with small hydro energy projects. Small hydro energy projects are economically viable and their gestation period is also low so these projects can boost the development of small-scale industries in villages and far-flung areas and enhance the socio-economic conditions of people.<sup>57</sup> Most of the small hydro energy projects are canal based or run of the river type projects which do not have adverse impacts on the river ecosystem. India had a target of 5GW from small hydel energy projects by 2022 which was achieved well before committed period.

---

<sup>54</sup>*Supra* note 17 at 49

<sup>55</sup>*Supra* note 20 at 40

<sup>56</sup> *Ibid.*

<sup>57</sup> Oying Doso, Sarsing Gao, "An Overview of Small Hydro Power Development in India" 08 *AIMS Energy* 900 (2020)

## Biogas Energy

Energy generated from biogas has a good potential in rural and semi-urban areas. Bio degradable wastes from animals, kitchen, agro-industry and farms provide raw materials for biogas plants. Biogas is generated by anaerobic digestion of biodegradable materials. Gas produced from biogas plant is clean and environment friendly and digested slurry obtained from biogas plant is used as manure because it contains micronutrients such as NPK (nitrogen, phosphorous and potash) for plants.<sup>58</sup> A central sector scheme named New National Biogas and Organic Manure Programme (NNBOMP) was launched by MNRE to develop small biogas plants to fulfill the energy needs of farmers, cattle herders and rural households.

Various other schemes such as Galvanizing Organic Bio-agro Resources Dhan (GOBAR-DHAN), waste to energy program, Pradhan Mantri Jaiv Indhan Vatavaaran Anukul Fasal Awashesh Nivaran (PM JIVAN), Manufacturing of Briquettes and Pellets and Promotion of Biomass based Cogeneration in Industries Scheme, are encouraging investors in the emerging bio-fuel sector in India. In the financial year 2020-2021, a target was to set up 60,000 small biogas plants in different States and Union Territories but total achievement of biogas plants on 31.01.2021 was just 8483. As on 31.03.2021, 5058054 number of biogas plants have been set up against the estimated potential of 12339300 number of biogas plants.<sup>59</sup> Bio-fuels are of great importance in India as it augers well with initiatives like Clean India Campaign, Make in India and provides opportunity to achieve targets of reducing air pollution, creating wealth to waste, reducing import dependence, generating employment opportunities and ultimately doubling farmers' income.<sup>60</sup> Central Motor Vehicles Rules, 1889 were amended in 2015 to include usage of biogas as bio-CNG in motor vehicles generated from waste.

## IV. Legislative Framework for Renewable Energy in India

Before 1947 the Government of India Act 1935 did not make any provision related to renewable energy and the makers of the Constitution did not discuss renewable energy at all in the Constituent Assembly debates because it was not a subject of concern at that time. Like

---

<sup>58</sup>Tara Chandra Kandpal, Bharti Joshi, Chandra Sekhar Sinha, "Economics of Family Sized Biogas Plants in India" 32 *ECM* 102-113 (1991)

<sup>59</sup>*Supra* note 17 at 68, 69

<sup>60</sup> IEA Bio-energy, "Implementation of Bio-energy in India" 03 (2021)

any other federal Constitution, article 246 of the Indian Constitution also divides the legislative powers between the Union and the States with respect to the subjects of legislation.<sup>61</sup> Though, renewable energy is not mentioned as a specific subject in the Seventh Schedule of the Constitution of India. But renewable energy can be considered part of electricity sector so it may fall under the ambit of electricity entry 38 in the Concurrent list of the Seventh Schedule of the Constitution where both the Union and the State governments have power to make laws. In case of conflict between the Union law and the State law on the subject enumerated in the concurrent list of the Seventh Schedule of the Constitution, the Union law prevails over the State law. There is one exception to this general rule, if the State law has been reserved for the consideration of the president and it has received his assent then that law prevails in that State only. But the parliament would still be competent to override such a law by subsequently passing a law on the same matter.<sup>62</sup> The Union government and the State governments are competent to enact a law on all aspects of electricity including renewable energy under article 48A and 51-A (g) for the protection and improvement of the environment.<sup>63</sup>

The Union government has also power to pass a law on renewable energy under entry 97, List I read with article 248 (1) of the Constitution which provides residuary powers to the Union government.<sup>64</sup> The Union government can make law on a subject which does not fall in any of the lists using its power under entry 97 which provides for making law on any other matter not enumerated in any List of the Seventh Schedule.<sup>65</sup> 73<sup>rd</sup> and 74<sup>th</sup> Constitutional Amendment Acts, 1992 also provide that the State governments may endow powers and authorities to the local bodies to make provisions with respect to renewable energy.<sup>66</sup> Entry 14 and 15 in Eleventh Schedule read with article 243G provide for rural electrification and the development of non-conventional energy sources by panchayats but for this purpose adequate financial resources and powers are to be entrusted to them by the States. Article 243G stipulates that State Governments should endow the rural local bodies with such

---

<sup>61</sup> M Laxmikanth, *Indian Polity* 14.1 (McGrow Hill Education Private Limited, Chennai, 5<sup>th</sup> edn.)

<sup>62</sup> *Id.* at 14.3

<sup>63</sup> The Constitution of India, arts. 48A, 51A cl. (g)

<sup>64</sup> The Constitution of India, VII sch. entry 97 & part XI, art. 248 (1) reads: "Subject to article 246A, Parliament has exclusive power to make any law with respect to any matter not enumerated in the Concurrent List or State List."

<sup>65</sup> *Ibid.*

<sup>66</sup> The Constitution of India, arts 243-243ZG; XI sch. art 243G, entry 15 & XII sch. art. 243W.

powers and authorities to perform functions required from them.<sup>67</sup> Twelfth Schedule (entry 8) of the Constitution provides for the protection of the environment. Thus, Urban Local Bodies can take recourse to renewable energy, which will promote sustainability not only in protecting the environment but also in providing energy security for future generations.

The Electricity Act 2003 mainly consolidates the laws related to generation, transmission and distribution of electricity and it also provides for measures conducive to development and use of electricity by promoting competition and protecting interest of consumers through supply of electricity to all areas, rationalizing tariff and ensuring efficient policies regarding subsidies and other matters.<sup>68</sup> Even though the Electricity Act 2003 has sufficient provisions with regard to conventional sources of energy but it lacks in providing for non-conventional sources of energy. It has very few provisions with respect to renewable energy and whatever provisions it has, are just enabling.<sup>69</sup>

The Electricity Act 2003 contains provisions pertaining to renewable energy such as section 3(1) has stated that the Central Government, from time to time, shall prepare the National Electricity and National Tariff Policy after consulting the State Governments and authority for development of energy based on optimal utilization of resources including renewable sources of energy. Section 3(2) provides for the publication of National Electricity Policy and Tariff Policy while section 3(3) makes provisions for reviewing and revising these policies as referred to in sub-section (1).<sup>70</sup> Section 4 of the Electricity Act 2003 provides that the Central Government after consultation with the State Governments shall formulate policy on renewable energy and non-conventional energy sources for rural areas.<sup>71</sup> For fulfilling the mandate under section 4 of the Electricity Act 2003, the National Electricity Policy 2005 was formulated but the promotion of renewable energy is not one of the main objectives of this Policy though one of the issues in the Policy is dealing with renewable energy to promote generation, distribution and consumption of renewable energy.

---

<sup>67</sup> J.N. Pandey, *The Constitution of India*, 598 (Central Law Agency, Allahabad, 46<sup>th</sup> edn. 2009)

<sup>68</sup> The Electricity Act 2003, (No. 36 of 2003)

<sup>69</sup> Sanjay Upadhyay, "Renewable Energy Development in India: The for a Robust Legal Framework", in Usha Tandon (ed.), *Energy Law and Policy* 156 (Oxford University Press, New Delhi, 1<sup>st</sup> edn., 2018)

<sup>70</sup> The Electricity Act, 2003 (NO. 36 of 2003), s. 3

<sup>71</sup> *Id.* s. 4 available at: <https://cercind.gov.in/downloads/pdf>. (last visited on February 27, 2023)



Clause 5.12.1 of this policy illustrates that renewable sources of energy are the most environment friendly and there is need to promote electricity based on these sources of energy. For this purpose, efforts should be made to reduce the capital cost of renewable energy-based projects. Energy generation cost can be reduced by providing an environment of competition within these renewable energy-based projects. At the same time, sufficient promotional steps should also have to be promoted for development of such technologies and resources.<sup>72</sup>

Clause 5.12.2 of the Policy provides that State Electricity Regulatory Commission (SERC) will promote co-generation and generation of electricity from renewable sources of energy by providing measures for grid connectivity and sale of electricity to any one for the purpose of electricity from renewable sources of energy but only a percentage of the total consumption of electricity in distribution licensee's area. SERC shall determine the applicability of tariffs on such percentage for the purchase of power from renewable sources. The share of electricity from renewable sources would need to be increased as prescribed by SERC. Distribution companies shall purchase renewable energy through the process of competitive bidding. Analyzing the fact non-conventional technologies will take some time to compete, in terms of cost, with conventional sources; the appropriate commission may determine different prices to promote such non-conventional technologies.<sup>73</sup>

The provision under section 4 of the Electricity Act 2003 does not impose any legal mandate but is just player to bring renewable energy into the centre stage of policy formulation. To give boost to renewable energy sector it is important to have a real substantive legal mandate to bring investors in this sector. After passage of so many years, a renewable energy policy has been formulated so far under the provisions of section 4 of this Act.

Section 61, 61(h) and 61(i) of the Electricity Act 2003 provides that the appropriate Commission while determining tariff shall take into consideration the promotion of generation of energy from renewable sources and specify the terms and conditions for determining suitable tariff on these sources of energy and in doing so, shall be guided by the following, namely, the promotion of generation and co-generation of electricity from

---

<sup>72</sup> National Electricity Policy 2005, cl. 5.12.1 *available at*: <https://www.powermin.nic.in/home/policies-publications/newgovernmentpolicies/pdf>. (last visited on February 27, 2023)

<sup>73</sup> *Id.* cl. 5.12.2

renewable sources of energy and the National Electricity and National Tariff Policy.<sup>74</sup> Section 86(1) and 86(1)(e) the State commission shall perform following functions, namely, the promotion of generation and co-generation of electricity from renewable energy sources by providing appropriate measures for grid connectivity and sale of electricity to any one and specifying a percentage of total consumption of electricity in the area of distribution licensee for purchase of electricity from renewable sources of energy.<sup>75</sup>

Energy Conservation Act 2001 defines energy as any form of energy derived from fossils (such as coal, crude oil and natural gas), nuclear materials, hydroelectricity and includes electricity or energy derived from renewable sources or biomass energy connected to the grid.<sup>76</sup> Hydro energy and all other forms of renewable energy can be included in the definition of energy as given under section 2(h) of Energy Conservation Act 2001 but this section includes only grid connected renewable energy projects and it excludes stand-alone renewable energy projects not connected to the grid system under its ambit. The Energy Conservation (Amendment) Bill, 2022 was passed by the Lok Sabha on August 08, 2022 and has been presented for the consideration in the Rajya Sabha.<sup>77</sup> This Bill amends the Energy Conservation Act, 2001 where the Union government will be empowered to establish a carbon credit trading market which, in turn, will promote renewable energy transition. It also includes provisions where designated consumers of energy would be required to fulfill a portion of their energy demands from renewable energy sources.<sup>78</sup>

National Renewable Energy Act was drafted in 2015 to promote the generation of renewable energy and reduce the dependence on fossil fuel-based energy for the protection of environment and mitigation the adverse effects of climate change by reducing CO<sub>2</sub> emissions and other greenhouse gases. It will also ensure energy security for sustainable development in social, economic, financial and environmental aspects.<sup>79</sup> This draft Bill can contribute and fulfill India's national and international commitments on increasing the proportion of energy

---

<sup>74</sup>The Electricity Act 2003 (No 36 of 2003) s. 61

<sup>75</sup>*Id.* s. 86

<sup>76</sup>The Energy Conservation Act 2001 (No 52 of 2001), s. 2 cl. (h)

<sup>77</sup> Amendments to Energy Conservation Act, 2001, *available at*: <https://pib.gov.in/PressReleasePage.aspx?PRID=1881941>. (Last visited on February 27, 2023)

<sup>78</sup>The Energy Conservation (Amendment) Bill, 2022, *available at*: <https://prsindia.org/billtrack/the-energy-conservation-amendment-bill-2022>. (last visited on February 27, 2023)

<sup>79</sup>Draft National Renewable Energy Act 2015, *available at*: <https://www.mnre.gov.in/uploads/pdf>. (last visited on April 10, 2022)

generated from renewable sources of energy. The Draft National Renewable Energy Act, 2015 is classified into four broad sections:

**Institutional structure:** this section of the Act provides for general powers of the Central government and State governments. Central government shall take measures to promote deployment and development of renewable sources of energy and the State government shall formulate and implement renewable energy policy and renewable energy plan at State level to encourage renewable energy transition.<sup>80</sup> State government may/shall establish implementing and nodal agencies at State level and these agencies will be responsible to monitor and implement renewable energy related projects in the State.<sup>81</sup> Furthermore, the Central government shall establish the National Renewable Energy Committee (NREC). The NREC shall make inter-ministerial coordination for the purpose of the implementation of the provisions of this Act and shall provide advisory inputs to the Central government.<sup>82</sup> The Central government shall also constitute National Renewable Energy Advisory Group, like NREC, it will also advise the Central government for the effective implementation of the provisions of this Act. It will publish an annual report highlighting renewable energy sector and also publish issue-based reports on key challenges which are being faced by renewable energy sector.<sup>83</sup>

**Supportive ecosystem for renewable energy deployment:** Under this section the Act established that the Union ministry (MNRE) shall formulate and publish National Renewable Energy Policy after consultation with the State governments, this policy shall be based on the principles of integrated energy resource planning. The ministry shall also undertake and complete a detailed renewable resource assessment study for all types of renewable energy resources, a Nodal Entity shall be designated to undertake the task of potential resource assessment for the promotion of renewable energy. The ministry shall, in consultation with the State governments, identify and develop renewable energy investment zones through Renewable Energy Corporation of India (RECI) or any other agency.<sup>84</sup>

---

<sup>80</sup>National Renewable Energy Act 2015, ss. 4, 5

<sup>81</sup>*Id.* s. 6

<sup>82</sup>*Id.* ss. 7, 10

<sup>83</sup>*Id.* ss. 7,14

<sup>84</sup>*Id.* ss. 15, 16, 20

Economic and financial framework: The ministry shall constitute National Renewable Energy Fund to support all objectives of this Act for the promotion and development of renewable energy.<sup>85</sup> The State governments shall also constitute State Green Funds to support the promotion of renewable energy resources. These funds shall be utilized for infrastructure development of renewable energy, investments in renewable energy projects, financial supporting to adopt renewable energy technologies, renewable energy resource assessment, research and development, skill development, purchasing equity participation in renewable energy projects, for adoption of international best practices in this sector etc.<sup>86</sup> The capacity building of banks and other financial institutions shall also be undertaken so that financial requirement of renewable energy projects is not hindered.<sup>87</sup>

Renewable energy applications and energy access: The Central government and State governments shall encourage decentralized and stand-alone renewable energy applications in rural as well as in urban areas. It shall include cost effective grid interacted renewable electricity production, renewable electricity generation based on off grid system or mini or community grids for agricultural, residential, commercial or industrial applications, renewable energy for transportation sector considering its sustainability and heating and cooling applications such as space, water etc.<sup>88</sup> Central assistance shall be provided to maintain decentralization of renewable energy generation. This section also includes the provisions related to renewable generation obligations (RGO) and renewable purchase obligations (RPO) by companies through grid connected renewable electricity.<sup>89</sup>

India is one of the few countries which has elaborate legal framework for the protection of the environment but the questionable problem of implementation of these laws at the bottom level, has been undertaken by the National Green Tribunal (NGT) and the Supreme Court by diluting the old principle of locus standi.<sup>90</sup> Environmental protection laws associated with sustainable development, namely; Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Environment (Protection) Act, 1986, National Green Tribunal Act, 2010 and the rules made to implement these laws give an

---

<sup>85</sup>*Id.* s. 23

<sup>86</sup>*Id.* ss. 24, 26

<sup>87</sup>*Id.* s. 29

<sup>88</sup>*Id.* s. 30

<sup>89</sup>*Id.* ss. 39, 40

<sup>90</sup> Faisal Ali Khan, "Environmental Law and its Implementation in India; A Judicial Role" 8 *LDIJL* 13 (2020)

effective platform underpinning the four major pillars of sustainable development, viz. environmental, social, economic and peace. Development cannot be sustainable if well designed environmental laws are not effectively implemented by capable governmental institutions.<sup>91</sup> The NGT is mandated to deliver awards and orders in conformity with the principles such as “polluter pays principle”, “precautionary principle” and the principle of “sustainable development”.<sup>92</sup> In *M.P. Patil v. Union of India*<sup>93</sup> the NGT delivered: “the three principles governing the field of environment are polluter pays principle, precautionary principle and sustainable development. These three principles are statutorily stipulated under the Indian environmental jurisprudence. Developmental activities may be taken up to fulfill the need of a developing society but these are to be regulated in such a way to fulfill the requirement of conservation and preservation of natural resources which are the bona fide assets of society.”<sup>94</sup>

The NGT is the pivot for sustainable development in the Indian environmental jurisprudence but a balance to be maintained between development and environment is both contentious and complex.<sup>95</sup> Thus NGT as a statutory body under National Green Tribunal Act, 2010, Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB) under Water/Air (Prevention and Control of Pollution) Act, 1974/1981 and any other authority constituted under section 3 (3) of the Environmental (Protection) Act, 1986 have become the cynosure for the application of sustainable development and would keep a striking balance between these conflicting issues (e.g. sustainable development and environment).

## V. Governmental Policy Initiatives

### National Offshore Wind Energy Policy 2015<sup>96</sup>

The policy was promulgated with the objectives to harness and develop offshore wind energy in maritime zones of India, namely, Indian territorial waters which extends upto 12 nautical

---

<sup>91</sup> UN Environment, “*Environmental Rule of Law: First Global Report*” 01 (January 24, 2019)

<sup>92</sup> National Green Tribunal Act, 2010 s. 20

<sup>93</sup> National Green Tribunal Judgment, March 13, 2014.

<sup>94</sup> *Ibid.*, paras 72, 74

<sup>95</sup> Gitanjali Nain Gill, “Environmental Justice in India: The National Green Tribunal and Expert Members” 05 *Transnational Environmental Law* 118 (2015)

<sup>96</sup> National Offshore Wind Energy Policy 2015, (No. 51/58/Cab/2011-Wind), available at: <https://www.mnre.gov.in/uploads/pdf>. (last visited on April 12, 2022)

miles (nm) from the coastline and exclusive economic zone (EEZ) of India beyond 12 nm to 200nm where coastal country has right to build structures such as offshore wind turbines.<sup>97</sup> The Policy provides for the public private partnership to promote investment in offshore wind energy projects and achieve energy security for coastal communities. India has a vast coastline of 7516.6 km and is surrounded by seawater on three sides and some specific areas in Gujarat and Tamil Nadu have high potential to generate offshore wind energy.<sup>98</sup> National Institute of Wind Energy (NIWE), Chennai is the nodal agency under MNRE to assess and develop offshore wind energy in territorial waters and EEZ of India. Offshore Wind Energy Steering Committee will also be constituted to oversee the execution and effective implementation of offshore wind energy initiatives. India has potential of about 70 GW in offshore wind energy but adequate steps have not been taken up to tap this vast potential.

Offshore wind energy projects offer much better quality of wind energy generation as compared to onshore wind energy projects because of Lack of any obstruction in the sea. Another advantage of offshore wind energy project is related to the size of turbine, offshore wind energy turbines (8-14 MW per turbine) are larger in size than onshore wind energy turbines (2 to 3 MW per turbine).<sup>99</sup>

### **National Policy on Bio-fuel 2018<sup>100</sup>**

The policy was formulated to facilitate the development and utilization of biomass for the production of bio-fuels; it also focuses on more efficient bio-fuel technologies such as first generation, second generation, third generation etc. which would be based on new feed-stocks. The bio-fuel policy has vision, medium term goals, strategy and approach and a framework for financial, technological interventions and institutional mechanism for bio-fuels, distribution and marketing of bio-fuels, research and development, quality standards and international cooperation. The policy envisions an important role for bio-fuels in energy

---

<sup>97</sup> National Offshore Wind Energy Policy 2015, cl. 1.3

<sup>98</sup> Prabir Kumar Das, "Offshore Wind Energy in India" Akshay Urja 23, *available at*: [https://www.researchgate.net/publication/333717700\\_offshore\\_wind\\_energy\\_in\\_india](https://www.researchgate.net/publication/333717700_offshore_wind_energy_in_india) (last visited on April 2019).

<sup>99</sup> Ministry of New and Renewable Energy, "Offshore Wind" *available at*: <https://mnre.gov.in/wind/offshore-wind> (last visited on February 28, 2023)

<sup>100</sup> National Policy on Bio-fuels 2018, (S.O. No. 2492 E), *available at*: <https://www.petroleum.nic.in/files/pdf>. (last visited on April 12, 2022)

and transportation where it can contribute to energy security, climate change mitigation leading to environmentally sustainable development. Initially a target of 20% of blending bio-fuels was proposed. A National Bio-fuel Coordination Committee headed by prime minister was set up to oversee coordination, implementation and monitoring. 10 GW target of energy from biomass has been achieved before its stipulated 2022.<sup>101</sup>

### **National Wind Solar Hybrid Policy 2018<sup>102</sup>**

It was felt that wind and solar energy resources are complementary and hybridization of these technologies would minimize the problem of infrastructural challenges. India had set a target of 100 GW of solar energy and 60 GW of wind energy by 2022. As on February 2022, wind and solar energy contribute 85 percent of total renewable energy.<sup>103</sup> Certain areas have been identified where both wind and solar energy have vast potential. Wind energy farms have potential for establishing solar photo-voltaic and generating solar energy similarly solar energy plants have the scope for wind energy mills.<sup>104</sup> Wind solar hybrid policy aims to promote grid connected wind solar hybrid energy plants to use the common infrastructure such as land and transmission lines for their optimal utilization and to encourage such technologies which can be helpful to harness their potential. The central Electricity Authority and Central Electricity Regularity Commission will have regulatory powers and formulate standards and guidelines for these hybrid projects. Financial and other incentives will be provided to the developers and support will also be given for research and development in wind solar hybrid system.

---

<sup>101</sup> Press Information Bureau (PIB), Ministry of New and Renewable Energy, “Year End Review 2020” available at: <https://www.pib.gov.in/PressReleaseDetailm.aspx?PRID=1685046>. (last visited on April 12, 2022)

<sup>102</sup> National Wind Solar Hybrid Policy 2018, (No. 238/78/2017-Wind), available at: <https://www.mnre.gov.in/wind/policy-and-guidelines/pdf>. (last visited on April 13, 2022)

<sup>103</sup> National Investment Promotion & Facilitation Agency, “Creating a Sustainable World” available at: <https://www.investindia.gov.in/sector/renewable-energy> (last visited on April 13, 2022)

<sup>104</sup> Alok Das, Hardik K Jani, Garlapati Nagababu, Surender Singh Kachhwaha, “A Comprehensive Review of WIND-Solar Hybrid Energy Policies in India: Barriers and Recommendations” 35 *REF* 108-121 (Dec. 2020)

## VI. India's Global Position in Renewable Energy Capacity

India was ranked third position in Renewable Energy Countries Attractiveness Index (RECAI) with a score of 66.2 in May 2021 (First being USA and second China).<sup>105</sup> India has improved in this biannual report which ranks the top 40 countries of the world based on the attractiveness of investment in renewable energy.

In “The Energy Transition Index” 2021, India is ranked 87<sup>th</sup> out of 115 countries of the world.<sup>106</sup> India is consistently improving its position in renewable energy with a strong political engagement and emerging regulatory framework for renewable energy transition. India had committed to achieve 40 percent of electricity from renewable sources of energy by 2030 under INDCs at Conference of Parties 21 in 2015 in Paris and this target has been achieved by 2022. India has raised its INDC target of 450 GW to 500 GW which is to be achieved by 2030. India has also pledged to achieve net zero carbon emissions by 2070 at 26<sup>th</sup> conference of parties (COP26) of UNFCCC in Glasgow.<sup>107</sup> One Sun One World One Grid (OSOWOG) initiative was also formally launched at COP26 which is a transnational grid to tap solar energy and supply it seamlessly across borders. UN Climate Action Summit was held in 2019 where countries including India pledged to ensure sustainable actions and increase investments for sustainable and low carbon future. It was reiterated in the summit that investment in non-fossil fuels based energy sources is lower than investment in polluting fossil fuels so it was decided that investment in renewable energy should reach at least \$1 trillion every year by 2030 including both public and private sectors.<sup>108</sup>

International Solar Alliance (ISA) aims to mobilize one trillion dollar by 2030 to support solar energy infrastructure in developing countries so that they can meet their energy requirements through renewable source of energy.<sup>109</sup> ISA was conceived on the sidelines of

---

<sup>105</sup> Ernst & Young, Renewable Energy Countries Attractiveness Index (RECAI) 2021, *available at*: [https://www.ey.com/en\\_in/recai](https://www.ey.com/en_in/recai). (last visited on April 14, 2022)

<sup>106</sup>World Economic Forum (WEF), “The Energy Transition Index and Fostering Effective Energy Transition 2021” *available at*: <https://www.weforum.org/reports/fostering-effective-energy-transition-2021/pdf>. (last visited on April 14, 2022)

<sup>107</sup>Ministry of Environment, Forest and Climate Change (MoEFCC), “India’s Stand at COP 26” *available at*: <https://pib.gov.in/PressReleasePage.aspx?PRID=1795071#:~:text=The%20Government%20of%20India%has,heId%20in%20Glasgow%2C%20United%20Kingdom> (last visited on April 14, 2022)

<sup>108</sup> U.N. Climate Action Summit, “*Action for People and Planet*” (2019) *available at*: [www.un.org/climatechange](http://www.un.org/climatechange)

<sup>109</sup> Framework Agreement on the establishment of the International Solar Alliance, 2015



COP21 to UNFCCC in Paris on November 30, 2015 as joint effort by India and France. Government of India made contribution of \$27 million, in addition, Indian Renewable Energy Development Agency (IREDA) and Solar Energy Corporation of India (SECI) also contributed \$1 million each for ISA corpus to build infrastructure and bear recurring expenditure over the duration from 2016 to 2021.<sup>110</sup>

## VII. Challenges in Renewable Energy Transition in India

The MRNE and State Governments have been taking steps to increase the renewable energy status in India, enormous efforts are being done in this regard but various challenges have emerged. A dedicated comprehensive regulatory and policy framework is not prevalent in India with regard to renewable energy sector. A comprehensive policy is the need of hour to promote the growth of renewable energy.<sup>111</sup> Different States have separate regulatory framework and definitions of Renewable Generation Obligation (RGO) and Renewable Purchase Obligation (RPO) are not same throughout India. It has adverse impacts on investment opportunities in renewable energy sector as it inhibits growth prospects in this sector. State Electricity Regulatory Commissions (SERCs) have obligations to meet a part of their energy demands from renewable energy sources through RPO under the Tariff Policy, 2016. RPO does not impose any obligations on captive consumers. Provisions of penalty are not mentioned in any State compliance mechanism except Rajasthan and Maharashtra which impose some short of penalty. Recently the Parliament has proposed some penal provisions in the draft Electricity (Amendment) Bill, 2021 for States which do not comply with RPO targets.<sup>112</sup>

Central Electricity Regulatory Commission (CERC) regulations related to tariff imposition have not been adopted by SERCs. The parameters related to tariff imposition are not clear in the regulatory framework. Tariff determination through competitive bidding instead of feed-in tariff mechanism reduces the profitability of wind energy projects thus under the bidding

---

<sup>110</sup> *Id.* art.6

<sup>111</sup> Gisele Schmid, "The Development of Renewable Energy Power in India: Which Policies Have Been Effective" 45 *EP* 318-325 (Aug. 2011), available at: [https://www.researchgate.net/publication/22163626\\_The\\_Development\\_of\\_Renewable\\_Energy\\_Power\\_in\\_India\\_Which\\_Policies\\_Have\\_Been\\_Effective](https://www.researchgate.net/publication/22163626_The_Development_of_Renewable_Energy_Power_in_India_Which_Policies_Have_Been_Effective). (last visited on April 14, 2022)

<sup>112</sup>Editorial, "States to meet 25% of their energy needs from renewable energy sources" *Business Standard*, July 24, 2022

mechanism some wind energy developers resort to aggressive bidding and decrease the prices to unsustainable level and ultimately come out of the project.<sup>113</sup>

There is lack of coordination and cooperation in institutions related to renewable energy, this poor cooperation delays the implementation of policies and it adversely affects the investment climate in renewable energy sector.<sup>114</sup> Pre-feasibility reports of State governments do not reflect true picture of renewable energy potential areas. These inefficient reports affect the interests of small renewable energy developers who invest in renewable energy projects. Even though renewable energy is being produced at commercial level but still the capital cost has not decreased, so the cost of production still remains high.

Finance is required to complete renewable energy projects but financial constraints create hurdles in completing projects in time. In the beginning, costs incurred on renewable energy projects are very high as compared to fossil fuel-based projects and this initial burden creates challenges for new developers.<sup>115</sup> Thus Lack of proper assessment of potential resources and high risk involved also create financial hurdles for investors in this sector. Provisions related to incentives and subsidies are not clear and transparent. Investors are hesitant because they estimate low returns and high risk even though demand of renewable energy is high in the market. Renewable energy projects which have low performing track record face the risk of lack of funding.<sup>116</sup> Financial institutions such as banks and NBFCs have lack of expertise in renewable energy sector and hesitate in providing financial supports to small and local developers. Debt burden on SERCs and distributors is a big problem because they delay in payment to developers and thus developers run on the risk of default. By the end of 2021, IREDA had disbursed loans of Rs 18,630 crore to 757 wind energy projects out of which Rs 600 crore turned as non- performing assets (NPAs). One main reason behind NPAs is non repayment by discoms. By April 2022, the amount of Rs 14,250 crore was overdue to wind power producers.<sup>117</sup>

---

<sup>113</sup> *Supra* note 52 at 33

<sup>114</sup> Akash Kumar, K. Sudhakar, Prasant Baredar, "Renewable Energy Resources in South Asian Countries: Challenges, Policy and Recommendations" 03 *RET* 432-346 (2017)

<sup>115</sup> Rohan Singh, "India's Renewable Energy Targets: How to Overcome \$200 Billion Funding Gap" 16 *REF* 61-62 (2018)

<sup>116</sup> *Ibid.*

<sup>117</sup> PRS Legislative Research, "Standing Committee Report Summary" available at: <https://prsindia.org/policy/report-summaries> (last visited on March 04, 2023)

SERCs are unable to utilize generated renewable energy because Grid connectivity is not sufficient to evacuate renewable energy. Thus, evacuation infrastructure for renewable energy transmission is inadequate. It is not economically possible to connect small renewable energy projects to transmission lines and the seasonal character of renewable energy projects also affects the demand supply mechanism.<sup>118</sup> There is inadequate supply of equipments such as solar panels and non-availability of land for solar and wind energy projects.

Wind turbine occupies vast land area and negatively affects critically endangered IUCN wildlife and their habitat such as Godavan bird in Rajasthan. Birds collide with wind-blades. Installation of Offshore wind turbines is dangerous for marine wildlife. Sound produced by wind turbines is not only a matter of concern for wildlife but also for human beings who live in the vicinity. Like wind energy plants, solar energy plants also require large chunk of land, it also affects wildlife and their habitat negatively. Hydroelectric turbines kill aquatic animals and pose existential threat to several fresh water species. In the manufacturing of photovoltaic cell, hazardous chemicals are used these chemicals are not only harmful for human health but also contribute in land degradation. Renewable energy market calculates costs such as material cost, labor cost and product cost but it does not include benefits of environmental cost.

Well trained and skilled workforce is not available in this sector there is also lack of research centers for development of renewable energy technologies. There is lack of customer care centers to provide proper information and guidance to renewable energy developers with regard to renewable energy projects and their sustainability. Once installed renewable energy is cheaper but its storage increases the cost thus it is not a lucrative source of energy. People do not understand the environmentally beneficial impacts of renewable energy and there is lack of adequate knowledge and awareness among people.

---

<sup>118</sup>Subhes C. Bhattacharya, "Shaping A Sustainable Energy Future for India: Management Challenges" 38 *EP* 173-185 (March, 2010)

### VIII. Suggestions to Remove Challenges

Adequate legal provisions related to renewable energy should be enacted and enforced in letter and spirit.<sup>119</sup> Renewable energy certificates (RECs) mechanism should be established to increase the scope of renewable energy transition. These market-based certificates can promote renewable energy resources and develop market for renewable energy.

MNRE in consultation with CERC and SERCs should plan a comprehensive policy framework and regulatory framework. SERCs should be given power to do away policy ambiguities and to identify core areas for renewable energy development. Ecosystem related to RPO and RGO should be defined uniformly throughout India and SERCs should strictly follow RPO targets. According to the National RPO trajectory for 2020-21- only four states, namely Andhra Pradesh, Himachal Pradesh, Karnataka and Tamil Nadu have reached 19% of their RPO targets. All States should ensure RPO compliance and enforce penalties against defaulters. Even though, under the new RPO mandate, it is required from the States to meet one fourth of their energy need from renewable sources of energy.<sup>120</sup>

Distribution companies (DISCOMs) have financial issues and are reeling under debt burden. Ujwal Discom Assurance Yojna (UDAY) scheme has not been as effective to bring them out of financial stress. Thus, an effective mechanism should be adopted to avoid their debt burden therefore Union as well as States should allocate sufficient budget to renewable energy sector. Countries such as the USA, China and Germany provide budget allocation to renewable energy sector much higher than that of India. The budget for the financial year 2023-24 may give boost to green growth but some specific measures for incentivizing private participation and enabling carbon market mechanism should have been included in the budget.<sup>121</sup> Renewable energy sector should be included in the list of priority lending sectors so that banking participation in credit availability can be enhanced to this sector as priority sector lending gets concessional credit.<sup>122</sup> Incentives such as interest rebate to individuals on

---

<sup>119</sup> *Supra* note 69 at 168

<sup>120</sup> *Supra* note 107

<sup>121</sup> Editorial, "Budget and Green Growth: Significant Focus on Government Investment" *The Hindu* (February 07, 2023)

<sup>122</sup> Reserve Bank of India, "Master Directions- RBI (Priority Sector Lending- Targets and Classification) Directions, 2020" (2020)

housing loan who install renewable energy applications such as solar rooftop PV panels and income tax rebate can also be extended to income invested in renewable energy applications. Renewable energy developers are investing in renewable energy projects but construction of transmission lines to evacuate energy is insufficient and existing transmission lines are running at their full capacity.<sup>123</sup> So Power Grid Corporation of India (PGCIL) should take effective steps to plan evacuation and develop substations and transmission lines. PGCIL is developing Green Energy Corridors to connect renewable energy generating plants to the national grid but financial constraints are main hurdle to remove this obstacle budget allocation should be increased to PGCIL. There should be cooperation between renewable energy developers and State Transmission Units (STU) for overall development of renewable energy.<sup>124</sup> STUs are responsible for construction of transmission lines within the State and their fund requirement for construction of transmission infrastructure should be fulfilled through State budget outlay.

India imports more than 85 percent of its solar photovoltaic panels from China and Taiwan so this import dependence should be decreased through Make in India Programme and domestic manufacturing of solar PV panels should be increased by providing incentives to foreign investors and domestic developers. The government should focus on R&D in renewable energy sector and budget allocation should also be increased for R&D in this sector with effective monitoring of R&D and budget allocation.<sup>125</sup> India should promote industry-academia partnership in renewable energy sector so that application based innovative R&D can solve technological hurdles of renewable energy sector. This partnership will initiate the exchange of ideas between policymakers, industry and academia to develop renewable energy sector.

India has vast potential of renewable energy sources such as solar, wind, biomass, geothermal and hydro and to tap this potential Renewable energy investment summits should be organized and ease of doing business should be made effective in this sector.

---

<sup>123</sup> *Supra* note 111

<sup>124</sup> Kumar.J, C.R. Majid, M.A. “Renewable Energy for Sustainable Development in India: Current Status, Future Prospects, Challenges, Employment and Investment Opportunities” 10 *ESS* 1-36 (2020)

<sup>125</sup> Parul Kumar, Bharath Jairaj, “India’s Energy Transition: The Challenge with Decision- Making at a Time of Rapid Change” *TERI* (2020), *available at*: <https://www.teriin.org/article/indias-energy-transition-challenge-decision-making-time-rapid-change> (Visited on April 15, 2022)

Sufficient infrastructure should be available to support installation and maintenance of renewable energy equipments and the government should open educational and research institutions to spread the knowledge of renewable energy technology. Hybrid projects can solve the problem of availability of land and transmission infrastructure.<sup>126</sup> Wind-Solar Hybrid Policy 2018 was formulated but it lacks mandatory regulations for hybrid energy projects. India should consider the hybridization of two or more renewable energy sources along with battery storage in hybrid energy projects. Solar energy should not be prioritized over the wind energy as both solar energy and wind energy are complementary to each other.<sup>127</sup>

Unskilled and semiskilled workforce should be given skill through these above mentioned educational and research institutions to provide employment opportunities in this emerging sector along with skill up-gradation of existing work force. This trained workforce would provide impetus to renewable energy applications.

Local bodies such as municipalities and Panchayats should be given incentives for projects based on renewable energy development. State governments must fulfill their Constitutional obligations under 11<sup>th</sup> Schedule (entry 15) of the Constitution of India so that these local bodies would utilize renewable energy resources at local level.<sup>128</sup> Awareness programs should be organized to provide social recognition to renewable energy and its beneficial effects to the environment through these grass-root democratic institutions.

## IX. Conclusion

India with 3.1 trillion-dollar economy is 5<sup>th</sup> largest economy in the world and it will rise to 8.4 trillion by 2030 surpassing Japan.<sup>129</sup> India's development objectives are focused on socio-economic growth and human well-being. Energy plays very important role in socio-economic development. The energy strategy should be focused on efficiency and accessibility, security and environment friendly for sustainable development. Fossil fuels play major role in energy

---

<sup>126</sup> Alok Das, Hardik K. Jani, Garlapati Nagababu, Surendra Singh Kachhwaha "A Comprehensive Review of Wind-Solar Hybrid Energy Policies in India: Barriers and Recommendations" 35 *REF* 108-121 (Dec. 2020).

<sup>127</sup> *Supra* note 52 at 35.

<sup>128</sup> *Supra* note 67.

<sup>129</sup> IHS Markit, "Week Ahead Economic Preview, Indian Economic Outlook" available at: [https://cdn.ihsmarkit.com/www/pdf/4245451\\_4245399\\_0.1.pdf](https://cdn.ihsmarkit.com/www/pdf/4245451_4245399_0.1.pdf) (last visited April 16, 2022).

security of India and will continue to play important role for the next few decades; however, these resources are not sustainable being limited and non-renewable in nature. India is blessed with renewable energy resources which are inexhaustible and thus critical for sustainable development.

This paper aims at mainstreaming of sources of renewable energy and envisages a central role for renewable energy for energy security, mitigation of climate change and thus leading to sustainable development. India has set ambitious INDCs at UNFCCC and is taking several pro-active steps to tap its vast renewable energy potential. Looking at India's peculiar location solar and wind energy has immense potential. India is one of the most attractive renewable energy-market in the world and has the highest rate of growth in generating renewable energy.<sup>130</sup>

India's total estimated renewable energy potential is 1096GW and to tap this vast potential India has initiated several steps such as National Solar Mission, PM KUSUM, Solar City, Production Linked Incentive Scheme, Solar Park Scheme, Roof Top Scheme and Green Energy Corridor etc. India has doubled its renewable energy capacity from 70GW in 2017-2018 to 152GW in 2022. Solar parks and wind mills are being established to generate solar and wind energy throughout India. Public, private and joint ventures are being encouraged in renewable energy sector. India had committed to achieve 40 percent of electricity from renewable sources of energy by 2030 under INDCs at Conference of Parties 21 in 2015 in Paris and this target has been achieved by 2022. India has set an ambitious target of 500GW from renewable energy by 2030 at COP26 in Glasgow and its long-term vision of One Sun One World One Grid has also been conceptualized.<sup>131</sup>

India has formulated policies to encourage renewable energy such as National Offshore Wind Energy Policy 2015, National Bio-fuel Policy 2018 and National Wind Solar Hybrid Policy 2018. India also drafted a National Renewable Energy Act 2015. India has committed to be carbon neutral by 2070. Thus India needs pro-active steps in renewable energy sector for sustainable development. The renewable energy sector is facing some notable challenges in India. These challenges are in the nature of policy and regulatory challenges, financial and

---

<sup>130</sup> *Supra* note 17 at 02

<sup>131</sup> *Supra* note 107

fiscal challenges, market challenges, technological challenges, awareness, education and training challenges and environmental challenges etc. Looking at India's developmental status, growth prospects, Industrialization and human development renewable energy sources are the only viable and sustainable sources of energy to fulfill India's growing energy demand for sustainable development in energy sector. At the end this paper also provides some suggestions to remove these challenges so that sustainable development can be achieved in energy sector by working on renewable energy transition.