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RENEWABLE ENERGY SECTORS IN INDIA: GROWTH, CHALLENGES, INITIATIVES AND AWARENESS-A BRIEF REVIEW

Joydip Ghosh*1, Dr. Soupayan Mitra*2

*1Assistant Professor, Mechanical Engineering Department, University of Engineering & Management, Kolkata, West Bengal, India.

*2Associate Professor, Mechanical Engineering Department, Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India.

ABSTRACT

India is currently the third largest producer and third largest consumer of electricity in the world with national grid connected installed capacity reaching 374 gigawatts (GW) as of November 2020. Electricity production reached 1,252.61 billion units (BU) in FY20. India was ranked fourth in wind power, fifth in solar power and fifth in renewable power installed capacity in 2018. India has about 36% of renewable power installed capacity whereas; only about 23% electricity is produced from renewable sources in India. The government has initiated a venture to fund of US$350 million to enhance solar projects in the country which is sharing about 41% of the generation from the total renewable energy sources. Besides, the overall scenario is facing challenges like PPA(Power purchase agreement),renewable purchase obligations(RPO), DISCOMs issues and demands, land acquisition, subsidy distribution, state funding amount and conditions etc. This paper shows the overall scenario of the sector wise installation, target, initiatives and generation of renewable energy scopes in India. After going through various reports published by government authorities and research papers published in reputed journals, it has been ventured to highlight various challenges and policies regarding installation and generation of renewable in India.

Keywords: Renewable energy, Installed capacity, Challenges, Electricity Generation

I. INTRODUCTION

The generation and adoption of Renewable Energy (RE) is an issue that is a burning problem in India. It is a big domain of customer research and investment with policy making which is also a question yet to some extent, as mentioned in the study [1].Some idea was also given in the study[2].Having population of almost 1.38 billion and being one of the fastest-growing economies, India will play important role for the future of the global energy forum. The Government of India has improves in recent years in enhancing citizens' availability to electricity and green energy. Government has also successfully set up a wide range of energy market reforms and executed an enormous amount of green electricity, notably in solar energy. The government has expressed its will in clean cooking with liquefied petroleum gas(LPG). India will continue to promote green cooking energy and off-grid rural electrification solutions, including a drift toward using solar photovoltaic generated electricity for cooking and charging equipments. The Central Government's focus on attaining 'Power for all' has expedited installed capacity addition in the country. At once, the competitive approach is increasing at both the market and supply chain scenario (fuel, transport, funding, and human resource). This study objects to present notable remarks, prospects, and projections, generation of electricity, as well as challenges and investment and employment opportunities due to the development of renewable energy in India. In this review, we have summed up the many hurdles faced by the renewable energy sectors. The inputs based on the study outcomes will surely cater useful information for policymakers, innovators, project developers, investors, industries, associated stakeholders and departments, researchers, and young minds.

II. LITERATURE REVIEW

Considerable number of research papers have been published on Renewable energy sectors. It can be summarized into an opinion that an enormous possibility of enhancing and exploiting the resources are still lying untouched in India. Major shift on energy scenario had been observed since 2008 in Solar and Wind power sectors; this was upheld in [1]. Even though India has achieved a fast and remarkable economic growth, energy is still scarce. Firm economic growth in India is accelerating the demand for electricity, and various number of energy resources are strongly needed to cope up with this demand. Simultaneously, because of over population and environmental degradation, India is facing the extreme challenge of sustainable development. The major demand and supply gap of energy is anticipated to rise in the near future as predicted in various studies cited here. The steep demand in infrastructural development, manufacturing sectors, socio-economic

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scheme implementation is driving the industrial demand for power. An increased infrastructure and the switch to groundwater harvesting and irrigation across mainly in the rural areas of the country are driving the mechanical equipments' demand in the agriculture sector, and therefore the huge fuel and electricity demand. The previous views were scripted in a study in [1].In a study & report [3, 4], there were some research gap that focused on investment policies, operational barriers, distribution of power, land acquisition issues etc. In this study it has been tried to cover the gap portions to the latest policy, schemes and initiates taken by the Indian Government.

The energy security of India has improved widely through the generation of a single national power system and vital investments in conventional and renewable energy capacity. According to the reports published by [5, 6, 7], National power scenario is currently encountering a major switch to alternative higher shares of renewable energy, which is making system combination and pliability priority issues. International occurrences suggest that a assorted mix of pliability investments is solicited for the successful system amalgamation of wind and solar photovoltaic. The report [8] reflected this flexibility is available not only from the coal fired plants – it can be opted from natural gas, many renewable themselves, energy repository, demand-side response and state or national power grids.

III. INSTALLED AND GENERATION CAPACITY

Being one of the largest electricity producing countries, India's RE installed capacity as of 27.11.2020, is almost 37% of India's total installed electricity generation capacity (Around 138 GW out of 372 GW). India has obligated to an Intended Nationally Determined Contributions (INDC) target of achieving around 40% of its total electricity generation from non-fossil fuel sources by 2030 in the Paris Agreement .India is keeping an eye for even more aspiring target of almost 58% of the gross total electricity capacity from RE sources by 2027 in Central Electricity Authority's (CEA) strategic report. According to 2027 vision, the country is aiming to have around 275 GW from RE, round 73 GW of hydroelectricity, nearly 15 GW of nuclear energy and close to 100 GW from other "GREEN ENERGY" resources.

FUEL	MW	% of TOTAL
TOTAL THERMAL	231321	61.8
COAL	199595	53.3
LIGNITE	6260	1.7
GAS	24957	6.7
DIESEL	510	0.1
HYDRO (LARGE)	45699	12.2
NUCLEAR	6780	1.8
RENEWABLE (MNRE)	90399	24.2
TOTAL	**374199**	

Table1: Installed capacity as of 30.11.2020 **Ref.-[8, 24]**

SOURCE	TOTAL INSTALLED CAPACITY(MW)	2022 TARGET (MW)
WIND	38124.15	60000
SOLAR	36050.74	100000
BIOMASS (Biomass, gasification and Wool pellets/chips Cogeneration)	10146	10000
WASTE TO POWER	168.64	
SMALL HYDRO	4740	5000
TOTAL	**89230**	**175000**

Table-2: Installed capacity as of 30.09.2020 **Ref.-[8, 24]**

Year	Growth in Renewable Generation (%)	Growth in Overall Generation (%)
2015-16	6.47	5.69
2016-17	23.97	5.80
2017-18	24.88	5.35
2018-19	24.47	5.19
2019-20	9.12	0.95
2020-21	4.60	-4.75

Table-3: Growth in Renewable Energy **Ref.- [24]**

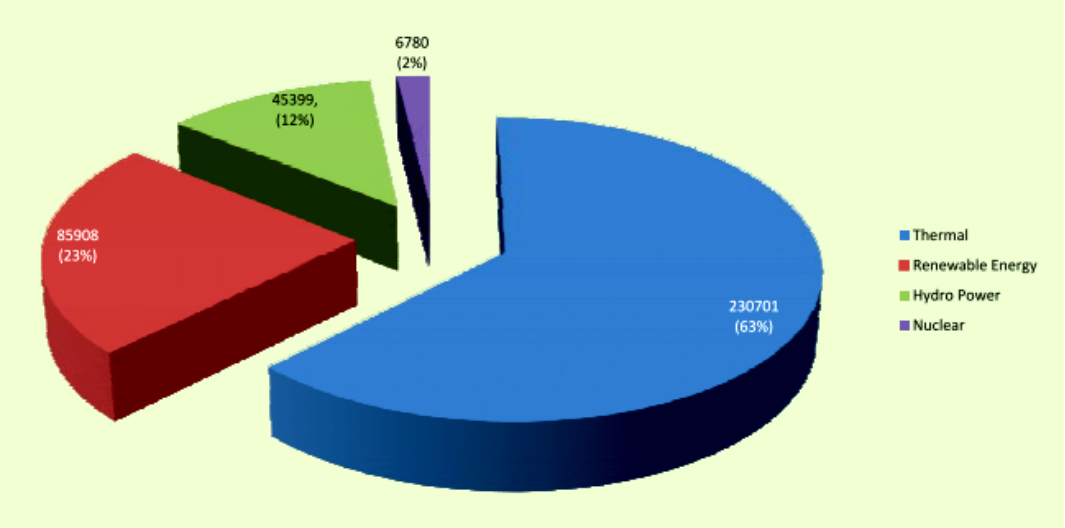

Figure-1: India - Source Wise Installed Power Generation Capacity (MW) as on 31.12.2019 **Ref.: - [5]**

IV. MAJOR RENEWABLE ENERGY SECTORS

The Government of India (GOI) has set ambitious renewable electricity targets for the short to medium term. The country aims to acquire around 175 GW of installed renewable electricity capacity by the year 2020. In 2018 the Central Government declared an enhanced aspiration of around 228 GW RE capacities by the year 2022 and around 276 GW by 2027. The PM of India put out a new goal of 450 GW of renewable electricity generation capacity at the United Nation's (UN) climate summit in 2019.

SUPPLY AND DEMAND TRENDS:

Recent report [7] reflected that renewable energy in India has long been dominated by traditional use of biomass in the residential sector. However, over the last few years the country has rapidly expanded its use of renewable power sources. This has kept the share of renewable in electricity generation stable at around 16% over the last decade amid strongly increasing electricity consumption, although the share of fossil fuels in total primary energy supply (TPES) and total final consumption (TFC) has significantly increased since the 1970s.

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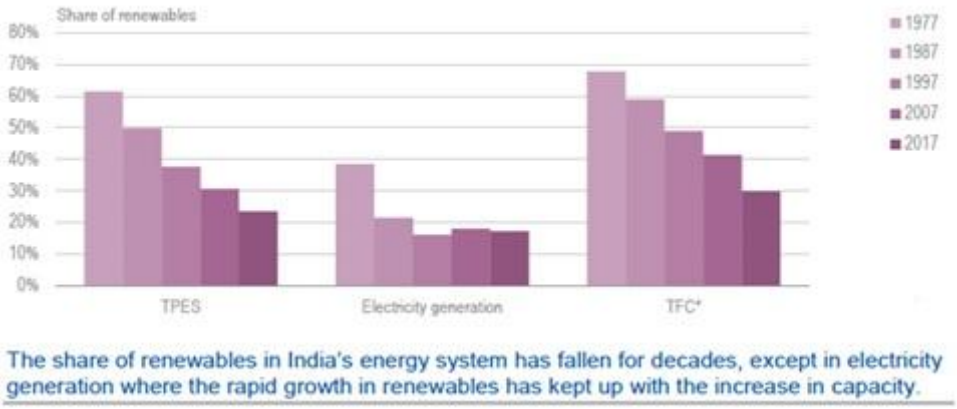

Figure-2: Division of RE in TPES, electricity and TFC, 1977-2017 **Ref. - [6]**

RENEWABLE ENERGY IN TPES:

Conventional use of bio energy for heating and cooking in domestic purposes is by far the largest resource of RE in India. Bio energy consumption has escalated steeply with the country's population growth for the past decades, though at a slower rate than overall energy generation and supply. Therefore, the division of RE in TPES has been shrinking over the time, despite a recent climb in renewable power generation from hydro power sources, wind power and solar photovoltaic (PV) resources. The supply of renewable energy was around 200 Mtoe totaling, representing 23% of TPES in 2017.

ELECTRICITY FROM RENEWABLE ENERGY:

Hydropower has been the dominant source of renewable electricity in India for a long time. In the late 1970s hydropower alone accounted for around 40% of total electricity generation. Although the supply of hydropower has increased steadily, its share of electricity generation has fallen to around 10%. In the last decade very strong growth in electricity from wind, solar PV and bioenergy has maintained the total share of renewable stable around 16-17%.

Wind power generation has increased at an average annual growth rate of 14% in the ten years 2007-16, accounting for 3.3% of total electricity generation in 2017. Solar power has only started to grow in the last few years, supported by the 2022 target and auctions for new PV installations. In the five years 2013-17, solar power generation increased by 64% per year on average.

Bioenergy is also increasing in power generation. The principal source is co-generation units using bagasse residues from India's large sugar industry. Using biomass for power generation is a more sustainable use of bioenergy resources than the traditional use in households.

GOVERNMENT INSTITUTION:

The assigned ministry, **Ministry of New and Renewable Energy (MNRE)** is presently in charge of the development of policies for renewables in electricity, transport and heat in India. The MNRE contains the National Institute of Solar Energy (NISE) and the National Institute of Wind Energy (NIWE), undertaking activities related to RandD, testing, certification, standardization, skill development, resource assessment and awareness. The MNRE also covers bio energy for electricity, including energy from waste (EfW), and biogas. Authorities like, The Indian Renewable Energy Development Agency (IREDA) under the aegis of MNRE operates as a financial body, non-banking for disbursing loans for competent RE and possible energy efficiency projects.
In addition to that, Solar Energy Corporation (SECI), Power Ministry (MOP), authorities like The Indian Renewable Energy Development Agency (IREDA) under the MNRE, commission like Central Electricity Regulatory Commission (CERC), Petroleum and Natural Gas Ministry (MOPNG), Science and Technology Ministry (Central DST & DBT) has been liable for innovation and has a strong focus on bio energy technology research.

ENERGY CONSUMPTION:

The Total Final Consumption (TFC) of the country has gone up by around 50% in the past decade ranging from 2007 to 2017, with noteworthy increase across all sectors. Almost half of the improvement generated from the industrial sector, which noted for round 41% of TFC in 2017, accounting non-energy consumption. Industrial

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sectors ingest a mixture of energy from conventional sources and bio fuels, together representing round 57% of total consumption. The domestic sector is the 2nd largest energy client at 29% of TFC in the year 2017. Logistic energy consumption has magnified double in a decade, adjudging for one-quarter of TFC growth. The service industry accounting agriculture engrossed around 12% of TFC in 2017, with electricity adjudging for more than half of the total.

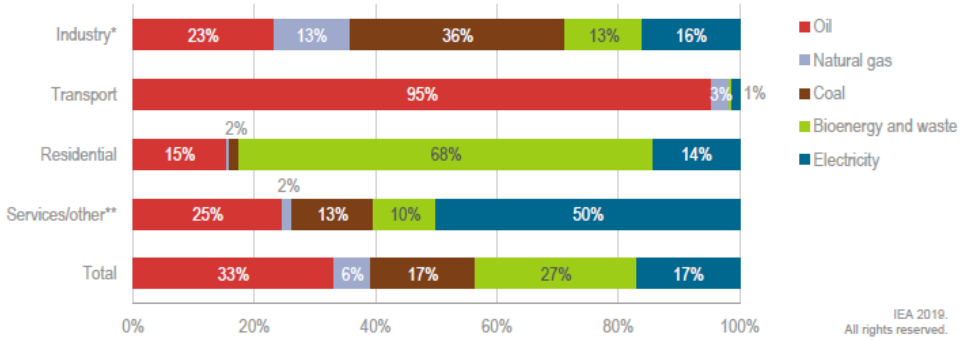

Figure-3: TFC by source and sector, 2017 **Ref.-[6]**

REGULATION AND POLICY:

Some of the notions came out of the study, [3, 4, and 8], the central government has a vision to achieve around 176 GW of grid-connected renewable electricity by March 2022: 100 GW solar, 60 GW wind, 10 GW biomass and 5 GW of small hydropower. In addition, the MNRE is targeting 1 GW of geothermal capacity by 2022. The 2018 National Electricity Plan sets out ambitions to achieve 275 GW of renewables by 2027, which would increase their share to an estimated 44% of installed capacity and 24% in electricity generation. The Electricity Act of 2003 introduced the unbundling of transmission, generation and distribution and provided for wholesale and retail competition, where distribution/retail companies have the choice to purchase power from several generators. By law, electricity users above 1 MW are already free to choose their supplier; however, in practice most consumers are supplied by their local DISCOM. Open access means that DISCOMs have uncertainty of their load, as open access customers frequently switch between procuring power from the exchange or the DISCOM. Unbundling of supply and transmission has been carried out in all states. The last state was Jharkhand. Small and north-eastern states have carried out unbundling based on company size and commercial viability after their unbundling. India's DISCOMs combine generation and distribution activities.

The 2014 amendment to the Electricity Act introduced the separation of carriage and content. International experience shows that the unbundling of retailing from generation and distribution (networks) is usually done at the functional or legal level and less so at the ownership level. Notably, in small or rural supply areas the business case for the distribution system operator might be challenging without the retail business. Retail markets are mostly under the competence and regulation of state governments and the SERCs, notably with regard to the DISCOMs. The high level of non-payment and technical and commercial losses make it very challenging for DISCOMs to operate in a commercially viable manner.

UTILITY SCALE RENEWABLES:

For utility-scale renewables India relies on renewable purchase obligations (RPOs), renewable electricity certificates (RECs), accelerated depreciation of renewable energy assets for commercial and industrial users, and most recently on open tenders. DISCOMs are required by the RPOs, energy producers and determined buyers to achieve a division of their electricity from renewable sector resources. [6, 7] showed that the certainty of RPO routes and surveillance of facilitation are executed by the State Electricity Regulatory Commissions. In the year 2018 the RPO stipulation was increased from round 17.3% to 22.1%, with around 0.5% from solar, steep from 6.75%, and 10.5% from non-solar renewable sources by the year 2022, increase from 10.25%. It will require to be increased for the round 450 GW target in the coming future.

To fulfill the vision of 2022 target, the government introduced cut throat auctions for solar photovoltaic (2010) and wind energy (2017) with deep-rooted power purchase agreements (PPA) containing fixed price contracts. The MNRE announced it would tender around 25 to 30 GW yearly up to the end of 2021 to reach the solar PV generation target of around 100 GW by the year 2022 (in 2019, India had 32.5 GW of installed solar capacity).

ROOFTOP SOLAR PV:

For residential and commercial solar PV applications, the central government has chalked an aspiring target of round 40 GW of rooftop solar by 2022 within the 100 GW solar targets. The MNRE has adopted compliance

factors for the implementation of Phase II of its Grid-Connected Rooftop Solar Programme. Reports, [7, 5, 6, 9, 10] cumulatively showed that the target is supported by RPOs, rooftop auctions and programmes that facilitate the deployment of rooftop solar PV on government buildings across states. The MNRE has several policies to incentivize and facilitate rooftop installations: a) providing central financial assistance for residential, institutional, social and government buildings; b) advising states to implement net/gross metering regulations and tariff orders; c) providing a model memorandum of understanding, power purchase agreement (PPA) and CAPEX agreement for rooftop projects in the government sector; and d) appointing experts to support public-sector undertakings in the implementation of rooftop projects in ministries and departments. The Cabinet Committee on Economic Affairs (CCEA) consented its support by funding a total of USD 6.5 billion by 2022 to promote the use of solar among farmers in February 2019. Solar deployment is picking up given India's high electricity retail prices with net metering programmes in 28 states with various tariff structures.

EMERGING TECHNOLOGY AREAS:

Floating Solar- During FY 2019-20, SECI has awarded capacity of 150 MW floating solar project to be set up in Rihand dam, Uttar Pradesh. SECI has signed PSA with Uttar Pradesh Power Corporation Limited (UPPCL) and PPA with the successful bidders. SECI is also planning to develop floating solar projects with own investment in Lakshadweep, Uttarakhand and Jharkhand. Technical and environmental due-diligence are in progress.

Solar wind hybrid- Under tenders for selection of developers for setting up solar-wind hybrid projects issued by SECI in previous year, 600 MW capacities has been awarded during FY 2019-20, thereby bringing cumulative awarded capacity to 1440 MW.

RE with Energy storage- SECI is planning to deploy several energy storage systems to address the challenges of grid stability due to increasing penetration of intermittent RE generation. Several systems are being planned under CAPEX projects, and tenders for setting up of RE projects, incorporating energy storage systems, have also been issued.

WIND ENERGY SECTOR:

The wind energy sector of India is guided by aboriginal wind power industry and has depicted a compatible progress. The enlargement of the wind industry has come out with a strong ecosystem, project functioning ability and manufacturing base of about 10,000 MW per year. These researches shows that [1, 11, 12, 13, 14] India is currently having the 4th highest wind energy installed capacity in the world accounting a total installed capacity of around 38 GW (as on December, 2019) and nearly 62 billion units were generated from wind power during the session 2018-19.This energy sector is sporadic and location-specific source of energy and hence, a substantial wind power resource assessment is requisite for the selection of key sites. [2, 7, 15],concepts from these studies along with the earlier one, GOI, through (NIWE), has set up over 800 wind-monitoring stations all over the country and furnish wind power prospective maps at around 50 m, 80 m, 100 m and 120 m above ground level. The latest survey indicates the evident wind power potential of nearly 302 GW and 696 in the country at about 100 meter and 120 meter severally, above mean sea level (MSL).

Sr. No.	Year	Wind (MU)
1	2014-15	33768
2	2015-16	33029
3	2016-17	46004
4	2017-18	52666
5	2018-19	62036
6.	2019-20 (upto 31.10.2019)	47729

Tabl-4: Year wise Electrcity Generation from wind energy sources **Ref.-[5, 6]**

TECHNOLOGY DEVELOPMENT AND MANUFACTURING BASE FOR WIND POWER:

The Wind Turbine Generator Technology (WTGT) has unfolded and state-of-the-art technologies are now readily accessible in the country for the assembly of wind turbines. About 70-80% localization has been attained with strong in-house production in the wind power sector. All the key global organizations in this domain have their appearance in the country and over 30 unalike models of wind turbines are being manufactured by more than 15 different companies, through (i) joint endeavors under authorized creation (ii)

auxiliaries of unfamiliar organizations, and (iii) Indian organizations with their own innovation. The unit size of equipments has risen up to 3.00 MW. The current yearly creation limit of wind turbines in the nation is around 8000 megawatt to 10 megawatt.

INCENTIVES AVAILABLE FOR WIND SECTOR:

(i)The Government is advancing wind power projects in whole nation through private area speculation by giving different monetary and monetary impetuses, for example, Accelerated Depreciation advantage; concessional custom obligation exclusion on specific parts of wind electric generators. Furthermore, Generation Based Incentive (GBI) Scheme was accessible for the wind projects charged up to 31st March 2017.

(ii) Notwithstanding financial and different motivating forces as expressed above, following advances likewise have been taken to advance establishment of wind limit in the nation:

- Technical help including wind asset appraisal and ID of expected locales through the National Institute of Wind Energy (NIWE), Chennai.
- In request to encourage between state offer of wind power, the between state transmission charges and misfortunes have been deferred off for wind and solar based undertakings to be authorized by March, 2022.

NATIONAL WIND-SOLAR HYBRID POLICY:

The Ministry gave National Wind-Solar Hybrid Policy on fourteenth May, 2018. The primary goal of the strategy is to give a structure to advancement of huge grid associated wind-solar based PV cross breed framework for ideal and proficient usage of wind and solar based assets, transmission foundation and land. According to [5, 6, and 10] the wind - solar based PV mixture frameworks will help in diminishing the inconstancy in inexhaustible force age and accomplishing better lattice soundness. The strategy likewise expects to energize new innovations, strategies and way outs including consolidated activity of wind and solar oriented PV plants. The significant features of these strategy regions under:

i. A wind solar oriented plant will be perceived as half and half plant if the appraised power limit of one asset is in any event 25% of the evaluated power limit of other asset. ii. Both AC and DC coordination of wind solar oriented cross breed project are permitted. iii. The force obtained from the cross breed task might be utilized for satisfaction of solarlight based RPO and non-solar based RPO in the extent of appraised limit of solar oriented and wind power in the crossover plant individually. iv. Existing wind or solar based force projects, ready to introduce solar oriented PV plant or WTGs individually to profit advantage of cross breed project, might be permitted. v. All monetary and monetary impetuses accessible to wind and solar based force activities will likewise be made accessible to mixture projects. vi. The Central Electricity Authority (CEA) and Central Electricity Regulatory Commission (CERC) will figure important guidelines and guidelines including metering procedure and principles, anticipating and planning guidelines, REC instrument, award of network and sharing of transmission lines, and so forth, for wind-solar based crossover frameworks. vii. Capacity might be added to the half breed task to guarantee accessibility of firm force for a specific period. Service is giving concessional custom obligation exception authentications (CCDC) to the makers of wind worked power generators according to Ministry of Finance. For this reason the qualified turbine and part makers need to get the bill of material for RLMM recorded turbine models affirmed and afterward apply in recommended arrangements to Ministry for a CCDC endorsement for their import transfers.

OFFSHORE WIND DEVELOPMENT IN INDIA:

India is blessed out with a coastline of around 7600 km encompassed via seawater on three sides and has gigantic force age potential from seaward wind energy. Considering this, the Government had informed the National Offshore Wind Energy Policy according to the Gazette Notification dated sixth October 2015. According to the strategy, Ministry of New and Renewable Energy will go about as the nodal service for advancement of Offshore Wind Energy in India and work in close coordination with other government substances for Development and Use of Maritime Space inside the Exclusive Economic Zone (EEZ) of the nation in a compelling way for creation of gigantic amount network quality electrical force for public utilization. Public Institute of Wind Energy (NIWE), Chennai has been assigned as the nodal office to execute different pre-plausibility exercises identifying with asset evaluation, reviews and studies inside EEZ (Exclusive Economic Zone), division of seaward likely squares and encouraging seaward wind energy project designers for setting up seaward wind energy ranches.

AN ALTERNATIVE CONSIDERATION FOR WIND ENERGY USE:

In the early 1990's 850 water-pumping windmills were installed under the National Demonstration Program (mentioned in the introduction). 120 of these were geared type well wind pumping systems. The remainder

was 12-PU-5 type, and after a few years these particular windmills were shown to be below par in terms of performance. The entire project had been heavily subsidized, and was a failure for two main reasons. The equipment that was being used was not adapted for Indian circumstances (hence broke down and could not be fixed by locals) and communities involved had no sense of ownership in the project. However a useful lesson can be learned from this example. It is that these wind pumps have a big role to play in a decentralized rural community, and that the previous two mistakes need to be avoided.

SMALL HYDRO POWER:

MNRE is vested with the responsibility of developing hydro power projects of capacity up to 25MW, categorized as Small Hydro Power (SHP) Projects. These projects have potential to meet power requirements of remote and isolated areas in a decentralized manner besides providing employment opportunity to local people. SHP projects are supplementary categorized into small, mini and micro hydro projects based on their capacity as follows:

Micro hydel ≤ 0.1 MW

Mini hydel > 0.10 MW to ≤ 2.00 MW

Small Hydel > 2.00 MW to ≤ 25.00 MW

The estimated potential of small/mini/micro hydro projects in the country is 21133.65 MW from 7133 sites located in different States of India. The SHP projects in the country are being set-up both in public and private sectors. Setting up of SHP projects normally require about 3-4 years depending upon its size and location. The national target for SHP is to achieve a cumulative capacity of 5000 MW by 2022; under overall targets of achieving a total grid associated RE Projects of 175,000 MW. Against this target of achieving an aggregate capacity of 5000 MW by the year 2022, an aggregate capacity of 4671.557 MW been achieved by 31st December 2019 through 1127 small hydropower projects. In addition, 109 projects of about 529.24 MW are in different phases of execution.

For the year 2019-20, a target of commissioning of 100 MW small hydro projects was set. Against this target, 12 projects of aggregate capacity of 78.402 MW have been synchronized to the grid by 31st December 2019. In addition to commissioning of these 12 projects, two old have been renovated by introducing more efficient electrical and mechanical equipment in the State of Mizoram.

V. MAJOR CHALLENGES IN RENEWABLE ENERGY SECTORS

MAJOR CHALLENGES IN SOLAR POWER SECTOR:

Some of the key challenges, after reviewing the study [4, 5, 14, 16, and 17] have been highlighted hereunder.

- Cost and TandD Losses: Solar PV is some years away from true cost competitiveness and from being able to compete on the same scale as other energy generation technologies. Adding to the cost are TandD losses that at approximately 40 percent make generation through solar energy sources highly unfeasible. However, the government is supporting RandD activities by establishing research centers and funding such initiatives. The government has tied up with world-renowned universities to bring down the installation cost of solar power sources and is focusing on up gradation of substations and TandD lines to reduce TandD losses.
- Land Scarcity: Per capita land availability is very low in India, and land is a scarce resource. Dedication of land area near substations for exclusive installation of solar cells might have to compete with other necessities that require land.
- Funding of initiatives like National Solar Mission is a constraint given India's inadequate financing capabilities. The finance ministry has explicitly raised concerns about funding an ambitious scheme like NSM.
- Manufacturers are mostly focused on export markets that buy Solar PV cells and modules at higher prices thereby increasing their profits. Many new suppliers have tie-ups with foreign players in Europe and United States thereby prioritizing export demand. This could result in reduced supplies for the fast-growing local market.
- The lack of closer industry-government cooperation for the technology to achieve scale.
- The need for focused, collaborative and goals driven RandD to help India attain technology leadership in PV.
- The need for a better financing infrastructure, models and arrangements to spur the PV industry and consumption of PV products.
- Training and development of human resources to drive industry growth and PV adoption.
- The need for intra-industry cooperation in expanding the PV supply chain, in technical information sharing through conferences and workshops, in collaborating with BOS (balance of systems) manufacturers and in gathering and publishing accurate market data, trends and projections

MAJOR CHALLENGES IN WIND POWER SECTOR:

Some consuming central issues have been summed up in the wake of alluding the investigation, [3, 6, 7, 11, 12, 13, 18, and 19].The absence of satisfactory clearing and transmission foundation is probably the greatest hindrance in outfitting the wind energy potential. For example, alluring potential wind locales in Rajasthan, Gujarat, and beach front Tamil Nadu stay less tapped in light of deficient matrix departure limit and transmission framework. Matrix issues: Wind turbines attract a great deal of intensity when firing up thus this occasionally caused the lattices they were associated with experience voltage vacillations – lessening power quality and undesirably affecting client's machines. These vacillations debilitate a matrix and have a negative criticism on the wind turbines themselves. In 1996 network irregularities actuated a 20% misfortune in expected income because of 'direct age misfortune's (failure of wind plants to work when the wind is blowing). A big part of every one of these misfortunes is because of feeble matrices in the district. There is an absence of overhauling and support mastery to deal with wind ranch upkeep. Utilities are enduring the weight of having wind ranches associated with their networks.

MAJOR CHALLENGES IN HYDRO POWER SECTOR:

Some of the major challenges are focused which have been reflected after the following study, [6, 11, 14, 17, 20].

1. Hydro Power Projects are Site specific. 2. Area hindrance Projects are situated in remote having almost no framework and correspondence offices. For example, Arunachal Pradesh. It takes at least 2 days for a normal passenger to reach project sites and if there are multiple landslides, hundreds of vehicles could easily get stuck for days together without access to basic amenities such as food and water. In such conditions, one could undoubtedly envision how troublesome it is transport project gear, apparatus, and so on by means of such courses. What's more, if by chance there aren't a lot of avalanches, local people/understudy collections of neighboring areas and states typically considers Bandhs and square the streets at their impulse. 3. Shortage of Result Oriented Reputed Contractors/Skilled professionals/laborers. 4. Non-Availability of Grid Power during Construction period of Project. 5. Production of new safe-havens and public parks by Forest Department without talking with the Hydro Power Department of State. 6. Insufficient foundation/Lack of Communication framework – As Hydro Projects are situated in inside distant, uneven landscape, avalanches, slope slant breakdowns, barriers especially during rainstorm season due to substantial downpours and remarkable floods cause serious misfortunes in development prompting time and cost over-runs. Non-accessibility of Approach Street to Project site – The expense of Approach Street, whenever included inside the Project foundation, brings about expansion in generally speaking task cost. Aside from helpless street network, the district has very poor or no portable availability.

VI. GOVERNMENT'S SCHEMES, ACHIEVEMENT AND INVESTMENTS

NOTABLE SCHEMES:

Exhaustive report, [5, 6, 7, 21] mentioned that all the states and union territories were on board to fulfill the Government's vision of ensuring 24x7 affordable and quality power for all by March 2019. India achieved 100 per cent household electrification by March 31, 2019, as envisaged under the Saubhagya scheme. More than 26.2 million households have been electrified under Saubhagya scheme. Under Union Budget 2019-20, the Government allocated Rs 5 crore (US$ 0.73 million) to increase capacity of Green Energy Corridor Project along with Rs 920 crore (US$ 130 million) for wind and Rs 3,005 crore (US$ 440 million) for solar power projects.

In the Union Budget 2020-21, Rs 15,875 crore (US$ 2.27 billion) has been allocated to the Ministry of Power, while Rs 5,500 crore (US$ 786.95 million) has been allocated towards Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY).

National Solar Mission (NSM), launched on 11th January, 2010, had set a target for development and deployment of 20 GW solar power by the year 2022. The Cabinet in its meeting held on 17/6/2015 had approved revision of target under NSM from 20 GW to 100 GW. With a view to facilitate quick start-up to NSM and also speedier implementation of the then on-going projects under advanced stage of implementation in different States, this scheme was introduced in Feb 2010 to allow the migration of such projects to NSM. A total of 16 projects of 84 MW capacity (54 MW SPV and 30 MW ST) were approved under this scheme for long-term procurement of power by NVVN at CERC notified tariff for 2010-11 viz. Rs.17.91/unit for SPV and Rs.15.31/unit for ST. Eleven SPV projects of 48 MW capacity were commissioned under this scheme.

Ultra Mega Solar Power Projects (UMPP): The Scheme for setting up of Solar Parks and UMPPs was rolled out on 12-12-2014 with aggregate capacity 20,000 MW. Further, the capacity of the Solar Park Scheme was enhanced from 20,000 MW to 40,000 MW on 21-03-2017 to set up at least 50 solar parks by 2021-22.

The capacity of the solar parks is generally 500 MW and above. However, smaller parks (up to 20 MW) are also considered in in States/UTs where there is shortage of non-agricultural land. Approximately 4 to 5 acres per MW of land is required for developing of solar parks. The total central grants approved under the Scheme are Rs.8100 crore (Rupees Eight Thousand and One Hundred crore).

Under the plan, the Ministry gives Central Financial Assistance (CFA) of up to Rs.25 lakh per solar based park for readiness of Detailed Project Report (DPR). Alongside this, CFA of up to Rs.20.00 lakh per MW (Rs.12 Lakh/MW for advancement of interior foundation of solar oriented park and Rs.8 lakh/MW for improvement of outer force departure framework of solar based park) or 30% of the task cost, including Grid-availability cost, whichever is lower, is likewise given on accomplishing the achievements recommended in the plan. The affirmed award is delivered by Solar Energy Corporation of India Ltd. (SECI) according to achievements.

The Government intends to twofold the portion of introduced power age limit of environmentally friendly power to 40 percent by 2030. India has likewise raised the solar based force age limit expansion focus by multiple times to 100 GW by 2022. The Government is setting up a 'lease a rooftop' strategy for supporting its objective of producing 40 GW of intensity through solar powered housetop projects by 2022. The pinnacle power interest in the nation remained at 180.80 GW in FY20 (P).

INVESTMENT SCENARIO:

According to the data released by Department for Promotion of Industry and Internal Trade (DPIIT), FDI inflow in the Indian non-conventional energy sector stood at US$ 9.22 billion between April 2000 and March 2020. More than US$ 42 billion has been put resources into India's environmentally friendly power area since 2014. New interest in clean energy in the nation arrived at US$ 11.1 billion of every 2018.

In March 2020, the Central Government consented to virtual arrangement to close essential deals in Kamarajar Port Ltd, THDC India Ltd and North Eastern Electric Power Corporation Limited (NEEPCO), and it will get Rs 13,500 crore (US$ 1.93 billion) from these arrangements.

Some significant speculations and improvements in the Indian environmentally friendly power area are as per the following:

- The Solar Energy Corporation of India (SECI) executed enormous scope focal sales for solar based stops and has granted agreements for 47 parks with more than 25 GW of joined limit.
- Adani Group plans to turn into the world's biggest solar oriented force organization by 2025 and the greatest environmentally friendly power firm by 2030.
- Around Rs 36,729.49 crore (US$ 5.26 billion) speculation was made during April-December 2019 by privately owned businesses in environmentally friendly power.
- Brookfield will put US$ 800 million in ReNew Power.
- ReNew Power and Shapoorji Pallonji will contribute almost Rs 750 crore (US$ 0.11 billion) in a 150 MW drifting solar based force project in Uttar Pradesh.
- As of 2019, India was set to open its solar based force plant, Bhadla Solar Park in Rajasthan, which would be world's biggest solar plant with a limit of 2,255 MW.

ACHIEVEMENTS:

A portion of coming up next are the accomplishments of the Government in the previous four years as detailed in Initiatives and accomplishments, [5, 6, 21, 22, 24].

- In April 2020, NTPC Vindhyachal turned into the biggest force plant in the nation to accomplish a plant load factor (PLF) of 100%.
- India's rank leaped to 22 out of 2019 from 137 out of 2014 on World Bank's Ease of working together - "Getting Electricity" positioning.
- Energy shortfall decreased to 0.7% in FY20 from 4.2% in FY14.
- Over 353 million LED bulbs were disseminated to customers in India by Energy Efficiency Services Limited (EESL) under Unnati Jyoti by Affordable LEDs for All (UJALA) in July 08, 2019. 11.17 million LED bulbs were sold by private players till March 2019.
- As of April 28, 2018, 100% town jolt was accomplished under Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY).

- Hon'ble PM Narendra Modi initiated Asia's biggest 750 MW Rewa Solar Project' to the country. This key modern undertaking fortifies Modi govt's vision of "Aatma Nirbhar Bharat" and its responsibility towards accomplishing the objective of 227 GW introduced sustainable power limit by 2022.
- The Kamuthi Solar Power Project is a 648 MW solar photovoltaic (PV) ranch in Tamil Nadu, India. It cost US $710 million, and got operational in 2016. Accordingly, India got number three on the planet for utility-scale solar PV parks, behind just the United States and China. To arrive at the third spot, India needed to jump the United Kingdom, and this solar homestead gave them barely enough edge. The Kamuthi Solar Power Project possesses 2,500 sections of land and can supply energy for around 150,000 homes in Tamil Nadu.
- 12 biogas based tasks have been dispatched with a force age limit of 212 kW and relating biogas age limit of 1805 m3 for each day. With this, the aggregate absolute of 316 biogas based ventures with a complete force age limit of 7.166 MW with a combined all out biogas age of 69,500 m3 for each day has been set up in the nation, up to 31.12.2019.
- Under the Green Energy Corridor project, approx. Rs.2000 crore has been dispensed to the States from the Government of India offer to cover projects granted under it.
- Around 60.61 lakh sun powered examination lights were conveyed to the understudies under 70 lakh sunlight based investigation light plan in the States of Assam, Bihar, Jharkhand, Odisha and Uttar Pradesh. Under the Scheme, more than 7436 nos. of ladies were prepared as solar lighting professionals, 1769 nos. of fix and upkeep focuses were set up, around 1896 individuals were prepared in business venture improvement and 832 nos. of solar shops have been opened.
- Under the Suryamitra program, Suryamitra Trainings are being coordinated through 223 instructional hubs/associations in various states the nation over under the coordination by the National Institute of Solar Energy since March 2018. During the current year, for example 2019-20, 20,700 youth are focused to be prepared as Suryamitras in 690 clumps the nation over. All out 40,441 no. of Suryamitras have been prepared aggregately up to 31st December 2019.
- More than 74 lakh sun powered lights and study lights; in excess of 17 lakh home lights have been conveyed under the Off-Grid and Decentralized Solar Program. Furthermore, more than 6.80 lakh streetlamps have been set up in the towns of India. More than 2.46 lakh Solar PV Pumps have been introduced in the rustic zones for water system and drinking water purposes.
- An online entrance has been created and dispatched in December 2019 by Ministry for giving concessional custom obligation exception endorsements (CCDC) to the producers of wind worked power generators according to the Ministry of Finance levy warning.

In view of flow arrangements, India's energy request could twofold by 2040, with power request possibly significantly increasing because of expanded apparatus proprietorship and cooling needs. The IEA stresses that "without critical enhancements in energy effectiveness, India should add gigantic measures of intensity age ability to fulfill need from the one billion cooling units the nation is relied upon to have by 2050".

"By raising the degree of its energy effectiveness desire, India could save some $190 billion every year in energy imports by 2040 and stay away from power age of 875 terawatt-hours out of each year – practically 50% of India's present yearly force age."

Indian Renewable Energy Development Agency Limited (IREDA) is a Mini Ratna (Category-I) Government of India Enterprise under the managerial control of Ministry of New and Renewable Energy (MNRE). IREDA is a Public Limited Government Company set up as a Non – Banking Financial Institution in 1987 occupied with advancing, creating and expanding monetary help for setting up tasks identifying with new and sustainable wellsprings of energy and energy preservation with the maxim: ENERGY FOR EVER.

VII. SUPPORT PROGRAMMES

INFORMATION AND PUBLIC AWARENESS PROGRAMME:

In terms of renewable energy capacity, India stands among the top five countries in the world. The Ministry has implemented various arrangements and projects for accomplishing the goals in renewable energy sector. Waiver of Inter-state transmission charges available to be purchased of solar based and wind power;

Renewable Purchase Obligation trajectory, competitive bidding guidelines for procurement of wind and solar power; flexibility in generation and scheduling of thermal power stations; solar cookers programme; solar-wind hybrid policy; solar PV manufacturing linked with assured take-off; Atal Jyoti Yojana and norms for sending of Solar PV systems are some of the major initiatives as published in the report by [5, 6, 21, 22].

The event is implemented using Government departments viz. (i) Directorate of Advertising and Visual Publicity (DAVP); (ii) National Films Development Corporation (NFDC); (iii) Doordarshan; (iv) All India Radio (AIR); (vi) State Nodal Department/ Agencies for renewable energy; and (vii) NGOs/ Academic institution, etc., and participation in exhibitions of national importance by the Ministry and also through other relevant Institutions/Organization. It is also providing information and awareness through its three autonomous Institutions i.e. NISE, NIWE and SSS-NIBE and two PSUs i.e. IREDA and SECI extensively. Exposure utilizing electronic and print media was made for the Second Assembly of the International Solar Alliance (ISA) on 30th and 31st October 2019 at New Delhi. A short video film competition has been organized by the Ministry to create awareness about renewable energy across the country.Publishing the Ministry's bi-monthly newsletter 'Akshay Urja' continued in English and Hindi.Logo Supports were extended to different organizations for different events/exhibitions on Renewable Energy. Programmes, schemes, achievements are regularly posted on Social Media through Ministry's three Institutes and two PSUs.

PLANNING AND COORDINATION:

The Planning and Coordination Division is responsible for overall planning and coordination for all matters related to various schemes/programmes being implemented, various policy and fiscal reforms being undertaken, etc. by the Ministry. Its work involves maintaining a close liaison with different Programme Divisions of the Ministry and with other concerned Ministries/Departments i.e. PMO/NITI Aayog/MEA/ Cabinet Secretariat, PIB etc. and State Government Agencies i.e. State Nodal Agencies, etc. on a regular basis.

NATIONAL RENEWABLE ENERGY FELLOWSHIP SCHEME:

National Renewable Energy Fellowship (NREF) Scheme for pursuing M.Sc./M.Tech/ PhD/ PDF degree courses.

- National Renewable Energy Science Fellowship Scheme for eminent scientists working in research institutes with an innovative idea in solar energy;
- Support to higher educational institutions for laboratory and library upgradation;
- Development of course/ study materials through experts/expert institutions; and
- Internships.

Ministry continued its support to students/scholars for pursuing higher studies such as M.Sc, M.Tech, Ph.D, courses in renewable energy in 12 selected educational institutions by way of providing fellowships/stipend under NREF Scheme. In the beginning of 2019-20, 34 Ph.D, 29 M.Tech/M.E and 20 M.Sc fellowships were being provided under NREF programme out of which 5 fellows completed Ph.D, 7 students got M.Tech/M.E degree and 10 students got M.Sc (Renewable Energy) degree in 2019-20. During 2019-20, 28 M.Tech, 41 for JRF/SRF and 20 for M.Sc fellows are continuing under NREF programme out of which 6 M.Tech,12 Ph.D and 10 M.Sc fellowships are awarded in the year 2019-20. The NREF fellows/students have published 10 research papers in the national and international journals of repute, besides presenting 5 papers in seminars totaling to the scientific output of NREF fellows to 568 research papers and 171 papers in seminars and 3 filed patents.

VIII. RENEWABLES FOR SUSTAINABILITY

Various study and researches have already been published, [1, 2, 19, 23], said that the energy sector plays a critical role in both meeting sustainable development objectives and reducing environmental externalities in India. The nation is powerless against environmental change impacts and is presented to developing water pressure, tempests, floods and other outrageous climate occasions been summed up in an examination [10]. Transformation and versatility of the energy framework to these conditions ought to get higher political need. Additionally, India appends incredible significance to the Kigali Amendment to the Montreal Protocol on ozone-draining substances, given its taking off cooling interest. India recognizes that early activity to address air contamination and emanations will lessen future variation needs. According to [5, 6], providing secure, manageable and sustainable energy to all is an important policy priority in India, and major progress has been made towards the United Nations Sustainable Development Goals (SDGs), notably SDG7 on energy. India has been addressing energy related environmental pollution since the 1980s, including issues related to air, water and land, and energy sector waste, with ground-breaking legislation under the Air (Prevention and Control of Pollution) Act. Cutting down the health impacts of energy production and use and air pollution (now part of

SDG3) is a key priority and the GOI has adopted comprehensive and stringent rules for the power and transport sectors. Climate change (SDG13) is a driver of the policy agenda on which India shows strong international leadership. Global energy-related carbon dioxide (CO_2) emissions share of India has increased by more than two percentage points since 2007, to account for 4.4% of the global total, with emissions rising by around 70% in absolute terms. India has submitted a IEA. All rights reserved. Nationally Determined Contribution (NDC) under the Paris Agreement with considerable mitigation efforts taking into account India's low per capita emissions and its development priorities.

Investment in energy efficiency and renewables is an effective low-carbon transition strategy as it entails strong co-benefits, reducing air pollutants by about 25% for SO2, 30% for NOX and 20% for PM 2.5, as illustrated in above Figure Equally, accomplishing general admittance to current energy by 2030, when fostering clean cooking, can achieve a reduction in PM 2.5 of nearly 15%.

Reflecting the extensive growth potential for modern renewables, the public authority set a sustainable limit objective of 175 GW by 2022, focusing on 60 GW of utility-scale sunlight based photovoltaic (PV), 40 GW of housetop solar PV, 60 GW of wind power, 5 GW of little hydro and 10 GW of bio energy. It plans for 227 GW by 2022 (114 GW of solar, 67 GW of wind, 31 GW of skimming solar and seaward wind, 10 GW of bio energy and 5 GW of little hydro). By 2019 India had an all out introduced sustainable power limit of 80 GW, and in the exact year India reported its desire to expand its environmentally friendly power ability to 450 GW.

IEA projections based on India's stated policies show the share of modern renewable rising to 13% of TFC by 2030 and 17.5% by 2040. The share of traditional biomass in TFC is expected to decline from 22% today to 12% in 2030 (and 8% in 2040). Electricity generation from renewables sees considerable growth, from 18% today to around 45% of electricity by 2040, while the share of coal declines from 74% today to 46% in 2040. This analysis is based on India meeting its renewable extent earmark of around 175 GW by 2022, and seeing capacity growth to almost 430 GW by 2030 and 800 GW by 2040. With this growth, India will fulfill the SDG 7.2 objective of substantially surging the division of REs in its energy mix.

CARBON PRICING:

Perform, Achieve and Trade (PAT) scheme, developed by bureau of energy efficieny(BEE), combines improvement targets with market-based incentives for strong performance. The following studies, [5, 6, 11, 27, 28] showed it is implemented on a rolling basis and has entered its third and fourth cycle. Mainly focusing on energy efficiency, the PAT scheme covers a majority of large installations and has created a registry and trading platform, which lends itself to a possible extension to carbon trading, thereby bringing carbon pricing up the policy-making value chain. In particular, revising and expanding the PAT scheme for the power sector (and potentially other sectors of interest) could provide appropriate price signals. The power sector could arguably be effectively carved out of the PAT scheme and migrated to a carbon scheme, using the PAT registry and trading platform. Many jurisdictions have introduced carbon pricing in a prudent way, with pilots for selected sectors or provinces and parameters set in a way to gradually increase the price of carbon. The GoI could use a similarly prudent approach for the power sector, which would help phase out inefficient coal and also benefit renewables and gas-powered generation. Carbon pricing can also serve as a tool to ensure effective energy pricing for industry and households. Cost covering energy prices for residential and industrial clients can assume a significant part in India's perfect energy change.

India has had the option to fulfill the hole between need for and homegrown stockpile of energy while tending to the ecological externalities related with energy use. Notwithstanding high development rates experienced in energy-serious areas, energy utilization and carbon dioxide (CO_2) outflows have not developed as quickly as GDP (GDP).India has seen a decrease of around 13% in the emanations force of its economy (energy-related CO_2 produced/GDP in PPP) during the previous decade, while absolute last energy utilization and power age keep on rising. The development in CO_2 outflows has eased back and a minor decoupling of GDP development from emanations has arisen since 2013. The Clean Development Mechanism (CDM), which was presented during the 2000s as a component of the Kyoto Protocol, endeavored to boost organizations and nations to decrease outflows by making a business opportunity for the marked down discharges - which others could purchase at a cost. The thought was a straightforward one: help non-industrial nations without accomplish economical turn of events, while additionally assisting created nations with accomplishing their objectives. To be a piece of this exchange, nations and corporate need to certify their ventures under the CDM. The undertakings can change from expanding mechanical proficiency to creating environmentally friendly power projects like wind factories and solar parks. The outflow balance of these tasks are then determined. For each huge load of carbon dioxide (CO_2) decrease, a CER or Certified Emission Reductions testament is given to the scheme developer. According to a report published in The Hindu Business Line, Nov 2020, an Indore-based company, Enking International may become the world's first company that operates in the carbon markets space to go in for an initial public offering (IPO). The 12-year-old organization works in the arising region of

exchanging carbon balances. These are market-tradeable instruments (like Renewable Energy Certificates) that are given to substances whose ventures lessen carbon dioxide outflows. Enking purchases these counterbalances from Indian organizations and offers them to purchasers abroad. Dabkara said the organization's top line for the half-year just crossed Rs 100 crore, accomplishing the achievement unexpectedly. The organization, which professes to be the world's biggest carbon credit designer and provider, includes a few major names in the Indian force area among its clients: NTPC, NHPC, Indian Railways, GAIL, IOC, ReNew Power, Azure Power, Greenko and numerous others. Aside from exchanging carbon counterbalances, Enking likewise assists organizations with building a 'carbon unbiased procedure' and causes them get the balances. In 2019, carbon counterbalances worth $214 billion were exchanged worldwide, 34 percent up from the earlier year. Since 2005, India has endorsed 3,028 activities, of which 1,667 have been enrolled by the United Nations Framework Convention on Climate Change (UNFCCC). This is around 21% of the 7807 activities enlisted internationally. Indian ventures add up to 11.6% of all around the world expected normal yearly guaranteed emanation decreases, as indicated by the UNFCCC.

Exchanging carbon balances is required to get once the principles for carbon markets are outlined under Article 6 of the Paris Agreement. Carbon exchanging started under the Kyoto Protocol of 1997 (which came into power in 2005). Under this, 'ensured discharge decreases' or CERs, were given to substances that set up ventures that diminished outflows —, for example, wind, sun powered, or energy effectiveness. These CERs were to be purchased by evolved nations. It didn't turn out great and Indian substances are left holding around 750 million useless CERs. Be that as it may, today a few nations and numerous organizations purchase counterbalances under what are called 'consistence' and 'intentional' markets, separately. In any case, the genuine development in the market is relied upon to happen simply after the carbon market rules are outlined under the Paris Agreement.

IX. CONCLUSION

The renewable energy sectors have always been a non-exploited domain of energy and faced innumerable obstacles. Some are geographical, some are regulatory, some political and socio-economic. Deficiency of capable hands and wishes with modern globalized framework and energy policies enhanced this sector as a null effective one. Also lack of private sector encouragement and regulatory bound drifted the production rate and blooming of green energy sectors. While our fossil fuel based energy consumption is shared about 70%, renewable energy consumption is only about 30%. For the last decades, India has started empowering these sectors and mobilized the funding and regulatory framework policies also. India has also come up with various schemes for promotion and implementation of renewable energy sectors. Also public awareness, human resource, training programmes have been regularized. Up skilling of manpower, instruments import, price of the installation, scope of enhancement, all these have been a long times barrier. But now the country is moving towards a global market and its FDI policy is helping outside funds and manpower to come and contribute towards a sustainable future. Also the grid connectivity for the renewable energy has been implemented successfully with the motto of “One Nation One Grid” that encouraged many investors to put forward their opinions and ventures. Renewable energy sector constitutes a fundamental piece of India's current and future energy strategy. In the event that India follows the eager arrangement it has chipped in for, it can achieve the double objective of monetary turn of events and efficient power energy creation, which is absolutely inside the domains of probability. Hybrid energy generation can be one of the vital outreach of the programmes and planning. RandD sectors are engaged and being funded for more inputs in exploring new possibilities. Many IITs, NITs, State level, National level, even private sector labs are bein utilized for research purpose. Infrastructure of service and maintenance are being executed for gaining the consumers’ and investors’ faith in involving this sector. Also India government has set up e-office and e-portal for surveillance on disbursement and application of projects. Vivid fiscal policy for funding should be set up by the central government. Also government should take care of the interest of the power DISCOMs that they have purchasing power agreement (PPA) to cover fully their acquire commitment known as renewable purchase obligations (RPO). Making it instrumental, India is moving towards a clean and green sustainable future for next generations.

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