BARRIERS IN SOLAR ENERGY REGIME: A COMPARATIVE ANALYSIS OF INDIA AND GERMANY LEGAL FRAMEWORK

A thesis submitted to the
UPES

For the Award of
Doctor of Philosophy
in
Law

By
Yatish Pachauri

October 2023

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DECLARATION

I **Yatish Pachauri** hereby declare that the thesis entitled **Barriers in Solar Energy Regime: A Comparative Analysis of India and Germany Legal Framework** has been prepared by me on the basis of original research under the guidance of Dr. R.K. Chopra, Professor of School of Law, UPES, Dehradun. I further declare that, No part of this thesis has formed the basis for the award of any degree or fellowship previously.

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ABSTRACT

It is an established fact that Non-Renewable (Conventional) energy major sources are being used from time immemorial to generate electricity. The scarcity of renewable sources of energy has enhanced the cost of electricity and other utilities which made mankind across the world search for other sources of energy. Non-Renewable sources became popular and harnessing Hydro and Solar power started bridging the gap in energy requirements.

The utilization of Non-renewable energy sources is quite limited, and it takes billions of years to rejuvenate these sources. With the advent of technology, it has been observed that conventional sources of energy cause more pollution to the environment, which is a serious concern as it leads to environmental degradation and climate change. The present research focuses on Solar energy, as it is high time for a paradigm shift toward renewable source energy. The research starts with a positive assertion on the Government of India’s policy initiatives to harness the solar energy sector, but the current study shows that these achievements are not up to the mark. The study aims to focus on the barriers to the development of Solar energy in India with a comparative analysis as well as learning the best practices used in Germany. The research focuses on barriers to the development of the solar energy sector in India. The barriers are as follows.

- The Barriers relating to Existing Policies and Regulations like the National Solar Mission (NSM) Atal Jyoti Yojana (AJAY), Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan Scheme (PM- KUSUM), and Rooftop Scheme and Compliance of RPO as a barrier.
- The lack of coordination between the Ministry of New and Renewable Energy and Discoms and Generators.
- The Financial and Fiscal barriers related to tariffs and grant of subsidies by the financial institution.
- The Open Market Barriers including poor infrastructure and lack of Grid integration.
- The Technological Barriers as high efficiency solar panel's cost are very high.
- Environmental barriers in setting up Renewable Energy power plants.

The above-mentioned barriers have hampered the development Renewable Energy sector as compared to the advancements of other sectors in terms of usage, adaptability, diversification as well as technology in terms of usage of solar energy.

BARRIERS IN THE SOLAR ENERGY SECTOR IN GERMANY.

Some of the barriers in the Solar power sector in Germany have been identified after thorough research and are mentioned hereunder.

- The Installation of PV Panels on land (Wirth, 2021).
- The theoretical potential of utilisation is considered with respect to technological advancements.
- The technological constraints as faced by the various industries in Germany (Wirth, 2021).
- The Economical potential is considered as a major challenge in Legal parlance (Wirth, 2021).

This research examines the comparative analysis between the two countries (Germany and India) policies and the existing laws governing the Solar Sector which are suggested by removing the above-mentioned barriers and which will help in aiding the effectiveness and enhancing the efficiency of this sector.

This Research includes an introduction to the Electricity sector and the historical background of electricity legislation relating to in India. Electricity was treated as a major commodity till recently but nowadays it has become an essential requirement and necessity for living and carrying out day-to-day activities. India, being a developing nation, the demand for electricity is very high and sometimes during the months summer, it goes beyond the generation capacity which is leading to blackouts.

In India, the primary sources of electricity generation are still the conventional sources like coal, oil, and gas. Focus is on the challenges in the Electricity sector irrespective of the source of electricity generation which may be from non-renewable energy (conventional sources) sources or renewable energy in India.

These challenges create barrier because of which the electricity sector in India has not been able to be developed to the levels of expectation and demands. The said barriers have been pointed out in this chapter by elaborating the research with a comparative analysis with the existing policies and system prevalent in Germany, where the weather conditions are far more critical to use solar energy as renewable energy as a source for the generation of electricity.

Germany has made significant contributions in harnessing of solar energy and attained a leading position among other countries. The Germany PV sector with its all-technological developments along with the topmost engineers has quality materials and their manufacturing is aided with the help of various Research and Development institutes. This endeavour is being amply supported by the Government in Germany by providing training facilities which has enhanced the scientific advancements and development in the solar sector (Wirth, 2021).

In the current day scenario, technology is no longer restricted to a particular area, region, or country, rather it spread in a global setup. Therefore, Globalization is now the need of the hour which connects and allows trade with every nation in the world and further obligates other countries to follow International Laws and commitments through different Conferences, Conventions, and Treaties.

Sustainable developments demand that the environment be kept safe, healthy and pollution free, which is a duty of all the States jointly. It is an endeavor which must be taken by all the states irrespective of their status of being developed or developing countries.

In the past, many conferences such as Stockholm in 1972, the Vienna convention in 1985, Montreal Protocol in 1987, the Kyoto protocol in 1997, Kigali Amendment (Amendment in Montreal protocol) in 2016, Paris Agreement (COP 21) in 2015, Katowice climate change conference (COP 24), in December 2018 and Glasgow conference (COP 26) in October to November 2021 was organized to address the issues related to effects on the environment and climate change apart from harnessing Renewable Energy sources.

The motto “One Sun One World One Grid (OSOWOG)” was given by the Prime Minister of India Shri Narendra Modi, and UK Prime Minister Mr. Boris Johnson during the first assembly of ISA in October 2018 in Glasgow to connect all the nations to one grid. This will help people across the world to have sufficient power without degrading the environment and help in avoiding the instances of power blackouts.

The earth is a satellite which moves around the sun which denotes that if a sunset happened in one nation there may be sunrise in another nation and if all the nations are connected to this Electricity Grid cutting across the border, there will be no shortage of electricity in any part of the world. This can be made possible through On-grid and hybrid Rooftop systems though it is difficult to achieve the same.

The international conventions and policies are formulated on a global scale and how the inferences from these (convention and policy) can be implemented in India to harness to its the solar sector to the maximum possible capacity in India. India has also signed a Memorandum of Understanding (MoU) with the Government of Germany (Press Information Bureau Government of India Cabinet, 2015) to harness the solar sector in India under the aegis of the International Solar Alliance.

This research also reveals the focus on the development of State Nodal Agencies, Discoms, Municipal Corporations and other associated companies for the development of the RE power sector as efforts of these entities will lead to the achievement of around 1 GW of electricity generation. The research points out that there is no mechanism for any subsidy or Direct Benefit Transfer scheme-related provisions which is required mainly for the generation of energy in rural energy in rural areas and far fledged less developed east part of India.

This research also reveals tremendous work done in the field of rural electrification based on the usage of solar energy as a primary source. In view of the submissions and the various proposals, it is suggested that suitable amendments be made in the Electricity Act of 2003 by clarifying on the position of solar energy as a major contributor in the energy domain.

The existing legislation and policies related to renewable energy sources have been analysed to identify the lacuna in the existing solar sector power setup in India.

Research aims to find out the effectiveness of the existing policies and their relevance in India. Further, this also undertakes a comparative analysis between Germany and India about the prevalent legal framework and examines the best practices and policies which are used in Germany.

Germany has policies, and infrastructure which have influenced countries across the globe. Germany is one of the topmost countries in the field of lignite mining, which helps policy due to which the (Germany) policymakers are leading in the development of various incentive programs for Renewable Energy.

The Renewable Energy Act, 2000 (EEG) of Germany is the best example of incentives programs which was closely monitored by many nations (Wirth, 2021), and the same policies can be implemented in India also.

The legislation in Germany related to renewable energy has been discussed because in Germany 40 percent of electricity demand is being met through renewable sources and major contributors is from solar power.

The recent amendments in their (Germany) Renewable Energy Sources Act, 2000 has been deliberated and after research, it has been inferred that this sector requires robust development in formulating a separate legislation for the solar power sector in India. In this direction, an empirical study was conducted, and the survey method was used for an analysis and for interpretating the scope of existing policies and legislation along with the efficacies of subsidies which are provided by the Government of India. The observations of solar energy experts, legal professionals as well as the users have been taken into consideration and inferences drawn have been analysed. This research is aimed to identify the impact of existing policies on Renewable Purchase Obligations in the Solar power sector and whether legal professionals in the Energy sector are aware of the tariffs and schemes as enacted in the policies.

This part of research deals with the Renewable Purchase Obligations and their effectiveness in various states with the current targets and the challenges which are faced during the practical implementation of RPO in India. This was carried out to examine the various bottlenecks faced by the industry, which if removed can lead to enhancement of performance in India's solar sector. It has been found that RPOs obligations have been suppressed by the Discoms and the electricity generators by not fulfilling the targets as set by the Government of India.

A questionnaire on a 5-point Likert scale was designed and prepared to check the efficiency of the existing legislation. This data was collected as a primary source from the various respondents who are aware and are related to the Solar power sector in our nation. An endeavour has been made in this research to identify the Status of RPO and the quantum of fulfilment by the various Discoms. The google form questionnaire was given to the experts from the power industry through digital media and their responses were duly evaluated. This form and questionnaire were referred to the stakeholders associated with the solar power sector or were having adequate knowledge about the Solar energy sector in India.

This also highlights the difficulties in the collection of data, which was a herculean task and complicated, as industry experts were bound by confidentiality obligations.

This result indicates that many stakeholders irrespective of their involvement in solar sector need to gain adequate knowledge about the policies, tariffs, and subsidies available in the sector. After conducting the research survey, it is concluded that the Government should emphasize on awareness programs and to improve the existing tariffs and enhanced subsidies to attract customers of this sector by installing solar panels on their rooftops and available spaces to create a viable interest of the usage of Solar power as an alternate source of energy amongst the citizens.

This Research has also analysed some vital rulings on this subject for better clarity and precision in order to comprehend the reasoning which has been supported by the legislative provisions, and also elaborates on the ways and methods of how these Discoms and Generators are avoiding themselves from fulfilling the targets and avoiding monetary punishments conceptualised in legal provisions in India.

The further emphasises on the Feed in Tariff (FIT) policy in India and its effectiveness and as to how Gujarat, among all the states, has done exceptionally well due to the effective implementation of this policy and how the other states can follow a similar model.

The German enactments provide for a specific Act for Renewable energy sources where it is found that the Feed-in- tariff policy implementation has been one of the cardinal reasons for the faster development for the Solar power sector in their country despite their critical geographical conditions and the climatic challenges. Our research shows that in Germany the existing legislation was amended which is required for the betterment of RE sector. It must be worth mentioned and has been depicted that the efforts of German Government in the renewable energy sector (Mainly Solar energy), has been appreciated by many countries of the World.

India is at the forefront of adopting solar energy despite the challenges faced in the usage of the solar power to mitigate the rising demand for power. The reasons and issues include the limited availability of other natural sources, which are necessary for power generation which also include the enhanced prices of other conventional fuels. The limitation in using solar energy is also coupled with the challenges faced in the distribution of electricity in rural and remote areas.

With the current rate of development and investment in the solar sector, many businesses are switching to renewable (mainly solar) power sources due to their user-friendly mechanism and environment-friendly nature. The drawback is if the commercial solar power plants are not appropriately monitored, then the efficiency and output of the solar plants reduces drastically causing transmission and distribution losses.

As per the study conducted by Professor Christian Breyer at the Lappeenranta University of Technology Finland, by mid of the current century Electricity generation from solar power sources would contribute to around 69 percent of the global energy mix (BELLINI, 2021). India will achieve and fulfil 75% of its electricity demands through Solar PV by the year 2030 which is around 800GW by 2040 (Gould, 2021). India has already achieved the 5th position in electricity generation on a global scale by using solar energy. The usage (of Solar Energy) has enhanced in the last five years by 11 % which has significant potential and requires innovative policies with efficient and specific legislation to govern the solar energy sector. The mandate for opting to use

Solar power energy sources is not necessary but will become an essential requirement in India in the coming future.

This research also reveals that the Government of India has already started taking suitable steps in this direction by ensuring the reduction of the customs duty for the required raw materials as well as encouraging the manufacturers to provide efficient low-cost solar panels. The initiatives undertaken by the Ministry of Railways; Government of India are highly appreciated as they have installed solar panels in their railway stations. Their efforts to control the carbon footprint are highly appreciated as the electricity consumption is much higher as compared to the other sectors and they have been successful in saving money and saving the environment.

Concluding Remarks

The current research is focused on identifying the existing barriers in the renewable energy segment especially related to solar energy with a comparative analysis related to existing laws and policies between Germany and India.

The research also dwells on the upliftment of the solar power sector by seeking reference from various policies prevalent in Germany as well as eradicating the barriers which are faced in India by various entities which are involved in the transition and adoption of solar energy as a viable alternate to conventional methods of electricity generation.
The central research questions are mentioned below.

1. What are the Renewable Purchase Obligations (RPO) and its relevance in the Solar Sector?
2. What are the barriers to the development of the solar energy sector in India?
3. Whether the existing legislation and policies are viable enough to promote, develop and enhance the levels of consumption of solar power energy in India?

This research also depicts the following conclusions which are based on the doctrinal research, data analysis, and judicial decisions on the basis on which this study has been structured in this research.

The issues and challenges discussed and analysed in the preceding paras of this research reveal that our country lacks an optimal legal framework for promoting renewable energy sources, specifically for the solar power sector. It has also been understood that improper implementation and effectiveness of various policies and laws are without stringent provisions and non-fulfilment of RPO which causes the lack of development of the solar power sector.

Further, there must be an enhanced focus on the implementation of RPOs as it is expected to lead towards a positive change in the development of the solar power sector.

The analysis of this research depicts that electricity usage is one of the cardinal requirements for human life as the upcoming developments in the field of digital electronics, communication devices, appliances, and Electric machines and Electric Vehicles (EVs) require a continuous flow of electricity which is a critical source at this moment and required enhancing the need of electricity continuously.

Therefore, Taking the above into consideration, this research has deeply analysed the existing legal provisions as well as the guidelines which the Government of India issues to remove the bottlenecks. The best practices as inculcated by the Government of Germany which are relevant to Indian conditions are also recommended in this research. If these suggestions are implemented, they will be enhanced and ensure that India's goals become self-reliant on the usage of Renewable Sources of Energy in less than three decades from now.

The growth and development of our nation have been torturous towards mother earth. The natural sources have been vandalised which include the forest and rivers and they have been exploited to give way to the greed of humans for their growth. In this context, this research on renewable sources of energy and the other availability of fuels, especially in the field of power generation with the help of solar energy has been undertaken in this.

This depicts that solar energy generation, development, transmission, and its connectivity with a national grid along with RPO obligations do not provide by existing legislation through which the barrier can be removed therefore if refer Vienna Convention, Montreal protocol, Kyoto protocol and United Nation Framework Convention on Climate Change (UNFCCC) in the international scenario formed the basis on which the domestic law can be developed and the utilisation of RE source of energy mainly the solar sector can be best explored as depicted in our research. Nonetheless, the international convention is merely a guideline and do not provide any obligation relating to its enforcement as well as its role in mitigating climate change and associated environmental concern.

Therefore, taking the above into consideration some of the principles enunciated in these conventions and protocols along with the legislation in Germany have been suggested in Indian law.

In India, the legislation pertaining to solar energy is covered under the Electricity Act 2003 that present study reveals that there is no coordination between central and state agencies for the development of the sector. Our research suggests that the coordination between the Union and States both in terms of policy and guidelines must be complied with in a timeframe manner by fixing the realistic target or purchase of renewable energy.

In the prevalent Electricity Act, 2003 Hydropower has been mentioned as the only source of Renewable energy, and now this must cover other forms of renewable sources of energy like Solar, Tidal, Wind, etc so that they can be tapped as an alternative source of energy.

India is blessed throughout the year as Sun is freely available and the type of climate and the seasons in India made it a more viable option in renewable for electricity production, and utilisation to meet the enhanced demands. Further, no doubt installing a solar power plant has initial costs such as solar panels, including Solar Cell, which was very high, once the government has been able to provide a subsidy, lite material with Maximum output efficient panels, available for the user then only Solar power plants replaced conventional source power generating plants.

The case analysis on the subject evaluated during the research depicts that the current form of RPO is ineffective and the Discoms are utilising the existing policies and guidelines for their vested interest without taking into consideration the obligations as necessitated for sustainable growth.

RPO is not to be meant only for Union but also for the States as the no achievers state should be encouraged to reach a threshold level at the achiever's state should be given incentives both in terms of its utilisation as well as providing them a better cost for the energy generated but not utilised and supplied to the national grid.

In this study, the analysis of removing such barriers and the various modus operandi which has been described in Germany which have helped to eradicate these niggling issues have been mentioned in the following chapters of this study.

In view of the above anomalies, it was expected that the Government of India should be in dire need to pass separate legislation or make necessary amendments which will be incorporated separately in the existing E-Act, 2003 for adhering to the Sustainable Development Goals and make the target 2030 target of 175 GW Electricity generation from renewable sources and to promote and harness the policies like RPO and FIT. The policy guidelines applicable from time to time, if implemented correctly and effectively, will lead to creating a successful RE resource and be helpful to our nation.

Result of Hypothesis

At the beginning of the research, the following below-mentioned hypothesis is formed to find out the results.

> H1: There is a huge potential in the Solar Energy Sector in India and the same can be achieved through mandatory Region-Specific Renewable Purchase Obligation (RPO).
> H2: Increased Focus on the feed-in tariff system in India may help in the development of the Solar Energy Sector in India.

We have already witnessed the various states which have already achieved their set targets of RPO and are generating much more electricity than their demand and fulfilling their requirements. RPO not only helps Discoms but also helps small-scale Renewable energy generators. In many states, this was not executed properly and with zero targets for a whole year and the remaining states are fulfilling their targets by utilising Renewable Energy Certificates. This is primarily due to the lack of coordination between MNRE and various Discoms. If the law is made for the same and executed appropriately the results will be much better. The advantages of the fulfilment of RPO is already being discussed in chapter 4 as necessary steps for the betterment of the solar sector in states.

Hence H1 hypothesis is proved.

The Feed-in-Tariff (FIT) which was first incorporated by Germany in their Renewable Energy Act, 2000 and has enabled Germany to receive huge investments for RE sector and has appreciated in the fact that more than 40 percent of electricity generated is from RE sources, especially the solar sector. Post this, many nations like India too incorporated FIT in the RE sector in some of the states. The main objective of this FIT program is to provide financial independence to small-scale RE generators for a specific period. This has been given to almost all RE generators without discrimination, irrespective of their generation capacity. The major reason for the Gujarat model is FiT which provides tariffs to small-scale generators and helps in injecting electricity into the grid as and when required. The tariff is fixed for 25 (12 years for higher prices + 13 for lower prices) years in all types of projects. It was also categorised into two levels from 2010-2022 and 2023-2036 respectively (Y. Pachauri & Chopra, 2022 a). Tamil Nadu and Gujarat are the two states where rooftop price is calculated based on rooftop solar tariffs and the individual users get more subsidies from the grid which is paid by various operators like TANGEDCO in Tamil Nadu.

The future lies in the solar sector and if a proper system could be made to channelise and implement these policies till the time laws are framed, then only it will be good to focus more on developing such types of policies which increase the investment in the current solar sector like FIT has done.

Hence H2 hypothesis is also proved.

Detailed suggestions are available in the study.

SUGGESTIONS

Based on the research findings and analysis, the researcher would like to propose the following suggestions based on the conclusions, for the betterment of the Solar power sector which is mentioned below.

- To amend the existing laws to tackle policy and regulatory compliance barriers like the Renewable Purchase Obligation (RPO) and Feed-in Tariff (FIT) should be incorporated.
- To suggest adequate punishment and fines for Non-fulfilment of Targets of RPO specified by the Government agencies.
- It is suggested that subsidies on the initial investment and tariff for generating electricity be modulated for anyone generating electricity through solar plants, irrespective of ON-Grid and OFF-Grid types.
- It is suggested that the Government gives further incentives and enhances the number of Charging stations especially based on Solar Power across the country in order to make Electric Vehicles (EVs) a success to reduce the charging cost and carbon footprints.

- It is suggested that Government should also cater for separate funds for Research & Development activities and empowers the corporations like SECI and NISE.
- It is suggested to have functional reforms to reduce the cost per unit (ET Energy World, 2019) otherwise it will take another 7 years to reduce the cost up to 1.9 Rs. /Unit of electricity, by removing the financial burden on the generators and removing fiscal barriers which are faced by various operators.
- It is suggested that Transmission and Distribution losses must be reduced by improving infrastructure by using prepaid meters and benefitting from technological developments like solar water pumps.
- It is suggested that Discoms and other regulatory commissions follow the Revised Tariff rates as suggested by CERC and SERC which will help to enhance the coordination and generate more revenue.
- It is suggested to implementation of the power distribution franchisee model for metering, billing, and collection of bills across the states taking Bhiwandi (Maharashtra) or the State of Orissa as a role model.
- It is suggested that various schemes being implemented by the Central government like Direct Benefit Transfer (DBT) and measures undertaken by the states of Madhya Pradesh and the State of Punjab which coined 'Save water, Save Electricity and Earn Money' ("Paani Bachao Paise Kamao") scheme.
- It is suggested to install Commercial Solar Power Plants in barren areas of States like Gujarat and Rajasthan, and on the seashores along with roads integration of Photo Voltaic.
- It is suggested that Modular and Floating Solar Panels be incorporated which can be installed in the least permissible area to avoid the spread of solar panels on the land surface and avoid ecological imbalance.

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Yatish Pachauri

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AD	Accelerated Depreciation
AJAY	Atal Jyoti Yojana
Approx.	Approximately
Art.	Article
APTEL	Appellate Tribunal
BCM	Billion Cubic Meters
BEE	Bureau of Energy Efficiency
BEST	Brihanmumbai Electric Supply & Transport Undertaking
BHEL	Bharat Heavy Electronics Limited
$C_2H_3CL_3$	1,1,2-Trichloroethane
C_3H_6O	methyl vinyl ether
CAGR	Compounded Annual Growth Rate
CBET	Cross Border Electricity Trade
CBM	Coal Bed Methane
CCS	Coal Cartridge system
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CERC	Central Electricity Regulation Commission
CFA	Central Financial Assistance
CFCs	Chloro fluoro carbons
CGD	City Gas Distribution
CIL	Coal India Limited
CO_2	Carbon Dioxide
CONCOR	Container Corporation of India
COP	Conference of Parties
COVID	Corona virus disease
CPSU	Central Public Sector Undertaking
CPV	Concentrated Photovoltaic
CPWD	Central Public Works Department
CSD	Commission of Sustainable Development
CSP	Concentrated Solar Power
DBT	Direct Benefit Transfer
DDG	Decentralized Distributed Generation

DDUGJY	Deen Dayal Upadhyaya Grameen Jyoti Yojana
DISCOMs	Distributive Companies
DT	Distribution Transfer
E-Act, 2003	The Electricity Act 2003
E&P	Exploration and Production
EEG	Erneurbare-Energien- Gesetz
EESL	Energy Efficiency Services Limited
EPA	Environmental Protection Agency
ERC Act, 1998	Electricity regulatory commission Act, 1998
ES- Act 1948	The Electricity Supply Act, 1948
EUR	Euro
EV	Electric Vehicles
FiT	Feed in Tariff
FY	Financial Year
GAIL	Gas Authority of India Limited
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GOI	Government of India
Govt.	Government
GW	Gigawatt
H.C.	High Court
H_2SO_4	Hydrogen Sulphuric Acid
HCL	Hydrochloric acid
HDI	Human Development Index
HDV	Heavy Duty Vehicle
HELE	High Efficiency Low Emission
HERC	Haryana Electricity Regulatory Commission
HF	Hydrogen fluoride
HFCs	Hydro-fluoro-carbons
HIV	Human Immunodeficiency virus
HNO_3	Nitric acid
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IEA, 1903	Indian Electricity Act, 1903
IEA, 1910	Indian Electricity Act, 1910
INDCs	Intended Nationally Determined Contributions
INR	Indian Rupees
IREDA	Indian Renewable Energy Development Agency
ISA	International Solar Alliance

ISTS	interstate transmission system
JNNSM	Jawaharlal Nehru National Solar Mission
KWh	Kilo Watt Hours
MBOE	Million Barrel of Oil Equivalent
MDGs	Millennium development Goals
MERC	Maharashtra Electricity Regulatory Commission
MNES	Ministry of Non-Conventional Energy Sources
MNRE	Ministry of New and Renewable Energy
MOEF&CC	Ministry of Environment, Forests and Climate Change
MOP	Ministry of Power
MOSPI	Ministry of Statistics and Program Implementation
MoU	Memorandum of Understanding
MSEDCL	Maharashtra State Electricity Distribution Company Ltd
Mtoe	Million Tons of Oil Equivalent
MW	Mega Watts
n.d.	No date
N_2	Nitrogen
NAPCC	National Action Plan on Climate Change
NDA	National Democratic Alliance
NDCs	Nationally Determining Contributions
NEP	National Energy Policy
NF	Nitrogen Monofluoride
NGO	Non-Governmental Organization
NISE	National Institute of Solar Energy
NIWE	National Institute of Wind Energy
No	Number
NPCIL	Nuclear Power Corporation of Indian Ltd.
NRDC	National Research Development Corporation
NSM	National Solar Mission
NTPC	National Thermal Power Corporation
OA	Open Access
OALP	Open Acreage Licensing Policy
ODS	Ozone depleting Substances
OECD	Organization for Economic Cooperation and Development
OMC	Oil Marketing Companies
Ors	Others
P.M.	Prime Minister
PAWP	Paris Agreement work program

PGCIL	Power Grid Corporation of India
PLF	Plant Load Factor
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabhiyan
PMUY	Prime Minister Ujjwala Yojana
PNGRB	Petroleum and Natural Gas Regulatory Board
PPA	Power Purchase Agreements
PPP	Public Private Partnership
PSU	Public Sector Undertaking
PTC	Power Trading Corporation
PV	Photo voltaic
R&D	Research and Development
RE	Renewable Energy
REC	Renewable Energy Certificate
RPO	Renewable Purchase Obligation
RTS	Rooftop Solar
S.C.	Supreme Court
SDGs	Sustainable development Goals
SEBs	State Electricity Boards
SECI	Solar Energy Corporation of India
SERC	State Electricity Regulatory Commission
SERC	State Electricity Regulatory Commission
SNA	State Nodal Agency
T&D	Transmission and Distribution
TSOs	Transmission System Operators
TPS	Third party sale
TWh	Tera Watt Hour
U/A	Under Article
U.K.	United Kingdom
U/S	Under Section
UDAY	Ujjwal Discom Assurance Yojana
U.N.	United Nation
UNDP	United Nation Development Program
UNFCCC	United Nations Framework Convention on Climate Change
U.S.	United States
USD	United States dollar
UV	Ultraviolet
V.	Versus
VGF	Viability Gap Funding

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CHAPTER 1

1.1. INTRODUCTION

1.1.1. The Renewable Energy sources in India.

The developing countries embrace the path of progress and advance down the path of development by utilising higher levels of energy. The sources, based on the nature of the fuels are categorized broadly by being non-renewable which is also known as conventional source or renewable resources which is known as non-conventional sources. Fossil fuels which are used as primary constituents of electricity generation in developing countries is Non-renewable sources. It is harmful as it not only hastens the reduction of Non-renewable fossil fuel reservoirs but also increases the levels of carbon emissions, which reflects in the Pollution of the atmosphere and Global Warming. It is critical that global energy production and use shift to more environmentally friendly sources of energy and alter the utilisation patterns, including enhancing the production of electricity.

The Temperature change in the atmosphere and the rapid depletion of fossil fuels and other energy resources have made all of us innovate about the sources of clean and sustainable energy. The energy in the form of electricity produced and consumed in India nowadays is majorly generated from Non-Renewable fossils like coal and crude reservoirs of gas and oil pockets which are constituents of the global energy mix.

The perils of sustaining economic growth and achieving sustainable development are opposite and mostly contradictory. Economic growth is much more dependent on the availability of cheaper energy sources. The Fossils fuels are the most affordable and cheaper, but they cannot meet the standards of sustainability and are also depleting at a faster pace.

There is a need to create a portfolio of an energy mix which helps us in changing the present scenario. The “New Energy Policy” (hereinafter referred as NEP) of 2017 and 2022, attempts to regularise the source and secure India’s future energy.

The determining factors include the availability and the cost of various resources, the various geopolitical issues, and the various international commitments along with the objectives which are to be achieved.

The policies pertaining to the energy and the requirements of all nations vary accordingly. The Generation of Electricity in India depends primarily on coal based thermal power plants. In countries like Germany, which generates most of its electricity from renewable resources, nuclear power plants provide most of the electricity produced in France, whereas Wind Farms provide the electricity generation in Scotland.

1.1.2. Statement of the Problem

Energy is the lifeline for the development and sustainable growth of any nation. Energy is a crucial element in a human’s regular lifestyle, from electricity to transport. Electricity is directly responsible for the essential functionality of the nation. Electricity is one such wing of the Energy sector upon which this research will be focussed. It is to be considered a basic necessity of a man’s dignified life which is under the blanket of “Right to Life and Personal Liberty” encompassed under Article 21 of the Indian Constitution.

Electricity can be generated from either of the sources like renewable or non-renewable. In India it is mostly generated using non-renewable resources as renewable resources need sufficient infrastructure, development in technology, and geographical conditions along with having to battle climatic changes.

The non-renewable resources that emerge from fossils, hence, are being depleted and are at risk of not being available for future generations if they are exploited mercilessly or at the present pace. Furthermore, non-renewable resources cause higher levels of pollution, which also leads to global warming, climatic changes and is responsible for extremely unhealthy conditions.

India is a signatory to the Paris agreement, 2015, which requires all signatories to focus on sustainable development and climate protection. This agreement aims to curtail the temperature change globally in this era and enhancement up to 2 degrees Celsius above pre-industrial levels to control the situation.

There is a dire requirement for striking the right balance to cope up the development of the nation by securing the essential requirements of the country. The exploitation of the environment by protecting non-renewable sources for future generations is a major goal to achieve and this is a prerequisite for a rapid shift from non-renewables to renewables as per mandates of the agreement.

The climatic conditions in India are suitable throughout the year because of which generating electricity from solar energy is more feasible. The Government of India has initiated installing solar plants to generate Electricity through Photovoltaic cells on Rooftop and Ground. The Central and State Governments are encouraging the said project by providing subsidies to those who are fulfilling their energy demands through solar energy.

Electricity, being a subject matter under the Concurrent List (List III) as Item No 38, and according to it both the Union and the State Governments should take conducive steps to formulate a proper law for the "renewable energy sector in India". In India, "The Electricity Act of 2003" (hereinafter referred as E-Act, 2003) is the only law governing the distribution, transmission, and generation of electricity in the nation. Initially, it was like a ray of hope for the regulation of various sources (like non-renewable and renewable) of the energy sector effectively. In the actual scenario, the licensing for the generation of electricity through hydropower in the category of the renewable energy sector was only covered under the scheme of the said Act. The other Renewable energy sources were not given much importance in the scheme of the Act and were left for future policies or plans. Furthermore, the Electricity amendment bill introduced in 2021, however, had gone in vain as it was devoid of provisions for regulating the renewable energy sector. Further, there is no utterance of Solar Energy either in the Act or the amendment.

There is an urgent requirement to establish a regulatory framework on Solar energy including over the market, consumer interest, and dispute redressal mechanism. Avoiding robust Legal mechanisms backed by a firm executive hand in the implementation of the project, it may be difficult to make this crucial requirement of solar energy a success.

Many countries have already shifted towards Solar Energy. Germany is carrying out the same effectively and efficiently. An important aspect of this research is to conduct a comparative analysis between India and Germany on their solar electricity system and mechanism. The temperature in Germany during winter is 3.3 degree Celsius and to a maximum of 19 degree Celsius during summer. Under these extreme conditions, Germany has relied on its RE sources. Germany has been among the world's top PV installers with a total generation capacity amounting to 54.71 gigawatts (GW) as of January 2021 (Shukla, 2021).

The researcher has considered Germany for the present research due to the fact that the FIT system under the Renewable Energy Sources Act, 2000 has been successful. This is without prejudice the common law or civil law model.

Further to support the arguments there is a Memorandum of Understanding (hereinafter referred as MOU) was Signed in October 2015 between the "Ministry of New and Renewable energy", India, and "The Federal Ministry for Economic Cooperation and Development", Germany under the Indo-German Solar Energy Partnership. This MOU helps in developing Solar Rooftops, Solar Parks, and Solar Off grids for getting Sustainable energy (*Joint Statement: 6th India-Germany Inter-Governmental Consultations*, 2022).

(*Joint Statement: 6th India-Germany Inter-Governmental Consultations*, 2022).

1.1.3. Inspiration Of Study

The present Research is inspired by the fact that India is a country which is heavily populous and is developing in nature. The Electricity as a fuel is a key essential in the growth of a nation and to meet the needs of everyday life of an individual. Therefore, it is the need of the hour to fulfil the people demands without harming nature, and the environment, protecting fossils and maintaining energy security. Further, to fulfil the unstoppable demand of the nation, it is essential that there must be a continuous flow of the raw material which may be possible only through renewable energy resources. India being a sunny country, there cannot be a better raw material to justify the above. The natural availability of the raw material, which, if adopted by the country, will meet the demands of the country sustainably and efficiently. Further, the contra geographical nature of a country like Germany will make it easy to understand that with such limited availability of sun how the country has converted its system based on solar energy.

1.1.4. Review of Literature

Books

1. Chatterjee, S. K. in his book titled, "S.K. Chatterjee's Commentary on Electricity Laws of India: The Electricity Act, 2003", edition 2020, the author gives commentary on the electricity Act provision with recent case studies. Under the Electricity Act 2003, very few sections talk about Renewable Energy under Section 86 (1) (e). It is stated in the section that, The State Commission while discharging its duties, must promote the cogeneration from RE sources, also provide the measures to connect with the grid, and specify the percentage of electricity produced from those sources. This Section 86 (1) (e) is the sole provision under which the state commission mandates entire policies like RPO, grid connectivity, Open Access, and distribution licensees.

2. Ottinger Richard (2013) in its work titled Book "Renewable Energy law and Development", the author focused on the case studies of some countries in Asia's Renewable Energy sector like China, Philippines, Brazil, Indonesia, Pakistan, and India's Biofuel policy. However, there was no focus on any other form Renewable Energy sources such as solar energy being theme of this research. Further the author has not mentioned about RE sector in Germany; which is the roadmap of present research.

3. Author Peeters M, and Schomeru T. 2014, in their book titled, "Renewable Energy Law in the EU: Legal Perspectives on Bottom-up

Approaches" emphasis on the legal frameworks on which all European Union states must follow and acts during Energy Transition under sustainable development. This book emphasis on the electricity generation from Renewable Energy but do not focus on energy efficiency and energy saving, which is a mandate under national renewable energy targets which needs to be fulfilled and mandate by renewable energy directive.

4. Author Rosencranz, A., Wadehra, R., Bhadauria, N., & Chitale, P. (2018). In his chapter titled, "Clean Energy in India, Supply and Prospects". In U. Tandon (Ed.), Energy Law and Policy, the author in this chapter has described the population of India at present, their energy demand, and the possibilities in the future with the present electricity sector of India. The chapter also talks about the Renewable energy target of India of achieving 175 GW by 2022 and reveals the deficit amount of electricity received in a day in India. The authors also speak about the promises given by India in the Paris Agreement and the challenges before it. The Author only criticizes the Government and its initiatives but not provided solutions for the development of the sector.

5. Author Upadhyay, S. (2018). In his work titled, "Renewable Energy Development in India, the need for a Robust Legal Framework" In U. Tandon (Ed.), Energy Law and Policy the author in these chapters like all other authors of different books and articles raises concerns about the proper implementation of policies, enhancement, and encouragement of the Renewable Energy sector in India. The author very consciously describes the Constitutional Validity of Renewable Energy wherein he lays down the fact that the Constitution under Art. 48-A r/w 51- A (g) and Art. 14 and Art. 21 lays down the provision under which the State is bound to protect the environment for future generations and lowers the current pollution levels through sustainable development. The author has also mentioned it clear that Parliament is competent enough to frame legislation for Renewable Energy as the scope and objective of RE are within its legislative competence.

6. The author Wani, M. Afzal in his work titled, "Humanity, Energy and Law Urgencies and Challenges" In U. Tandon (Ed.), Energy Law and Policy the author tries to make a connection between humans, Energy, and Law. Further Author tries to give recommendations that how a policy regime should be drafted while keeping in mind all three aspects and the balance between better development and fulfilment of SDGs because the future is Renewable only.

7. Naseem, M., & Naseem, S. (2021). International Energy Law (Monograph in the International Encyclopaedia of Law/Energy Law) (2nd edition). Wolters Kluwer.
Review: The author in this book pivot on the international scenario of Renewable Energy. It demonstrates different sources of Renewable Energy, the Power Purchase Agreements, their importance, and relevance in the Renewable Energy market. It also highlights the importance of the Feed in Tariff (FIT) policy that was adopted by the U.S. in 1970 and later in 1990 by Germany.
Literature gap: No feed-in tariff concept in India has been discussed.

8. Author Smail L., and et al. (2021) in their work titled, "The Law of Renewable Energy" under Chapter 5 Solar Power focus on the advantages and Disadvantages of using solar power to generate electricity and what are the technologies that are being used in the generation. Further, this chapter also emphasizes the different types of solar parks and farms that are to be installed for power generation. The literature gap in this book is related to legislation and policy guideline relating to solar energy, which is found missing in this book.

9. The author Martha. M. Roggenkamp of "Energy Law, Climate Change and the Environment," 2021, this book is a part of many volumes and covers the impact on the environment due to Energy generated from various types of conventional and non-conventional sources and gives a global overview. This book also gives an overview regarding climate change and its impact on existing energy law. This book also emphasizes the need for an amendment to the energy law globally and discuss some of the nations like European nation, Canada, the United States, Australia, Russia, and China. But this book does not cover Solar energy in India or Germany specifically which is part of this research.

Articles

1. The author “Eric Martinot, et al.” in the article titled “Renewable Energy Futures: Targets, Scenarios, And Pathways, in the year 2007”, this article mentioned statistics relating to the generation of electricity through renewables, but It doesn’t focus on the policies and Electricity Act, 2003.

2. The author “Ashwani Kumara, et al.” in the article titled “Renewable energy in India: Current status and future potentials” in the year 2010 focuses on the model to be adopted to increase the generation of electricity through Renewables and to minimize the cost efficiency of Renewable sources but doesn’t focus on increasing the growth of electricity production through renewables & the analysis of existing policies and the Electricity Act, of 2003.

3. The author “Ashok Rajkumar, et al.” in the work titled “Consolidated Renewable Energy – A Future Hawk-Eyed Energy in India” in the year 2011 inferred the evidence gathered from the last forty years of energy generation and its consumption, and analysed the evolution of renewable energy status in India and it also through light on energy status across the world, but this paper is focused on the production of Electricity through renewables and status in Tamil Nadu and is not focused on others state.

4. The Author Dhanasree Jayaram, in the article titled “Defence and Diplomacy in Pursuit of National Security India and China in the light of ever-growing requirements of energy, increase in population and disturbing signs of changes in the environment. The paper threw light on the various aspects of also analysed the possibility of cooperation and conflict between India and China in the field related to energy production and environmental protection.

This article has not focused on the implementation of policies in India.

5. In the article titled "Policy Monitor: Renewable Energy Policy in India: Addressing Energy Poverty and Climate Mitigation", in the year of 2013, the author focused on existing policies on RE in India where the first oil crisis and second oil crisis were discussed, and a comparison with China's existing policies.

6. In the article "Renewable Energy in India: Study of Law and Policy" written by Dr. Uday Shankar & Utpal K Raha in the year of 2015 discuss the policies pertaining of renewable energy in India, and this article they didn't discuss the concept and system of the feed-in tariff in India which is major policy initiatives to harness the solar sector and the benefits of promoting the solar energy sector.

7. In this author Ali Reja Osmani in his work titled "Conventional Energy to Renewable Energy: Perspectives for India" in the year 2016 focused on understanding India's growth in the renewable sector and examining the existing organisational setup and the policy initiatives by the government. Now it's high time to take proper initiatives to create interest among public to use renewable energy, but this paper did not focus on any critical analysis of the Electricity Act, of 2003 and its provision relating to RE.

8. The Authors Dr. B. Madhusudhan & G. Damodhar, in their work titled "Renewable Energy in India: Advantages and Disadvantages of Renewable Energy 2017" only focused upon the advantages and disadvantages of Renewable Energy but doesn't emphasize how to increase the growth of the electricity production through renewables and the policies on Solar and wind.

9. In the work titled "Renewable energy for sustainable development in India: current status, prospects, challenges, employment, and investment opportunities" in the year 2020, the author mentioned the RE sector which has suffered a lot in past years, because of improper structure, and due to no specific legislation for RE, many RE technologies have not been adopted. This sector needs robust legislation and investment by investors. This can be overcome by proper R&D in the said sector but for that, it requires enormous investment. This sector has a lot of potential, along with many challenges. Equipment is very costly if imported, but domestic types of equipment compromise with the quality but are cheaper in cost. So, reducing the cost of domestic manufacturing must be promoted and encouraged. As a result, many investors fear investing in the said sector.

10. In the work titled, "India: Energy Laws in India" in the year 2020 author's emphasis is on electricity generation from Gas and Foreign Direct Investment in the gas sector. Further, this article also emphasizes certain gas short-lived schemes initiated by the Government for lending gas power plants.

11. In the policy review titled "India, Energy Policy Review in the year 2020 examines all the energy policies' achievements in harnessing the energy sector and the challenges included in it while ensuring SDG. Further, this report also depicts the rise of the energy sector of India globally. In these years India has come to a top position globally in the energy market, though specific reforms are still needed in existing laws and the infrastructure.

12. In this article titled, "India to have 60 percent renewable energy by 2030" Power minister RK Singh, predicts that the 2030 target of 450 GW of electricity generation, India would achieve, and mainly it would come from RE, along with 60 GW which would come from hydro.

13. In the work titled, "Renewable Energy 2021 India" the author focused on Electricity Act 2003, and the policy regime on Renewable energy law is discussed. Apart from that, the author also discussed the renewable energy draft Act, of 2015, and emphasized coming up with separate legislation for RE.

14. In the work titled, "Tangled Wires: Preparing India's Power Sector for the Clean Energy Transition" in the year of 2021 the author's prime focus is on the dysfunction of Discoms and their irregularities. Further, this also talks about historical developments in the electricity sector that how political parties used electricity to lure their voters by giving free electricity post-independence. But when the demand started to increase then it became difficult for state Governments to provide free electricity and then they started forming policies and Acts i.e., Electricity Act 2003.

15. In this author Deepak Chowdhury and M Arun Kumar in their work titled, “Renewable energy regulations in India” in the year of 2021 focused on the existing legislation and policies in the electricity sector. They also emphasize about separate legislation for RE is required to meet future goals and to accomplish SDG number 7, but nowhere they have mentioned anything about enacting separate new legislation on RE.

16. Author Mayank Aggarwal, in his work titled, “India Proposes New Green Energy Rules to Promote Renewable Power” in the year of August 2021, the author talks about green energy generated from waste i.e., one of the forms of RE. But the problem in India is that waste generated by people is not that much quality to generate the maximum amount of electricity. This article to some extent also discusses the draft of the new Electricity Rules 2021 and the RPO.

17. The authors A. Bhargava, and K. Kochhar, in their work titled, “The Need for Legislation on Renewable Energy for Sustainable Development in India” in the year 2022 emphasis on the demand for separate legislation for RE. The author is not specifically focusing on Solar or specific schemes related to Solar power plants or Solar rooftops. In the article, the author also tries to compare with other countries like China, Germany, the U.K., and Australia where RE has specific legislation to deal with.

18. In the Work titled, “The Expansion Of Electricity Generation From Renewable Energies In Germany: A Review Based On The Renewable Energy Sources Act Progress Report 2007 And The New German Feed-In

Legislation”, the author Uwe Busgen provided an overview of the Progress in the electricity sector due to then amendment in 2008 and provides the supplement with the statistical data and research findings included in various publication from the Federal Ministry of Environment in Germany. The author concluded that the Renewable Sources Act, 2000 of Germany already proved its success at all levels in EU and Globally.

19. In the work titled, “A Success Story – The German Renewable Energy Act Turns Ten, in the year of 2010, the author appreciated Germany's renewable energy Act and the tremendous development in the RE sector and how its reduced GHG emissions by 40 percent by 2020 since 1990 through policies like Feed-in- tariff which was first incorporated in the Act of Germany. This policy helped in many ways for the growth of the RE sector and attracts directs investment.

20. In the work titled, “Green jobs? Economic impacts of renewable energy in Germany” in the year 2012, the author analyses the investment scenario in the Renewable energy sector in Germany. Along with the development of the Electricity sector globally. This paper analyses the impact of huge investment in RE on labour market in Germany. RE not only clean energy but also generate employment in the said sector. The Author tries to depict the data on employment generated through RE in Germany also.

21. Author Robert Wand and Florian Leuthold, in their work titled “Feed-in Tariffs for Photovoltaics: Learning by Doing in Germany” in the year of 2020 examined the possible outcomes of German policy for small roof-top solar PV systems installed in 2009 according to the Feed-in tariff. Further, engaging in a limited equilibrium approach, assessment of the Feed-in tariff policy by checking the benefits from induced learning and avoiding environmental externalities against the social costs of encouraging the installation of PV on residential rooftops, but this article failed to provide an analysis of the Renewable Energy Act, of 2000 and how it affects the significant growth of solar sector in Germany.

22. In the Energy Policy review titled, “Germany 2020 Energy Policy Review” the report, focused on all the sources of electricity which are assessed, like what is the percentage of electricity in the total mix. As per the data under this report till the year 2018, the total generation capacity through renewables is approx. 40 percent, which is a great achievement in the countries like Germany where the geographical conditions are so critical to get the proper amount of Solar radiation to generate electricity.

23. The Author Mendoza etal in the work, titled “An Analysis Of Electricity Generation With Renewable Resources In Germany” tried to forecast the balance between the Renewable energy Sources Act and Feed In Tariff Mechanism in Germany and their successful results to develop the RE sector without ignoring the other sectors. The States in Germany able to perform their role as regulator, and to meeting the demands of Electricity without hampering the promotion and efficiency of the sector.
This gives an impression to compare the FIT system in both countries India and Germany.

24. In this Author Philip Schnaars, in his work titled, “The real substitution effect of renewable electricity: An empirical analysis for Germany” in the year 2021 aimed at estimating the emission displacement effect of renewables in Germany for 2017. This analysis also calculates the foregone emissions savings due to grid congestion.

25. In the work titled, “German Energy Transition (Energiewende) And What Politicians Can Learn For Environmental And Climate Policy” in the year 2021 the author pointed out specific backdrop and barriers in Germany’s Energy Sector, whether it is environmental, or political. This author suggested that for better energy transitions every sector or market needs organizational arrangements with specific missions and objectives to analyse Sustainable development, provide proper funding to the new market players at least in the beginning, and provide financial resources available to all so that after a certain point of time it's become a good practice.

26. In the work titled, "Effects Of The German Renewable Energy Sources Act And Environmental, Social And Economic Factors On Biogas Plant Adoption And Agricultural Land Use Change" in the year 2021 author primarily focuses on the results of the EEG Act on the Biogas plant under RE which is more useful for farmers. Furthermore, to add more to the subsidy program, all future amendments in EEG to promote the small biogas plants, because previously these are unsuccessful in the 3^{rd} and 4^{th} amendments of the Act.

27. In the work titled, "What's new in Germany's Renewable Energy Act" in year 2021" the author focused on the 2021 amendment in the Renewable Energy Act Because, the Act made the solar and wind electricity important sources of generation in Germany, but it has many reforms as per the need of the hour and renewables become one of the cheaper modes and most of the citizens agreed to use it to meet energy targets. Further, in the new amendment Act, the Government has postponed many decisions for 2021, likewise, to meet the target of 2030 EU. But this amendment still lacks certain aspects like the abolishment of surcharge, and PPA must be framed to empower the wind sites.

1.1.5. Need For This Research

The current situation globally demands that developing nations focus on cleaner and sustainable energy systems, to avoid the problems like drastic climate change and hazardous environmental problems along with energy security in coming years as this challenge may result in the ceasing of life on earth for the coming generations. In any nation, development should be self-sustainable and not at the cost of the life and liberty of mankind.

The present research is stimulated because India is a developing country, which is populous and has diverse climatic conditions. The energy requirements vary with the density of the population with variable requirements and load conditions. Electricity is one of the vital sectors for the progress of the nation and is also a necessity for meeting the requirements of day-to-day life, it is of utmost importance to meet people’s demands without harming the natural environment, protecting the fossil fuels and in maintaining the safety and security of these sources of energy. To fulfil the country’s unstoppable demands for energy and power, the sources should majorly be utilised from the resources which can be renewed, and this step will help in maintaining a continuous flow of electricity, without hampering the environment and in maintaining ecological balance.

India being a tropical country is blessed with sunlight and this can be exploited to be used as the best available alternative to non-renewable sources of energy. The natural availability of this raw material, if adopted appropriately by the Government, will meet the country’s demands in an efficient and sustainable manner. The contra geographical nature of countries like Germany will make it easy to understand that with such limited availability of sun rays, the Government in Germany has converted most of its energy system to be based on solar energy which is tapped extensively from rooftop panels to generate electricity and using solar-based thermal heating systems.

The UN “Sustainable Development Goals” (hereinafter referred to as SDGs) have energy listed at the seventh position which stipulates the generation of clean and economical energy to be fit for utilization without harming the environment. The consensus amongst various stakeholders (the Governments of different nations and various international agencies) is that the changes in climate must not be grave in nature and efforts to save the earth from destruction from the enhanced levels of pollution.

The concern of rising levels of pollution has also been addressed in the Paris Accord which formulated the creation of the “International Solar Alliance, (hereinafter referred to as ISA)” which was jointly announced by Shri Narendra Modi, India’s Hon’ble Prime Minister and Mr. Francois Hollande, France’s former Hon’ble President, on Nov 30, 2015, at the “United Nations Climate Change Conference of the Parties” (hereinafter referred as COP-21) in Paris, France. This meeting also addressed the need for Solar Energy and the various challenges faced by the innumerable players in the solar sector, irrespective of the boundaries of participating countries. (Government of India Ministry of New and Renewable Energy, 2016).

The Governments of various member countries were requested to submit a blueprint for their plans for future investments in the Energy Sector and the road map for shifting from Non-Renewable to Renewable sources of Energy. This is a herculean task to ensure, as the necessity of proper investments earmarked by the various Government and other agencies are essential to cater to the growing demands of this sector. The private players involved in energy sectors in various capacities like the small or the large scale (on micro and macro levels) are also required to channelise their resources in order to aid their governments and to accomplish the energy security goals on a global level.

The Government resources are limited and therefore the necessity for channelizing the finances is essential in order to attract new players who are ready to invest in cleaner energy resources along with improving the existing transmission technologies.

This research is mainly emphasis on examining the Electricity Act of 2003 and the various policies framed that govern the renewable energy sector, especially the Solar Energy sector with a comparison to the existing policies and laws prevalent in Germany for the renewable energy sector.

1.1.6. Objectives Of The Research

- To identify and highlight the barriers to the development of the Solar Energy sector in India and suitable references from the policies and laws enacted in Germany.
- To identify the lacunae in the Electricity Act of 2003 & also to suggest amendments for the mandate, if required
- To suggest suitable enactment of policies and amendments in the laws for the better management of Solar Energy production and consumption in India.
- To understand and elaborate the captive generation and electricity production through renewable energy sources.

- To recommend procedures which help in enhancing independent electricity generation and utilization.
- To compare the prevalent laws of India with Germany in the field of electricity.
- To determine lacunae in the policies (State Rooftop Attractiveness index, Shakti Sustainable Energy Foundation, JNNSM, etc.) framed by the Government of India.
- To suggest modifications to the already established authorities.

1.1.7. Research Questions

- What are the existing legislation and institutional framework pertaining to the electricity (Power) Sector in India?
- Whether the Existing Legislation and policies are viable enough to promote and develop the solar energy sector in India?
- Whether the subsidies provided by the Government of India are enough for development to the Solar energy sector?
- What is Renewable Purchase Obligation (RPOs) and its Relevance in the Solar Energy Sector?
- What are the barriers cum challenges to the pertaining to the potential growth of the solar energy sector in India?

1.1.8. Research Methodology

In view of the objective of the research, the researcher proposes to adopt the doctrinal, analytical, critical, and comparative methods for carrying out research work. The methodology comprises the analysis of the laws, data, Policies, and the entire framework pertaining to solar power energy in the nation. In order to comparative analysis, the laws and the framework of Germany are taken as a benchmark. Solar energy in India has a diverse geographical area with similar conditions to that of Germany which will be suitable for solar energy expansion. Furthermore, the "Socio-legal Research methodology" may be adopted to find out a specific information pertaining to the solar energy sector in which Advocates, eminent academicians, and Industry Experts will be interviewed.

The Questionnaires will be framed for a better understanding of the basic problems in RPO for solutions to make it successful. Discoms play a vital role in the RPO because its mandate is on Discoms mainly. As the core of this research is around RPO, Discoms may be helpful to gather data by sending questionnaires to them.

Also, to identify the current status of Renewable Purchase Obligation secondary data relating to Targets Set by CERC and SERC for Renewable Purchase Obligation will be collected. This collected data will be used as the state of the effectiveness of RPOs in India and a comparative analysis with Germany.

This research will follow a deductive method of analysis and logical reasoning, which will help in the formulation of the conclusion.

To conduct this research and the issues raised, and to suggests examining the electricity regime in India including its historical development, which is mentioned in the subsequent heading.

1.2. HISTORY OF THE ELECTRICITY REGIME IN INDIA.

Electricity is the foundation of all current technological developments. The Electricity Act’s 2003(hereinafter referred as E-Act, 2003) unstated goals were to overhaul the power sector and unleash its potential.

Initially, the E-Act’s Objectives and goals are forward-thinking. The sector has grown over time, and the Regulatory Compliance Authority, Tribunals, and the Courts have provided clarity and resolved many concerns.

Nowadays, Electricity is the basic need of every individual, and without a proper power supply, no country can develop in the way it must. This may be checked for developing countries especially India, that aspires to have a more significant contribution globally.

The welfare state’s Duty towards their fellow citizens is to provide an uninterrupted or continuous electricity supply to all. Under the Constitution of India, 1950 which includes “electricity in the Concurrent list” (ENTRY 38, LIST 3 of Schedule 7) where the Union and the State both governments are empowered to frame laws. Further, it acknowledges the central and state Government's partnership in promoting energy. "Power For All" is a major problem to tackle for the Government and a significant opportunity for Indian industry (Power for All, 2021).

India has its first industrial hydropower plant was established in 1897, in Darjeeling (Anwar, 2022). Private electricity suppliers gradually handled electricity generation and supply, mostly in urban regions before 1947. The 'Electricity Act of 1887,' later replaced by the Indian Electricity Act (hereinafter referred as IEA, 1903) of 1903, was the first legislation adopted to govern the generation, supply, and use of electricity.

After enacting the Act of 1903, it was acknowledged as a preliminary step, and from 1903 to 1909, numerous practical, electro-technical, and commercial difficulties were realised.

The E-Act of 1903 was amended with necessary amendments in the 'Indian Electricity Act' of 1910 (hereinafter referred as IEA, of 1910). The IEA of 1910 formulated the ruling principles for its steady supply and usage. Because the sector was still in its infancy, it required massive investments, which are anticipated to be covered by private licensees. During the presidency, states like Calcutta (now Kolkata) and Bombay (now Mumbai) established electricity-generating plants. After Independence, electricity generation is to spread all over the states.

The Electricity Supply Act of 1948 (hereinafter referred as ESA, of 1948) was enacted, which replaced the IEA of 1910 which has more emphasised on the United Kingdom "Electricity Supply Act of 1926", which made compulsorily the constitution of State Electricity Boards (hereinafter referred as SEBs) in every State and Central Electricity Authority (hereinafter referred as CEA) at the Central level (Regulatory and Policy Environment, n.d.).

In these years the electricity generating capacity, the network of transmission lines, and the distribution of electricity to different parts all over the country's length & breadth, it has a significant development in the power (electricity) sector. However, over a period, many challenges emerged. The SEBs becomes financially ill and were overwhelmed with massive debts. SEBs debt crossed more than 1,00,987 crores as of February 28th, 2022, from other agencies, which impacted the financial capacity of SEBs (The Hindu, 2022). The Electricity demand and supply gap was humongous. The quality in terms of steady voltage, as well as the quantity of power in terms of uninterrupted supply, was poor. Because of the vote bank politics played by the politicians, many political parties like AAP, Samajwadi party, INC, and AIADMK announced free electricity to farmers, and for residential buildings up to 300 units for others. This Manifesto agenda always influence the will of the electorate to vote (The Hindu, 2022).

India's power sector desperately sought reforms and restructuring of the sector and required immediate action to be taken. Afterward, in 1990s reforms in the sector were started along with Private Sector, and to encourage electricity Generation, the Power Trading Corporation (hereinafter referred to as PTC) was set up for Power Trading. Before, the E Act of 2003 the last initiative was the "Electricity Regulatory Commission Act, 1998" (hereinafter referred to as ERC Act of 1998), to separate the Govt from Tariff fixation. "Central Electricity Regulatory Commission", (hereinafter referred to as CERC) was established by the centre and "The State Electricity Regulatory Commission", (hereinafter referred to as SERC) by the state to fix the tariff and make sets of provisions for the power sector under the 'ERC Act,' of 1998 (Chatterjee, 2020) and it provides an opportunity for all commercial entities to plunge into the market of electricity for generation and participation in all the areas of power generation to achieve the Government targets of giving electricity to its citizens and to fasten the nation's development instead of generating the maximum profits from the market.

Renewable energy power projects deserve special attention. These projects have a unique position in the market. After enacting both Kyoto Protocol and the Paris Accord, every nation has been concerned about shifting from conventional sources to non-conventional sources. This has helped to make non-conventional energy generation more appealing, along with earning crucial foreign reserves for the country.

In 2000, the very first time an initiative to enacting a comprehensive Act was taken. The Electricity Bill 2001 was presented before the House of the people (hereinafter referred to as Lok Sabha) on August 30th, 2001, after being redrafted seven times (Chatterjee, 2020).

But, due to a lack of consensus, again the Bill was return to the standing committee on energy for further analysis. On December 19th, 2002, the standing committee submitted its Recommendations. The Government accepted most of the recommendations and inserted them into the bill.

The Lok Sabha passed the reformed electricity bill on April 9th, 2003. But, in the Council of States (hereinafter referred to as Rajya Sabha), the members focused on certain anomalies in the Bill. However, due to urgency and the assurance provided by the government that all the amendments suggested by the members of Rajya Sabha will be to incorporate in the next session of the parliament, the Rajya Sabha also given its assent and passed the Bill on May 5th, 2003. Then the bill was sent to president for his assent and then it was assented by the President of India on May 26th, 2003. After that, the E- Act of 2003 was published in the gazette as notification by the Government of India on June 2nd, 2003. Then, Union Government enforced the Electricity Act, 2003 (except Section 121) on June 10th, 2003 (Chatterjee, 2020). With this all previously enacted Acts, likewise IEA of 1910, ESA of 1948, and ERC Act of 1998, were repealed from the legal framework of India.

The Act is responsible for the powers of the Chairperson of Appellate Tribunal constituted under the Act. Under Section 121 power pertaining to supervision and control on the state commission which includes the appointment and transfer of the member of the state commissions etc are provided. Further, this same power conferred by the Apex court of India in the case of *Power Trading Corporation India Ltd. V Central Electricity Regulatory Co.* (2006)**,** held that Section 121 of the E- Act 2003 used words like "orders," "instructions", or "directions" didn't confer the power of judicial review in the Appellate Tribunal for Electricity. The court further said that the bench does not want to interpret the said section in a way like English law because, in some cases in England, the power of judicial review is "expressly" mentioned in the Tribunals constituted under the Act.

But because of the amendment suggested by the state governments it was amended under the First amendment in E- Act 2003 which as follows.

"*The APTEL may, from time to time, issue such orders, instructions, or directions to any commission for the performance of its statutory functions under this Act, after hearing the appropriate commission (state electricity regulatory commissions or joint electricity regulatory commissions) any appropriate parties, or another interested party.*"

Following this suggestion, a suitable adaptation in Sec. 121 of the Energy Act of 2003 was also implemented. This chapter further aims to explore the prevalent international energy laws, constitutional provisions, and legislative development and culminating in the passing of the E -Act of 2003 and a review of the two decades of development in the electricity sector.

The E-Act of 2003 also marked a turning point for the electricity sector reforms and growth in sector and helped in increasing the generation of power in India. This masterpiece of legislation significantly reformed the sector in India.

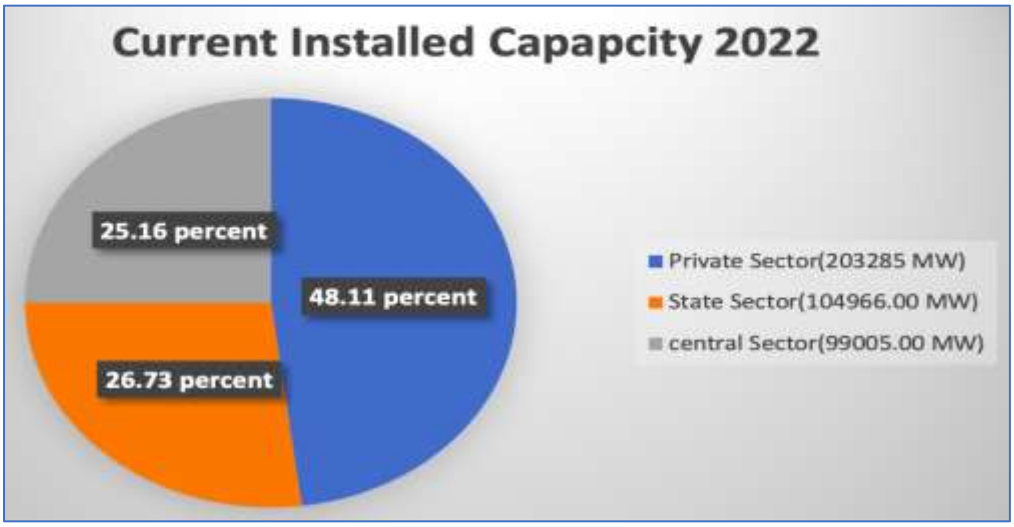
It is, therefore, necessary to examine the current status of electricity production through various sources by which electricity is produced are renewable and non-renewable sources like fossil fuels, i.e., coal and diesel. The quantum of electricity produced by all the major stakeholders and identified based on their sources and is differentiated in the following chapter. The endeavour is to find out about the available Petroleum substitutes like water or hydro or solar and wind apart from understanding the barriers posed by these policies and Laws governing the electricity sector in India with comparisons from inputs gained from the policies and other Laws prevalent in Germany.

1.3 THE CURRENT CAPACITY OF ELECTRICITY GENERATION

1.3.1 Present Electricity Generation.

As per the data released by the power ministry our nation's electricity generation capacity is around 4,07,797 MW (*Ministry of Power,* 2022.) as of 30th September 2022.

Figure 1.1 Current Installed Capacity 2022



The traditional thermal power generating plants (coal-fired) bestow with the highest share of 50 percent of total installed capacity in the sector with 2,04,709 MW (*Ministry of Power*, 2022.), and the other fossil fuels like gas have a capacity of 24,824 MW (*Ministry of Power*, 2022.), and diesel is of 562 MW, The nuclear power plants is 6780 MW, hydro 46,850.22 MW (*Ministry of Power*, 2022.), and Renewable Energy Sources (hereinafter referred as RES) is at 1,00,683.32 MW (*Ministry of Power*, 2022.).

The electricity generation capacity addition witnessed a -2.49 percent less due to the worldwide crisis of Covid 19. However, the Government has set a target of 15.21 percent for the year, 2021-22, and among all, the major development rate was from Renewable Sources (hereinafter referred as ORS) (24.08 percent) and Thermal Power (3.73 percent) (*Ministry of Power*, 2022.).

The Coal power plants generates approx. 70.83 percent of the total capacity of 267129 MW. But, Other renewable Sources (except hydropower) have a capacity of 58680 MW and a 15.56 percent share in total. The Hydropower and Nuclear both are accountable for 11.81 percent and 1.80 percent. Other power-generating entities are at 13.34 percent (50,289 MW) (*Ministry of Power*, 2022.).

1.3.2. Barriers in the Energy (Electricity) Sector

A. Barriers in the Non-Renewable (or Conventional) energy sector.

The Conventional source of energy is essential energy sources. From the rise of Industrialisation at the beginning of the 19th century, the sources of conventional energy were wood, natural biomass, and wind for marines. With the invention of steam engines, lignite was first used as an energy source and is still a significant primary energy source. Crude oil and its by-products like petrol, diesel, and kerosene became the most prominent source with the more usage of automobiles with internal combustion engines that required types of liquid fuels. But then, in the mid of 20th century natural gas has become a prime component in generating electricity and generating heat for commercial, and home usage (López, n.d.).

Coal lignite, crude (petrol, and by-products), and natural gas are all found so deep in Earth's core. It is created from biological processes in which organic materials mainly dead animals, plants, and marine organisms are under very high pressure and increased temperatures during earlier geological epochs for many years. It takes so many years to convert these fossils to become fuels. This is the reason they are referred to as fossil fuels. Universally, these fossil fuels have not accounted for a big part of electricity generation comparatively in the energy system; as per the data in the year 2019, Approximately 64 percent of our electricity was generated from fossil fuels (Ritchie, 2021). There are numerous reasons why this cannot be continued, even soon, as mentioned below. Nuclear energy, which accounts for 5.6 percent in total, and hydroelectric, account for the rest. Power generated from Wind and Solar in some nations has seen tremendous growth, but there are some countries where they have begun to start.

I. **FOSSIL FUELS**: Massive dominance of fossil fuels as a main source has several significant implications: They are, first and foremost, unequally distributed (*Distribution of Fossil Fuels | National Geographic Society*, n.d.). Two-thirds of known petroleum reserves, were available in five or six Middle Eastern countries, implying a level of reliance which is not particularly compatible with a reliable and uninterrupted supply. But natural gas is likewise available in that region, as well as in the Soviet Union, although coal is more uniformly dispersed over the globe (*Distribution of Fossil Fuels | National Geographic Society*, n.d.).

Secondly, these minerals are non-renewable in nature, and they were produced over a period of billions of years and are available in limited quantities. Crude as a primary source, that underpins the way of living in developed countries, could be a fleeting blip in humanity's history, lasting only approximately two centuries (López, n.d.).

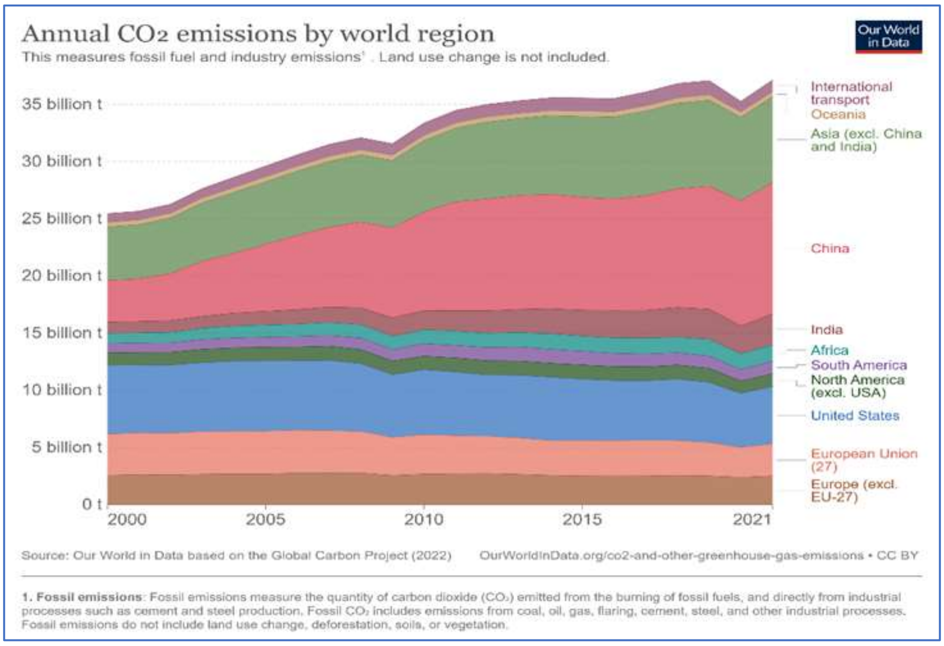
Thirdly, these raw materials are scarce in nature, and many debates are available about the amount of crude available for the next generations. Many experienced geologists and oil experts agreed on the fact that the oil consumption rate globally is no less than 97 million barrels per day (*Oil Consumption by Country 2022*), which depicts thousands of barrels of petroleum per second burned which means oil is enough for approximately 50 years.

The U.S., China, and India's total oil consumption is one-third of all the countries. These three have the largest population in the world except the U.S., a smaller number of people is accountable for the largest consumer in the world. It may be argued that the quantity of crude oil extracted is determined by the price and that production will have no practical limit if the price rises. However, this explanation ignores the reality that extracting petroleum from deeper or exhausted reserves requires more significant amounts of energy (exploration, pumping out, refining, and logistics). In mid of 20th century, the energy required to extract crude was approximately 1 percent of the barrel's quantity but now the cost of extraction has been increased between 10 to 15 percent.

If the energy required for the extraction of a barrel of crude oil is equivalent to 100 percent, then regardless of price, it will have ceased to be a primary energy source. At the same time, it may still be helpful in the petrochemical industry. According to the data, at the current consumption rate, proven Crude Oil reserves will last about 50 more years. In comparison, natural gas will last for 52 years (*World Natural Gas Statistics - Worldometer*, n.d.). Coal reserves will last approximately a century with the current consumption rate and unproven reserves (*World Coal Statistics - Worldometer*, n.d.). Though there will be discoveries in the coming future as well, then non-conventional petroleum derived from hydrocarbons distributed in “sand”, “bituminous schists”, or “heavy tars”. Still, the rising energy cost comes with a lower net yield and a bit high price. In any case, supplies will not abruptly cease, resulting in a drop in demand from current levels. Price increment will gradually increase, and a gradual decline in consumption and production.

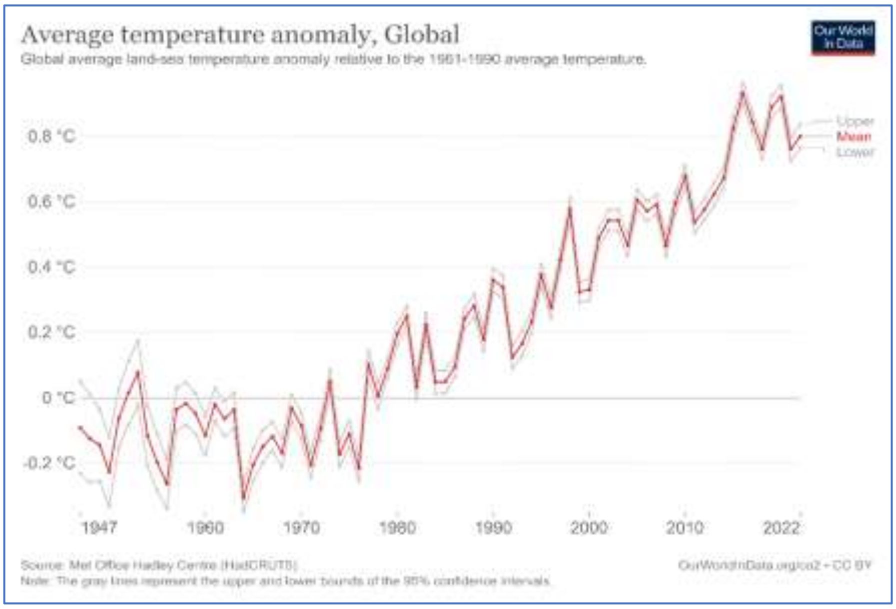
The burning of fossil releases massive volumes of CO_2 into the atmosphere. The below-mentioned **Figure 1.2** reflected Annual CO2 emissions globally from 2000 to 2021. Where China is in the top position and India is in the second position in terms of Carbon emissions.

Figure 1.2 Annual CO_2 Emission Globally From 2000 To 2021 *(Annual CO_2 Emission by World*, 2022).



This gas is responsible for the greenhouse effect, which results in Global Warming. This global warming affects life on earth and is dangerous for humans and animals (*The Greenhouse Effect and Our Planet | National Geographic Society*, n.d.).

Figure 1.3 Average Temperature Increase since 1947 to 2022 Globally (*Average Temperature Anomaly Global*, 2022).

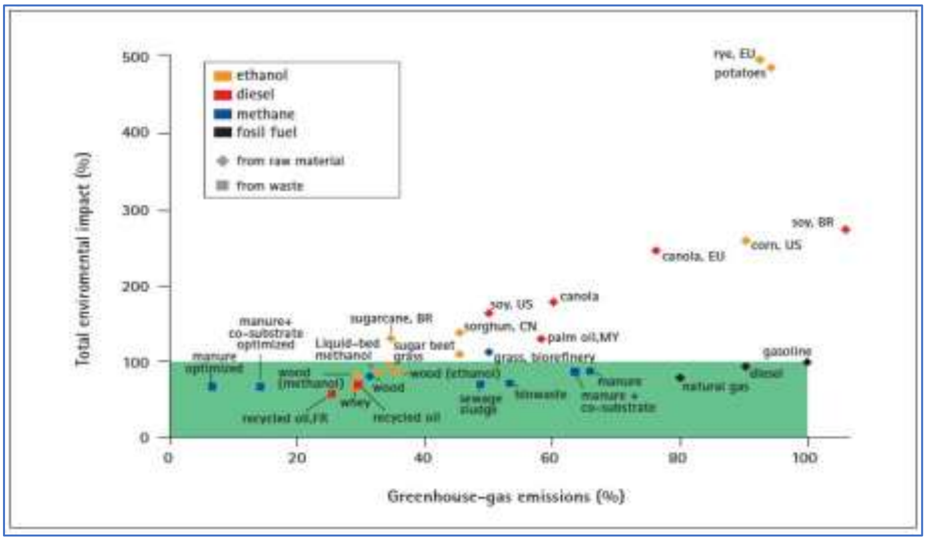


In this figure 1.3, it can be seen that the increase in the average temperature Globally from 1947 to 2022. The Upper and lower level in grey colour shows minimum and maximum temperature can rise and the middle level in red colour shows the average annual increased temperature.

From 1947 to now average 1-degree Celsius average temperature is increased globally. All GHG activities are the major drivers of this increase in temperature. This climate change impacts every sector like ecology, severe weather conditions, and severe impacts on human health. While exploiting these natural reserves, this must keep in mind that some limit must be there in our exploration of Non-renewable sources for our future generations and sustainable development as these are limited in nature. Nonetheless, coal will be a significant source of energy for many years. However, its exploration will only be accepted if the pollution it causes may be reduced by any technology, etc. As a result, the most challenging part is to reduce the electricity generation from fossil fuels and to fulfil the demand of people the alternative of coal must be generated in other forms of oils which are mentioned below.

II. **PREPARING PETROLEUM SUBSTITUTES** (López, n.d.): The Transport sector depends entirely on conventional fuels extracted from crude. Electricity Generation from coal and natural gas is very crucial, and very soon they would be replaced fully by alternatives fuels like Electric vehicles, Hydrogen use vehicles, Biofuel vehicles or vehicles that could use nuclear energy in the long run. But imagining alternatives to using conventional fuels for transportation is challenging. Firstly, the possible alternative is using biofuels like a blend of ethanol in existing fuels and biodiesel to partially replace conventional fuels. But blending of ethanol has its own challenges like the only material to make ethanol is corn (Skoufogianni et al., 2020), and wheat and barley are very less in total production. However, the prices of all have risen for these grains used in ethanol. But, 50 percent of bioethanol was produced by Brazilian sugarcane, and the sugar price has not increased. Secondly, producing ethanol by processing grains is a bad solution because it creates an unnecessary crisis for food from markets and poor energy yield. The reason is the amount of energy required to obtain one litre of ethanol from grains is more than that required to obtain it from Corn cereals (Skoufogianni et al., 2020). Usage of it is of no use in terms of energy point of view. Environmental concerns relating to the usage of water i.e., required for cultivating agricultural land are also a challenge (Zah, R 2007). The ethanol produced from sugar cane is comparatively more, because of its lignocellulosic biomass available in woody or herbaceous plants. This is known as second-generation ethanol and alternative to Grain and corn. All these conclusions can be seen in figure 1.2. (Zah, R 2007) and it shows the data about the consumption of fossil in growing, harvesting, pre-treatment, and other processes required to extract biofuels from different plant materials, as well as the overall environmental impact compared to the direct use of petroleum by-products.

Figure 1.4. Environment Impact and consumption of fossil in the production of biofuels (Zah, R 2007).



Thirdly, with the existing technology, it is very difficult to produce second-generation biofuels for the industry.

The cane ethanol and second-generation biofuels could diminish petroleum dependence in the transportation sector in the coming future, with the advancement of technology, but so far, it’s very challenging, and they could not entirely replace it due to the limited amount of tillable land and available biomass compared to that sector’s gigantic fuel consumption.

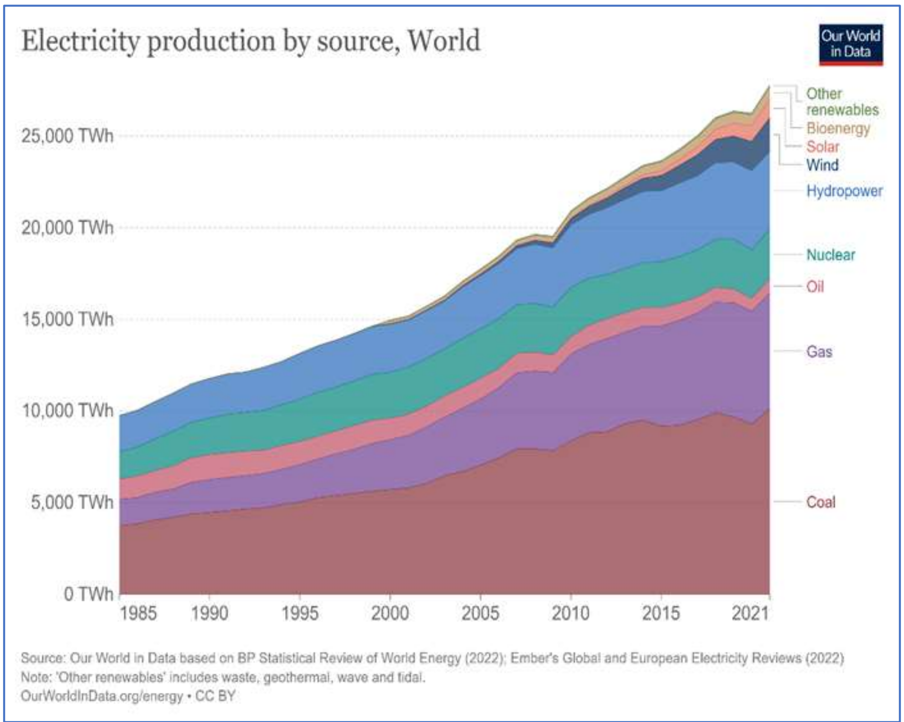
It is easier, at least in principle, to replace fossil fuels used to generate electricity resorting to renewable or nuclear sources than to find substitutes for every petroleum product. Thus, in the long run, it will turn to pure electric vehicles, starting with some hybrid engines and later fully electric ones. The problem that is still required research is the storage of electricity in a safe and cheaper way. The present batteries are inefficient and very contaminating for the environment if not dispose of properly.

In Energy, the more focus is on research on energy storage, be it electricity, heat, hydrogen, or any other form. Due to the future of the transportation sector and to mitigate the problems that emerged from the intermittence of renewable sources.

However, intense research is undergoing about new devices for storing electricity and allowing the production of electric vehicles with adequate performance in near future (López, C. n.d.).

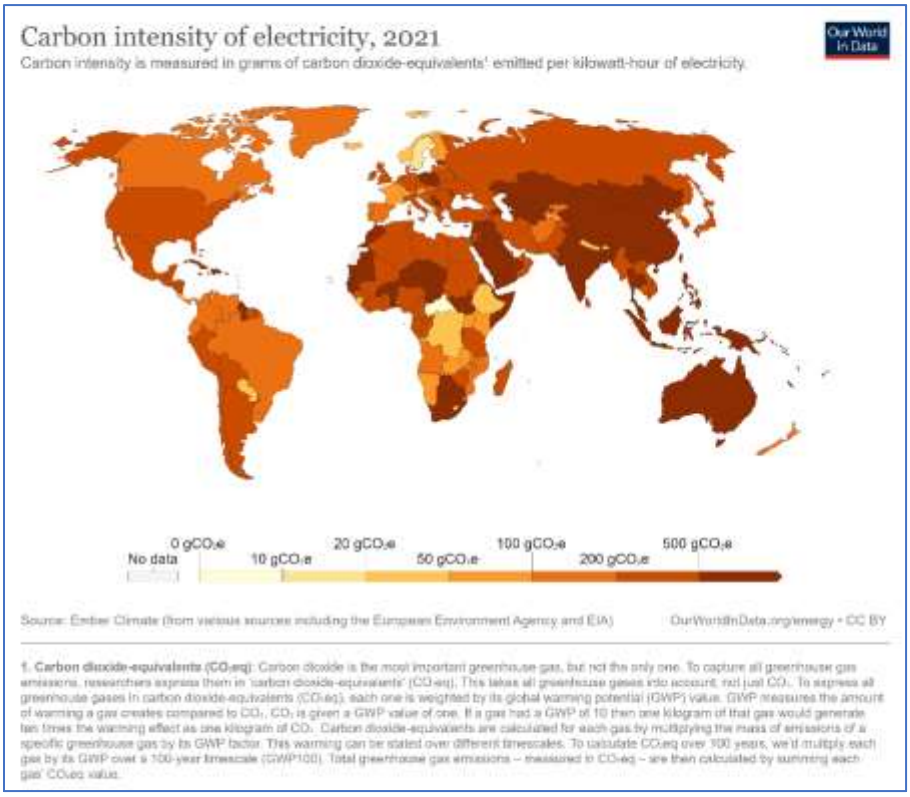
In other words, if this could be managed to improve electric storage technology (IEA Statistics; Club Español de la Energía 2008), which is a formidable challenge then the performance of a gasoline-based vehicle could be reduced and then an essential portion of future cars will be electric.

III. **CLEAN COAL:** The electricity production scheme varies from one country to another. In Figure 1.5, the data about the relative makeup of energy sources used to generate electricity in Spain, some other countries, and the world average (IEA Statistics; Club Español de la Energía 2008). **Figure 1.5 Global Electricity Generation Percentage From all Sources** (*Electricity Production by Source World*, 2022)



Coal is a very prominent and important fossil compared to others, it produces more carbon when burnt into the atmosphere per unit produced by gas, and more than 40 percent than gasoline.

Figure 1.6, Carbon Intensity of Electricity (*Carbon Intensity of Electricity, 2021*).



Carbon Intensity is the amount of CO_2 generated per unit of electricity. It is measured as one gram of CO_2 per KWH. The countries which have high electricity generation from high-carbon sources like coal will have high carbon intensity (*Carbon Intensity of Electricity, 2021*).

If no alternative to coal would be found in the future, then technology must be developed to remove or reduce the Carbon emission (CO_2), and other pollutants like sulphur must be reduced while combustion. This is Carbon Capture Storage (hereinafter referred as CCS) and is in its early development stage (Songolzadeh, 2014).

The CO_2 emission during coal burn could be captured through oxi-combustion techniques that enhance the components of the air which enter the boilers so that the gas emitted is mainly CO_2. This can be done through air-based combustion. Further, a way needs to identify to inject CO_2 either into underground or underwater deposits so that it will remain trapped there for centuries (Songolzadeh, 2014).

These Deposits formed naturally over billions of years. But these deposits could be used to inject carbon dioxide once the natural gas has been exploited fully. The same applies to exhausting petroleum deposits, sedimentary saline formations, etc. Across the globe many experiments have been conducted to store CO_2 in empty oil fields, to improve the production of oil, that would not be possible to extract by conventional methods (Songolzadeh, 2014).

In the North Sea around the Norwegian coast which is already a witness of disposing of carbon into deep seabed by mixing of salt and water in Sleipner gas field, methane, which is the main composition element of natural gas could be extracted through this method. Then the extracted gas could be processed again to separate the methane and CO_2 in refinery plants, then the extracted CO_2 could be again injected into the deep sea with a mixture of salt and water. This is being done since 1996. This process is added extra cost to the exploration of coal and other fossils, and that is recovering from the end user of the energy including the price of energy. Some experts predict that this cost could be increased from 30 percent to 100 percent by using non-CCS coal (Songolzadeh, 2014).

The conclusion is that humanity will not stop using such an abundant and widespread energy source as coal. However, its use has grave environmental consequences that must counteract with techniques such as CCS (Songolzadeh, 2014).

The following chapter deals with the challenges encountered by various stakeholders in various parameters which are based on different levels in terms of installation of solar power plants to maintaining the same along with shortcomings in the distribution and transmission of electricity so produced to the capital structuring to financing the project and in recovering the costings and charges as billed to the various users. The chapter also deals with various shortcomings in the field of finance, technology, environment protection, manpower, and organizational difficulties apart from land acquisition difficulties as faced by the producers or aggregators of the renewable energy sector in light of

Policies and Laws as framed by the Union and various State Governments.

B. **Barrier in Renewable Energy Sector in India.**

I. Policy regimes and regulation compliance Barriers

- The most viable and efficient policy and regulatory provisions/ framework are not presented in the RE sector. Moreover, when there is a need to encourage the growth of any technologies, policies may be developed accordingly for the growth of RE (Khare, V. etal, 2013).
- Each State's, regulatory provisions and procedures vary because Renewable Purchase Obligations (hereinafter referred as RPOs) are defined differently, which increases the risk of funding in the sector. Furthermore, these policies are only applicable for five years, and no framework for the biomass sector.
- In the Wind energy case, the wind developers received an incentive as Accelerated Depreciation (AD), and the results of it can be seen in India's wind energy sector. Many wind farm developers have installed wind farms only for tax benefits. Once the tax benefits were received policy could not provide any system for maintaining the wind farms and continuous production. The suppliers have no control, and they are liable for the development of wind power plants which includes commissioning, operation, and maintenance. Suppliers recover the cost from buyers and increased the cost, which leads buyers into a financial burden.
- Some buyers can also invest in some ready-made projects, but this is nothing just a honey trap in which customers fall to save some tax. and foreign investors are hesitant to invest.

Every state formulates its own regulatory policies. The targets of the RPO mentioned in the policy stipulated in the regulatory framework for various renewable sources are not specifically mentioned. RPO is not enforced on open access (OA) and captive consumers.

- RPO aims and requirements are unclear, and the RPO compliance cell only began collecting monthly compliance reports and dealing with non-compliance issues with appropriate authorities.

- Penalties for non-fulfilment are not mentioned in some states, and where it was mentioned, there is no proper implementation, and only two, Maharashtra and Rajasthan, have penalty structures for failures.
- RPO aims and requirements are unclear, and the RPO compliance cell only began collecting monthly compliance reports.
- The regulatory structure does not make the parameter used to determine the tariff transparently; hence many SRECs have set a rate for a limited time. The Feed-in- Tariff (hereinafter referred to as FIT) is only valid for five years, which impacts the project's bankability.
- Many States Electricity Regulatory Commissions (hereinafter referred as SERC) have yet to elect to adopt the Central Electricity Regulatory Commission (hereinafter referred to as CERC) tariff, as indicated in regulations dealing with tariff terms and conditions. The SERCs are considered the plant load factor (hereinafter referred to as PLF) because it varies by region, location, and technology. The current structure is insufficient to address these concerns.
- Because renewable generators cannot sell power to commercial consumers, and sale to the third-party are not permitted.

II. Organisational Barriers

- The organisation and agency investors who are ready to work according to the conditions of Ministry of New and Renewable Energy (hereinafter referred as MNRE) need better inter-institutional coordination. The disparity between cooperation and coordination delayed the limits of progress in RE. The delay in implementation due to disparity decreases investors' interest in investing (Khare, V. etal 2013).
- Some States have deficiencies regarding the Pre-feasibility, that affect the small generators, ready to install the RE projects.
- Manpower in different organisations and departments is not sufficient.
- Deficiency in necessary and equipped infrastructure research centres for the growth of renewable structures is also a significant problem.
- No help in terms of proper guidance for developers regarding renewable developments is not accessible.

- No proper quality check institution and laboratories are available to certify the technology used in the sector.

III. Financial and fiscal Barriers (Khare, V. etal 2013).

- Some financial restrictions, such as endowment division and finances, are time restricted to complete the prerequisite of development of the RE sector.
- The capital costs linking RE projects to fossil is very high which leads to a financial burden.
- There are many deficiencies regarding the calculation of the value of resources, poor technology, and major-risk insights that head towards the financial challenge to the inventors.
- The Translucency of subsidies and incentives is not there, resulting in a sharp drop in tariffs.
- High risk is noticed and felt by the investors as there is a reduction in gross returns by this sector despite these returns being high comparatively among the market standards.
- Very few developers wanted to install RE projects. New developers don't have sufficient finances which are needed for the development. It was even considered risky by the creditors and financial institutions, who were also not ready to provide monetary support.
- If the presentation of low-performance projects faces fiscal hindrances, they peril the deficiency of backing of renewable projects.
- Banking organisations lack confidence in the RE projects, that imposed financial burdens.
- Many times, SERCs won't release the payment timely to the developers, which imposes a financial burden on domestic and small developers because money lenders secured a guarantee on the loan.

IV. Open Market Barriers (Khare, V. etal 2013).

- Subsidies are adequately released for using the Non-RE sources, that gives the wrong message to the developers that electricity generated from Non-RE is of a higher priority than renewables.

- In India, the RE markets are divided into four groups, the Government market, the Government-driven market, the loan market, and the cash market.
- In Biomass, there is a demand-supply imbalance in the biomass market, which leads to increased cost in biomass prices because supply is unreliable, and the cost variation is incredibly more. The types of biomasses are different in every part of India, so demand and cost are too high.
- Cost-plus methodologies to compute the cost of RE (includes cost of material, labour, and product overhead). That does not include environmentally sustainable costs and ecological benefits of cleaner and greener energy.
- With poor infrastructure and a lack of grid integration, SERCs cannot use all generated power to meet the needs. This impacts the RE project, and the SERCs are bound to purchase electricity from neighbouring states to fulfil requirements.
- The Transmission lines cannot be extended every time and are not possible and suitable for economically small-size projects.
- There is a gap in transmission, distribution CapEx plans, and distribution licenses for renewables under the E- Act, 2003. Electricity transmission infrastructure for RE is not a part of the plans.
- The cost of RE projects is still increasing even with the advancements in technology. The total cost added by the developers and suppliers is very high due to exports, inadequate built-up capacity, and cartelisation of suppliers to control the prices.
- Non-availability of Land for installing wind and solar power plants is also one of the significant barriers in the sector, resulting in no proper electricity available in many states.

V. Technological Barriers (Seetharaman, etal 2019)

- Every installation of renewable projects needs environmental compliance because it contributes to the risk of some challenges, natural disasters, equipment failure, and profit loss.
- MNRE issued the channelisation of renewable energy projects policy (testing, standardisation, and certification). They are still at an elementary level as compared to international practices. Processes for quality assurance are still

in their infancy. Each renewable energy achievement is built on solid action plans for performance criteria, testing, and certification.

- It is critical to ensure the quality and reliability of manufactured components, imported equipment, and subsystems; therefore, quality infrastructure should be built. Testing laboratories, referral institutions, review mechanisms, inspection, and monitoring are all covered by no specific document.
- There are few RE centres for R&D. to reduce the subsidies and investment in R&D are missing. For technology, the Government is reliant on international sources. Spare components are scarce because they are not manufactured locally (Seetharaman, etal 2019).

VI. Awareness, full-skill training, and education, Barriers (Seetharaman, etal 2019).

- An appropriately Skilled and trained person is not available in the RE sector.
- During the establishment of any project/application, the proper follow-up to the project or support of the skilled workforce is required for maintenance.
- There is a gap in the distribution of knowledge and promotional programs about renewable energy, and no awareness activities are accessible to the public. Knowledge about the technologies is necessary to procure large tracts of land to construct electricity from a renewable energy plant. Further, Indians used the land for agriculture, and people were not ready to give their land to any power plant.
- The weather influences the renewable energy sector, and people are less interested in renewables as the weather changes.
- The technology is costly in the RE sector, and per capita income in India is very low, and most people find it more cost-effective than conventional energy sources.
- No proper electricity storage system increases the cost of RE

- Many times, people have yet to understand the advantages of using RE and generate negative perceptions of the same because of awareness and lack of information.

VII. Environmental Barriers other than Solar Energy (Seetharaman, etal 2019).

- Onshore Wind Turbines require space for installation, and when one or more turbines are installed, space and proper distance should also be Maintained from each turbine for practical work. This requires more area, including roads and transmission lines.
- In Offshore winds, the blades and turbines are more giant comparatively than onshore, and therefore require much area. Further, Offshore wind turbine installations impact marine life and activities.
- The Wind Blades and turbines also harm wildlife like birds and bats due to collisions and air pressure variations caused by wind turbines and wildlife habitat disruption.
- Wind turbines generate unpleasant sounds (aerodynamic, mechanical), and have aesthetic effects (*Wind turbine regulations*, n.d). Turbine developers are behaving unethically when it is for public issues and must adhere to noise regulations. Furthermore, there is a gap in surfaces and sound and usage of low-quality absorbent. The developers while installing Wind power do not consider the environmental impacts caused due to shadow flicker effect (*Wind turbine regulations*, n.d). The shadow flicker effect is a time when the sun is low on the horizon and shines through the rotator of wind turbines which makes a moving shadow of it. This is seen as a flicker because of the moving blades of turbines (*WIND Exchange: Wind Energy Projects and Shadow Flicker*, n.d.).
- Wind turbine material manufacturing, transportation, on-site assembly, operation, maintenance, dismantlement, and decommissioning is related to global warming.
- Commercial solar energy projects need more land areas, which leads to land deprivation and environmental loss.
- The components in the manufacturing of PV cells are hazardous in nature like 1-1-1 Trichloroethene, HCL, H_2SO_4, N_2, NF, and acetone. Workers

face very difficult and risk their life while working in the manufacturing industry.

- Disposing of manufacturing wastes is again a challenge. Precautions to use hazardous substances like cadmium—telluride, gallium arsenide, and copper-indium-gallium-diselenide, are missing, if not disposed of properly these create many threats to the public and the environment.
- Turbines used in Hydropower plants also disturb the marine environment and create pollution. Those blades damaged the aquatic lifecycle (like fish and other Aquatic organisms).

The following chapter is based on due deliberations and understanding of the various laws and policies governing the solar energy sector which are prevalent in Germany. The chapter also deals with the challenges and shortcomings in this sector which act as barriers to enhancing the development and accelerating the progress in the utilization of Solar Energy. The policy changes which are suitable for Indian conditions and the drawback of weather-related shortcomings in the solar sector are also mentioned in this chapter. The advancements in technology which is also act as a barrier to smoother functioning in this sector are also dwelled upon in the below-mentioned chapter.

C. Barriers In the Solar Energy Sector In Germany

Some of the barriers in the Solar power sector in Germany have been identified and are mentioned hereunder.

I. **Land Acquisition:** The Installation of Photo Voltaic (hereinafter referred as PV) Panels on land is very critical because acquiring land in Germany is again a big challenge for new commercial plants. And only a few citizens agreed to give their land for PV installation (Wirth, 2021).

II. **Technological Barriers:** The theoretical potential of utilisation is considered with respect to technological advancements. Germany is importing huge number of PV from Asia, i.e., around 80 percent. these imported panels cost around 50 percent of the total cost of solar power plants (Wirth, 2021) and the cost of electricity generating would also increase.

Initially at the beginning of electricity generation from renewable was very high and not affordable. But then the Government of Germany started manufacturing of PV and started importing from Europe. Europe has many patents and technological leadership in manufacturing solar PV and that makes its position strong globally (*Solar Production in Germany*, n.d.).

III. **The Economical Barrier:** Economic potential is considered as a major challenge in Legal parlance and R&D activities (Wirth, 2021). Germany has spent around 1.2 billion euros in R&D Activities, and 86 million is on Solar PV research. And Europe is forced to promote the Euratom program which emphasis hybrid research on all (*Solar Production in Germany*, n.d.).

IV. **Environmental Challenge**: CO_2 Emissions from the usage of conventional sources is a problem for all. And it can only be controlled by more usage of Renewables for electricity generation. Germany is currently planning to reduce its Carbon emissions by around 80 to 95 percent by 2050 (*Solar Production in Germany*, n.d.). But this cannot achieve with the current technology and usage of importing Solar PVs.

Germany's Renewables policies have influenced many nations on a global scale. The policy developers in Germany are a guiding force for developing nations worldwide. The EEG is one of the best examples and its effects are closely scrutinised by most nations. After decent growth in the electricity sector in Germany, there are still many a barrier which needs to be removed for further enhancements of the solar sector.

India, on the other hand, is a tropical country where there is an abundance of sunlight in almost all the corners of the country throughout the year and most of the time. The bureaucratic and legal compliances along with meeting environmental sustainability is a major criterion for the rapid development of the Solar Energy Sector in India. The below-mentioned chapter traces the development of the Solar Energy sector in India in a brief manner depicting the rise of an alternate source of Energy which is in a virgin state at the moment.

1.4. A BRIEF OF SOLAR ENERGY IN INDIA.

In India, since ancient times, the "foundation of life on Earth" is given by Sun. Many religious scriptures evidence the power of the sun in different forms. Industrial civilisation gave us the thought of using 'sunlight' as a form of energy foundation for producing Electricity. A country like 'India' is highly equipped in terms of solar energy potential. However, due to a lack of technology and development in the solar sector, it was not exhausted as expected. Land surface obtains around 5,000 trillion kWh of radiation yearly, and many provinces get 4 to 7 kWh per sq. m daily. Power from Sun through PV may be used efficiently in India, consenting for large scale. Solar energy may also produce power dispersed, allowing for speedy volume expansion with petite lead periods. Off-grid regionalised, and tender programs may help electrification in rural areas, where 'grid power' is either not available or reliable, to fulfil demands in rural areas and uninterrupted supply. Solar Energy, regardless of conventional or non-conventional sources, is the safest, most viable source of energy security, because it's easily available. According to the study, if the existing electricity infrastructure is improved then a small portion of solar radiation received may fulfil the country's demand (*Current Status | Ministry of New and Renewable Energy, Government of India*, 2022). There has been tremendous growth in the 'Solar Sector' in India. Many people in India have gained profit from solar energy-based plants that fulfil their essential energy requirements for cooking, to run household equipment and other demands in an eco-friendly way. The advantages of clean fuel also include social and economic benefits, with a lessening in drudgery among women and young girls in rural areas who collect wood-based fuel for too long and use it for cooking in a smoky kitchen. Using clean fuel reduces the risk of lung contraction and eye infections, and creates employment at the village level, improves the way of living, and increases economic opportunities at the village level (*Current Status | Ministry of New and Renewable Energy, Government of India*, 2022).

The solar sector of India has become a prime player in grid-connected power generation capacity across the globe. It promotes the Govt. schema for the long run and establishes it, as an essential contributor to meeting the demands and ensuring energy security.

The "National Institute of Solar Energy" (hereinafter referred as NISE) predicted that India's solar potential to be approx. 748 GW through solar PV modules covering around 3 percent of the wasteland. Harnessing Solar is the primary mission of India's "National Action Plan on Climate Change" (hereinafter referred as NAPCC), with the "National Solar Mission" (hereinafter referred as NSM). On January 11th, 2010, the NSM was launched. The NSM is a significant aspect of the Indian Govt., along with the prominent participation of all the states, to encourage environmentally feasible ways and addressing the India's energy security.

The status of a must-run Solar power purchasing guidelines based on a tariff-based competitive bidding process, Deployment Standards for Solar Photovoltaic Systems, and Devices Guidelines for rooftop solar and for the development of smart are available.

The New Building code was amended to make rooftop solar mandatory for new construction or structures with a higher Floor Area Ratio and the condition of solar infrastructure.

Further, to harness and promote financial institutions, raising tax-free solar bonds, Providing long tenure loans from many agencies, etc.

The following chapter deals with the development of the energy sector in Germany with a focus on the Solar Energy sector in Germany. It's also tracing the origin of development, regulation, and steps undertaken to promote the energy sector. This further highlights the proactive steps undertaken by the Government in Germany for promoting the achievements of this sector in the areas of the solar energy sector.

1.5. A BRIEF OF THE SOLAR ENERGY SECTOR ALONG WITH AN INTRODUCTION TO THE ELECTRICITY GENERATION SECTOR IN GERMANY.

A significant portion of the electricity market in Germany is by the private sector. Both conventional and nonconventional methods of electricity generation. The cost of electricity also depends on the source, charges, and tax imposed on electricity generation. As per the latest statistics, the electricity generated from non-renewables is accountable for 56.2 percent and renewable is accountable for 41 percent (236 billion kWh), and 2.9 percent from other energy sources (*Gross electricity production in Germany from 2019 to 2021,* 2021). Fewer generating companies are producing electricity through conventional methods; otherwise, a significant portion is from renewables. Some captive power generation is also there in Germany, depending on the user type. Industrials installed some gas plants to produce electricity, and domestic users installed rooftop solar panels. The key benefit of this method is that the electricity is provided for exchange, or some end users to corporate directly.

Some generating plants are kept as reservoirs for future use for dispatch services. The transmission grid of Germany provides electricity to neighbouring countries through cross borders connections; because of this, Germany can sell the electricity to foreign consumers. Further, some power suppliers also sell electricity to significant corporate users. Power-generating companies and suppliers both compete with each other. Because of this, transmission and distributing companies always monopolise the electricity market and require it to be regulated through laws.

1.5.1. Government Of Germany Policy Initiatives

The Energy Industry Act of 2005 is aimed at continuous, cheaper, & user-friendly electricity supply to every user in Germany. This Act is the Magna Carta of the Electricity sector in Germany. This electricity industry requires segregating the sector as per the sources of electricity. This also emphasises statutory regulations to generate electricity from renewable sources to the grid and construct smart grids for electricity reserve. This need was realised, and the Act was amended in the year 2012 to fasten up the process and expand renewable energy sources. The focus is on bringing the system change along with the Offshore Grid Development Plan's expansion with the help of the Offshore Grid Development Plan. This will help to improve the coordination between grid connection and offshore wind farms (*Energy Industry Act (Energie-Wirtschafts-Gesetz)*, 2022) Further, a compensation regulation for building and operating of grid to offshore wind farms was announced.

1.5.2. Current Scenario

The growth in the electricity sector has shown remarkable development in past years. From the last 12 months, the followings are the trends in the electricity market.

The legislature of Germany proposed a necessary amendment to the Renewable Energy Act (Erneurbare-Energien- Gesetz 2021) in 2021. This Act aimed to be greenhouse gas neutral till 2050, increase the share of renewable energy in Germany by at least 65 percent before 2030 and increase volumes concerning the sector premium for solar. Further, this amendment announced a "National Fuel Emission Trading System" from January 2021 under the Fuel Emissions Trade Act (Brennstoff-Emissions-Handels-Gesetz).

The Government is providing subsidies to transmission system operators of EEG accounts, which decreases the surcharge (*Energy Industry Act (Energie-Wirtschafts-Gesetz)*, 2022).

1.6. CONCLUSION

In India, primary sources of electricity generation are conventional sources like coal, oil, and gas, which are non-renewable in nature. The problems, which are faced by innumerable stakeholders and the resolutions attempted by the Government to overcome these issues and problems. The chapter also focuses on the challenges faced in the Electricity sector irrespective of the source of electricity generation from Non-Renewable energy or Conventional sources and Renewable Energy like Hydro, Wind, and Solar in India.

This chapter introduces the development of the Electricity sector in India and gives the history of legislation in the field of electricity in India ever since the inception of the Electricity Act which is nearly a century old (1903). The usage of electricity, which is not treated as a commodity and is now an essential product for living and carrying out day-to-day activities, that too 24x 7 x 365. The electricity demand is very high and in summer, it sometimes goes beyond its generation capacity. These challenges cum barriers are the reasons why the electricity sector of India has still not developed so far to fulfil its demand. Those barriers are pointed out in these chapters. This study is a comparative study with the existing system in Germany, where the weather conditions are critical to use renewable energy as a source of electricity generation. The Germans are however, still managing to generate about 40 percent of electricity through renewables and more from solar only. This chapter also focused on the primary legislation in Germany to deal with renewable electricity and promote harnessing the renewable energy sector in Germany.

CHAPTER 2

2.1 GLOBAL SOLAR ENERGY SCENARIO

2.1.1. International Conferences to Harness Renewable Energy.

The "Conference on the Human Environment," also identified as the "Stockholm Conference" by the U.N., which was held in 1972 in Stockholm, Sweden. This conference on environmental issues was the first conference in which the prime emphasis was on the importance of the environment in the nation's development. The guidelines and principles were laid down in the meeting for the preservation and protection of the environment.

United Nations Environment Programme was created after due deliberations in the Stockholm Conference, which alone dealt with challenges faced by the environment and the associated hazards. The Supreme Court of India also illustrated these principles in the famous case of *Essar oil Limited V. Halar Utkarsh Samiti and Ors* (1996) holding that the Stockholm Declaration is the most prominent document for protecting the nature and environment. This debate in the year 1987, again ignited the talks on the protection of the environment jointly by all the member nations as per the Brundtland Commission report.

In the year 1992, a good twenty years of the Stockholm declaration, a summit congregated in the city of "Rio-de- Janeiro", Brazil, which was recognised as the "Earth Summit", where the U.N. asked the Governments of different nations to reconsider the economic progress and to look over on other ways to protect the environment from the various pollutants and safeguard the natural resources from extinction. This Summit resulted from the deliberations that were initiated in December 1989. The knowledge to implement the strategies was given to the representatives of all the member countries of the U.N. which resulted in formulating twenty-one agendas critical for protecting the environment during the first Earth Summit. This Agenda-21 was a diverse plan which was to be adopted domestically and implemented universally by the member states and different institutes of the U.N., along with Major Environment Protection associations implemented the principles of Agenda-21 in every affected part where humans had polluted the environment drastically. This Agenda-21 was adopted and ratified by the 178 Governments of member countries during the “Earth Summit”.

The ‘Commission of Sustainable Development’ (hereinafter referred to as CSD) was also constituted for the proper implementation of the various agendas of this agreement at all levels. A five-year progress report was also prepared in 1997 by UN General Assembly to maintain a vigilant eye on the progress of Agenda-21 which required protecting the environment through Trans-border collaborations and having global consensus to help and aid domestic plans for ‘Sustainable Development’. This plan was designed to boost, support, and augment the national sustainable development programs and goals. It also urged all the member countries to improve, maintain and manage the ecosystem and take shared responsibility across the borders for sustainable growth in years to come.

The Rio Declaration (1992) covered 27 principles of collaboration amongst the member countries, in which the said declaration stated in Principle 3 *“The right to development must be fulfilled to meet developmental and environmental needs of present equitably and future generations*” (Rio Declaration, 1992).

The declaration further stated in ‘Principle 4’ which was about “*in order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it*” (Rio Declaration, 1992).

These principles had yet to achieve their projected success due to diverse reasons which were again laid down at the next Global Conference held in Johannesburg in 2002. The Sustainable Development Goals (hereinafter referred to as SDGs) were established in the year 2012 due to the combined efforts of the United Nations Conference on the topic of Sustainable

Development which was held in Rio de Janeiro to define universal goals which can address the world's concerns on an urgent basis.

As an outcome of this conference, the United Nations Environment Assembly formed a committee to make decisions on the environment on a global scale, This assembly started meeting at regular intervals to frame global policies and international laws for protecting the environment (United Nations, n.d.). In the year, 2013, before the deadline to achieve the Millennium Development Goals (hereinafter referred to be termed as MDGs). A special event was organized in New York, to decide on organising a global-level Summit meeting which was held in the month of September 2015. In this summit, it was decided to adopt a fresh set of goals which would be built on the fundamentals which were laid by the MDGs, and this issue was agreed upon by all the member states (United Nations, n.d.).

The emphasis changed from the MDGs to the SDGs on a global scale and was accepted universally, which gave the UN more confidence in borrowing a more comprehensive SDG (*Millennium Development Goals (MDGs)*, 2018). The MDGs successfully provided for advantages to more than a billion people to come out of severe poverty, it reduced child death rates, improved children's education, and reduced HIV infections (*Millennium Development Goals (MDGs)*, 2018).

In the year 2015, the "Summit on Sustainable Development" introduced "Agenda 2030" with "17 goals" along with "169 Targets". The various SDGs came into effect from the month of January in the year 2016, with the focus to attain the set targets by 2030. The help provided by various Government agencies, commercial players, and civil society along with United Nations Development Program (hereinafter referred to as UNDP) is responsible for implementing the SDGs, in a presence of one hundred and seventy nations and all the territories (United Nations, n.d.-b). These SDGs are to accommodate for the next 15 years.

The Seventeen sustainable goals (NJ MED, 2022) are mentioned below:

1. Eradicate poverty globally.

2. No hunger, to attain food security for all, and better-quality nutrition may be available in all countries.

3. To commit well beings and a healthy environment at every level.

4. To commit equality to value Education and ensure lifelong learning opportunities for all.

5. To treat everyone equally irrespective of their Gender.

6. For Providing proper water and sanitation for all is necessary to ensure Goal-3.

7. To provide energy security in affordable and sustainable manners for all.

8. To ensure steady economic growth for all nations and availability of skilful and employment for all.

9. To develop infrastructure and to promote sustainable industrialisation.

10. Create equality within and among the nations.

11. Make cities safe to live in and sustainable.

12. To make justifiable consumption and production.

13. To combat climate change and take steps for preventing measures

14. Sustainable use of marine, sea, and ocean resources.

15. To Protect and restore life on land and protect biodiversity.

16. To spread peace and creation inclusive associations and provide “Access to Justice for All” and develop efficient, responsible foundations in all sectors.

17. To give strength to the partnership for sustainable development.

The mentioned goals are related to energy consumption in the world, with Goal numbers 3,7, 9, 11, 13, and 17 highlighting the ways electricity is generated and in what ways it is being consumed. The plans will have to comply till the alternative conventional source of energy is exploited (United Nations, n.d.-a). The Goal number-7 emphasises providing energy security affordably and sustainably for all. The objective of the Goal number-7 was to ensure that mankind has access to cheaper, reliable, dependable, and environment-friendly green energy facilities by the year 2030. Further ways to enhance the share of renewable energy in the global energy mix were prohibited. The international collaboration with the help of technological innovations in the power sector needs to be improvised to get the maximum output without any extra burden of pollution which enhances and encourages investments in the energy infrastructure and helps in the production of cleaner energy (as referred in *Malaysia Energy/Electricity Supply, Team Members: - Coggle Diagram*, n.d.).

India is a developing country and the other developing countries, it is therefore critical to enhancing the capitalisation and usage of concerned support programs till 2030 (*Sustainable Development Goals | United Nations Development Programme*, n.d.). India, being a signatory of SDGs also has an additional responsibility to develop and promote the usage of RE (Solar and other sources). The UNDP promotes small private ventures for enhancing the usage of solar energy which is critical in fulfilling these goals (as in *Sustainable Development Goals |under United Nations Development Programme*, n.d.).

The ever-rising energy requirements create a huge burden to promote sustainable growth, which is enormous because of the huge population India has and because of the lack of fossil fuel reservoirs. India being a signatory to various agreements needs to promote the usage of renewable energy, especially solar energy.

With this it is concluded that in India, there is no specific policies and laws for regulating Renewable Energy production, distribution, and storage. The lack of a robust framework translates that only international conventions and treaties would be referred to for any development. In this following chapter, all the relevant policies are discussed to understand the role of these conventions and agreements in the development of the RE sector in India.

2.2 VARIOUS INTERNATIONAL AGREEMENTS AND THEIR IMPACT ON INDIA

"We need to evolve a comprehensive renewable energy policy for Energy Independence."

'Dr. A.P.J Abdul Kalam'

International agreements play a significant role in formulating domestic laws in any nation. All International Agreements establish and supports by "Pacta sunt Servanda". If any of the state is a party to any of international agreements then they are bound to honour the agreement according to the Article 26 of Vienna Convention, which clearly states that, "Every treaty in force is binding upon the parties to it and must be performed by them in good faith".

A comprehensive policy for research development, production, and marketing is necessary and the Laws formulated in any nation must be in compliance with Environment Laws. The same principle was reiterated by the Supreme Court of India in the landmark case of *Essar oil Limited V. Halar Utkarsh Samiti and Others* (2004), which specified that the purpose of the declaration at Stockholm was to harmonise the relationship between economic and social needs along with environmental concerns keep in mind. Furthermore, economic development shall disrupt the environmental ecosystem. Nevertheless, on the other hand, ecological development shall not disrupt economic growth. Therefore, they shall move parallelly, and due care should be taken while the protection of two is held in the famous case of the *Indian Council for Enviro-Legal Action V. Union of India* AIR (1996).

The harnessing of renewable sources in India is essential as per the "United Nations Framework on Climate Change" (hereafter denoted to as UNFCC) which mandates the decrease of international greenhouse gas emissions. The first convention in this regard was framed in the year 1985 in Vienna.

A. Vienna Convention 1985: The world has already witnessed the harm caused to ozone coating and its severe effects on lives and the environment. In response to damage to the ozone layer, the 'Vienna Convention for the Protection of the Ozone Layer' was initiated. This convention laid out a few principles by many states. The Vienna convention made history globally, which was signed by every participating State in 1988 and reached full ratification in 2009. This protocol emphasizes the issues involved in ozone layer depletion in that period and the common consensus in various countries to work in an organized manner to resolve them.

The convention's objectives were to promote cooperation amongst the member states via sharing data about the ozone layer and its effect on human lives and the environment. The policymakers have adopted preventive measures to tackle the reasons for ozone weakening and formulate innovative measures as the Convention is still in progress. The parties to the convention must meet every three years to resolve issues like, "Research and Systematic observations" and "financial and administrative matters".

The convention held in Vienna, however, did not require the states to take preventive steps to protect the ozone layer. This was later discussed in Montreal Protocol in 1987.

B. **The Montreal Protocol 1987:** The Montreal Protocol came into effect in 1987, which is an international pact to safeguard the 'stratospheric' layer of ozone by eliminating the generation and absorption of ozone-depleting substances (**hereinafter referred to as** ODS). This Protocol was unique and proved to be very pioneering and prosperous. This is the first treaty to achieve global ratification by all the States and the protocol also helped to garner international investments in alternative technologies. This was also developed majorly by the companies in America to repair damage to the ozone layer, which was being depleted and destroyed.

The function of the ozone layer in our environment is to filter harmful Ultra-Violet (hereinafter referred as UV) radiation. These rays cause cataracts and skin cancer, lowering agricultural productivity, and disrupting marine ecosystems. The U.S. endorsed this Protocol in the year 1988 and came across four further amendments. In the Protocol's history, the United States of America has been a pioneer, which took intense domestic action in order to phase out the production and consumption of ODS like chlorofluorocarbons (hereinafter referred to as CFCs) and halons (United Nations Environment, n.d.).

The U.S. Environmental Protection Agency (hereinafter to as referred as EPA) estimates that American citizens born between 1890 and 2100 will avoid 443 million cases of skin cancer, 2.3 million skin cancer deaths, and more than 63 million cases of cataracts if the Montreal Protocol is fully implemented with even more excellent benefits globally. According to the Montreal Protocol's Scientific Assessment Panel, a complete ozone layer recovery may be expected by the middle of the twenty-first century if the Protocol is implemented effectively (United Nations Environment, n.d.).

The U.S. played a vital role in the Montreal Protocol's negotiations. There was crucial evidence which emerged in the 1970s that CFCs, used in everyday household items like refrigerators and air conditioners, were depleting the Earth's shield ozone layer and making way for harmful UV radiation to reach Earth's atmosphere. The manufacturing and consumption of ODS, such as CFCs and halons, were vehemently opposed by other states and the U.S. which supported eliminating its usage.

In 1988, the U.S. Senate supported the ratification, unanimously of the Montreal Protocol and the pact had bi-partisan support for the last thirty years. The Montreal Protocol had achieved widespread support and agreement from industry and environmentalists in the United States throughout its history.

The developing countries have become members of the Convention on Climate Change in 1997. After this protocol, in the year 1997 again the Kyoto protocol was held.

C. The Kyoto Protocol (1997): The Protocol mandates member nations to follow the commitment, especially in terms of improved energy services to alleviate the effects of environmental change. The Kyoto Protocol mechanism of clean development envisaged the development of a market-based mechanism for industrialised countries so that they can meet their commitment towards the reduction of emissions while moving towards the usage of greener technology (Renewable Energy Sources) and enhancing the Energy proficiency of various products in the entire developing countries.

The Clean Development Mechanism (hereinafter referred to as CDM) enables developed countries to buy credits from developing countries to reduce carbon emissions and mitigates projects in developing countries. These projects help to reduce climate change in terms of Technology, Investment and enhance the Capacity-building sectors. The CDM, therefore, illustrated a new tactic for solving global environmental problems which could also greatly support promoting sustainable development as articulated at the Earth summit in 1992 and in Johnsburg in the year 2002.

The Kyoto Protocol brought in three user-friendly and market-based flexible suggestions for the operating mechanism which helped the states to meet their carbon emission reduction obligations in a very lucrative manner. The essential purpose of all these mechanisms was to reduce carbon emission differently in different regions, but with the benefit to the environment. After that, the Montreal Protocol was amended under the name of the Kigali Amendment. The said amendment is as follows:

D. **Kigali Amendment:** A New Phase in Montreal Protocol: The Kigali Amendment in Montreal Protocol was embraced on October 15, 2016, and intends to diminish the worldwide production and consumption of "Hydro-fluoro-carbons (hereinafter referred to as HFCs)". HFCs are commonly utilised substitutes for ODS like HCFCs and CFCs, which are previously regulated (United Nations Environment, n.d.).

Without compromising on performance, the said amendment provides stability in the market and introduced worldwide markets to improvised machinery, i.e., which was good for the ecosystem. It urged all nations to steadily reduce their HFC generation and usage over the next three decades, which was based on the flexible, innovative, and practical measures adopted by the Montreal Protocol over the past three decades (United Nations Environment, n.d.). The flexibility under the

Kigali amendment was appreciated by every stakeholder in which major corporations involved in related fields are from the United States of America. This Protocol had no binding effect on any of the nations and many countries realised that in order to control their climate change and pollution to the environment, all the nations have to come together and strictly reduce the carbon emission. The next progress was COP 21, which was held in Paris and therefore this agreement is called as Paris Agreement 2015.

E. **Paris Agreement (CoP-21)** This agreement was deliberated and signed in Paris on the 12^{th} of December 2015 and came into force on the 4^{th} of November 2016. This agreement had a legally binding effect as the International Agreement on Climate Change. The said agreement and its terms were accepted by 196 Parties (UNFCCC, n.d.).

This agreement between the member countries aims to lower the worldwide temperature by up to 2 degrees Celsius and more preferably to reduce the warming by up to 1.5 degrees Celsius if assessed to the temperatures prevailing in pre-industrial levels (UNFCCC, n.d.). To achieve these targets, the member states need to accomplish these long-term temperature targets and other states aim to achieve a climate-neutral and zero carbon footprint planet by mid-century as the peak level of global greenhouse gas emissions must be accomplished **(**UNFCCC, n.d.).

The Agreement prescribed long-term goals to follow for all the nations:

- Knowingly cut worldwide GHG releases to keep global warming to 2 degrees Celsius this century while also trying to keep it down to 1.5 degrees.
- To check Total liabilities on the gap of every five years.
- Provide monetary assistance to all developing nations to combat climate change, strengthen pliability, and develop capacities to adapt to climate impacts.

This Agreement mandates every state to curb their carbon emissions and collaborate to mitigate climate change and a call for states to implement their commitments over the said period. This agreement paves the door for developed states to assist developing states with climate change and adopt all the measures in establishing a set guideline for clearly examining and reporting Governments set targets **(**United Nations, n.d.-d)**.**

The Pact also offers a robust framework to lead universal efforts in the coming years. Towards what will be the beginning towards zero carbon emission. The Agreement's effective implementation is still a challenge to accomplish the SDGs (United Nations, n.d.-d)**.**

F. **The Conference of Katowice Climate Change (CoP-24):** This was the 24th conference of the UNFCCC (Mahapatra et al., 2021). The stipulations agreed under the stipulations of the Paris Agreement work program (PAWP), the 24th conference was planned to confirm the regulations for executing the Paris Agreement on climate change.

In this, the events related to various human settlements, the requirements of the industry in transport facilities, water harvesting, for the betterment of oceans and coastal areas, for conservation of energy, and the usage of land are mentioned (Hub, n.d.).

The following below-mentioned subject matter, a series of round table meetings were held:

- Issues related to finance and climate.
- On the topics of "SDG 12" (for responsible utilisation and production) and climate protection.
- On "SDG 8" (regarding decent work and proper economic growth) and environment.
- Flexibility and action for climate protection.
- Usage of natural resources like land, water, and sustainable use of energy.
- Of the Seas and along with coastal zones for the betterment of the transport sector; and
- "SDG 9" for various industries, innovations, and improving infrastructure along with the climate.

G. Glasgow Climate Change Conference (Hereinafter Referred to as CoP-26): The 'U.N. Global Warming Conference' in Glasgow, Scotland (Sengupta, 2021), which officially ended Friday (November 12, 2021) but continued till Saturday (November 13, 2021) and is deemed as an important for efforts to discourse on the impending threats to the climate change (Plumer et al., 2021).

Over the two weeks, more than 130 State and Government leaders and over a hundred diplomats convened to establish new objectives for finding methods to reduce emissions from the burning of coal or oil and gas which are causes of global warming. The meeting, though conducted every year, was critical this year since the scientists reiterated that if countries are to prevent the further deterioration of climate change, they must work towards having a rapid and sharp shift away from fossil fuels (Rappeport and Flavelle, 2021).

The said challenges are enormous as countries like Australia, China, and Russia amongst others have failed to earmark new targets for cutting their emissions of carbon for this decade or announced the ones which as per the scientists are considered to be weak. India has also pledged to enhance the production and utilization of renewable energy to a significant level, but usage of coal which provides the bulk of India's energy source for electricity production would remain the largest contributor to the energy mix in the coming decade (Friedman, 2021). Brazil had also announced that it would also reduce the emission levels by nearly 50 percent by the year 2030. This as per many observers is sceptical and the trust factor is very low that Brazilian president, Jair Bolsonaro, will keep his pledge.

It is shameful for mankind that only a few wealthy countries have assigned money to help the poor and susceptible nations to manage the harmful effects of climate disasters, their assistance is of little value in the help to mitigate the cause of sustainability. These two factors make the possibility of success at the conference, known as COP-26, ambiguous and uncertain (Friedman, 2021a).

In diplomatic jargon, the parties being referred to the 197 nations which had agreed to the UNFCCC at a meeting held in the year 1992, when the United States and some other countries met and ratified the treaty to combat the effects of "dangerous human interference with the climate system" and agreed to stabilise levels of greenhouse gas emissions in the atmosphere (New York Times, 2021).

The point which experts believe is that the dangers associated with global warming are lethal heatwaves, crop failures, water shortages, and the failure of the earth's ecosystem (Sharma', 2021). The British and United Nations hosts have reiterated that they want to "keep hope alive" by constraining global temperature rise to less than 1.5 degrees Celsius, or 2.7 degrees Fahrenheit as compared with the levels before the Industrial Revolution (Sharma', 2021).

In order to attain these targets, all the nations must promise to lower the level of emissions as much as possible in a concentrated battle against global warming ("Here's All We Know About COP26 so Far," 2021).

The Prime Minister of India Shri Modi ji, while speaking at the 'High-Level Segment for the Heads of States and various Governments' at the conference during UN COP-26 in Glasgow, stated that India is the only nation bringing in "letter and spirit" and the commitments to battle climate change as agreed under the 'Paris Agreement'. He informed all global leaders at COP-26 that India plans to reach net-zero emission by 2070 and increases non-fossil power to 500 GW in its energy mix by 2030 (PTI, 2021). Further, the Prime Minister stated that India's efforts to address climate change concerns are tremendous.

The following are the most critical points from the Prime Minister's historic speech at the COP26 Summit. *"In the middle of this worldwide brainstorming on climate change, I'd like to submit five nectar ingredients, or 'Panchamrit,' on behalf of India to address this challenge* (PTI, 2021)*."*

- India will enhance its Renewable energy generation capacity to 500 GW by 2030 (PTI, 2021).

- India will try and fulfil the 50 percent of energy demand from renewable sources of energy by the year 2030 (PTI, 2021).
- Till 2030, India will curb its estimated carbon emissions by 1 bn tonnes (PTI, 2021).
- India could curb its carbon intensity by more than 45 percent (PTI, 2021).
- And lastly, India will target a Net-Zero carbon emission by the year 2070 (PTI, 2021).

The future of enhancing India's electricity sector lies in harnessing solar energy and for that, the focus must be on to reduce the cost of per unit electricity generated from solar to give more and more benefits (PTI, 2021) to this segment. The commitments of our P.M. and the intentions are very clear towards attaining net zero emission while generating electricity.

India has already started to shift their electricity generation from conventional to renewable sources, and it's already committed globally to reduce our carbon emissions by the year 2070. This is possible only when the working could be monitored and to understand the challenges faced in the solar sector along with the possible challenges which have already been discussed in the previous chapter. The following chapters talk about some of the Government initiated schemes for harnessing the solar sector and the criteria for taking such a stand to reduce carbon footprints.

2.3 STAND OF INDIA GLOBALLY ON THE SOLAR SECTOR.

India contributes substantially to the global effort in the battle against climate change. The NSM aims to give India recognition worldwide in the development of solar energy by framing a regulatory framework and legislation that also allows solar harnessing to expand as quickly as possible throughout the length and breadth of our country. Under this mission, the aim is of setting up of grid-connected solar plants of 100 GW capacity by 2022 (*Overview | Ministry of New and Renewable Energy, Government of India*, 2022). India's

"Intended Nationally Determined Contributions" (hereinafter referred to as INDCs) objective is to achieve approximately 40 percent of the electricity production from Renewable Energy resources by the year 2030 and reduce India's GDP emission intensity to around 33 from 35 percent by the levels in the year 2005 to the current year 2022 (*Overview | Ministry of New and Renewable Energy, Government of India*, 2022).

The Government of India has adopted many schemes to achieve this aim, including the ones mentioned below:

- "Solar Park Scheme",
- "Viability Gap Funding" (hereinafter referred as VGF),
- "Central Public Sector Undertaking" (hereinafter referred as CPSU),
- "Defence Schemes",
- "Canal Bank and Canal Top Schemes",
- "Bundling Schemes",
- "Grid Connected Solar Rooftop Schemes", etc.

(The schemes are discussed in detail in the following chapter later in the thesis). One of the major policy actions was the issuance of RPO targets, for solar energy utilization. The "Inter-State Transmission System" (hereinafter referred as ISTS) costs and losses are waived for solar and wind power for inter-states and sales which are completed by March 2022.

India has also surpassed Italy and achieved fifth place worldwide for electricity generation through solar cells or solar energy. The installed capacity of Solar Receiver calls has spread more than 11 times in the time period of March 2014 to July 2019 from 2.6 GW to 30 GW. The Solar tariffs are still high and competitive pricing will reach grid parity in near future (*Current Status | Ministry of New and Renewable Energy, Government of India*, 2022).

This is because India has three types of Rooftop Solar power stations which are installed according to the area and the frequency of electricity disruption. In India, the demand for electricity consumption depends on many factors like Population density, Commercial activities, Agricultural activities etc., and during the summer month as the demand for electricity enhances because of the tropical heat conditions and use of air conditioners. It, therefore, is very difficult to fulfil the demands of people, and in many areas, there is a power shutdown and faults in transmission and distribution arise due to the overload. The below mentioned are the types of rooftop solar power plants installed in India.

2.3.1. Solar Rooftop Installations in India.

There are the following types of rooftop solar installation which can be opted by Consumers to Install on their rooftops to generate electricity from solar i.e., Off Grid, On-grid, and Hybrid systems namely. Both systems have their significance which depends on the area wise along with frequent power cuts. A detailed explanation is mentioned below.

A. OFF-Grid (Standalone System)

This type of system is useful where power cut is too frequent or where no power supply is there. This is also known as a stand-alone system and makes building self-reliant which is the main motto of our current Government. In this type of system, the focus is on to fulfil consumer demands for the whole day and night by using batteries to store electricity. This is similar to the traditional inverter and battery setup system used for an emergency. In this setup daytime PV cells charge the batteries and fulfil the daily demands and night-time batteries will supply the electricity. This type of system is a bit more expensive as batteries cost are a little high and require batteries as per the load. The Inverter and Battery play a very important role in this system to fulfil the peak demands of electricity and if all seems well, then the system will perform well and even during acute power outages.

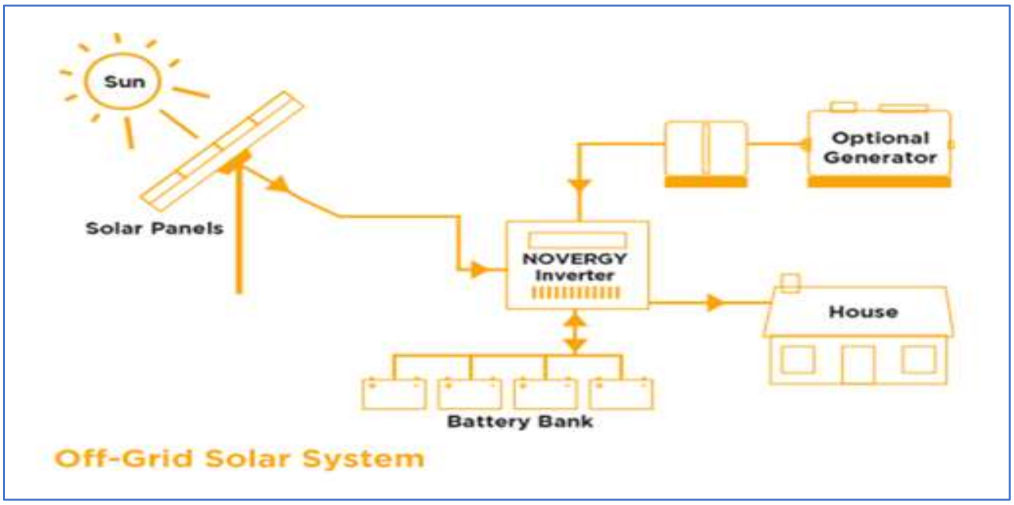


Image Source (*The types of existing Solar Systems (On-grid, Off-grid, and Hybrid) and the Use Cases*, 2021).

This system solely depends on solar and is free from any grid connections in some areas and gives maximum returns on investments.

Apparatus used in off-grid systems: PV Panels, inverters, and Batteries.

Suitable for: Suitable for use on Agricultural lands, Under Construction and in construction of industrial properties along with usage in rural and in remote Sites.

Off-Grid Solar P.V. Programme:

The off-grid Solar P.V. Application Programme is not new, as it was promoted by the government from the beginning, whereas the Ministry's vision was to promote solar-based products in such areas where electricity is not available through or is full of fluctuations. Products like lighting systems, streetlights, water pumps, new power plants, study lamps, and lanterns are solar-powered products which are distributed under the said program.

Under the NSM, for different phases, a target for off-grid is specified and mentioned below (*Jawaharlal Nehru National Solar Mission (Phase I, II, and III) – Policies*, n.d.).

Table 2.1 Solar Targets Under Phase I, II, and III.

Phase	Years	Target
Phase-I	2010-13	200 MWp
Phase II	2014 – 17	1000 MWp
Phase III	2017-2022	2000 MW

This data excludes the installation of solar pumps under the aegis of the PM KUSUM Scheme. The delivery of solar home lights was taken up under the 'Saubhagya' Scheme of the Ministry of Power.

The installation of Solar pumps is a fundamental part of the solar off-grid production program because it enables reliable irrigation in rural as well as remote places. The solar photovoltaic-powered water pumping systems in small and marginal farms can quickly meet their irrigation needs. The solar-powered pumps are being installed to replace the traditional irrigation system's diesel engine pump.

Table 2.2 Number of Units Installed under the Off-grid PV Programme is given below (*MNRE - Solar Off-Grid*, 2022.).

S.No	**Solar System**	**No. of units/ capacity installed**
1	Lamps/Lanterns	65,17,180
2	Pumps	2,37,120
3	Street Lights	6,71,832
4	Home Lighting Systems	17,15,639
5	Power Plants/ Packs	212 MWp

MNRE launched the program for the very first time in 1992. Approximately 11,600 pumps for solar were installed in the nation between 1992 and 2014. The Union Government had set aside Rupees 400 crore in 2014-15 to install nearly one lakh solar-powered water pumps for drinking water and irrigation crossways. There have been nearly 2.37 lakh solar pumps which have been built as part of the solar pump initiative. The Scheme provided 30% of the standard cost for purchasing solar pumps in the form of CFA. Individual solar pumps are primarily a part of the Off-grid and the re-organized Solar Photo Voltaic Applications Scheme which was there till 31/03/2017 (*MNRE - Solar Off-Grid*, 2022).

The Union Government had launched "Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan" (PM-KUSUM), whose primary goal was to install individual solar-powered energy pumps in isolated areas and to solarise more of the existing grid-connected power pumps for agriculture. This move helped the farmers get a dedicated irrigation channel and increase their income for farmers and their inclusive economic status and welfare (*MNRE - Solar Off-Grid*, 2022).

The Ministry for Renewable Energy had also implemented a scheme for distributing 70 Lakh Solar lamps for study, which aimed to provide good quality and accessible clear and clean light to the students of rural areas. The

Scheme for individual purposes was implemented in five states namely, Assam, Jharkhand, Bihar, Uttar Pradesh, and Odisha, which included more than 50% of the non-electrified households as per the census which was done in the year 2011.

Under this scheme, blocks with more than 50% of the households depending on kerosene are covered. Students have to pay only Rs.100 as the cost of the lamp out of the total cost, which is Rs 450 per lamp and the rest of the financial support is being given by the Government, respectively.

The cost support of up to 75% was needed for installing solar-powered LED streetlights in the urban areas, semi-urban areas, and rural areas under the Atal Jyoti Yojana (AJAY) was given by MNRE, and the rest, 25% of the cost support was given by MPLADS.

The solar LED Street lights provide sufficient light on the major roads, public conveniences, markets, other commercial areas, etc., in rural and off-grid areas, which would help the nation lead a secure and safe life (*MNRE - Solar Off-Grid*, 2022).

B. ON-Grid (Grid Connected solar rooftop)

In this type of setup Rooftop solar setup is connected to the grid in a way that the exceeding electricity can be transferred to the local supplier to supply to other consumers and that can be traced by net metering that how much electricity is generated and consumed by the owners and how much electricity is transferred to the grid. This type of system is popular in areas where power cuts are not much frequent, and you can solely rely on electricity generation through solar and through local suppliers. For injecting electricity into the grid consumer will be compensated as per the tariff plan in their Electricity Bill. But in the case of a power shutdown consumer is majorly relied on local suppliers and his electricity bill was shot up to the core because there is no setup of storage system in the On-Grid setup. Further, Local suppliers will charge the consumer for basic and minimum charges for connecting to the grid.

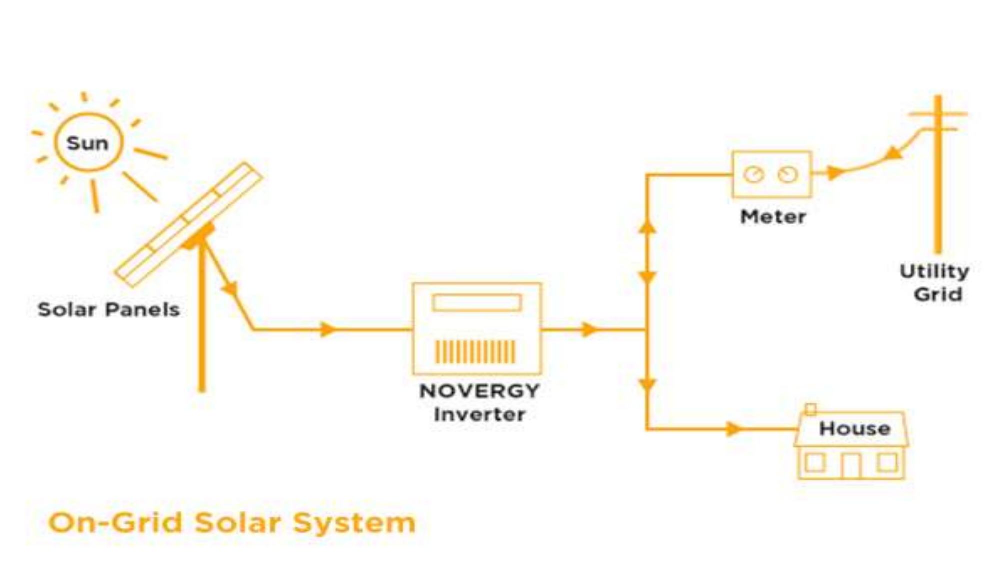


Image Source (*Types of Solar Systems (On-grid, Off-grid and Hybrid) and Use Cases*, 2021)**.**

This type of Solar System helps in generating extra income and lowers electricity bills and gives a good return on the investment made.

Equipment Required for the On-grid systems is the PV Panels, Meters, Grid-tied inverters, and the local grid utilization.

This is suitable for Residential, Commercial, and Industrial properties with robust grid availability where the power cut is less or minimal.

Grid-Connected Overview: In India, the area and sector of solar power have increased and grown in a short period of time and upcoming sectors in the last few years. The Government's strategy is being supported by solar power for sustainable growth in the journey of evolution which is an essential part of the providing solution to meet the country's need for providing energy and as a vital player for the utilisable energy security.

Initially, this target was for the installation of 100 G.W. of grid-connected solar-powered by 2022. To fulfil and attain the above targets, the Union Government had launched several schemes to motivate people to use solar power across the nation like the VGF Scheme, the Defence Scheme, the Canal top scheme and the canal bank, the Grid-connected rooftop scheme, the CPSU Scheme, the Solar Park Scheme, etc. The other policy measures and systems were also undertaken to promote grid-connected power plants of solar-powered energy harnessing systems.

India is currently ranked in the 5th position worldwide in the production and utilization of solar power. The Solar energy capacity rapidly has increased by more than eleven times in the past five years to 28.18 G. W. in March 2019 from 2.6 G. W. in March 2014 ("Annual Report 2018-19, (2020)"). The economic scale and deduction in the solar cell/module prices of usage of Solar tariff in India are becoming less competitive and have gained a substantial amount of grid parity with the help of technological advancement.

C. Hybrid Solar Systems

This is the third type of system as suggested by the name Hybrid systems it worked as both On-grid and Off-grid. This system is helpful to fulfil the demand and to generate revenues. Once, the battery is fully charged extra generated electricity is transferred to the grid. Hybrid System function

both. Nowadays, these are preferable and cost-effective in nature. Investment is comparatively less, and very much popular among investors and consumers, because of no or fewer blackouts.

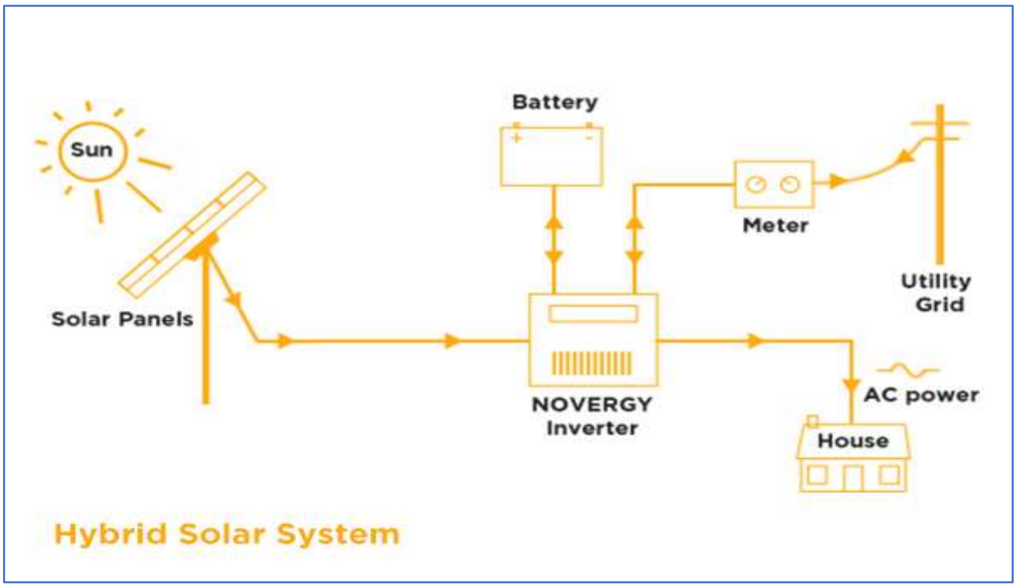


Image Source (*The types of Solar Systems (On-grid, Off-grid, and Hybrid) and Their Use Cases*, 2021)

Apparatus used in hybrid systems are Solar Panel arrays, batteries and inverters for conversion, meters for calibrating, and a grid.
Suitable For usage in the agricultural sector, in residential Areas, by micro or small grids, in rural areas and small offices.

These different solar power plants have a huge impact on the electricity sector of India, and Govt. has different policies and schemes to promote each type like the distribution of Solar pumps, Solar lanterns, solar streetlights etc., to promote off-grid power plants in rural areas.
Despite these efforts, the Government's efforts are not giving positive results, because the electricity sector infrastructure for Transmission and Distribution is required for robust development, and that could be possible with the help of other countries who have already overcome all the challenges in the Solar sector.
"One Sun, One World, One grid" this motto can only work if all the nations developed, and developing come together for the development of the Solar Sector by sharing their technology and finances with each other. The International Solar Alliance (ISA) is a step toward this mission.
The following chapter is focused on the role of ISA in mutual efforts and the development of Solar Power harnessing and utilization.

2.4. ROLE OF INTERNATIONAL SOLAR ALLIANCE AND ITS BENEFITS WITHIN INDIA AND GERMANY.

The International Solar Alliance (hereinafter referred to as ISA) is based on inter-governmental alliance in the form of an international treaty of the 121 solar resource-rich countries that are located between the Tropics of Cancer and Capricorn. It was founded in the year 2015 following the United Nations Climate Change Conference's 21st Meeting of the Conference of Parties (COP 21) in Paris (UNCCC) (*International Solar Alliance*, n.d.).
The ISA vision and mission were to provide a devoted platform for collaboration amongst the solar resource-rich countries where members of the global community, including various bilateral and multilateral organisations,

corporations, the members of this industry including various other stakeholders could contribute to the common goal of enhancing the usage of solar energy in providing energy to the various needs of all the prospective ISA member countries in a secure, convenient, and reasonable manner.

The ISA accelerates solar technology adoption, mobilising finance, promoting SDG-7, and brightening the sun. India took the initiative to form the ISA of countries with abundant solar resources. The idea is that solar energy technology has advanced significantly and is now regarded as a viable choice for satisfying long-term energy needs.

The Government of India supports ISA with 62 million US$ in starting, exceptionally to construct infrastructure for the headquarter (*the Government of India's 'International Solar Alliance' will Be the First International and Inter-Governmental Organisation with the participation of 121 Countries to Have Headquarters in India, with the United Nations as Strategic Partner*, 2016). The repetitive expenses on the ISA will be sourced from the membership fee, the donations from the multilateral and bilateral agencies and numerous other sources.

An upbeat offering or contribution is expected to be made by ISA toward the goal is expected to increase the utilization of solar energy in the area or region. The Secretariat of ISA is located in the National Institute of Solar Energy (hereinafter referred to as NISE), Gurgaon.

2.4.1. **Guiding Principles of ISA.**

1. Members will coordinate actions through voluntary programs and activities targeted at healthier harmonising and aggregating the demands for solar finance, technology transfer, newer innovations, the research, and development activities, and for enhancing the capacity building, among other things.
2. Members shall work closely together to build mutually beneficial connections with appropriate organisations, public and commercial stakeholders, and non-member countries in this endeavour.
3. Under ISA, each member shares and updates relevant information related to the needs and goals of solar applications seeking to benefit from collective action based on the general analytical mapping of solar applications. To

achieve these goals, national measures and initiatives have been taken to remove the obstacles present in the value chain and in the dissemination process and the Secretariat maintains a database of the ratings to show the potential for various collaborations.

4. A National Focal Point will be designated for the ISA by each member. A permanent network consists of National Focal Points of ISA correspondents and member countries. They, among other things, interact with each other and with related stakeholders to identify areas of common interest, draft program proposals, and work on how to implement ISA objectives. Make a recommendation to the bureau.

2.4.2 Programme and Other Activities

1. To gain the goals, objectives and guiding principles as given in Articles I and II, of the ISA practices a program consisting of projects, a series of actions, and a set of activities to be taken appropriately and framed by the respective members. The program is designed in such a manner to ensure the participation of the members at a larger scale and scale effect at the maximum level (*the Government of India's 'International Solar Alliance' will Be the First International and Inter-Governmental Organisation with the participation of 121 Countries to Have Headquarters in India, with the United Nations as Strategic Partner*, 2016).

2. Program proposals, with the support of the Secretariat, are based on inputs as shared by the members and are developed through open consultation between all national focal points. The program may be proposed by any two member countries or groups of members present in the Secretariat. The Secretariat on its part ensures consistency across all ISA programs.

3. The proposals of the Program are digitally sent to Assembly by the Secretariat via the National Focal Points network. The program proposal is supported by at least two members and will be accepted by future members if two or more countries do not object.

4. The candidate members will formally approve the given proposed program through a shared declaration. The decisions regarding the program's operation are made by the members participating. The program is carried out within the

guidelines and the guidance along with the support of the specified Secretariat by the national representatives which are appointed by each program member. They are then carried out under the support and guidance of the Secretariat.

5. The annual work plan overviews the ISA program and other activities. It is submitted to Parliament by the Secretariat, which confirms that the various programs and activities as agreed upon in the Annual Work Plan are in the scope of the objectives of ISA's.

The ISA is a member-driven, action-oriented, and collaborative platform for increasing the use of the technologies that motivate solar energy as a resource to bring access to power, ensuring the security of energy and getting the evolution of energy in its member countries.

The ISA aims to help various member countries to develop pathways for low-carbon growth, focusing on influencing countries which are being classified as the least developed countries (LDCs) and other small island developing states. This strive to build and arrange cost-effective, innovative energy solutions which will be powered by solar energy. Developing countries, as a global platform, partnerships between ISA and Multilateral Development Banks (hereinafter referred to as MDBs), Development Finance Institutions (hereinafter referred to as DFIs), the private and the public institutions, the civil society, and other international organisations will help ISA make the desired changes to the world. It's the key.

ISA will mobilise $ 1 billion in solar energy solutions by 2030, using clean energy solutions to provide energy access to 1 billion people and install 1,000 GW of solar capacity (*International Solar Alliance*, n.d.-b). It is in line with the 'Towards 1000' strategy of being able to do it. This will help reduce global solar energy emissions by 1 billion tonnes annually. To achieve these goals, ISA follows a programmatic approach. Currently, ISA has nine comprehensive programs, each focusing on specific applications that help expand the deployment of solar energy solutions. Activities under the program concentrate on analysis and advocacy, capacity building, program support and preparation to help create an environment that enables solar energy investment to take root in the country.

India and France comprehended the ISA as a joint effort to mobilise energies to address climate change by utilising solar energy solutions. These were devised based on the aegis of the 21st Conference of the Parties (COP-21) of the United Nations Framework Convention on Climate Change (hereinafter referred to as UNFCCC) held in Paris in 2015. With the Framework Agreement amendments of 2020, all the members of the United Nations can now participate in the ISA. Currently, 101 member countries have signed the ISA Framework Agreement, and 80 of which have submitted the list of ratifications required to become full members of the ISA (Admin, 2021).

Germany has about a quarter of the world's PV capacity, with more than 38.25 GW of installed capacity. The share of RTPV was 9% for residential, 26% for commercial, and 24% for industrial capacity, with nearly 1% from the building envelope and the rest 40% coming from the ground-based installations. In the year 1999, nearly 1,00,000 rooftops were adopted to motivate household solar installation by providing a 0% interest financing (Confederation of Indian Industry, 2018). The Union Government had subsidised rooftop solar with an enormous cost reduction, user-friendly installation policies, and a Feed-in-Tariff (hereinafter referred as FiT) that is changed regularly. The Gross metering system was adopted in the year 2009 to encourage the construction of solar projects that are not dependent on the captive load of the consumers. The Preferential tariffs provided motivational income to the household owners. The Small consumers who helped in electricity generation were given premium FiT EURO 0.25/kWh and those who also supplied energy to the grid at EUR 0.47/kWh. In the year 2013, Government decided to support the battery backup plan in each household to facilitate the storage of energy produced to further incentivise RTPV use further (Confederation of Indian Industry, 2017). In addition to various financial incentives, the regulatory measures which include Renewable Resources Act guidelines for interconnection are to be implemented on a priority basis and with a low-voltage grid (Goel, 2016).

2.4.3. Memorandum of Understanding (hereinafter referred to as MoU) between Germany and India to develop the Solar-Energy sector.

The Union Cabinet, led by the current Prime Minister Shri Narendra Modi, has signed, and approved a Memorandum of Understanding between India and Germany signed in October 2015 to expand bipartite development cooperation in areas which was for increasing the usage of solar energy by technical and financial collaboration in India. This MoU will aid in firming the bipartite cooperation between India and Germany (Gupta, 2015).

In the present agreement, Germany was obliged to provide one billion Euros in concessional loans over the next five years through their Kreditanstalt fur Wiederaufbau (hereinafter referred as KfW). The earmarked funds of KfW would be utilised for providing soft loans to numerous end-users through the partner banks (India.com Education Desk, 2015).

The MoU would lead to-

i. Co-operation in the field of solar rooftops.

ii. The development of solar zones or solar parks (if possible, near the Green Energy Corridors financed by KfW under Indo-German Financial Cooperation). and

iii. Solar off-grid utilities and applications to enhance access to clean and sustainable energy.

In the Indian Context (as per *Indo-German Solar Energy Partnership (IGSP)*, 2022) the development and growth of solar power in India is predicted to be around 7 percent per annum in the coming future and it also possesses enormous energy and climate policy challenges. With 2.44 billion tonnes (t) of CO_2 per year (2020) (Friedlingstein et al, 2022), electricity generation is accountable for high emissions which are around 49 percent of the total (“India Can Cut Carbon Emissions by Deploying Renewables, Gas Power: GE Gas Power,” 2021). It’s high time to create a balance between the existing energy demand and access to electricity for all, in India (Indo-German Solar Energy Partnership (IGSP), 2022).

To achieve the target of 500 GW by 2030 (Vishnoi, 2021) with the change in climate and supply of uninterrupted electricity to all consumers, The Government of India has also increased the renewable energy generation target from 175 GW by 2022 to 500 GW by 2030 COP 26 and out of this nearly 280 GW will be produced from solar energy. However, as of December 2021, only over 150.54 GW. The annual expansion rate is insufficient to achieve the target for 2030. To accomplish the same, India has to install approximately 40 GW (Vishnoi, 2021) of power plants annually, which is a big order. This capacity has excluded the ability of the Large Hydro Power Energy Plant.

Even with the support from Union and State Govt. about policies and regulatory compliance, there are many challenges that still exist and affect the harnessing of solar power by rooftop development on a large scale (Vishnoi, 2021). The challenges like the absence of innovative and attractive business opportunities coupled with lack of awareness are the incapabilities to promote rooftop solar PV cells installation. This requires adaption and to accommodate the business environment by adapting to new Technology and accepting the challenges, etc. Therefore, the current annual progress is inadequate to achieve the targets envisioned for the year 2030 by the present Government.

Purpose of the MoU

This collaboration generates market forces creates proper mechanisms and increases investments in Solar rooftop PV systems. The main focus area of this collaboration is to promote competition in the solar energy market and to enable work in a systematic manner in specified project areas with the help of the four fundamental players mentioned below.

1. “State Nodal Agencies” (hereinafter referred to as SNAs),
2. “Distribution Companies” (hereinafter referred to as DISCOMs),
3. “Municipal Corporations” of the concerned areas, the licensing authorities, and
4. Local companies in the municipal limits and the various participants from the market (likewise project developers, investors, etc.).

2.4.4. Approach towards Investment in the Solar sector under ISA.

In this multifaceted approach, this collaboration is prone to market forces to hasten the process of rooftop PV systems by enhancing the mechanisms that facilitate more investment in rooftop PV Solar systems.

This collaboration mainly works in four different sectors to attain the objectives:
i. to create favourable local conditions.
ii. executing effective business models, and they may be promoted.
iii. Information dissemination and upscaling.

Players involved in developing the rooftop solar power sector like the DISCOMs, the Municipal Corporations, the SNAs, Business Model Operators, etc.) will be guided through IGSP, and with the help of analysis, dialogue promotions, and process-related support, as per the requirement of the project, could be a reason for aggregate 1 GW of rooftop solar PV demand.

In the residential sector, the IGSP also creates a new standardised PV system, also known as "PV Ports" with a capacity of 2-4 kWp. GIZ, a German Development Agency in collaboration with the MNRE, is also implementing the IGSP project, with the German authorities and commissioned it as part of the German Climate Technology Initiative (DKTI) with MNRE.

2.4.5. Results of Implementation of ISA

The following objectives for the successful execution of the IGSP project in the states are as follows.
The installed rooftop PV system capacity has increased twofold each year (as a result of the *Indo-German Solar Energy Partnership (IGSP)*, 2022).
Rooftop PV systems' total installed capacity (in MW) has increased fourfold (*Indo-as a result of German Solar Energy Partnership (IGSP)*, 2022).
The number of rooftop PV systems which have been installed in the industry, trade, and housing sectors has doubled with nearly 30% in the housing sector) (under the aegis of the *Indo-German Solar Energy Partnership (IGSP)*, 2022).

2.5. CONCLUSION

Globalization connects and allows trade with every nation in the world; and it obliges countries to follow International Laws and their obligations through different Conventions, Treaties, and Conferences. Keeping the environment healthy, safe, and pollution free is not a duty of one state. Still, it is a measure to be taken by all the states irrespective of their status as developed countries or developing countries. In the past, many conferences were organized to address issues about the environment and changes in the climate. This chapter concluded that because of all international obligations, many policies are formulated to harness the solar sector in India. But this International proved to be a toothless tiger for many nations because many of the policies were not properly implemented or lacks with strict implementation methods. To shift from Non-RE to RE is not a new concept that evolves in the 20th century, but it started in the late 19th century and the Stockholm declaration was the major for environment protection. It was also reiterated in the Essar oil Limited case of 1996. After that many conventions were enacted like Vienna, Montreal, Kyoto, Kigali, Paris Agreement, Katowice, and Glasgow conference recently. The objective of these conventions is to promote and harness alternate sources of electricity throughout the world. But, without strict implementation, it is very difficult to impose all such conventions. Further, the developing countries in every part of Asia, Europe, and African countries couldn't follow these international obligations, and their carbon emission is also high, and to reduce carbon emission solar should use as an alternative to conventional sources. These Solar plants have three types one is connected to the grid called On-Grid Connected solar plants, second is an Off-Grid solar power plant which is only for individual usage, and third is hybrid solar power plants which have both On-grid and Off-grid features.

Furthermore, to harness the development of the solar sector in India with the help of Govt. of Germany India entered into an MoU named as International Solar Alliance (ISA). To understand, the ISA and its effects. Under this, the focus is on the development of SNA, Discoms, Municipal Corporations, and local companies for the development of the sector, and it was predicted that because of this at least 1 GW of electricity generation can be added in total. But again, this ISA also has certain challenges, no mechanism for any subsidy or DBT scheme-related provisions mentioned in it. Further, no specific amendment will be made to the E- Act 2003.

CHAPTER 3-

3.1. THE EXISTING LAW, POLICIES, AND DEVELOPMENT SO FAR IN INDIA AND GERMANY AND ITS COMPARATIVE ANALYSIS.

3.1.1. Introduction

The new “Electricity Act of 2003 (E- Act of 2003)” repealed all previous legislation and to attain the electricity demands of end users and harness the electricity sector. The Act was enforced on June 10th, 2003. In the year 2001, an Electricity Act bill was on August 30th. Then the ministers constituted a standing committee on energy. The standing committee prepared its report and submitted it on December 19th, 2002. The Lok Sabha passed the bill and suggested amendments by the standing committee on April 9th, 2003, (Kumar, 2012).

Rajya Sabha also passed the bill on May 5th, 2003, and then the President of India gave his consent on May 26th, 2003 (The Electricity Act, 2003). On June 2nd, 2003, it was published by the government in Gazette (The Electricity Act, 2003). The E- Act was enforced after six months on January 27th, 2004, and the remaining provisions came into effect on June 10th, 2003, Except S. 121.

The E-Act, 2003 consists of 185 sections in all and is divided into Eighteen Parts and one schedule. It Starts with preliminary aspects of the Act, which include applicability and definition clause; Second Part covers the “National Electricity Policy and Plan”, whereas the C.G. was empowered U/S. 3, 4, 5, 6 to formulate the policies for electricity generation. It was further amended in 2007 and 2014.

3.1.2. The Current Electricity Legislation i.e., the Electricity Act 2003.

This Act aim is to provide electricity and electrification into all parts of the nation, and the Objective of the Act states that.

> *"An Act to consolidate the laws relating to the generation, transmission, distribution, trading, and use of electricity and generally for taking measures conducive to the development of the electricity industry, promoting competition therein, protecting the interest of consumers, and supply of electricity to all areas, rationalisation of electricity tariff, ensuring transparent policies regarding subsidies, promotion of efficient and environmentally benign policies, the constitution of Central Electricity Authority, Regulatory Commissions and establishment of Appellate Tribunal and for matters connected in addition to that or incidental to it"*

The preamble cum objectives implies the intention of the Act, to combine all the previous laws implemented into the sector and constitute self-sufficient regulatory commissions and agencies, it allowed the Govt. to take steps to develop the sector and to promote fair competition among generators. This also focused on the ground realities of energy poverty and ensures an uninterrupted electricity supply. The Act also ensures environmental compliance and promotes environment-related policies.

In the case of *GMR Energy Ltd V. Government of Karnataka* (*2010)*, the petitioners must maintain and operate the electricity generating power plants to distribute electricity to the Discoms and to provide to the grid to meet the peak demands of electricity that falls U/S 11 of the Act ordered by the State Govt. The Petitioners challenged the govt. order and the power of the state govt. of issuing orders. The court in its order stated that to ensure "power to all", the Govt. also ensures deals with the electricity shortage in the nation and is empowered to give any directions to any private electricity generators under the Act.

The "Electricity Appellate tribunal" has reiterated the same decisions to set precedent in other similar cases. Therefore, the Act amendment is required to battle this scarcity in future U/S 11 to insert "severe scarcity of electricity" or add a new section to meet the electricity shortage.

The Act also reflects the spirit of the legislation to make environmentally favouring sources of electricity. This was reiterated in the case of the *Chhattisgarh Biomass Energy Developers Association and Ors. V. Chhattisgarh State Electricity Regulatory Commission* (2006), it was held that the "State Boards" and all "regulatory commissions" are guardians of the Act of 2003, and creating unnecessary problems for the RE developers is not fair. Furthermore, the APTEL has rightly stated that for the Biomass plant imposing Three percent wheeling and transmission, charges are justified but levied of 6 percent is unreasonable by the decision of the Electricity Regulatory Commission of Chhattisgarh. The tribunal also stated that the commission has power when the PPAs are only favour one party to the agreement but not concerned with the MNES (now MNRE) guidelines.

3.1.3. POWER SECTOR REGULATORY MECHANISM

The Electricity sector of India and the Regulatory Mechanism combines both Central and State Govt. policies framed, and other agencies to work together effectively. The details are as follows:

A. The Monitoring System

The monitoring system is under the control of the centre and state levels (Surendran, 2018). Many institutional and various regulatory frameworks were framed under the E- Act of 2003, for performing various duties and exercising regulatory powers. The below mentioned are the authorities formed under the said Act (Surendran, 2018).

B. Power Ministry

The Power Ministry is the head regulating and governing the electricity sector. On July 2nd, 1992, the said Ministry became an independent ministry; (earlier, "Ministry of Energy Source") (*About Ministry*, n.d.). The Ministry's sole responsibility is to develop an electrical system in India in such a way as to provide an uninterrupted power supply to the consumers (*About Ministry*, n.d.). The Power Ministry is responsible for framing policy. The detailed duties of the said ministry are (*Responsibilities*, n.d.) mentioned below:

1. Frame Policy for the power sector and deal with issues of energy policy and coordination between the two (*Responsibilities*, n.d.).

2. Hydropower generation (Less than 25 MW), Conventional thermal power plants, and transmission and distribution lines (*Responsibilities*, n.d.) are subject to license.

3. R and D activities, and technical assistance (*Responsibilities*, n.d.).

4. Electricity Act managed all the previously enacted Acts like the "Energy Conservation Act, 2001 (52 of 2001)", the "Damodar Valley Corporation Act, 1948 (14 of 1948)", and "Bhakra Beas Management Board" as mentioned under the "Punjab Reorganization Act, 1966 (31 of 1966)" (*Responsibilities*, n.d.).

5. Issues about CEA, CEB, and CERC:

a) Ensuring total Electrification in rural areas; and
b) to launch schemes related to power, along with the solutions to the problems relating to power supply/ power programs/ decentralised the electricity sector and to enhance the distribution and generation system in all the States and Union Territories (*Responsibilities*, n.d.).

6. Issues About the following Organizations (*Responsibilities*, n.d.):

a) "The Damodar Valley Corporation (hereinafter referred as DVC)": DVC was established in 1948 according to suggestions by the committee, after the 1947 floods. This corporation is tasked to control the wild and erratic Damodar River in Bihar (now Jharkhand and West Bengal) to control the flood situation.
b) The "Bhakra Beas Management Board (hereinafter referred as BBMB)": the Pact between India and Pakistan, the waters of three rivers namely Sutlej, Beas, and Ravi were specifically allotted to India. Afterward, the BMB was incorporated U/S 79 of the Punjab Reorganization Act, 1966. This was renamed "Bhakra and Beas Management Board" in 1976 with the transfer of a Beas project on completion (*Formation of BBMB*, n.d.).
c) "National Thermal Power Corporation Limited (hereinafter referred as NTPC)": NTPC is one of the biggest power utilities in the nation (*Formation of BBMB*, n.d.). The corporation's main aim is to become a

130 GW generating company by 2032. India's demands are mainly fulfilled through thermal power stations.

d) “National Hydro-electric Power Corporation Limited (NHPC)”: NHPC is incorporated for the development of a Hydro Power plant throughout India. It attained the status of Mini Ratna in 2008 (*Formation of BBMB*, n.d.).

e) “Rural Electrification Corporation Limited (hereinafter referred as REC)”: REC is under the Ministry of Power and received the status of Navaratna company (Top10Stockbroker, 2022). Rural Electrification is considered of utmost exigency in India, where many populations depend on agriculture. It’s played a vital role in the development of nations’ by securing food security through agricultural irrigation and no dependency on monsoons (*Corporate Profile*, n.d.). Rural Electrification has also helped farmers to install Solar water pumps in the fields with lesser operating costs.

f) “North-eastern Electric Power Corporation Limited (hereinafter referred as NEEPC)”: NEEPC is also the leading power generating agency in the north-east, working since 1976. This is the sole corporation in India that owns and operates thermal and hydropower together (*Company Profile | North-eastern Electric Power Corporation Limited*, 2022).

g) “Power Grid Corporation of India Limited (hereinafter referred as PGCI)”: PGCI attained the status of Maharatna Company under the MOP (Online, 2020). This became India’s Central Transmission Utility (CTU) and is the country’s most prominent Electric Power Transmission Utility. The corporation registered as a Company in 2007.

h) “Power Finance Corporation Limited (hereinafter referred as PFC)”: PFC has been a Navaratna Central Public Sector Enterprise since June 2007. The company’s objective is to provide finance for the necessary infrastructure for the electricity sector. It is the largest NBFC, and it is the direct Agency for working for developing the power sector schemes, mega power projects, and transmission projects (*Profile*, n.d.).

i) “Tehri Hydro Development Corporation (hereinafter referred as THDC)”: it is a registered company under the Company Act, 1956 that is a joint venture between GOI and Govt. of U.P and MOP has all the administrative control with the sole objective to develop, operate, and maintain the 2400 MW Tehri Hydro Electric Project (*About Us*, n.d.).

j) "National Power Training Institute (hereinafter referred as NPTI)": This is the national apex body for training and human resources development in the power sector. More than three lakh professionals have completed training from the Institute (*About NPTI*, n.d.).

k) "Bureau of Energy Efficiency (hereinafter referred as BEE)": BEE came into existence on March 1st, 2002, under the "Energy Conservation Act 2001". The said Act is to be improving energy efficiency and BEE is empowered to look after the energy efficiency measures in India (*About BEE*, n.d.).

7. Issues pertaining to saving energy and energy efficiency:

a) Cell for investment growth.
b) Hydroelectric Power and administration.
c) Proper Planning, Coordination, and Energy Management.
d) Conventional Coal power plants.

8. Additional Help and Financial support.

The MOP performs its functions with the help of all organisations mentioned below to maintain the electricity sector (*Unit Wise Work Allocation*, n.d.).

C. Statutory Bodies

Different bodies like CEA, CERC, CAC, SERC, and JERC were established under the E- Act 2003 U/S 70, 76, 80, 82, and 83. These authorities conduct multiple functions and duties bestowed on them.

The following bodies are the "Central Electricity Authority", The "State Electricity Boards", the "Central Electricity Regulatory Commission", the "Electricity Regulatory Commissions" of the State, and the "Appellate Tribunal" for concerned matters of electricity.

i. "Central Electricity Authority (hereinafter referred as CEA)".

The CEA has constituted U/S 3 of the "Electricity (Supply) Act 1948". U/S 70 of the Act empowers all existing authorities to continue under the new legislation. Further, S. 73 of the Act also requires the constitution and functions of respective authorities. With the central Government's permission, the said authority primarily prepares and creates a national power policy. Further, the said CEA advises the MOP on all matters about technical and economic affairs to regulate and supervise the national resources. CEA has all regulatory powers about generating stations through hydropower; it also controls the licensing of new hydro-generating stations. Further, the safety standards include guidelines and all technical regulations to set up a new hydro-generating plant.

The Members of the CEA include the following:

- Chairman, (ex-officio secretary, GOI), and
- Six Members (additional secretary rank) are representatives of different sectors like power systems, hydro, economic, and commercial, grid operation, distribution, and thermal planning.

Furthermore, the member designated for RE is the highest in electricity authority, while there are members for thermal and hydro. However, the CEA prepares and notifies the National Electricity Plan through the National Electricity Policy every five years. Therefore, as per Section 73 of the Act, the below-mentioned functions of CEA:

- The CEA may give Advice to the Central Government.
- The CEA specifies the technical Specification for generation plants, transmission channels, and connections to the grid.
- The CEA also specifies the Specification for safety while constructing, operating, and maintaining any power plants.
- The CEA also specifies the Specification for transmission lines for further operations and grid connectivity.
- The CEA also specifies the appropriate meter installation rules to monitor electricity consumption.
- To assist in the promotion and harnessing of the sector.
- Skill enhancement program for people involved.
- Data collection and monitoring of the sector.
- To Promote R and D activities.

- To conduct any enquiry about electricity (generation, transmission, and distribution).
- The CEA also Advice the states, Discoms, and Electricity generation companies.
- May advise appropriate Governments and commissions.
- Other functions as it may deem fit.

ii. “State Electricity Boards (hereinafter referred as SEBs).”

Section 5 of the Act states that the Governments of every state may constitute the SEBs in exercising powers under the “Electricity (Supply) Act, 1948”.

Section 12 states that the *“Board shall be a body corporate having perpetual succession and a common seal”* and it was entitled to embrace any property, in its name and can sue and be sued. The SEBs also have regulatory functions, granting licenses, formulating rules and regulations, and revoking permits.

SEBs, also have recommendatory powers to recommend State Governments because installing the captive generating units requires approval from the “Central Electricity Board”. SEBs on par with the Generating Companies managed electricity supply through transmission lines and distribution to deficient power areas. These initiatives are aimed at achieving the objective (Pargal and Mayer, 2014) of harmonising the relationship between the State Government and the organisations to reflect the clarity and provide space for commercialisation.

Section 131 also empowers the States to formulate a scheme for transferring their (SEBs) assets and any liabilities through publishing it in the govt. gazettes. The States can make and transfer the assets directly to all companies involved in the power sector.

SEBs also empowered to control the electricity sector’s generation, distribution, and operations. All the Board members are “public servants” under the 1948 Act. Further, the issue is about whether the employee of the corporations carved out of the SEBs, are public servants after the enforcement of Act, 2003.

This was answered in the case of *V. Srinivasan V. Secretary to Tamil Nadu Generation and Distribution Corporation* (2013), under the purview of the definition of the term “public Servant” as per Indian Penal Code, 1860 U/S 21, the Prevention of Corruption Act, of 1988 U/S 2(c), and the Electricity Act U/S 169.

The H.C. of Chennai stated that “an employee of the electricity corporation, which falls within the definition of a Government Company U/S 617 of the Companies Act of 1956, shall be a “public servant” for any corruption charges.”

But the 2003 Act has defined the term public servant includes chairperson, members officers, employees of the APTEL and commission, secretary, and assessing officer under the 2003 Act for offences.

The new Act specifically wanted the employee of corporations to be like private entities and now the govt. has shifted electricity supply from sovereign function to commercial activity. Also, no employee is protected under any corruption charges.

iii. “Central Electricity Regulatory Commission (CERC).”

The CERC was created on July 24th, 1998, “Electricity Regulatory Commissions Act, of 1998” (from now on, the 1998 Act). The CERC and many SERCs were established to rationalize electricity tariffs, maintain transparency in subsidies, and promote policies that are environmentally friendly. The 1998 Act suggests the problem of the electricity sector is due to increased demand, and the supply gap can be resolved through independent regulators, they helped to attract more private investments into the industry.

The 2003 Act repealed the 1998 Act through Section 185 and permits to the continuation of the commission’s U/S 76 of E- Act, 2003 with their functions mentioned U/S 79 of the 2003 Act as a “body corporate” with “perpetual succession”.

The roles of the “Central Commission” are mentioned below as per Section 79 of E- Act, 2003:

a) Control the tariff fixation system of the generating companies owned or controlled by C.G.

b) Control the tariff system of independent generating companies whose business is in all over states (More than one state).

c) Control and set the tariff for electricity transmission among the states.

d) Control electricity trading among the states and advise the C.G. to prepare any tariff policy under the National Electricity Policy.

The role of the CERC (Webb, 2013) is to endeavour to improvise the transmission lines through the "Availability Based Tariff (hereinafter referred as ABT)" and the "Indian Electricity Grid Code (hereinafter referred as IEGC)." Further, this also connects "open access" to "transmission and trading" among the states. Another significant role of CERC is to advise the Government regarding setting the guidelines for new players who wanted to Start and Leave the Business and remove challenges for fair competition (*MISSION*, n.d.).

iv. "State Electricity Regulatory Commission (hereinafter referred as SERC)."

Every State's Government is allowed to constitute a Regulatory Commission in their region for electricity as an organisation to regulate the electricity sector. These newly constituted Commissions are allowed to continue under the E-Act, 2003. After this, more than 20 states constituted the Regulatory Commissions in their states and set up a model for other remaining states to follow. The vital functions mentioned in U/S. 86 are mentioned below:

a. To Fix tariffs for consumers (wholesale, bulk, and retail).
b. To Fix procurement processes, power purchase is fixed for distribution licensees.
c. Further, to promote competition among the Discoms, improve efficiency, increase the economic activities under the electricity sector, and performs other functions from time to time.

v. "Appellate Tribunal for Electricity (hereinafter referred as APTEL)".

Section 110 of the E- Act 2003, the APTEL was constituted, and it's empowered to entertain all the appeals against the orders of the commission.

“A bench of the APTEL may consist of a minimum of two members (one judicial and one technical)” as per U/S 112 (2)(b), The E-Act, 2003, and for chairperson, a person should be a judge or has been of S.C. judge and Chief Justice of High Court appointed by the C.G.

The Judicial member-member of the APTEL is or has been a judge of the High Court or qualified to be one U/S Sec 113 (1)(a), The E-Act, 2003.

A technical member shall be a person who has been a Secretary dealing with economic and infrastructure matters in the department or Central Government’s Ministry U/S Sec 113 (1)(b), The E-Act, 2003.

Whether CERC can fix trading margins by any order was challenged in the case of *PTC India Ltd. V. Central Electricity Regulatory Commission Thr. Secy.* (2006), along with some significant issues like, APTEL has jurisdiction over the CERC Regulations, 2006 and the APTEL power of judicial review U/S 121. On 2006 regulations by APTEL, S.C. held that the tribunal could not exercise any power of judicial review.

Furthermore, observed that, *“the powers of the central commission to make regulations provided U/S. 178 of the 2003 Act are broader in scope than the regulatory functions enlisted U/S. 79 (1) of the Act. The rules are placed before the parliament and are subordinate to legislation, while orders discharge the duties U/S. 79. A regulation U/S. 178 is part of the regulatory framework and can override existing contracts between regulated entities. Section 178 gives authority to delegated legislation, and its validity can be tested only by a judicial review by the court U/A. 226 and not by the tribunal. Supreme Court has further stated that Section 121 of the 2003 Act does not include the powers of judicial review on the APTEL, it has the jurisdiction to hear matters regarding a dispute arising out of the adjudication or elucidation of a law made U/S 178 through an appeal preferred before it. However, it cannot review the validity of the law itself.”*

3.1.4. RENEWABLE ENERGY REGULATORY FRAMEWORK UNDER ELECTRICITY ACT 2003

The E-Act of 2003 allows taking necessary regulatory actions to incite the use of RE. It has adopted a regulation that can cater to a new technological advancement or solution to energy needs. The 2003 Act's regulatory and administrative instruments typically apply to all electricity sources, whether conventional or non-conventional. The E-Act, 2003 provides for specific handling of RE in addition to the customary laws and standards by:

a) To Specifies the tariff.
b) To Specifies the RPO for the Discoms.
c) To provide a grid connectivity facility. and
d) development of the RE market through Promotion.

A. The Renewable Energy Under the Act.

The Provisions of RE under the Act that directly or indirectly promote and harness the RE sector is specified below. The below-mentioned paragraphs discuss the advantages and disadvantages of RE investment.

i. "National Electricity Policy and Plan"; S. 3 (1) of the Act provides that, the "National Electricity Policy", and "Tariff Policy" is to be prepared by the C.G. with the assistance of the CEA and the S.G. and ensure the maximum utilisation of every source (conventional and non-conventional) during framing the policy. The C.G. shall also alter the old policy accordingly. The CEA should also draft a Plan to implement the policy. In the case of *Transmission Corporation of AP V. Andhra Pradesh State Electricity Regulatory Commission (*2006), the petitioner in the case is a private electricity generating company that applied to the APSERC for the sale of surplus electricity due to reduced consumption from the captive facility to the state utility by way of an enhancement in supply under the already existing power purchase agreement. Also, the commission ordered that the power surplus be supplied to state transmission utilities or DISCOMs only. The transmission utility, the first appellant, prayed to the commission not to order an increase in the purchase from the respondent.

The other respondent has installed a 6 MW cogeneration plant through biomass and pursues a policy formulated by the national and state to sell the surplus. These policies encouraged private investments in renewable energy.

The order of the commission stated that *"the surplus energy shall be supplied to the state grid and the unwillingness of the state utility to purchase the surplus has created an unfavourable market condition for the renewable energy developer. The commission's order has created barriers to selling electricity under open access and is against the spirit of the 2003 Act and National Electricity Policy."* It's held that, *"if the power purchase agreements not benefitted for the promotions of RE, then the appropriate commission may make necessary amendment amendments in PPA under Section 86(1)(e). The commission shall ensure that such modifications would help sustain the operational stability of the renewable energy projects and are in pursuance with Section 86 (1)(e) and Section 61 (h) of the 2003 Act."*

In *Citizen Forum Through Its Secretary Shri Rajiv S/O Gajanan Jagtap, V. The State of Maharashtra, Through Its Secretary, Department of Energy (Excluding Nonconventional Energy) and Ors.,* (2008) the H.C. of Bombay has observed that the appointment of distribution franchisee in pursuance of the 2003 Act and National Electricity policy to promote private participation is valid.

From the above consideration of the case, it's predicted that the electricity market is not entirely ready for the competition. In many instances, the relevant authorities do not take relevant measures to enforce the objectives of the 2003 Act.

ii. National Policy for Captive generation plants (Stand-alone Systems); Section 4 of the Act states that the C.G. may draft and notify a national policy to allow captive power generation for rural areas with the consultation of state Governments. In *T. Bhuvaneswari V. District Collector Cum District Magistrate of Erode Dist* (2014), the Chennai HC held that, *"land use for erecting towers or poles or drawing lines above it does not require acquiring it fully; owners are eligible for compensation only to the limit of land under the transmission lines".* In *R. Santhana Raj V. The Chief Engineer* (2011), the petitioner's grievance is that the respondent had decided to install a storage wind farm substation and had ready to install transmission lines above the petitioner's land.

The petitioner has two contentions:

- Firstly, *"that to install the wind farm station the consent of the petitioners as required is not obtained U/S Section 12(2) of the Indian Electricity Act, 1910;"* and
- Secondly*, "that instead of using petitioners' land, there is alternative land available in public roads, through which the high-tension wires can be carried."*

The Madras H.C. in the case held that *"even if the court's prayer for mandamus was allowed, it is still open to the respondents to approach and get an order U/S 16 (1) of the Telegraph Act, 1885. If the district magistrate exercises his discretion under the said provision, the power of judicial review is limited over such exercise of discretion. On the other hand, if the prayer is refused, the petitioner can approach the district magistrate U/S 16 (3) of the Telegraph Act, 1885 for sufficient compensation and U/S 17 (1) for requiring, removing, or altering the line or post to the respondent or under 17 (2) to apply to the District Magistrate to direct the removal. One of the significant challenges for rural Electrification is building network lines for transmission, which require drawing electric lines above the lands of multiple owners, inviting delays due to many disputes being raised."*

Section 4 provides that the installation of captive generation, Non-RE, and RE systems. This instigates the remote areas to install and adopts solar panels. This Aids Govt. to avoid any delays and preventing extra costs of litigation in "Rural Electrification".

According to Sections 61, 61(h), and 61(i) of the Act, the Promotion of Co-generators and Electricity creation from Renewable Sources of Energy stated (Surendran, 2018), The Appropriate Commission may draft the relevant policy and decide its rules and regulation to determine the tariff about the Act and shall be governed by the below-mentioned points:

a) that the promotion of cogeneration and power generation from RE; and (*Renewable Energy in India*, 2017)

b) the "National Electricity Policy and Tariff Policy".

S. 61 allows to formulation the framework for the fixation of preferent tariffs for RE and NON-RE sources, and the commission must adhere provision and frame the conditions for determining tariffs, considering the development and sustainability of RE.

The “Tamil Nadu Solar Energy Policy, 2012” was questioned in the case of *Tamil Nadu Electricity Consumers and trade Association (Represented by Its President) and Another V. Tamil Nadu Electricity Regulatory Commission, Tidco, and Others* (2013), The TNERC notified the RPO Regulation 2010, making it compulsory for the organisation to purchase some percentage of electricity from RE sources as per section 86 (1) (e). The same regulation was altered again in the year of 2011, to specify minimum targets of the solar energy purchase RPO making it compulsory for entities to meet the targets. The accountable entities shall purchase not less than Nine percent of the total annual utilisation from RE, of which 0.05 percent from solar, and the remaining 8.95 percent shall be procured from other than solar RE sources. Further, in the year 2011, the commission reduced the “Solar Purchase Obligation” (hereinafter referred as SPO) from 0.15 percent to 0.05 percent because of the lack of electricity generated from solar energy sources.

The Tamil Nadu Govt. in the year 2012 came up with the Tamil Nadu Solar Energy Policy, which issued directives to the TNSERC U/S 108 of the Act for appropriate measures.

The TNERC passed an order and specified certain schemes and advice to the consumers. TNERC also increased the percentage from Three percent in 2013 and Six Percent in 2014, requiring 720 MW and 1500 MW of solar energy. The definition was also changed in 2010 and 2012 by Commission and the State. The S.G. regulation stipulated the grid and sale of electricity to any person and a percentage of total consumption for purchasing power from such sources.

The appellants herein his appeal contended that the commission has acted under the impression that the directives of states are binding on the commission and did not make an independent evaluation of the Scheme before implementation. “Tamil Nadu Generation and Distribution Corporation Ltd (hereinafter referred as TANGEDCO)” claimed that by 2022 the Nationwide Tariff Policy prescribed for solar-specific RPO to be increased to 3 percent. This Electricity Policy also provides guidelines for the sustainable growth of RE sources. The S.G. directives must adhere to the C.G. objectives. The regulatory commission ensures that these measures helped to fulfil these objectives.

The questions in issues are as follows:

1) State Commissions must be obligated by the policies provided by the State Government U/S 108 of the Electricity Act of 2003 regarding the execution of the Solar Policy.
2) Is it correct for the State Commission to specify the Solar Purchase Obligation for the distribution licensee’s HT and LT Commercial category of consumers by the State Government’s directive without considering its RPO Regulations, 2010?
3) Is the contested decision imposing a Solar Purchase Obligation on a subset of the distribution licensee’s customers discriminatory and violating its RPO, 2010?
4) Is it possible that the State Commission may have imposed the Solar Purchase Obligation because of the policy direction it issued U/S 108 of the 2003 Act without utilising the powers vested in it U/S 86(1)(e)?
5) Was the contested order issued only to carry out the State Government’s U/S 108 directives without regard for the law or application of mind?

Afterward, APTEL held that the state commission must follow all the directives given by the state as per S. 108 of the 2003 Act under its ambit and not go beyond its scope. Further, the state commission can’t issue orders related to SPO on its own. Otherwise, it was subject to conflict U/S. 86(1)(e) and U/S. 108 under the 2010 regulation of the commission.

Further, in the case of *APTRANSCO V. Sai Renewable Energy Private. Limited*, (2011), The Hon’ble S.C. of India held that the state commission is not compelled by any policy issued by the States as per the 2003 Act if those directions will obstruct the functions of the state commission in any way prescribed by the Act.

The APTEL in the case of *Polyplex Corporation V. Uttarakhand Electricity Regulatory Commission* (2010), also held that the Commission is an independent statutory body. The directions the State Govt. is given are not compulsory to follow by the commission regarding the fixation of tariffs.

There are multiple agencies responsible for renewable energy's regulatory and policy formulation; however, these lacunae in coordination among the agencies create barriers to the harness of RE.

3.1.5. RE AGENCIES

Many Agencies are working towards transforming India into a clean energy Nation by executing various policy regimes. The MNRE collaborated with various institutions to support and development of RE Sources. The following are institutions like the "National Institute of Solar Energy" (hereinafter referred as NISE), the "National Institute of Wind Energy" (hereinafter referred as NIWE), the "Indian Renewable Energy Development Agency" (hereinafter referred as IREDA), and the "Solar Energy Corporation of India" (hereinafter referred as SECI).

A. "Ministry of New and Renewable Energy (hereinafter referred as MNRE)."

The MNRE is one of the essential ministries of GOI while dealing with matters about renewable energy. The ministry's role is to promote renewable energy sources, which generate energy sources like solar, wind, tidal, biogas, etc., to minimise energy poverty in the nation. Further, the development in the said Ministry happened earlier by constituting various departments like the "Commission for Additional Sources of Energy (hereinafter referred as CASE)", which was constituted way back in the year 1981, and constituted the "Department of Non-Conventional Energy Sources (hereinafter referred as DNES)" in 1982, and the "Ministry of Non-Conventional Energy Sources (hereinafter referred as MNES)" in the year of 1992. The name of MNES was changed in 2006 to MNRE.

The purpose of the said Ministry is essential in every aspect to secure energy security and minimise energy poverty in the nation by using all renewable energy sources for generating electricity. After the 1970 oil shocks, GOI realised to shift their electricity generation from conventional to non-conventional methods and established CASE in 1981, whose primary responsibility is to formulate the policies and their execution about new and renewable energy and promote R and D in the sector. Further, to develop more of the country's solar sector, the Ministry set up a new organisation, i.e., the "National Institute of Solar Energy (hereinafter referred as NISE)".

B. Establishment of the NISE for harnessing Solar energy in India

NISE is an independent corporal body registered as per the Society Registration Act, of 1860, on October 24th, 2013, under the umbrella of MNRE by developing the Solar Energy Centre (hereinafter referred as SEC), with a mandate to increase the R and D in Solar Energy nationally.

The development of photovoltaics and to creation a skilled workforce in the solar sector area. In addition, NISE coordinates between science and technology research on solar power. Another primary liability of NISE is to aid MNRE in implementing the "National Solar Mission" (National Institute of Solar Energy, 2013).

C. "National Institute of Wind Energy (NIWE)."

The wind energy source is also developed to comply with international commitments by India under MNRE. The NIWE was constituted in the year of 1998, the head office in Chennai for R and D in wind energy. The primary responsibility of the institution is to give alternatives to the problems that arise in the wind energy sector through R and D activities to improve technology and remove difficulties.

With the technical support of the Denmark Government and financial support from "Danida," a Wind Turbine Station was installed at Kayathar, in Thoothukudi District, Tamil Nadu, as an integral liability of Institute NISE (*National Institute of Wind Energy*, n.d.).

D. "The Indian Renewable Energy Development Agency (IREDA)."

The IREDA was registered as a Non-Banking Financial Institution (hereinafter referred as NBFC) in 1987 as per the Companies Act, 1956, to improve the current flow of funds in RE to promote, develop, and set up new projects in the

RE sector. IREDA has a motto, “Energy for Ever,” and worked under the administrative controls of the MNRE.

The below mentioned are the objectives of IREDA:

1. To give funds for electricity generation through renewable energy sources.
2. To provide effective and efficient financing services.
3. To increase participation of IREDA in RE sources.
4. Consumers satisfaction.
5. A competitive institution in RE sources.

E. “Solar Energy Corporation of India (SECI).”

SECI is also a non-profit organisation and is constituted as per Section 25 of the Companies Act, 1956. However, in 2015, the capacity of SECI was changed as per section 3 ˙of the Company Act 2013. As a result, the administrative control of SECI is vested in the MNRE. Currently, Dr. Anil Kakodkar is the Chairman of the Corporation. SECI is bestowed with the responsibility of implementing of JNNSM Phase-II. It is expected to install 3000 MW of power plants in various phases in India’s renewable energy sector.

The main objectives of the SECI are mentioned below:

1. Generating, purchasing, selling, and trading power products in India and abroad.
2. To carry out any activity to establish any RE sources plant in India and Abroad.
3. Proposal of the program on development and execution thereof.
4. To provide equipment and facilities on the lease, hire, and rent related to RE sources in India and Abroad.
5. To prepare a detailed report on all the RE sources plants.
6. To review, control and guide the companies regarding their maximum plant utilisation.
7. To Assist MNRE in implementing all the Solar programs.
8. To provide basic research to the pilot projects in India and Abroad to make commercialisation.

9. To monitor all the activities and provide Consultancy services about solar energy sources in India and abroad.

3.1.6. The Investment Scenario in The Renewable Energy Sector.

The energy business was traditionally in the hands of the State and Government institutions due to the considerable investment requirement and strategic importance. The entry of RE made energy production and consumption a more localised activity with increased private participation (Bhushan, 2014).

The sector was dominated by power companies and Oil Companies. Government initiatives carefully crafted the current energy market through the Act. The Rural electrification is decentralised and distributed under the Act. That has accelerated investments and attracted investors to and with the support of local self-government, consumer associations, cooperative societies, and NGOs. Private investors can also set up standalone systems in rural areas.

In 2016, the total global investments in the electricity sector surpassed the oil and gas sector. The main reason was the 36 percent drop in oil and gas investments in two years. Even though there was a 5 percent drop in investments in power generation, the 6 percent increase in investments in network assets has balanced out the final investment figures. As a result, the overall energy investment fell 12 percent in 2016 (*World Energy Investment*, 2017). The primary reason is the oil and gas sector investment drop due to the fall in revenues and oil prices since mid-2014.

In 2017 the global energy investment was USD 1.8 trillion (*World Energy Investment*, 2017). However, the investment in real terms fell by 2 percent due to lower levels of fossil fuel spending and lower capacity additions in thermal, nuclear, and hydropower plants.

According to the UN Environment Programme and Bloomberg study, the RE market is making great progress, but still required more push (*Global Trends in Renewable Energy Investment 2018 | Capacity4dev*, n.d.). According to the data for 2021 renewables accounted for only 28.7 percent of the electricity produced globally (*Renewable Electricity – Analysis*, n.d.). China, the U.S., and Japan are in the top three global positions with their investment of 90 billion USD, 58.9 billion USD, and 17.90 billion USD (*More Alternative Energy Resources*, 2022).

While China makes progress in leaps and bounds, India has witnessed increased investment in the energy sector by 7 percent behind China and the United States, backed by the strong push by the Government to augment the power systems (*World Energy Investment 2017*, n.d.).

Fossil fuel investments have had a share above 60 percent in the total energy supply investments since 2000. For the first time, the full share of fossil fuel investments in the total energy supply has dropped below the 60 percent mark. This suggests the shift of focus from energy solutions to non-fossil fuel sources. The drop in fossil fuel and nuclear-based power generation from the 2015 figures amounted to 17 percent, which has impacted the worldwide decline of investments in power generation to 5 percent (*World Energy Investment 2017*, n.d.).

The assets in renewable electricity were also affected during this period due to lesser investments in hydropower. The policy push for solar and wind, uncertain demand outlook. In the OECD region, the investments in power generation are 144 trillion USD in renewables, 8 trillion USD in nuclear, and 38 trillion USD in thermal power plants. During the same period in the non-OECD countries, it is 153 trillion USD, 18 trillion USD, and 79 trillion USD, respectively (*India Energy Security Scenarios, 2047*, n.d.).

In **Figure 3.1**, the RE sector investments are much higher than those in thermal power plants. There is an apparent shift in energy planning and energy mix focus toward clean energy. However, in the same period, the investments in India were still led by thermal power stations for power generation. The assets in India are 10 trillion USD in Renewables, 3 trillion USD in nuclear, and 21 trillion USD in thermal power plants. Southeast Asia and the Middle East also showed a similar trend during the same period, with more thermal power generation investments than renewable energy.

Both regions had zero investments in nuclear power plants in 2016. Southeast Asia has invested seven trillion USD in renewables and 9 trillion in thermal plants. The Middle East has invested one trillion in renewables and six trillion in thermal plants (*World Energy Investment, 2017*). China, on the other hand, had made 90 trillion plants (*World Energy Investment, 2017*).

USD investments in the region out of a total of 153 trillion (*World Energy Investment, 2017*). Their thermal power and nuclear assets were 34 and 10 trillion USD, respectively plants (*World Energy Investment, 2017*). While the world is moving toward green energy and embracing sustainability and energy efficiency, India lags. It moves on the wrong path with additions to thermal power plants (*World Energy Investment, 2017*)**.** The share of conventional energy, including thermal power and fossil fuels, rose to 59 percent in 2017, which witnessed a marginal increase after 2014 for the first time.

The worldwide electrical sector will see a 5 percent rise in investment in 2021 (*World Energy Investment 2021 – Analysis*). In 2020, the pandemic slowed investment in this sector, as the robustness of renewable-energy spending compensated for declines in electricity systems and more significant losses in fossil-fuel generation. The return of an increase in electricity spending underscores the essential importance of electricity in development strategies and energy transitions and hopes for economic and public health advantages.

Figure 3.1 Global investment in the power sector by technology, 2011-2021 (*World Energy Investment 2021 – Analysis*, 2021.)**.**

Given its competitiveness and the existing pipeline of projects committed in bids, auctions, and corporate power purchase agreements (PPAs), solar PV is expected to dominate the expansion in renewables spending in 2021 rather than wind.

Solar PV investments are expected to increase by more than 10 percent in China, India, the United States, and Europe. This increase is due to the completion of utility-scale solar PV projects and an increase in distributed solar PV investments aided by improved economic and public health circumstances. Investment in electricity is still far behind what is required for a cleaner and more electrified energy future. The headline numbers for electricity investment offer some encouraging indicators, particularly resilience in 2020 and the potential for growth in 2021. However, a closer examination of some of the details and a comparison to what would be required in climate-driven scenarios paint a far bleaker picture. The globe is still a long way from the course that must be taken to avert severe climate change consequences. Moreover, the modest increase in new coal-fired plant Final Investment Decisions (FIDs) in 2020 demonstrates that not all signs are moving in the right direction.

3.2. NATIONAL SOLAR MISSION (NSM) AND ITS ACHIEVEMENTS SO FAR.

The sector acquired a significant boost in 2010 when the National Solar Mission was launched as a part of the National Action Plan on Climate Change (NAPCC). That led to the initiation of the Jawaharlal Nehru National Solar Mission (hereinafter referred as JNNSM), officially launched on January 11th, 2010.

The document related to the mission to specify the simple strategy to develop the solar sector, both on-grid and off-grid, and the primary emphasis on developing domestic manufacturers and required technologies through facilitating R and D programs.

Initially, the mission was planned to set up a 20 GW grid-connected solar plant and separate targets for other processes like Solar streetlights, solar water heating, cooking through solar equipment, and other applications. These primary targets for the same are mentioned below:

Table 3.1 Data about the Targets and their timelines for completion.

("Annual Report 2017-18. (2019)").

The following data categorise the target into three Phase sets for 2010-13, 2013-17, and 2017-22 (cumulative) for all solar applications.

S.No.	Applications Areas	The target for Phase I (2010/13)	The target for Phase II (2013/17)	The target for Phase III (2017/22) (cumulative)
1	Solar collectors	7 million square meters	15 million square meters	20 million square meters
2	Off-grid solar applications	200 MW	1,000 MW	2,000 MW
3	Utility grid power, including rooftop	1,000-2,000 MW	4,000-10,000 MW	20,000 MW

3.2.1. Government initiatives like RECs, Rooftop schemes, Solar Parks, etc.,

A. "Atal Jyoti Yojana (AJAY) PHASE I."

The Ministry launched the AJAY Scheme on December 18th, 2018. In the beginning, it was proposed and valid for one year (Shetty, 2020). However, on March 5th, 2020, the Ministry extended the Scheme till March 31st, 2021. According to the circular, the vendors appointed by EESL to work on the project will continue installing solar streetlights against the sanction for MPLAD funds provided or authorised by the individual DMs until March 31st, 2020. Therefore, the Scheme will be implemented by Energy Efficiency Services Ltd (EESL) per the previously authorised parameters (Shetty, 2020).

The Government has chosen not to operate MPLADS for two years, from 2020 to 2022, due to the outbreak of COVID-19, according to the notice published by the "Ministry of Statistics and Programme Implementation" (MOSPI) on April 8th, 2020. As a result, the Government has decided to terminate Phase 2 of the AJAY Scheme on April 1st, 2020.

Solar Street lights with a 12MW LED capacity were built in parliamentary seats covered by the AJAY Scheme in Phase 2, with 75 percent of the cost of solar streetlights funded by MNRE funding and the remaining 25 percent covered by MPLADS (Member of Parliament Local Area Development) money. Solar streetlights for which MPLADS sanctions of providing funds have been imposed before April 1st, 2020, can only be installed under the plan if district authorities confirm the availability of MPLADS funds against these penalties, according to the document. The AJAY initiative was established to illuminate dark areas by installing solar streetlights. It is a sub-scheme of India's MNRE off-grid and decentralised solar application plan. The project's overall cost is Rs 583 crore.

MNRE issued a circular in March 2020 requesting a one-year extension in the scheduled commissioning date of renewable energy projects, citing disruption of supply chains due to the spread of coronavirus in China or any other country as a force majeure event. According to the circular, the Ministry of Finance has clarified that supply chain disruptions caused by the spread of coronavirus in China, or any other country should be considered a natural calamity, and the Force Majeure Clause (FMC) may be invoked as needed if the proper procedures are followed.

B. "Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan (PM-KUSUM)"

On July 22, 2019, MNRE issued a circular about providing central financial assistance of Rs. 34,422-crore for the PM-KUSUM scheme, and the Model PPA and Model Lease Agreement will inspire farmers to produce electricity to run their conventional pumps through solar power in their farms for agricultural purposes and contribute to the use of clean energy ("Conference of Power and Renewable Energy Ministers of States and UTs.," 2019).

The below mentioned are following three Components under the Scheme:

I. Under Component A, the 10,000 MW of decentralised ground-mounted grid-connected renewable energy power plants may be installed with capacities ranging from 500 kW to 2 MW, primarily on barren land, within 5 kilometres of a substation. The DISCOMs will buy power at a pre-determined rate, with PBI ranging from Rs. 0.40 per unit to Rs. 33 Lakhs per MW over five years.

II. Under Component B, around 17.50 lakh Solar Powered Agriculture Pumps may be installed. The central and state Governments will bear the 30 percent cost each, and the remaining cost will be borne only by the beneficiary farmer. In Northeast and hilly areas, the centre alone would bear up to 50 percent of the cost of a solar pump.

III. Under Component C, around 10 Lakh solar-powered agricultural pumps may be installed and connected to the existing grid. The central and state will bear the 30 percent cost each, and the remaining cost will be borne only by the beneficiary farmer. In Northeast and hilly areas, the centre alone would bear up to 50 percent of the cost of a solar pump (*Conference of Power and Renewable Energy Ministers of States and UTs*, 2019).

Status received from the states regarding the demand of pumps MNRE supplied all the states who sent their demand as per their requirements on 13.08.2019. However, some states still need to send their requirements under the Said Scheme to the centre. Though this allocation was temporary, the Ministry has issued sanctions to the States, which have confirmed the quantity allocated and the availability of state share of the subsidy. EESL has initiated centralised tendering for 1.75 lakhs standalone Solar Powered Agriculture Pumps under Component-B, bid closing date was 30.9.2019, and technical evaluation is under progress. To ensure that scheme objectives are achieved within the given time frame, it is necessary to launch a rigorous awareness campaign and plan for implementation. Other component-wise action points to be undertaken to help achieve targets envisaged under the Scheme are given below:

COMPONENT-A

I. DISCOMs must assess and inform Renewable Energy power generation that can be fed into specified rural distribution substations of 33/11 kV, 66/11 kV, or 110/11 kV.

II. DISCOMs should publicise the available capacity and solicit RfS from interested farmers/representatives.

III. Farmers interested in leasing their land to develop RE plants near the above substations may register with the Discoms office closest to them. A list of interested farmers may be posted on the Discoms website so that they may be contacted by the power plant developers interested in working with them.

Farmers who want to set up a plant on their own should look for the RFS document, which the respective Discoms will issue.

IV. State Government decides the tariff below when Discoms wants to buy electricity from farmers.

V. State Nodal Agency assists farmers/developers in obtaining the necessary approvals, financing from banks/financial institutions, technical assistance for DPR preparation, EPC tendering, and contracting project implementation.

VI. Within two months of the RFS being issued, the successful farmers/developers would be finalised.

COMPONENT-B

I. For Component B, state Governments will choose an Implementing Agency (IA).

II. IA will create an online site for solar pump installation and monitoring.

III. IA will publish an advertisement soliciting applications and describing how to apply. Farmers who want to install solar water pumps must first register with their local IA office through the portal, either in person or online.

IV. The IA will establish criteria for allocating solar pumps, including their capacity.

V. Farmers can get a loan from the State and IA to cover half of the cost of solar pumps.

VI. Soon after the centralised bidding is completed, IA will educate farmers about the empanelled vendors selected through centralised tendering, the quality of solar pumps specified, the five-year AMC provision, the service centre and hotline numbers of service providers, and so on.

VII. Farmers may select vendors of their own choice for installations.

VIII. IA to describe the mechanism for collecting the State/share, Farmer's paying the installer, and receiving advance payment from MNRE after the LOA is issued.

IX. IA to specify the post-installation inspection and completion report submission procedure. MNRE will make a follow-up/balance payment to IA once the job is completed.

X. IA will oversee monitoring the pumps functioning and resolving any issues promptly.

COMPONENT-C

I. The state Government will assign Component-C to an Implementing Agency (IA).

II. Identify feeders for solarisation of current agricultural pumps by DISCOMs.

III. IA will release an RFS for solarisation vendor empanelment.

IV. IA will create an online site for installing and monitoring solar-powered agricultural pumps.

V. Discoms will purchase surplus power from farmers at a fixed tariff decided by the state Government.

VI. States must determine the metering process and the specifications for the meters that will be deployed.

VII. Soon after the empanelment of vendors is finalised, IA will educate farmers on the quality of solar pumps specified, the five-year AMC provision, the service centre and helpline numbers of service providers, and so on.

VIII. Farmers must choose one of the pre-approved providers to solarise their existing agricultural pumps.

IX. The State and Implementing Agency collaborates with the bank and financial institutions to provide loans to the farmers.

X. The implementing agency needs to set up a universal procedure to collect the cost from the farmers and provide payment to the installer and the mode of payment from MNRE after issuing the LOA.

XI. The implementing agency set up the framework for post-installation inspection and submission of the completion report. For balance payment from MNRE after completion of work.

3.2.2. Status Of Execution

On July 22nd, 2019, the MNRE released implementation guidelines/modalities. Capacity was sanctioned to the States under the three components in 2019-20 and 2020-21 based on the demand from the States. The total capacity sanctioned to the States under the Scheme's three components is listed below.

Table 3.2. Data of all State's Capacity Sanctioned from 2019-2022 (APPENDICE 3A).

Under Component B, 16,546 standalone solar pumps have been installed in various states out of the above-sanctioned capabilities. Distribution Companies completed a pilot project of 24 solarisations in the State of Rajasthan under Component-C. The states of Haryana, Himachal Pradesh, and Rajasthan have allotted capacity under Component-A ("Annual Report 2020-2021,"2021).

Solarisation Guidelines for Agriculture Feeders were recently released, allowing distribution companies to solarise agriculture feeders. In addition, the solarisation of individual grid-connected farm pumps is already available. This clause will allow state Governments to carry out CAPEX or RESCO solarisation of agriculture feeders and give power to farmers for free or at a reasonable cost ("Annual Report 2020-2021,"2021).

A. Execution of Rooftop Scheme (SRISTI): In Phase -I, the Ministry is all set to implement the small solar rooftop plant and grid-connected solar plant, which provides 30 percent of subsidy paid by the Government to all the states and 70 percent of subsidy to some northeast states and hilly area states like Sikkim, Uttarakhand, Himachal Pradesh, Jammu and Kashmir, and Lakshadweep, Andaman, and Nicobar Islands for setting up rooftop solar plant on the grid in residential buildings, institutions, and social sector; and, for Government sector the subsidy is limited up to 25 percent of the total cost in all the states and UTs and 60 percent cost in Northeast and hilly states. Approximately 4200 MW is expected under this Scheme, out of which 2100 MW is provided subsidy and remaining without subsidy by 2019-20. So far, about 2098 MW solar rooftop systems have been sanctioned/ approved under the Scheme. Aggregate 1827 MW (APPENDICE 3A) has been reported online as installed in the country on October 3rd, 2019.

In February 2019, Phase II of the Grid connected rooftop solar program was approved with a target of achieving a cumulative capacity of 40,000 MW from Rooftop Solar (RTS) Projects by 2022 (Eduindex News, 2020). The program will be implemented with a total central financial support of Rs. 11,814 crores through DISCOMs (Staff, 2021). Operational guidelines were issued on August 20th, 2019. Central Financial Assistance (CFA) for the residential sector has been restructured in the Phase-II Program (Kabeer, 2019). Essential features of Phase II of RTS are as under:

- Power Distributing companies (Discoms) will be the implementing agencies.
- Subsidy/CFA will be available for the residential sector. Only l CFA under the residential category will be provided for 4000 MW capacity. The same will be provided based on benchmark cost or tender cost, which is lower (Government of India, 2019).
- 40 percent CFA for RTS systems up to 3 kW capacity and 20 percent for RTS system capacity beyond 3 kW and up to 10 kW. No CFA beyond 10 KW.
- For Group Housing Societies/Residential Welfare Associations (GHS/RAW), CFA will be limited to 20 percent for RTS plants to supply power to shared facilities. However, the capacity eligible for CFA for GHS/RAW will be limited to 10 kW per house with a maximum total capacity of up to 500 kW.
- Residential Consumers/Group Housing Societies/Residential Welfare Associations must pay the only balance amount after deducting the CFA to the empanelled vendor to install the RTS project for availing the benefit of CFA indigenously manufactured PV Modules and Cells to be used. Furthermore, performance-based incentives will be provided to DISCOMs based on RTS capacity achieved in a financial year (i.e., April 1 to March 31 every year till the duration of the Scheme) over and above the base capacity, i.e., cumulative capacity achieved at the end of the previous financial year as per following rates (Government of India, 2019).

Table 3.3 percentage of Central Financial Assistance (CFA).

S. No	Parameter	Incentive
1	For installed capacity achieved up to 10% over and	No incentive.
2	For installed capacity achieved above 10% and up	5% of the applicable cost for capacity achieved above
3	For installed capacity achieved beyond 15% over and above installed based	5% of the applicable cost for capacity achieved above 10% and up to 15% of the

The incentive to the Discoms will be available for the initial 18,000 MW. Capacities for the current year have been allocated to those nine willing Discoms who gave given their consent on August 20th, 2019. For the remaining Discoms, capacities are being allocated. Even advance to Three Discoms from the State of Gujarat is being released as per the provision of the Scheme and the demand received from Discoms. In addition, multilateral agencies have been allocated to the States to provide technical assistance. The service of these agencies can be availed to create a single-window clearance portal and demand aggregation.

Request to States:

I. Tenders to be issued by DISCOMs for empanelment of vendors.

II. Authorities at the district and sub-divisional levels are to be notified by DISCOMs for acceptance of the application and implementation of the program.

III. Integrated portal for application and processing of implementation to be kept ready.

IV. Mass awareness through media campaign for the Rooftop Solar Programme.

V. Discoms which have not yet come forward for participation in Phase II of RTS should come forward. They can take the support of State Nodal Agencies if they so desire.

VI. RTS capacity is permitted up to 100 percent of the connected load.

VII. Distribution Transfer (DT) capacity is increased to avoid permission denial for setting up RTS on this ground.

VIII. Mandatory notification for installing rooftop solar projects on all Government buildings and new buildings (above some built-up regions).

IX. Monitoring of sanctioned RTS capacity and expediting commissioning of the allotted capacity.

Timely and correctly submitted project proposals and project commissioning reports for the timely release of funds (*Rooftop Solar Program Phase II*, 2019).

3.3. ROLE OF TARIFF AND SUBSIDIES IN SOLAR POWER GENERATION.

Rooftop installation generates electricity to the grid and generates monetary benefits from it to the installers when transferred to the grid ("Solar Subsidy – All You Need to Know," 2021). The new solar panels are eco-friendly and more efficient than the previous ones, which helps curb the carbon footprint as the technology improves day by day. In addition, electricity generation may give power to residential homes, commercial spaces, and industrial buildings. As a result, a rooftop installation is an excellent investment.

However, the cost incurred is the main problem in installing the rooftop solar system. As per the data from MNRE, the average cost spent on installing a grid-connected rooftop solar system is approximately Rs. 75 Per watt is too high to afford in India for middle-class people (Product Line, 2019). However, to tackle this solution and promote solar energy among the population, the Government decided to develop subsidy schemes and other incentives (Product Line, 2019) to lure the population to install rooftops. The said subsidy is given to both the Government (Central and State) and other states' Nodal Agencies (SNAs). The main agenda of this subsidy scheme is to encourage the population to exploit solar energy and its electricity cost (Research, 2022).

According to the MNRE, the Central Government pays a 30 percent subsidy to the general states and more than 30 percent subsidy to some states like Uttarakhand, Sikkim, Himachal Pradesh, Jammu and Kashmir, and

Lakshadweep the subsidy offered for the installation is up to 70 percent of the installation cost. The more subsidy on rooftop PV installations (Rai-Roche, 2021). Furthermore, the State Nodal Agencies also provide subsidies. The institutional, residential, and social sectors are all covered by this subsidy programme. Commercial, industrial, and public sector enterprises, on the other hand, are not affected. Incentives based on energy generation are available to PSUs; other Government incentives for installing a rooftop PV system.

Other than the subsidies, there are other advantages too likewise:

- Consumers who installed rooftop PV systems may take a loan of 10 lakhs from nationalized banks. This loan is categorized under house loan and home improvement loan.
- Consumers can also receive 2 Rs. per unit of electricity generated through the rooftop (Product Line, 2019).

Excess-generated electricity may be sold to the grid to generate more monetary benefits, calculated as per the tariff decided by the Government. The rooftop PV system specifications for the subsidy programme Require about 100 square feet of area to install. Without subsidies, the average cost of installing a rooftop PV system is roughly Rs 60,000-70,000 per KW. After getting a 30 percent discount, the consumer will have to spend approx. Rs 42,000 - 49,000 per KW to install a rooftop PV system. To qualify for a generation-based incentive, a user must generate 1100 kWh - 1500 kWh per year (Chandra, 2022).

A customer can earn up to Rs 2000 to 3000 per year as a generation-based incentive under the Scheme (Chandra, 2022).

The application process to receive the Subsidy under the Scheme.

Those interested should contact their electricity provider and express their want to participate. The installation site will next be visited by concerned officials, who will examine it and approve it (Product Line, 2019).

- They will also go through the installation requirements and the cost structure.
- During their visit, users can also ask inspection officials for permission to install monitoring systems. After the installation is complete, the customer must contact the electrical provider for an inspection.

The officer will inspect the installation and grant their clearance for the subsidy.

Customers can then apply for the subsidy. They can also obtain information on the tariffs applied to the extra units sold to the Government.

Though the initial cost of the solar rooftop is high; otherwise, it is very beneficial in the long run compared to other sources like diesel operating generators. That is why GOI is trying to put solar equipment. Although the upfront cost of installing a rooftop PV system is high, it is inexpensive in the long run compared to electric generators (C, Do I Qualify For Solar Panel Grant, 2021). Moreover, because Solar Rooftop systems use solar energy as raw instead of fossil fuels, they do not require additional costs other than equipment maintenance (Product Line, 2019).

3.4. RENEWABLE ENERGY ACT DRAFT, 2015.

In local and global environmental concerns, energy security problems are progressively being addressed nationwide through various legislative and regulatory measures. These concerns were first addressed by constituting a separate nodal ministry for renewable energy. Until no specific legislation, Ministry's formulated policies are the guidelines to deal with it. India's electricity sector is governed by many rural ministries that operate independently. Currently, the renewable energy sector is driven by MNRE incentive-based promotion. In contrast, policy, and regulatory initiatives in the power sector (Post Electricity Act 2003) have proven to be as effective as bait with some flaws, such as the lack of a credible compliance mechanism (*National Renewable Energy Act 2015 Cover Note Purpose Rationale*, 2015).

The Renewable Energy Act 2015 Draft is a step toward India's fulfilment of its promises. This Act aims to encourage the production of energy from renewable sources based on climate, environmental, and macroeconomic concerns to reduce reliance on fossil fuels and assure supply security. This Act intends to reduce reliance on fossil fuels, improve supply security, and reduce CO_2 and other greenhouse gas emissions by promoting energy production through renewable energy sources based on climate, environmental, and macroeconomic concerns. This Act may contribute to the achievement of national and international goals to increase the share of energy generated from renewable sources.

3.4.1 Key Essential of the Act

Energy services are required in all cultures to provide basic human requirements (for example, lighting, cooking, space comfort, movement, and communication) and support production processes. Energy services must be secure and have low environmental implications for development to be sustainable (Moomaw et al., 2011). Renewable energy can help with social and economic growth, energy access, reliable energy supply, climate change mitigation, and the elimination of harmful environmental and health effects. India installed a power generation capacity of 268 GW, primarily fuelled by fossil fuels (70 percent). Over the 12th and 13th Plan periods, future energy and peak demand are expected to grow at a seven percent Compound Annual Growth Rate (CAGR). However, in the long run, continuing the business-as-usual development of fossil fuel-based generation had limitations due to a variety of factors, including limited fossil fuel resource availability, risks in securitising external fuel supplies, macro-economic constraints such as the balance of payments problems, and a high current account deficit, externalities of fossil-based generation, international climate mitigation pressures, and water availability constraints. In addition, dependence on imported fossil fuels exposes India to unpredictable costs, foreign exchange rate concerns, competition with other importers, and the source nations' domestic demands.

A cost-effective energy system would mean that cost would become the most critical factor in a business-as-usual situation. However, the appeal of a particular energy supply choice is influenced by broader economic, environmental, and societal factors. When the environmental and social externalities of conventional power generation are estimated and absorbed in the pricing of fossil fuel-based power, RE-based power becomes competitive or even cheaper. Furthermore, renewables are the only free hedging option against fossil fuel price volatility (*Draft National Renewable Energy Act 2015 | ESCAP Policy Documents Management*, 2015). As a result, a generating portfolio that includes renewable energy has a lower risk-adjusted cost than a fossil-fuel-only portfolio. Another apparent advantage of renewable energy technologies is their capacity to operate in centralized and decentralised modes, ensuring energy independence for regional and local mini grids (*National Renewable Energy Act 2015 Cover Note Purpose Rationale*, 2015).

To secure reliable and cost-effective energy supplies, there is a need for a systems-level view that integrates energy with resource planning in the form of Integrated Energy Resource Planning. This planning exercise should look at all available energy resource alternatives, including supply-side resources, transmission and distribution networks, their operation, and demand-side resources such as energy efficiency and demand response. Risk elements, such as fuel availability, fuel costs, and two other possible advantages, co-benefits, direct and indirect costs, cost of externalities, and hazards connected with each energy alternative, should be accounted for throughout this planning exercise. The existing energy and resource thinking are out of sync with this integrated approach, and it needs to change (*Draft National Renewable Energy Act 2015 | ESCAP Policy Documents Management*, 2015). There is a requirement for a RE Law. Climate, environment, social and economic repercussions, and other qualitative issues related to long-term national hazards, crucial to long-term energy policy, are now ignored in current energy sector planning centred on techno-economics.

Despite the explicit recognition of renewable energy's benefits in these value-based metrics, the existing project evaluation system and energy sector planning do not expressly address these benefits. These distortions show that RE does not compete on an equal footing with traditional electricity systems it needs Governmental backing to be given its due. In the current setting, increasing the amount of renewable energy in the energy mix will necessitate enabling policies to encourage changes in RE deployment rules and procedures and procedures connected to the planning of the entire energy system (Ministry of New and Renewable Energy, Government of India, 2015). The mandatory provisions enacted after the enactment of the Renewable Energy Law will provide the necessary backbone framework to facilitate an increase in the use of renewable energy for all relevant applications, including electricity, heat, and transportation, in an effective and coordinated manner that is well integrated with the energy and electricity system, and to do so by developing a supportive ecosystem, laying down an institutional structure, and creating a framework that is well integrated with the energy and electricity system.

3.4.2. Threshold Areas

This Act is broadly classified into the following sections:

1. Organizational Setup: The establishment of Government decision-making and advisory bodies ensures the formulation and implementation of a stable and suitable policy regime to encourage investments in renewable energy development (Guneet, 2015).

2. Additional Structure: Creating a favourable environment that encourages renewable energy sources and allows for investment. This comprises the RE Policy and Plan, Resource Assessment, Testing, Monitoring, Verification Policies, and indigenous component production.

3. Financial and Economic guidelines: The establishment and operation of national and state-level funds to achieve the Act’s goals.

4. window for RE Applications: This section examines how the paradigm outlined above can be used for two types of renewable energy:

a. distributed renewable energy applications and energy access; and

b. grid-connected renewable electricity.

The features mentioned above of the Act may benefit the sector and enhance the development of the renewable energy sector so that the share of the renewable energy sector may be achieved as it was committed at an international level to India. However, this draft was never discussed in any house of the parliament and was discarded by the MNRE itself.

Afterward, even in the recent amendments to the Electricity Act, 2003 is nowhere mentioned the relevant provision related to the solar energy sector specifically, which requires these days.

3.5. GOVERNMENT OF INDIA EFFORTS TO DEVELOP THE SOLAR ENERGY SECTOR.

The lives of 1.3 billion people in India began to be illuminated by solar energy in the early eras. It is among many sources having low-carbon emissions and has the potential to scale up tremendously. Nowadays, Solar power plants are expanding rapidly due to their performance and developments in the technology involved, making them the best option in renewable energy sources. The GOI support for installing and promoting solar energy sources by providing subsidies under various schemes cannot forgotten and allowing consumers to contribute to achieving the clean energy goal.

The below-mentioned are the Government's major initiatives for solar-related programme projects, which are aimed at encouraging more people and businesses around the world to go for solar and 100 percent renewable:

A. **"Jawaharlal Nehru National Solar Mission (hereinafter referred JNNSM)"**

Former Prime Minister Dr. Manmohan Singh founded the JNNSM in January 2010. Its goal is to initially lower the cost of solar power generation and construct 20,000 MW of grid-connected solar power throughout the country (Amplus Solar, 2021).

- Policy initiatives for the Long-term.
- goals to promote at Large-scale.
- R and D activity to promote RE sources.
- production of Solar cells in India's manufacturing plants.

The purpose of JNNSM is to revolutionise India's rural economy and provide large-scale grid-connected power. India's rural economy will be transformed by rapidly adopting solar lighting systems, water pumps, and other sun-powered applications to fulfil electricity demands. The goal is to grow India's solar energy industry and become a global leader. After the launch of this scheme, it was revised twice and increased the set targets to 100 GW through Solar till 2022. Each revision is aided by revised policies and new targets. During Phase, I target in the year 2010-13 the set target was 1000 MW for grid connection and rooftop. For Phase II in the year 2014-17 the set target was 200 MW for OFF Grid Solar, other than this for grid connection target was 4000-10000 MW, and establishing Solar parks in some parts of the countries was also set to achieve. In Phase III 2017-22 the mega solar power Project is approved with a target of 40GW As of now more than 30 Solar parks was established which is generating more than 25000 MW of Electricity (Tandon, 2021).

B. **Solar Rooftop Photovoltaic Scheme**

Solar Energy Corporation of India (hereinafter referred as SECI) has awarded 200 MW of rooftop projects, of which 45 MW of capacity has been commissioned under the rooftop scheme. In addition, special schemes have also been established, including 73 MW for warehouses and 50 MW for the CPWD (Central Public Works Department). The largest global tender was launched by SECI, which offered a 30 percent subsidy to the residential sector, private, non-profit educational organizations, the social sector, and health institutions. The tender is part of MNRE's commitment to building momentum toward the 40 GW rooftop solar power generating target for 2022. Similarly, SECI intends to launch a 1,000 MW rooftop tender in the near future, which will not be competitive. But Our Current Prime Minister during the G20 Summit held in Saudi Arabia while addressing increased the target from 450 GW to 2030 (Tandon, 2021).

C. **Solar Parks in every state Scheme**

MNRE has devised a plan to build multiple solar parks, each with a capacity of almost 500 MW, across several states. In terms of land allocation, transmission, access to roads, and water availability, the plan proposes offering the Government of India financial support to establish solar parks in order to facilitate the creation of infrastructure required for the establishment of new solar power projects in terms of land allocation, transmission, access to roads, and so on. The State Governments will build these solar parks following the policy. The land needed to build solar power projects with a combined capacity of 500 MW or more will be found and purchased. The solar park will allow states to attract investment from project developers while also providing jobs for the local people.

The Solar Park is a dedicated area for developing solar energy-producing installations. SECI, on behalf of the Indian Government, will be the implementation agency. By avoiding emissions equal to the solar park's generated capacity, the state will be able to decrease its carbon footprint.

Table 3.4 Currently Established Solar parks in States of India (Attached as APPENDICE 3B).

The Solar plants are generating more than 25000 MW of Electricity Generation jointly.

D. **VGF (Viability Gap Funding) Scheme.**

The Viability Gap Funding (VGF) plan, which will allow SPDs to build, own, and manage solar PV power projects with above 5000 MW, will be executed through an open and transparent competitive bidding process. The solar energy generated will be sold to buying Discoms / State Utilities / bulk consumers at a pre-set pricing of Rs. 5.00 per kWh or less, as determined by MNRE based on market conditions, with a trading margin of 7 paise per kWh by the SECI as per the Government of India order Number. 32/3/2014-15/ GSP. The MNRE will form a committee to establish SECI's solar power acquisition tariff. The Viability Gap Funding scheme is implemented by SECI. In recent years, SECI has made several project allocations under the VGF process. The initial 750 MW allotment has already been completed, with a total capacity of 680 MW installed and operational. In addition, solar power developers who build and operate grid-connected solar PV projects with a capacity of at least 2000 MW will receive VGF support (Amplus Solar, 2021).

E. **Solar Energy Subsidy Scheme.**

Financial help and capital subsidies of 50 percent, 75 percent, and 90 percent of the essential cost of the solar energy plant will be offered to the applicant under this Scheme. According to the Government Yojana, if a person gets solar panels placed on his roof, he is eligible for a subsidy. The amount of assistance is determined by the solar power plant's capacity. The initiative is primarily designed to encourage solar energy in the power loom. The solution will solve the light issue, and the plant will employ solar energy to boost output and increase the textile industry. As a result, people would be able to save money on their electricity bills, and the burden on thermal power will be reduced.

F. **“Ujjwal Discoms Assurance Yojana (hereinafter referred as UDAY) Scheme.”**

The Government of India introduced UDAY in November 2015 as a revival package for India’s electricity distribution firms to find long-term solar power solutions to the financial crisis that the power distribution industry was in at the time. It intends to reform the power industry, enhance operational efficiency, develop renewable energy, lower the cost of power generation, and conserve energy.

The states, on the other hand, can choose whether to participate in the plan or not. Under this plan, the state Government assumes up to 75 percent of the debt by issuing sovereign bonds to repay the lenders, with the remaining 25 percent being issued as bonds. UDAY hopes to find a long-term solution to the electricity sector’s past and potential future problems (Amplus Solar, 2021).

3.6. LESSON LEARNED FROM GERMANY RENEWABLE ENERGY SOURCES ACT, 2000 (WITH AMENDMENT) AND POLICIES RELATING TO THE SOLAR SECTOR.

3.6.1. INTRODUCTION

Germany is most populated nation among all the states in European Union with a population of approximately 82 Million with an area of approx. 3,57,000 Square Kilometres and with a GDP of 4.31 Thousand of Billions of US Dollars (*GDP, Current Prices Germany*, 2023).

A. India and Germany Political Relations:

Germany is India' Biggest Trading partner in all European States. Ranked 5th larger trading partner in world and ranked 8th in terms of FDI sources and ranked 2nd in terms of Technological collaboration partner ("India-Germany Relations," 2013).

B. Political Relations between two Nations:

India was first among all nation who ended a state of war with Germany in 1951 and granted recognition to the Germany as federal republic of Germany. This relationship which is based on common values and rule of law of democracy gained popularity by the time and strengthened during 1990's when India is moving towards the liberalisation ("India-Germany Relations," 2013). Further India and Germany also worked very closely on certain issues of "United Nation Security Council" (hereinafter referred as UNSC) to expand under group of four also known as G4.

Since a year 2000 India and Germany have strategic partnership to discuss on certain issues like strategic dialogue, foreign office consultations, joint commission on Industrial and Economic cooperation, defence committee dialogue and jointly working on counter terrorism ("India-Germany Relations," 2013).

In the past many of the Indian Prime Minister has visited Germany and Its part to strengthen the relation between two nations.

This is the reason that, the researcher has taken Germany for comparison with India to adopt the policies in RE sector to Improve and enhance the RE sector in India. Germany has already come up with Renewable Energy Sources Act, 2000 which is further discussed in below mentioned paragraph.

C. Renewable Energy Sources Act, 2000

By 2010, the Act sought to double the electricity generated from renewable sources (*Germany's Renewables Energy Act – Policies*, n.d.). The Electricity Feed-In Law of 1991 is repealed by this Act. The utilities' responsibility to provide grid access to renewable energy projects and purchase electricity at premium prices has been transferred to the grid operators (*Germany's Renewables Energy Act – Policies*, n.d.). Tariffs are determined for each technology based on the actual cost of production. Except for wind power, the pay level for a single plant is fixed for more than two decades. The increased generation of wind electricity is rewarded with a large sum of money. The payment is reduced once the limit is reached. The lower price will be paid for up to 20 years after the facility is commissioned. In an average location, the payment for wind power is throughout a twenty-year lifetime, the cost is 0.084/kWh. Because the payment for each plant is not updated for inflation, the remuneration is reduced in actual terms. Since 2002, the compensation for newly commissioned plants has been lowered yearly to provide more substantial cost-cutting incentives (*Germany's Renewables Energy Act – Policies*, n.d.). Photovoltaic installations have a factor of 5 percent, wind power plants have a factor of 1.5, and biomass-fuelled plants have a factor of 1 percent. The actual price decrease is more significant than these rates show because inflation is not considered.

The Act also establishes obligations for grid connection and reinforcing charges. Plant operators are responsible for grid connection costs; however, the grid operator is responsible for grid reinforcement costs if necessary (*Germany's Renewables Energy Act – Policies*, n.d.). There are no public funds involved. The Act addresses the unequal burden distribution (as in the EFL) by forcing all electrical suppliers to use the same percentage of renewable energy in their fuel mix (*Germany's Renewables Energy Act – Policies*, n.d.). Grid operators must balance the amounts of electricity remunerated according to the Act. For three months, the EEG electricity share is equal on all grids. Then, all electricity suppliers using the public grid must buy an equal share of EEG electricity at a price comparable to the average remuneration paid for all EEG electricity (*Germany's Renewables Energy Act – Policies*, n.d.). This approach evenly distributes the costs and benefits of the generated electricity. This distribution technique is an ex-post quota because electricity suppliers only know how much renewable energy they must buy after the fact. In this design, there is no need to determine the area value of the electricity fed. On the other hand, the physical distribution of renewable energy electricity among all suppliers entails additional costs (*Germany's Renewables Energy Act – Policies*, n.d.).

The additional costs of regulation are unknown. However, according to the Renewable Energy Sources Act, a supplementary rule released in 2001 specifies which biogenic chemicals and technical procedures are eligible for payment (*Germany's Renewables Energy Act – Policies*, n.d.).

Photovoltaic projects were only eligible for compensation if they had a combined capacity of 350 megawatts. This limit was raised to 1000 MW in 2002. Revenue for photovoltaic projects was further varied based on on-site specifics in November 2003 (*Germany's Renewables Energy Act – Policies*, n.d.). The compensation for photovoltaic installations was initially limited to a total capacity of 350 MW. The ceiling was raised to 1000 MW in 2002. Revenue for photovoltaic projects was further divided based on site details in November 2003.

2021 Targets as per the Act, 2021: According to the Renewable Energy Act 2021, renewable energy's share of gross electricity consumption in Germany should be 65 percent by 2030 (*Section 1.2*). This target is based on the expected gross electricity consumption of 580 TWh and, thus, on an electricity generation from renewable resources of 377 TWh. Further, the Renewable Energy Act sets legally binding targets for electricity generation to be greenhouse-gas neutral by 2050 (*Section 1.3*).

The Renewable Energy Act also provides much more specific targets concerning the expansion of various renewable energy sources:

- An installed capacity of 71 GW for onshore wind plants by 2030 (*section 4.1*.a).
- An installed capacity of 20 GW for offshore wind plants by 2030 (*section 1.2, WindSeeG*).
- An installed capacity of 100 GW for photovoltaic plants (*section 4.3.e*).
- An installed capacity of 8.4 GW for biomass plants (*section 4.4*).

These targets are legally binding.

So far, there are no specific targets concerning the construction and use of battery-storage facilities.

I. Government Policies/Incentives:

The Renewable Energy Act provides a promotion scheme for operators of renewable power plants. Two following models exist:

- Operators participating in the feed-in tariff model sell electricity to the respective Transmission System Operators (hereinafter referred as TSOs) and obtain a long-term fixed price specific to the energy source used to generate electricity. In return, the TSOs sell the generated electricity on the market.
- Operators participating in the market premium model sell the generated electricity directly on the market (or employ a third-party direct marketer to do so on their behalf). They obtain a premium representing the difference between the monthly (as of 2023, the yearly) average electricity exchange market price and an electricity value explicitly determined by the energy source used. Since 2017, a tendering process has determined this value.
- The market premium model is the standard remuneration scheme. The feed-in tariff model is only prevalent among older or small-generation plants.

The renewable energy surcharge finances the feed-in tariffs and market premium. This surcharge applies to energy companies that supply electricity to end consumers and to end consumers not supplied by such energy companies (such as self-producers and importers). Both the revenue from the renewable energy surcharge and the expenditure for the feed-in tariffs and the market premium are administered by the TSOs. As of 2021, the accounts of the TSOs will be subsidised by a government fund to cover the expenditures, thus ensuring a maximum surcharge of 6.5 ct/ KWh in 2021 and 6.0 ct/ KWh in 2022. In principle, the renewable energy surcharge also applies to the supply or consumption of electricity from renewable energy sources. However, self-producers that generate electricity from renewable sources or mine gas next to the place of consumption are subject to only 40 percent of the regular EEG surcharge (*Section 61b, EEG*).

Similar to the Renewable Energies Act, the Combined Heat and Power Act (KWKG) provides premium payments for operators of cogeneration plants. Further, operators of highly efficient cogeneration plants are subject to only 40 percent of the regular renewable energy surcharge (Sections *61c and 61d, EEG*).

German energy law provides various exemption rules specific to operators of battery storage facilities. Most of these rules ensure that storing electricity does not trigger additional charges or fees compared to a scenario where the path from electricity generation to electricity consumption is not interrupted by storage. For example, using electricity for hydrogen electrolysis or other storage methods does not constitute an obligation to pay grid charges (*see section 118.6, EnWG*). Besides relief rules, many states, and the German state-owned Development Bank (*Kreditanstalt für Wiederaufbau, KfW*) have several programmes to encourage the development of battery storage capacity.

II. Recent Changes in Germany RE Act.

Germany's ruling coalition agreed on changes to its energy law on December 14th, 2020, creating the legal foundation for the long-term expansion of renewable energy and assisting the country in meeting its 2030 objective of producing 65 percent of its electricity from clean sources (*Germany's Renewables Energy Act – Policies*, n.d.). The law became effective on January 1st, 2021. It aims to ensure that by 2050, electricity supply and consumption will be carbon neutral. In addition, the law establishes the rate at which renewable energy sources such as wind and photovoltaics will be grown in the coming years (*Germany's Renewables Energy Act – Policies*, n.d.). For the first time, the 2021 Renewable Energy Sources Act provides annual monitoring, which can be used to adjust if necessary (*Germany's Renewables Energy Act – Policies*, n.d.). The renewable energy levy in Germany, a fee on electricity bills to support renewable energy, will be EUR 0.065 (USD 0.077) per kWh next year, down from EUR 0.06756 in 2020 (*Germany's Renewables Energy Act – Policies*, n.d.). As a result, power prices will drop by 1 percent for the average home. German households should expect reduced energy bills next year due to a reduction in the extra they pay to support renewable energy. The transmission grid companies, including Elia's 50Hertz, Dutch Tennet, ENBW's Transnet BW, and Amprion, stated that capping the price at 6.5 cents would necessitate federal support payments of 10.8 billion euros (*Germany's Renewables Energy Act – Policies*, n.d.). The Government also agreed that the price would be reduced to 6.0 cents in 2022 to relieve clients of financial constraints in the fight against the coronavirus's economic consequences. In addition, the Federal Cabinet approved the EEG amendment 2021, which amends the Renewable Energy Sources Act. The cabinet also approved an amendment to the Federal Requirements Plan Act that included requirements for expanding the electrical system.

Update as of November 26th, 2021, is that the Federation and the Länder established a new Bund/Länder Cooperation Committee under the Renewable Energy Sources Act to accomplish its renewable energy commitments (*Germany's Renewables Energy Act – Policies*, n.d.). According to a recent assessment published by the Federation and the Länder, the targets will not be met unless additional wind-power projects are permitted. The available acreage for onshore wind farms is insufficient to satisfy the 2030 target of 71 GW of installed capacity and yearly auction volumes (*Germany's Renewables Energy Act – Policies*, n.d.).

3.7. CONCLUSION

This chapter is dedicated to the law and policies relating to the electricity sector, further this chapter all the organisations involved in the power sector and how all these coordinates with generators. This chapter also emphasises the roles and responsibilities of the Power Ministry and the Ministry of Renewable Energy. The establishment of central electricity authority, state electricity boards, and central electricity regulatory commissions and coordination among all for harnessing the solar sector. Further, this chapter also emphasises on renewable energy under the E- Act, 2003 and the policies formulated for harnessing the sector also discussed, and their lacunae for the specifically solar sector, in India. This research also emphasises on the national solar mission and how its effectively implemented in India along with on-grid and off-grid schemes for the solar sector. This chapter also emphasis the role of tariffs in promoting the solar sector and luring consumers to attract and install solar panels. From 2003 till 2015 electricity Act dominates the sector, then in 2015 a Renewable Energy Act draft, 2015 was proposed for the enhancement of the sector. But this draft was never presented before any of the houses. But it is highly recommended that a new Renewable Energy Act is needed in the current scenario specifically for RE. Even the Germany RE Act was implemented for harnessing the RE Sector. Germany has very critical weather conditions and still, they managed to generate around 40 percent from RE sources. This is comparative research between India and Germany's Legal Framework. India and Germany have a Memorandum of understanding to develop the solar sector in India. The Government of Germany-initiated legislation on RE is also discussed for comparison. After all, it was found that this sector still needs robust development in formulating separate legislation.

CHAPTER 4-

4.1. RENEWABLE PURCHASE OBLIGATION: A NEW APPROACH

4.1.1. Introduction of RPOs

The development of electricity is due to the policy enacted by the Government of India, majorly in the RE sector. The development can be seen in the past few years. The MNRE, with the help of Some Nodal state agencies, initiated the policies to attain the 175 GW target 2022 of electricity generation through renewables (*Objective-National Portal for Renewable Purchase Obligation-MNRE*, 2022).

The said target was committed during UNFCC to reduce carbon emissions and the total generation from renewable energy must be at least 40 percent renewables. These international and domestic commitments constitute a significant motivation for energy security and becoming self-reliant on renewables. It’s a step toward meeting global commitments. Under Electricity Act, of 2003, the SERC must fix a certain percentage of electricity generation through renewables and Electricity consumption of Discoms from RE sources. Though tariff policy changed in January 2016, SERCs set aside the Minimum amount to buy solar energy. This electricity generation must be approximately 8 percent excluding hydropower by March 2022, declared by the Central Government in 2018; the GOI, through its notification in 2018, notifies the RPOs for solar and non-solar for all the states and Union territories will reach to 21 percent by 2022 with approx. 10.5 percent with Solar energy for the long-term.

4.1.2. RPOs: A way forward

RPO is a mechanism where the Discoms and other entities are mandatory to buy a certain amount from the total consumption of electricity generated from

Renewable Sources as U/S 86(1)(e) of the E- Act 2003 and from National Tariff Policy. Further, RPO is distinguished under "Solar and Non-Solar" (generated from other renewable sources like wind, tidal, etc.). However, to achieve success in meeting the RPO, MOP has notified the said targets for 2022. The detailed targets for all the states are mentioned later in Figure 4.2 The mentioned targets must be achieved uniformly by all the entities under all the states and union territories without default.

The idea behind the RPO is further explained under the Objectives by the ministries as follows:

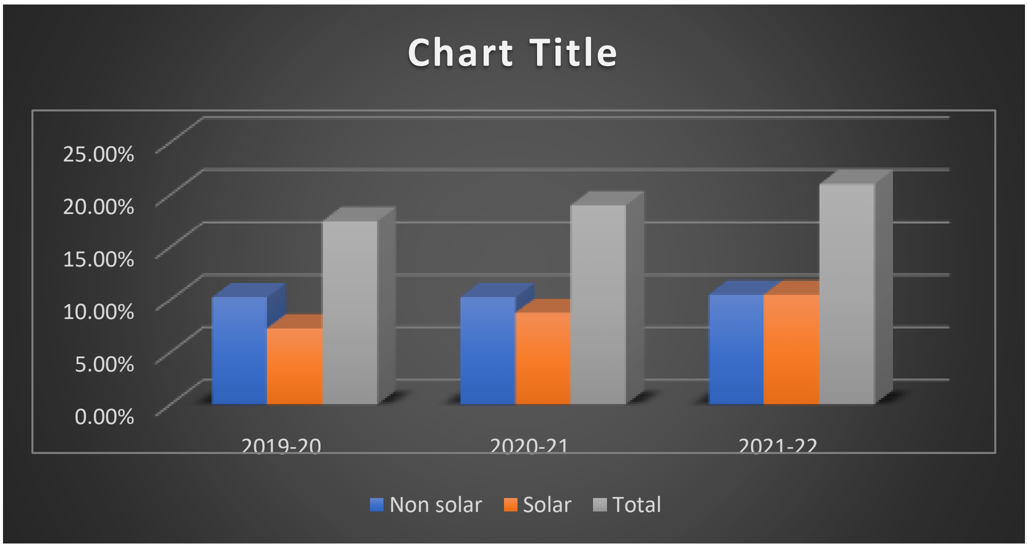
- To create one single platform to monitor all the activities related to RPO for all states and UTs.
- To prepare a list of all the entities and decide their RPO targets and compliance reports.
- To facilitate and monitor all the RE transactions for all entities.
- To create a database where SERCs get all the information for the Audit of RPOs and their compliance.
- To maintain transparency in RPO compliance.
- Further to make a User (Entities) Interface to provide data on RE purchases and cross verifies the data with monitoring agencies provided by users.
- Finally, to enhance the efficiency of the database to check the credibility of RPO obligations in all the states.

4.1.3. Targets of RPOs

To comply with RPO targets is itself a very tedious task and there is no roadmap prepared by the Government to enforce compliance. Further, in May 2018, the Government, with the help of MNRE, set up a compliance cell to coordinate with the states, CERCs, and SERCs on RPOs compliance. The compliance cell will prepare a monthly report about the achieved targets. Furthermore, it also escalated the noncompliance issues to higher authorities (Prateek, 2019). Though every state needs to maintain the reports on RPO mandates twice and quarterly a year by nodal agencies established by states to state electricity regulatory commissions for compliance of RPO by Discoms and other organisations, some states only keep an eye on RPO compliance about open access and captive generators.

According to the MOP order dated January 29th, 2021, RPO targets for “Solar and Non-Solar” was commonly notified for all states and UTs for three years from 2019 -2022. For 2019-2020 the target for Solar RPO is 7.25, for 2020-2021 is 8.75, and for 2021-2022 is 10.50 percent.

Figure 4.1: Target sets by MOP for years 2019-2022.



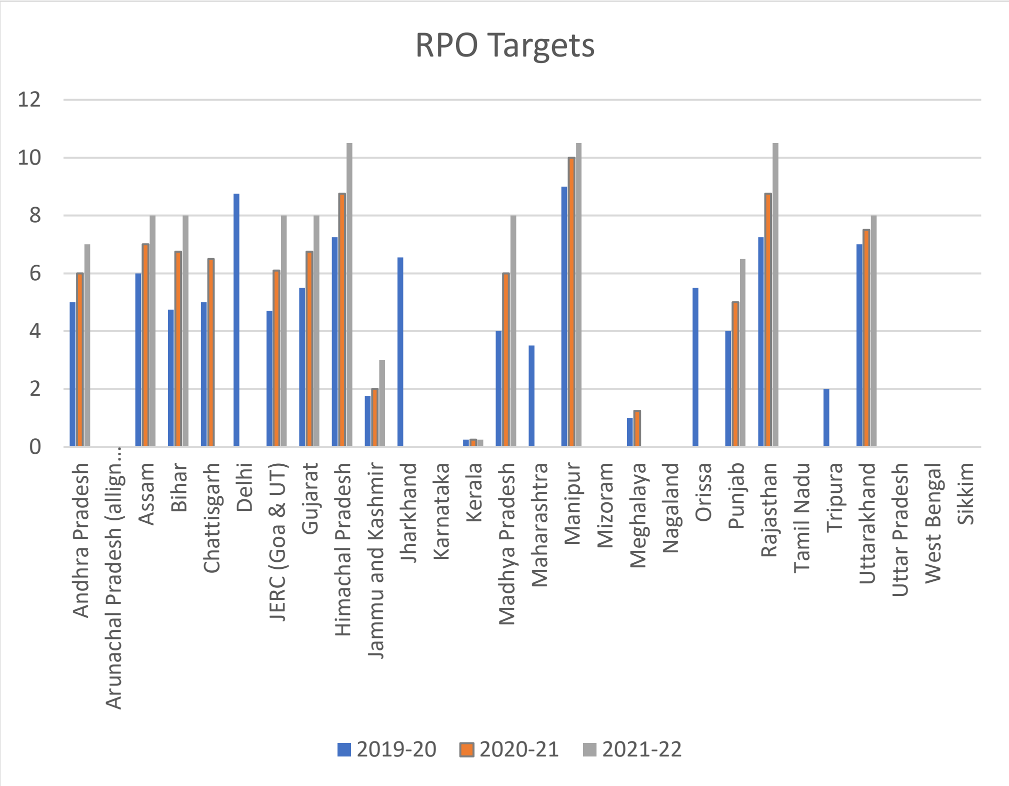
Further, the order specified that SERCs might notify the set RPO to the states about the uniform trajectory.

However, only ten nodal agencies began to review the compliance status. Depending on geographical and environmental challenges, many states have the resources to generate electricity. The data on Solar radiation received on land helps to find a better place to install “solar parks” and “solar power projects” and help to install solar rooftops in urban and solar areas. The best example is the Solar project installed in Kutch, Hayathnagar, Srihari Kota, Jaisalmer, and Mahendragiri.

Many states like Rajasthan, Gujarat, Karnataka, Madhya Pradesh, and Tamil Nadu generate electricity through Solar. The targets specified in every state vary as per their geographical conditions. The targets for all the states from 2019 to 2022 to achieve are mentioned below.

State Wise Data of RPO in India from 2019-20, 2020-21, 2021-22(*Objective-National Portal for Renewable Purchase Obligation-MNRE*, n.d.).

Figure 4.2. RPO Targets are set for 2019-20, 2020-21, and 2021-22.



The Government has set a target for every year for RPO obligations in every state of India; it can be seen from the above chart that in the year 2019-20, the highest target is Nine (9) percent in Manipur and many states have Zero (0) percent target in states like Arunachal Pradesh, Karnataka, Mizoram, Nagaland, Tamil Nadu, Uttar Pradesh, West Bengal, and Sikkim. In 2020-21, the maximum target was Ten (10) percent in Manipur. Those states have a Zero (0) percent target in 2019-20 and continue with a Zero (0) percent target in 2020-21, too, along with a few more states like Delhi, Jharkhand, Maharashtra, and Orissa. And for 2021-22, the maximum target is set at 10.5 percent in three states, Himachal Pradesh, Manipur, and Rajasthan, and Zero (0) percent targets in Arunachal Pradesh, Delhi, Chhattisgarh, Jharkhand, Maharashtra, Mizoram, Meghalaya, Nagaland, Orissa, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Sikkim. Every state has its reason for not achieving its RPO targets, even though there are no environmental challenges to fulfilling the targets. This target applies to all “Distribution licensees”, and “Open Access consumers”, along with “Captive power plant” owners who generate electricity independently from renewables. On failure to meet the targets, the commission further may direct entities to put up a certain amount as a security, based on Shortfall in fulfilling the targets (*Objective-National Portal for Renewable Purchase Obligation-MNRE*, 2022).

Further, the commission may appoint an officer of the state agency to obtain power exchange certificates for the shortfall in completing the targets. Obligated entities are also liable for penalties U/S 142 of the E- Act of 2003. Furthermore, every state agency is empowered to prepare a quarterly report of compliance with RPO targets and submit it to the commission.

Moreover, it’s tough for Discoms to comply with all those targets and only a few states can comply with the RPO targets. Due to the Covid-19 pandemic, many states have not set their RPOs targets for the preceding three years and Discoms are operating independently and without thinking about compliance.

No strictness on failure gives ultimate power to the Discoms not to comply. Even the Electricity Amendment Bill, 2022 states that the RPOs should not be lower than the minimum certain percentage specified by the C.G. If any party is in default and failure to meet the targets, then they *“will be punishable with a penalty between 25 paise and 50 paise per kilowatt of the shortfall, which is much less for big Discoms.”* (*The Electricity (Amendment) Bill, 2022*, n.d.) This punishment is not to impose any hardcore penalty on the Discoms that again will be a reason for failure.

4.1.4. Compliance Status of RPOs In India.

Promoting and developing Renewable Energy Installation in India requires more focus on RPO. Discoms must buy electricity generated from renewable sources by private/ state electricity regulatory commissions (SERCs) as per their set targets and limits, this is known as RPOs. Electricity transmission and distribution companies, self-sufficient captive power generation plants, along with Industries are ordered to attain the RPO to buy electricity, a fixed amount of their RPO targets from RE. The existing policies framework also provides Renewable Energy Certificates (RECs) instead of renewable power from obligated entities from the National Load Dispatch Centre. However, enforcing compliance with mandates is challenging, with 16 states and Union Territories achieving less than the targets. Unfortunately, many states have shown disastrous results in compliance. The achievements of RPO mainly depend on strictly adhering to the targets and enforcement. This lack of consistency in the data for enforcement can be seen in decisions given by MERCs.

Implementation of RPOs targets is very complicated because of restrictions on trading REC's. Electricity producers from RE sources meet their RPOs target by selling power to "Distribution licensees" at same price as Non-RE and recovering the remaining costs by selling their RECs to third parties. Using RECs allows required organisations to plan and take advantage of market conditions without purchasing renewable energy (Joshi, 2018).
CERC, by their order dated March 31st, 2020, due to a disagreement about a price change by the CERC, trading in RECs was placed on hold. Business (Selling or buying) in Non-Solar RECs is permitted till now, but recently, Business (Selling or buying) in solar RECs was not authorised. Several parties blamed the suspension of solar REC trading for failing to reach RPO requirements. Businesses started questioning SERCs, to continue even with their shortfall. The CERC indicated in May 2018 that a Supreme Court ruling could do trading in solar and non-solar RECs at the "floor price" and "forbearance price" established by the CERC.

"Floor price is the minimum price at which a REC can be traded on a power exchange; forbearance price is the ceiling price".

However, there is now a lack of consistency due to this. On July 31st, 2018, MERC issued several orders. MERC in its one order instructed the "Maharashtra State Electricity Distribution Company Ltd" (hereinafter referred as MSEDCL) to buy solar power and RECs to make up the difference by March 2019 till March 2020, as MSEDCL had sought. MERC took notice of MSEDCL's arguments for not meeting its targets. MERC observed that regardless of circumstances, MERC's RPO shortfall has increased and anyhow MSEDCL must attain its RPO targets.

The "Haryana Electricity Regulatory Commission" (hereinafter referred as HERC), in their order passed on June 30th, 2018, stated that RPO targets are fixed, and no reason to change them. HERC further stated that the party fails to provide a convincing reason to increase the time for RE by more than 12 months.

But, in another order on the same date, MERC allowed "Brihanmumbai Electric Supply and Transport Undertaking" (hereinafter referred as BEST) to attain its non-solar RPO targets through renewable energy or obtaining REC's. BEST used this opportunity, to meet the targets. In addition, "Reliance Infrastructure Ltd" (Distribution) was also allowed to fulfil its solar and non-solar shortfall vide an order dated June 30th, 2018. These orders may create a supply-demand gap and adversely affects renewable power generators (Joshi, 2018).

Enforcement of RPO policy, even with the availability of RECs, is humongous for many Discoms. To tackle this, the Govt. established the RPO Compliance Cell.

According to the Gazette Notification issued by the Govt., the compliance cell is to work with CERC, and SERCs in matters of RPO fulfilment, along with compliance reports to be prepared monthly and to escalate the non-compliance issues to proper authorities. Enforcement of RPO was a difficult task in the past, and futuristic performance of it is yet to see. The current problem is this compliance Cell has no enforcement powers, and its advice or directions, or orders would be non-binding in nature.

Non-compliance with RPO targets could result in relevant SERCs deposing RPO regulatory charges and forbearance prices determined by the relevant

SERC into a separate fund. Whilst regulations of most states link regulatory charges to forbearance prices, SERCs usually have the discretion to specify what charges are to be deposited in the fund and how such charges are to be utilised. Most regulations empower SERCs to authorise an officer to procure requisite RECs from the power exchange out of the amount deposited in the fund to meet the RPO shortfall.

Furthermore, considering the recent results of trading RECs, it can. Be predicted that the obligated entities will attain their RPO shortfalls to avoid fines in the coming future (Joshi, 2018). In the long run, electricity consumers get the benefit of proper implementation of RPO and helps the Govt. to attain future targets. Therefore, a proactive initiative from the Govt., and consistent approach across all SERCs, uninterrupted trading of RECs, clarity on the role of the RPO Compliance Cell, and stringent and uniform enforcement of RPO are needed (Joshi, 2018).

4.1.5. Judicial Intervention in the Cases of RPOs Obligation In India.

In the case of *Hindustan Zinc Ltd. V. Rajasthan Electricity Regulatory Commission* (2015), the respondent was empowered under Electricity Act and exercised his powers as per sections 51, 66, 86(1) (e) and 181 issues notifications of Renewable Purchase obligations 2007 and Renewable Purchase Obligation and Renewable Energy Certificate compliance framework regulations 2010. As per these Notifications, all captive generators and open access consumers are mandated to buy some percent of electricity from RE sources and non-fulfilment of these Obligations will attract a surcharge as a penalty. Aggrieved companies filed a writ petition to challenge the validity of the notification of RERC and the conditions imposed in it. The Appellant filed an appeal against the order before the Rajasthan High court, where the High Court dismissed the appellant's petition against the order of RERC. It stated that all the RPO obligations are per the provisions of the Constitution of India Under Articles 14 and 19(1)(g), so they cannot be declared unconstitutional. The appellant, aggrieved from the H.C. order, decided to file a Special leave petition before the Honourable Supreme court. Furthermore, the Supreme Court held that such RPO mandates are framed for all states concerning captive power plants. The regulations were formulated to encourage and promote the usage of renewable energy and curb pollution as per the National Electricity Policy and the tariff Policy in India. These Obligations are par with the Constitution of India under Articles 21 and 51 A(g); hence these are not violating any of the constitutional provisions and the Electricity Act.

In the case of *Tata Power Company Ltd. Distribution V. Maharashtra Electricity Regulatory Commission & Others* (2018) for the fulfilment of the RPO. The State Commission didn't bother about the cogeneration process held, but Apex court in the case of *Century Textiles and Industries Limited. V. Central Electricity Regulatory Commission & Others.* (2017) and *Lloyds Metal & Energy Ltd V. Maharashtra Electricity* (2012) by Tribunal along with the Apex Court in Hindustan Zinc Ltd have answered that co-generation producers of all types of fuels are to be promoted according to section 86(1) (e) of the E-Act of 2003 and not to be attached with RPO mandates.

In another case, *JSW Steel Limited V. Maharashtra Electricity* (2020)**,** the Appeal is filed before the honourable Supreme Court against the MERC order dated 29th August 2020. The said order is against the appellant's contention against getting exemption from RPO mandates for the financial year 2010-11 to 2013-14 and the coming years by stating the reason that the appellant's consumption from its cogeneration plant is an excess of RPO targets for all the years mentioned herein and ended up to March 2019. The exemption claimed by the appellant is U/S 86(1)(e) of the E- Act 2003. Appellant constructed two captive power plants: gas expansion turbine and waste gas-based co-generation. Respondent contended that the appellant's co-generation plant is fossil fuel based and does not require any exemption as MNRE does not specify fossil fuel as a source of RE.

After hearing both parties, Court concluded that the bare reading of provision 86(1)(e) of the E- Act of 2003 does not say co-generation means generation from RE source alone. Hence the meaning of Co-generation can be explained as per Section 2(12) of the Act.

According to the Section, there are two types:

(a) Co-generators; and

(b) Electricity generation from Renewable energy sources.

The states must promote both categories as per the section and distribution licensees must purchase electricity from both generators. Furthermore, the court agreed with the appellant's contention, allowed his appeal, and provided the remedy as he asked.

Further in the case of, *Vaayu (India) Power Corporation (P) Limited V. Tamil Nadu Electricity Regulatory Commission and Others* (2019), the Petitioner in the said case entered into the many power purchase agreements (PPA), based on the availability of the existing conditions. Petitioner informed to the court that they invested a lot of their finance based on the PPA. Petitioner also contested that the respondent must continue to fulfil the agreement conditions and the terms must change during the execution of an agreement. After hearing the party, the Court held that the court does not have the proper authority to examine and fix the tariff, these won't come under the judicial powers and only if the tariff fixation was illegal, arbitrary, or ultra vires the Act, then only Court can take action.

In the case of *Rajasthan Renewable Energy Corporation Limited. vs. Shree Cement Limited. & Others.* (2017), the issue in the case is whether the generated electricity through waste can be included under RPO obligations under a captive power plant. The court in the case held that, S. 86 (1) (e) of the E- Act of 2003 specified that RE and Co-Generators both should be promoted equally. Till the captive consumer uses electricity generation from Co-generating power plants they don't need to buy REC under the RPO obligations and once the entities fulfil U/S 86 (1) (e) of the Act if solar and non-solar are separately specified, then the captive Co-generators plants must not bound to fulfil REC.

These Judicial pronouncements favours most electricity generators when they don't fulfil the RPO obligations, and this is because of no proper explanation is mentioned under the E- Act of 2003 which is a major drawback. Other than these there are major challenges in the implementation of RPO in India. The following chapters talk about the challenges like transmission, tariff fixation, financial issue etc.

4.1.6. Issues and Challenges in RPOs and Reasons for its Failure in India.

A. Transmission Issues

Irrespective of installing solar panels to generate electricity without a proper transmission system, there is no point in generating electricity because, during transmission only, there is much loss of electricity, which means even if it generates an ample amount, it will always be less to reach the consumers. Even after so many years, India still has the world's biggest brownout in many states, which leads to hundreds of millions of people living without power, because of grid failure.

"Brownouts are due to changes in weather and demand for electricity is too high, which causes more strain on the grid, resulting in low voltage and voltage fluctuation."

Comparatively, brownouts are more dangerous than blackouts because the risk of damaging the electrical appliance is more due to voltage fluctuation. Further, brownouts can be identified as no proper energy transmission facilities. The low efficiency of transmission lines created a significant gap between the generation and transmissions to the end users of the nations. That's why India's electricity demand has increased significantly. Because of steady growth in the Solar energy sector, the focus on grid management is the weakest link to supply power to all end users.

Further, the lack of grid connectivity is the main reason Discoms suffered losses because of the worst transmission infrastructure in India. And due to the non-payment of charges by some of the state's Governments, developers and investors can't make the necessary investments to improve the health of the transmissions sector. Some studies predict that only by improving grid management, electricity storage, and demand response can make 25 percent or higher of solar panels. Now it's a need of an hour to strong our transmission sector to get maximum output from solar and other sources.

B. RPOs Target Expanded but Needs Execution

Besides the issues in the transmission sector, the solar energy sector also faces hurdles in fulfilling the targets ("How Failure in Meeting RPO Targets Has Become a Hurdle for Solar Growth," 2022). The GOI urges all the states to buy an amount of electricity from non-conventional sources. However, approx. 16 Indian states cannot achieve the RPO targets (less than 60 percent of their targets) ("How Failure in Meeting RPO Targets Has Become a Hurdle for Solar Growth," 2022). Although Rajasthan and Gujarat are doing well in solar installation and have enormous potential to be a leader in India's solar revolution, they failed to fulfil the RPO targets. Many states in India have failed to fulfil the set targets for the preceding five years. Moreover, the SERCs allowed Discoms to fulfil the RPO the next year and increased the issues due to a lack of enforcement ("How Failure in Meeting RPO Targets Has Become a Hurdle for Solar Growth," 2022).

C. Financial Issue

Discoms are very much burdened with debt is one of the aspects of failure of attaining the RPO target. Even GOI tries to help Discoms with UDAY Scheme to transfer their debt, but the Scheme has not succeeded much.

Furthermore, Discoms are allowed to complete their targets for the next year is added fuel to the fire. Besides, lack of payment guarantees, lack of policy enforcement, energy transmission, and evacuation issues also hinder RPO target fulfilment in India ("How Failure in Meeting RPO Targets Has Become a Hurdle for Solar Growth," 2022).

Tata Power Delhi Distribution Ltd. Vs. M/s Duggar Fiber Private Limited. & Another (2017) Appellant in the case is aggrieved due to the enforcement of set targets of RPOs then some REC would have been purchased to fulfil the targets and financial helps to the appellant could be provided, the purchasing of the REC is to create a balance between the States where RE generation is more than the capacity and the states where the capacity is low or no RE sources. All States are allowed to do Intra states REC selling or buying, and all the entities are free to get certificates. According to the National Tariff Policy, the State Regulatory Commission needs to enforce all RPO compliance and monitor all the entity's activities. But Commission is also diligent while disposing off the matter that what kind of challenges the generators are facing, because of tariffs, REC availability, and in this case, the commission has rightly imposed RPOs compliance.

D. Tariff Fixation

The MNES (Now MNRE) prepares the guidelines in the early 90s to fix the tariff for power for RE sources. Those guidelines are based on the tariff provided to independent Power Producers at that time. The mentioned guidelines are technology neutral, likewise one single tariff for every renewable energy technology. These standards were accepted by various state utilities with variable degrees of variance. According to Section 22(1) of the ERC Act of 1998, the SERC is now in charge of setting tariffs. The ERC Act also outlined the fundamentals of fixing tariffs. Some users took the initiative to set rates for electricity generation using renewable resources. The first such order was a pricing order for bagasse power projects issued by the Maharashtra Electricity Regulatory Commission (MERC). Then, separate state regulatory bodies issued several tariff orders tailored to different types of renewable energy technologies.

Further in the case of *Transmission Corporation of Andhra Pradesh Limited. v. Sai Renewable Power Private. Limited.,* (2011), where the two judges bench held that the fixation of tariff is not under the purview of judicial powers and under the statutory authority. The tariffs are to be fixed by the experts assigned by law. Only when the tariff fixed by the appropriate commission was illegal court will respond.

Examining the tariff orders issued by the SERCs for buying electricity from RE based facilities makes it evident that all commissions have embraced the "cost-based tariff" concept. Although the "cost-based tariff" method is the general strategy adopted by all SERCs, there are challenges unique to each renewable energy source.

Once the tariff is fixed it shouldn't change during the execution of PPA. In the case of *Raj West Power Limited. Vs. Rajasthan Electricity Regulatory Commission & Others.* APPEAL NO. 228 OF 2018 & APPEAL NO. 235 OF 2018. In this case, the respondent's contentions are that the Commission reduced the tariff by 14 paise as a condition for sale, but the Commission had accepted the tariff rate during the bid U/S 63 of the E- Act, of 2003.

E. Impact Of Covid-19

The pandemic in 2019 hit very hard in every field and sector and has further distressed Discoms.

Discom's financial situation was harmed by the abrupt decline in demand from high-paying Commercial and Industrial (hereinafter used as C and I) end users during the shutdown. Due to the growing revenue gap, the fall in sales to C and I users is anticipated to push Discoms reliant on subsidies to 1 trillion rupees in 2020–21 ("Discoms Dues to Generators Jump 34 percent to Rs 1.2 trillion Amid Covid-19 Hit," 2020). By October 2020, the pandemic had increased the Discoms unpaid debt to 1.39 trillion rupees, surpassing the pre-UDAY peak of 1.3 trillion rupees in the year of 2015. By October 2020, the amount owed to generators had risen 34.4 percent from the previous year to more than one trillion rupees. In May 2020, the national Government announced a 90,000-crore liquidity infusion plan for the communications sector. The restriction was later raised much further ("Loans Worth Rs 1.25 Lakh Cr Sanctioned Under Discoms Liquidity Package; Disbursement at Rs 46 Cr," 2021). In May 2020, the national Government announced a Rs. 90,000 crore liquidity infusion plans for the communications sector. The restriction was later raised much further. The Discoms were able to settle their immediate debts and make payments to the generator firms thanks to this inflow of liquidity. With these loans, state-owned Discoms gross debt could increase to Dollar 6 lakh crore in FY 2022. A significant increase in operational effectiveness and a decrease in the tariff and the cost of supply are essential to improve Discom's financial status since such significant debt levels may not be manageable.

F. Non-Payment Of Dues to Generators.

"One Nation One Grid"

In a recent address to the citizen by our Current Prime Minister, Shri Narendra Singh Modi, in July 2022 related to the electricity sector in India. As per his statement, the power sector is facing so many Crises in most of the states, and if the power sector is weak in any state, then it will affect the power sector of the nation and the future of that state will lead to darkness. As per the studies, the total country dues have crossed over One Lakh Crore rupees (Mahapatra, 2022). The losses in the distribution sector are in double digits in our nation compared to the other developed nations; it was very few. That means in our nation, the loss of electricity is more, and no matter what amount the electricity is generated to fulfil our demands, it is always insufficient. And to fulfil our demands, the electricity must be generated more and more electricity and must exhaust our Non-renewable energy resources more and more. Now the question here is, why is there no proper investment done to stop and prevent the losses in the distribution and transmission of electricity in states? Most distribution companies (Discoms) lack the financial resources to implement the infrastructure required to prevent losses; this situation applies to private and public distribution companies. As a result, Discoms are forced to use outdated transmission lines, which causes daily losses that increase the cost of electricity for consumers.

This also reflects that the electricity generators are generating sufficient electricity. However, they still don't have much more funds to develop the necessary infrastructure and most companies belong to the Government.

Union power ministry studies say that Maharashtra is at the top of the list of Defaulters; Around Rs. 21,249 crores are pending with the state Governments after that, Tamil Nadu is in the second position with Rs. 21,132 crores, Rajasthan is third with Rs. 12,393 crores Uttar Pradesh is in the fourth position with Rs. 11,307 crores, Madhya Pradesh Rs. 6,964 crores, Karnataka with Rs. 202 crores Jharkhand with Rs. 2773 crores, Bihar with Rs. 1,781 Crores and Delhi with Rs. 1,398 Crores (Mahapatra, 2022).

Some North-eastern states are clearing their dues, and Arunachal Pradesh has the lowest dues of Rs. 10 crores, Uttarakhand has Rs. 54 crores, Himachal Pradesh with 257 Crores, Odisha with Rs. 338 Crores, Chhattisgarh with Rs. 738 crores, West Bengal with Rs. 946 Crore, and Gujarat with Rs. 149 Crores (Mahapatra, 2022).

Very few times do the distributive companies get their funds on time; otherwise, the vast amount is pending with the Government. It is very disheartening and unacceptable because more than 1lakh Crore Rupees bill is pending cumulatively with the state Governments. The State Government must pay this money to the generators because the state Governments have already purchased electricity from generators and are still not clearing their dues. Most Government and local departments owe around Sixty thousand crore rupees of Discoms.

The difficulties don’t stop there; state Governments’ promises to offer electricity subsidies are still outstanding and haven’t been fulfilled for Discoms.

This bill is of around more than seventy-five thousand crores rupees still pending. From generating electricity to transmission and distribution to the end consumers, around 2.5 lakh crore Rupees are Still pending with the state Government. In this situation, the necessary investment in the distribution and transmission sector is impossible, affecting the nation’s future needs. P.M. also urges the state Governments to clear the dues of Discoms as soon as possible because this is primarily the cost of generating and distribution. And requested the states that if the citizens of India are paying their electricity bills honestly, why not the State Government pay their dues on time? The solution to this problem is necessary for every state, and it’s an hour. For the development of India, the infrastructure of the power and Energy sector must be strong enough to face any challenges and provide more output. The development in the past few years has been excellent; somehow, the specific results have achieved.

Repeated blackout in the nations is reduced. Electricity is reached every corner of the nation; the only thing that it must work on is an uninterrupted power supply at an affordable price.

4.1.7. Quantitative Data Analysis and Its Interpretation

A questionnaire on a 5-point Likert scale was prepared to collect the primary data from the respondents. Likert scale helps to understand the format of questions and the respondent can express their scale of agreeing or disagreeing on the number of statements and questions. The mentioned 5 point have following components which is mentioned below:

1. Strongly Agree
2. Agree
3. Don't Know
4. Disagree
5. Strongly Disagree

The objectives of this 5-point Likert scale are to identify and analyse the opinion quantitatively.

Further, the questionnaire was prepared to collect data related to the Solar sector, followed by the efficiency of existing legislation in the nation. To identify the Status of RPO not followed by the Discoms, the google form questionnaire was forwarded to the industries experts through digital media, and very few have responded. The google form questionnaire referred to people working in some or the other way in the solar sector or having adequate knowledge of the Solar sector of India. The questionnaire was circulated to the respondents, who can read and understand the questions, and to fill in the google form, and submit it. The collection of data is a herculean task and complex and the industry experts are bound by confidentiality obligations.

A. Administration of the questionnaire

The respondents were identified through the researcher's contacts and social media was used to effectively identify the respondents, communicate, and collect the data. The Google form questionnaires were sent to the respondents through Digital media and the responses were collected and processed further.

The questionnaire was Circulated to the respondents in the month of September 2022 through digital platform. A copy of the questionnaire is annexed as **Appendix 4.2.** A cover letter explaining the nature and importance of the study, the purpose of the survey, the importance of their response and assurance of strict confidentiality of the responses and the name of the respondents and the company. The questionnaire was also sent to the respondents via WhatsApp and the professional network LinkedIn. Telephonic, as well as personal communication, were made to motivate the respondents to fill up the details.

B. Limitations of the Empirical Study

All efforts are made to collect the data from the respondents, but certain limitations can be noticed as.

1. The survey is confined to the legal professionals working in the Solar sector. The randomly selected data does not represent the whole population.
2. Many respondents did not respond because of their reasons.
3. Because this study is all about the Solar sector not everyone knows about the importance and relevance of the sector.
4. The questionnaire is prepared to get demographic data along with knowledge among people about existing benefits provided by the Government, and policies like RPO, REC, and FIT’s efficiency in India.
5. Lack of knowledge about the Solar sector and policies envisaged in it, make no sense
6. Lack of time to check and verify the factual position would also affect the questionnaire’s effectiveness.
7. The casual approach to answering respondents’ questionnaires would lead to wrong answers.

C. Data Analysis

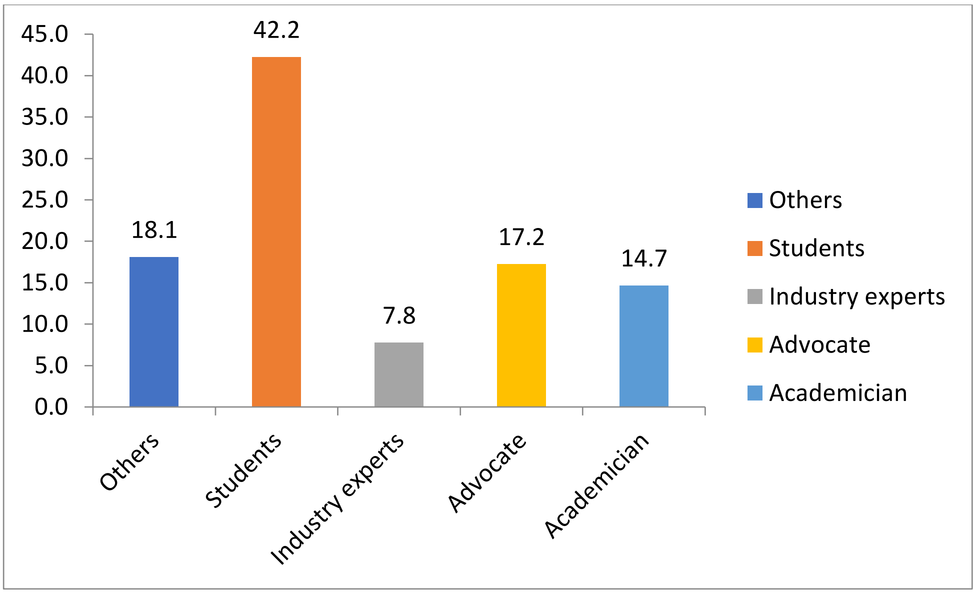
The primary data collected were subjected to data analysis and interpretation to draw meaningful solutions to the study’s research problem. The data were analysed using the Statistical Package for Social Sciences (SPSS). Statistical tools such as simple frequency distribution, descriptive statistics and multi-dimensional scaling were applied to the survey conducted among the respondents. The results of the empirical evidence about the simple frequency distribution are presented in a below-mentioned table.

Table 4.1 Different Patterns of the respondents related to the Solar Energy

Profession(N=116)	Frequency
Academician	17
Advocates	20
Industry Experts	9
Students	49
Others	21

Table 4.1 reflected that most of the respondents are Law Students, then others (under which people from different fields and sectors) advocates practised in the Energy Law area, followed by Academicians.

Figure 4.3 Percentage Distribution of Respondents.



For conducting the study, Google form was circulated among various law professionals like academicians, advocates, industry experts, Law students, and others. Out of 116 respondents, 42.2 percent are law students, followed by 18.1 from other domains, thirdly with17.2 percent are Advocates practised in the Electricity sector, Academician with 14.7 percent, and industry Experts with 7.8 percent.

Table 4.2. Descriptive statistics of all the responses.

Descriptive Statistics							
	Mean		Std. Deviation	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Statistic	Std. Error	Statistic	Std. Error
SE1	4.52	.073	.786	-2.522	.225	8.508	.446
SE2	4.08	.083	.896	-.376	.225	-1.158	.446
SE3	4.52	.116	1.254	-2.353	.225	3.813	.446
SE4	4.66	.055	.589	-2.095	.225	5.710	.446
SE5	4.54	.075	.806	-2.218	.225	5.241	.446
SE6	4.75	.055	.588	-3.021	.225	10.590	.446
SE7	4.68	.056	.599	-2.221	.225	5.914	.446
SE8	4.60	.085	.913	-2.618	.225	6.752	.446
SE9	3.44	.102	1.098	-.185	.225	-1.057	.446
SE10	4.02	.081	.875	-1.383	.225	2.730	.446
SE11	3.84	.114	1.223	-1.075	.225	.175	.446
SE12	4.03	.089	.959	-1.452	.225	2.296	.446
SE13	4.41	.070	.757	-1.566	.225	2.867	.446
SE14	4.51	.064	.692	-2.038	.225	6.650	.446
SE15	4.57	.097	1.049	-2.419	.225	4.919	.446
SE16	4.33	.072	.778	-1.212	.225	1.436	.446
SE17	4.22	.073	.789	-.945	.225	.748	.446
SE18	4.24	.073	.787	-.893	.225	.459	.446
SE19	3.81	.073	.790	-.293	.225	-.263	.446
SE20	4.16	.080	.861	-.889	.225	.248	.446
SE21	4.14	.135	1.450	-1.359	.225	.291	.446
SE22	3.57	.109	1.174	-.152	.225	-.535	.446
SE23	3.57	.114	1.232	-.261	.225	-.602	.446
SE24	3.98	.126	1.358	-.987	.225	-.231	.446
SE25	3.16	.145	1.564	-.137	.225	-1.345	.446
SE26	2.98	.119	1.278	.007	.225	-.502	.446
SE27	3.15	.110	1.189	.375	.225	-.684	.446
SE28	3.10	.138	1.483	-.099	.225	-1.531	.446
SE29	2.64	.135	1.459	.260	.225	-1.442	.446
SE30	2.71	.129	1.390	.106	.225	-1.462	.446
SE31	3.36	.143	1.540	-.280	.225	-1.557	.446
SE32	1.93	.115	1.242	.964	.225	-.438	.446
SE33	2.03	.093	1.004	.298	.225	-1.325	.446

SE34	1.97	.107	1.153	.778	.225	-.539	.446
SE35	2.53	.129	1.386	.167	.225	-1.473	.446
SE36	2.34	.141	1.516	.554	.225	-1.283	.446
SE37	2.11	.122	1.317	.766	.225	-.812	.446
SE38	3.00	.110	1.180	.194	.225	-.619	.446
SE39	2.78	.105	1.135	.127	.225	-.587	.446
SE40	2.80	.110	1.181	.136	.225	-.693	.446
SE41	3.06	.119	1.281	.012	.225	-1.021	.446
SE42	2.97	.108	1.164	.102	.225	-.679	.446
SE43	2.70	.113	1.217	.247	.225	-.762	.446
SE44	2.76	.098	1.060	.143	.225	-.374	.446
SE45	3.43	.158	1.705	-.431	.225	-1.494	.446
SE46	3.15	.154	1.659	-.389	.225	-1.600	.446

Data Analysis of responses to every Question: the above table explained the pattern of respondents' data.

The scale used in the instrument is more consistent and highly reliable.

Table 4.3: Mean and standard deviation of total knowledge

	Mean	Std. Deviation
Total Knowledge Valid N (listwise)	161.84	16.627

It was observed that different statistical measures like mean and standard deviation values are robust measures, indicating that the data is normally distributed among the total knowledge score of the respondents.

Mean score 161.84 in below tables indicate that the respondent to the questionnaire were somewhat positive, and the mean score is more than the midpoint which is 3 generally on 5-point scale.

Further the standard deviation of 16.627 indicate that the variation and dispersion in the responses of respondents. The more value of standard deviations indicates the more disagreement or variability among all respondents. Lower value suggests more agreement or consistency.

Figure 4.4: Mean and standard deviation of total knowledge score of Responses.

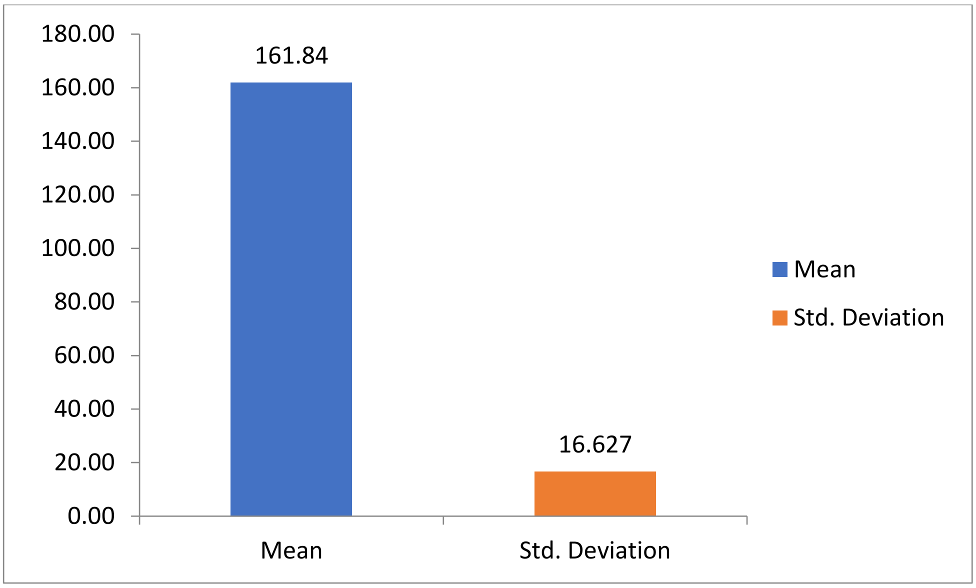
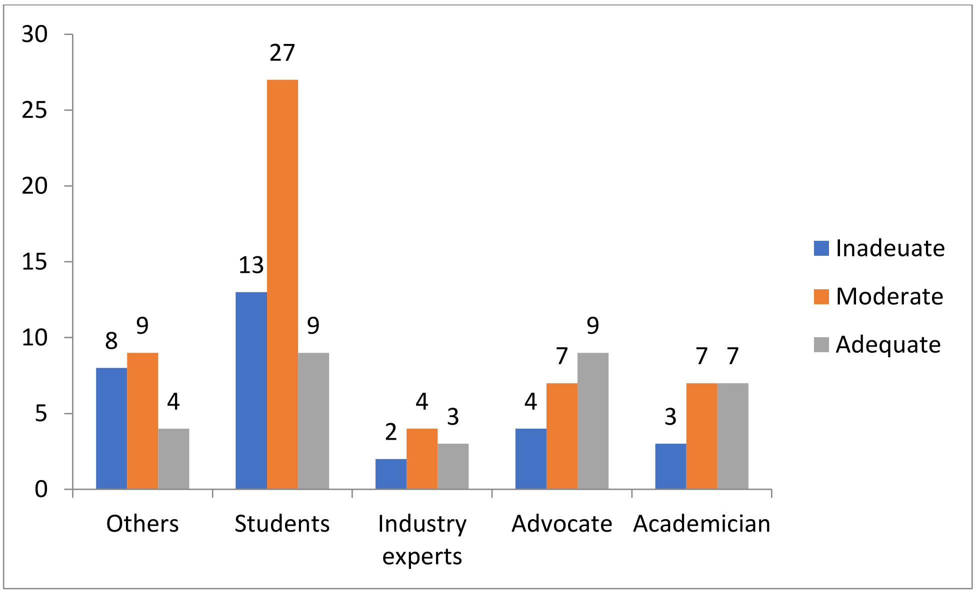


Figure 4.5: Knowledge Levels of Respondents on the Solar sector and Existing Policies benefits.



The Government of India introduced many policies and awareness programs to make people aware of the development of solar and solar sectors. This survey shows that many people, irrespective of their involvement in solar, need to gain adequate knowledge.

D. Result of Survey

The solar sector is not new, even though the experts in the said field need to gain knowledge about the policies, tariffs, and subsidies regarding the same. After conducting this research survey, it was concluded that the Government should emphasise more and more awareness programs and improve the Tariffs and subsidies to lure customers into installing solar panels. Furthermore, it was concluded that the existing subsidies and tariff policies are insufficient to create a viable interest among the citizens.

4.2. RE-LAW IN GERMANY

4.2.1. Introduction

In Germany, the Renewable Energy Act, of 2000, also known as Erneuerbare-Energien-Gesetz (hereinafter referred as EEG), is the legislation to govern electricity in Germany. Instead of Renewable Purchase Obligation, Feed In tariff policy is appreciated for promoting and developing the solar energy Sector. This policy has been in existence for the past 20 years (Sutton, 2021). This is the only policy because the production of electricity from renewables in Germany increased from 6.3 percent in 2000 to 28 percent in 2014. More than 80 countries used this FIT model of Germany as a benchmark, especially in China (Wfcadmin, 2016). This FIT gives priority access to the national power grid for renewable Energy, and a fixed price is provided to producers of electricity from Renewable Energy for every KWh for 20 years. This fixed price is more than enough to ensure the profit on investment.

In feed-in tariff, all types of RE are considered, and the amount of tariff of any plant depends on the source and size and the year in which the plant was ready for operation. The extra cost, if any, is shared by all electricity users as a surcharge which means that the end user of electricity needs to pay certain amount for every unit per KWH consumed (Wfcadmin, 2016).

This fixed tariff is reduced by the Governments based on the market situation. The central essential aspect of this policy is to secure the renewable energy market financially for all types of renewables, which makes Germany stand apart globally in terms of electricity generation from RE. because of this policy, many people invested in utilities as well as in domestic renewable energy projects as they are economically viable because of fixed long term revenue generation for an individual and to generators who all are consumers earlier.

Further, this policy also gives a chance to invest in the RE sector because of decentralised, bottom-up mobilisation, which resulted in many RE infrastructures in Germany being owned by Private players, and not by any large utilities.

This decentralised, local generator approach in Germany is considered one of the best moves in developing the solar energy sector. This policy is also responsible for reducing Green House Gas (hereinafter referred as GHG) in Germany and making the environment sustainable for future generations.

This feed-in tariff provides a tariff based on cost sharing mechanism as a surcharge. This distributes equally the cost into electricity bills of all end users. This cost calculation is separated from the national budget, making it less political influence.

In the year 2000, EEG became the primary regulatory mechanism for electricity generated from all types and sources of renewables. As per the EEG, the tariff depends on the type of RE, size, and location, and it was uniformly fixed for 20 years. The tariff price in EEG was decided as per the scientific study to earn profits and use state-of-the-art technology advancements. A further amendment in price is proposed every four years to keep up with the market and technology advancements. The tariff reflects the market price of RE technology.

The Renewable Energy Act 2000 in Germany was amended many times, like in 2004, 2009, 2012, 2014, 2017, and 2021 (Wfcadmin, 2016). The promise of long-term tariffs is essential to this feed-in-tariff scheme in Germany. In the same year, many legislative measures and policies like tax reforms and exemption from tax (for Biofuel) were proposed to stop nuclear power plants by 2001.

A major amendment throughout all years in the RE Act of Germany is being discussed below;

In the year 2004, it was first amended, and this amended Act was very much different from the old one and enhanced its efficiency to a new level. Germany aims to increase its share in Renewables Electricity Generation by at least 12.5

percent before 2010 and 20 percent before 2020. The tariff rate decided to reduce yearly was set too high in a new amendment to encourage technological advancements and save some money in the RE sector. This New EEG Act is the main reason for Germany's RE sector development. Because of EEG Act, European Union Directives are fairly implemented in the Electricity Sector of Germany (Wfcadmin, 2016).

In 2009 again, EEG 2009 was amended by the coalition of "Christian Democrats" and "Social Democrats". The primary feature of the Amendment Act was to be retained and to support green energy. Still, some political leaders think this policy should be amended so that renewables would be the new choice for electricity generation. A market premium is paid to create a balance between the EEG tariff and the Market value. Like, from the wind the electricity was promoted to sell directly to the power exchange and not receive any feed-in tariff. Further market premium is offered due to additional work involved. This option will only be preferred when it seems profitable compared to EEG and constitutes a risk-free bonus.

In 2012 again, it was amended to strengthen Germany's electricity infrastructure so that private players could invest in the RE sector for construction and building facilities and Maintenance of the existing setup.2012 amendment was a political move of the German Federal Government after the Fukushima nuclear accident in Japan in 2011 to remove Nuclear power plants altogether; even in Germany, Nuclear power plants got a lifetime extension in 2010 only. This amendment aimed to focus on making laws end-user friendly and the consideration provided for Bioenergy; the rest was unchanged. The main motive of this amendment is to reduce the RE prices and make them too similar to market prices. Further, this amendment introduced incentives for the promotion of energy with a market premium to improve the interaction between conventional and non-Conventional sources of energy and energy storage. Moreover, RE producers still have a choice to either go for fixed-in-tariff or Market Premium (Wfcadmin, 2016).

So far, Germany's RE sector has done tremendous work till 2014. With the 2014 amendment, all the efforts go in vain. Because with this amendment energy sector again is going back into the hands of Private players, those who are most favoured in the conventional method like fossils for generating electricity in Germany. This policy creates a gap between society and regions, safeguarding Industrialist interests. Ultimately, this policy change is a set of agreements to protect and harness the conventional source of Electricity and Private players. Below mentioned are the thrust areas of this amendment (Wfcadmin, 2016)**.**

1. *Cap for wind and sun energy*
2. *Exemptions for energy-intensive industry*
3. *Taxing self-consumption of solar PV*
4. *Direct marketing*
5. *Quota system instead of Feed-in Tariffs*
6. *Feed-in Tariff (FIT) surcharge*

After all these amendments throughout the years, in 2017, the EEG was further amended to change the way of investment in the RE sector. The level of payment is decided by auction in the RE sector because the development in all these years strengthened the RE sector to compete with conventional energy sources (BMWK - Federal Ministry for Economic Affairs and Climate Action, n.d.).

As per the 2017 amendment, the funds will be provided to those who demand them and used in such a way as to get maximum output feasibly. The objective behind these is to provide an opportunity to participate in the auction by every stakeholder, whether private players or citizens (Scholz et al., 2021).

The necessary amendment in 2017 is Funding for landlord-to-tenant electricity approval. In this mechanism, whatever electricity is generated by a solar installation on the rooftop of any residential building and then transferred to end users (specifically tenants) staying within the premises or any residential facility or building situated near the generating building and that is connected directly to the installation rather than via the public grid. This supply helps to reduce certain expenses like grid charges, taxes, and any fees. This bonus is provided for every kilowatt hour of electricity generated in this, which is more profitable, and the revenue generated also eliminates the electricity bills of tenants.

The EEG Act was further amended in the year 2021. The vital aspect of this is to increase tender volumes for solar energy. Solar energy is more potential in Germany's Electricity sector (*The Amendment of the German Renewable Energy Act (EEG 2021) | Freshfields Bruckhaus Deringer*, 2021)

This amendment gives privileges to green hydrogen Producers purchasing electricity. This surcharge is fixed for a 15 percent cap or sometimes it may be waived off entirely, to promote and harness water Electrolysis Technology and the primary purpose of this amendment is till 2050 all the electricity produced in Germany must be greenhouse gas neutral.

To prevent climate change and tales precautionary measures for sustainable development. Further, in the 2021 amendment, there are two types where solar energy to be promoted and developed in Germany; the first one is ground-mounted solar photovoltaic cells, and the second is on the roof-top to generate electricity. But the biggest challenge in this is related to the second type because it involves a hefty investment to install Solar photovoltaics on rooftops.

Further, the landlord-to-tenant concept is more improvised and strengthened in this latest amendment; and the surcharge is also increased. It also clarifies that the electricity is provided to the consumers from solar power by the operator only, but also by some third parties in the electricity sector to recognise the supply chain by the legislature. The '*Smart Metering'* concept was also introduced in this amendment. So far, RE-generating plants are only entitled to 95 percent of loss in revenue if by any means Plant feed-in- capacity is reduced because of grid congestion, and now losses will be covered up to 100 percent (*The Amendment of the German Renewable Energy Act (EEG 2021) | Freshfields Bruckhaus Deringer*, 2021).

Over the past 20 years, Germany amended their Act to their need and necessity to get maximum output from the RE sector and moulded its policies as required from time to time. That's why Germany's RE sector is considered a benchmark globally.

4.2.2. Implementation Of Feed-In Tariff In Germany

This FIT policy in Germany has a taste of success by implementing as a Statute in 1991 as The Electricity Feed-in-Tariff Act of 1991. This Act has increased the transition to one hundred percent RE and more than sixty percent is coming from Solar rooftops. The major transformation in RE in Germany is because of separate legislation of the FIT Renewable Energy Act 2000(EEG Act). This Act is incorporated to increase electricity generation through RE (Jaeger, 2021). Germany has already a way forward from sustainable development goals and that is the reason for incorporating EEG Act to increase the electricity mix with zero emission and for future developments.

When the EEG Act was incorporated the total generation from RE is 6.2 percent in the year 2000 from RE which increased to 23.7 percent in 2012 and 28 percent in 2014. If the current growth continues then Germany may be fully powered through RE by 2035 (Reuters, 2022).

Salient features of EEG Act.

1. Access to the Electricity grid.
2. The tariff is fixed for 20 years from RE.
3. All plants evaluated, irrespective of size and year of installation.
4. EEG surcharge gives the extra cost to all end users and expect to pay a certain amount for every KWH used.
5. The Government reduced the fixed tariff.
6. Provide financial assistance to all types of RE plants.

This Act was amended many times since its incorporation, and the last amendment was in the year 2021.

The First time the Government of Germany's intentions was reflected through this Act about zero GHG emission by 2050. This amendment contains many measures to harness RE Sector and by giving more strength to long-term PPA. This amendment also attracted investment in the RE sector, as most of the power plants in Germany are owned by private individuals and cooperatives and require more and more citizen participation.

The main objectives of the Act are to expand the energy supply to protect our environment and battle against climate change and save remaining fossils for future generations. This Act also aimed for increasing the energy mix through renewables like 35 percent by 2020, 50 percent by 2030, 65 percent by 2040, and 80 percent by 2050. Furthermore, to reduce GHG levels by 40 percent by 2040.

Table 4.4: Feed in Tariff Data Germany from 2014-19 (OECD, 2021a)**.**

Source	2014	2015	2016	2017	2018	2019
Solar PV	0.217	0.097	0.097	0.000	0.000	0.000
Wind	0.118	0.099	0.098	0.095	0.114	0.108
Small Hydro	0.110	0.091	0.091	0.090	0.094	0.089
Biomass	0.078	0.065	0.065	0.105	0.112	0.106
Waste	0.000	0.000	0.000	0.162	0.121	0.115
Geothermal	0.335	0.280	0.279	0.285	0.298	0.282
Marine	0.000	0.000	0.000	0.000	0.000	0.000

All Units are in US Dollars.

This data is the average value to be fulfilled in a year as per long-term PPA. Payments are made for new set-ups for a specific year, not from the previous year's contract. United States per KWH is used to compute the FITs.

4.2.3. Feed-In Tariff in India: A Ray of Hope

A. Introduction

India secured 2nd Rank position (*The 30 Largest and Most Populous Countries*, n.d.) in population and 3rd Rank in consumption of Electricity (*India Ranked 3rd Largest Primary Energy Consumer in the World*, 2022) globally, after China and U.S.; and due to high electricity consumption in the nations, its demand is fulfilled through electricity generation from conventional and non-conventional sources. The Government purchased electricity from both sources.

This procurement can be carried out in two ways.

1. FIT for a fixed price; and
2. Percentage (depending on the market).

The word FIT was first reiterated in the Renewable Energy Act of Germany in 2000 (Couture et al., 2010). The main objective of this FIT program is to provide financial independence to small-scale RE generators for a specific time. This is given to all RE generators without discrimination, irrespective of their generation capacity.

The paradigm shift from Non-RE to RE and mainly focused on the Solar Sector due to the decline of Solar Photo voltaic Cells is one of the reasons for harnessing FIT. This tariff is the reason for many harnessing solar sectors in India. In India, it was decided by central and state regulatory authorities. Gujarat is the only state who is among the top in the electricity generation from solar (B, 2017).

B. Implementation of FIT in Indian States

The major reason for the Gujarat model is FIT which provides tariffs to small-scale generators and injected electricity into the grid if required (B, 2017). This tariff is fixed for 25(12 years for higher prices + 13 for lower prices) years in all types of projects, and it was categorised into two levels from 2010-2022 and 2023-2036 respectively. Other than Gujarat, Tamil Nadu is also one of the states where rooftop price is calculated based on rooftop solar Tariff. With this, Users get more subsidies from the grid paid by TANGEDCO. For Example, under this policy, all domestic users will get the first 100 Units free. Further, since 2014 Government won't charge users who used less than 500 Units per month (B, 2017).

Many consumers install roof-top in high-end buildings and terraces, and it depends on the size of the area to generate electricity through solar ranging from 2 kW to 15 kW. But in this setup net metering is not fixed and due to that extra electricity cannot be transferred to the grid. As discussed above this type of rooftop requires 80,000 Rs INR to 1,00,000 Rs INR per KW to set up a rooftop. This is only an Off-grid system that requires 30 percent extra investments in terms of maintaining the lithium-ion batteries for storage, which is a serious concern.

Centrally, CERC is empowered to decide the tariff, but every state may also set the tariff rate as per their choice and conditions.

Table 4.5: Feed in Tariff Data India from 2014-19 (OECD, 2021-b)**.**

Source	2014	2015	2016	2017	2018	2019
Solar PV	0.116	0.117	0.084	0.000	0.000	0.000
Wind	0.088	0.083	0.080	0.000	0.000	0.000
Small Hydro	0.070	0.079	0.076	0.079	0.081	0.081
Biomass	0.102	0.113	0.115	0.119	0.104	0.114
Waste	0.000	0.123	0.114	0.116	0.114	0.111
Geothermal	0.000	0.000	0.000	0.000	0.000	0.000
Marine	0.000	0.000	0.000	0.000	0.000	0.000

All Units are in US Dollars.

The above table depicts the FIT tariff in India from 2014-2019 respectively for all types of RE generations like Solar PV, Wind, Small Hydro, Biomass, Waste, geothermal, and Marine. After 2019 Covid -19 affect all the states globally. For solar, mainly from the year 2014-2016 some of the targets are fulfilled but from 2017 onwards no fulfilment from Solar except for Small Hydro, Biomass, and Waste.

C. Challenges in FIT in India.

FIT provides two levels of Tariff in India first is related to the fixed cost of running generators and the second level of a tariff depends on the quantum of electricity generation through plants. Initially, it was for thermal and Hydropower electricity generation only, and not for any RE like Solar, Wind, and nuclear power. Variables price for thermal power plants is computed based on the fuel like gas, coal, crude, and lignite based on type. But this is very critical in Hydropower as river water doesn't have any valuation to calculate, hence no valuation. Installation of a Hydro power plant is a little expensive and half of the installation cost is considered a variable cost in this case. Solar, wind, and Nuclear are only for single-part tariffs. Nuclear is the only exception because of technology where the generation is steady and uniform and does not increase or decrease generation. Still, the contribution of Nuclear is still less compared to RE generation which is around Ten (10) percent of the total. Our current Government has indicated in COP-26 Glasgow to increase the percentage from Ten (10) percent to Fifty (50) percent by 2030. RE sector is set-up for must-run because every day the sun is available, everyday winds blow, and if it is not utilised, then it's gone for that day. SLDC must use this approach. But the problem here is "must run" goes against the economic theory. According to it, to reduce the cost the dispatch must be at a lower value and work higher.

Electricity cost from solar is not cheap at 2.5 Rs per Unit. Where in some areas it is lower as 1.36 Rs. in Simhadri and Korba, 1.43 Rs in Sipat and 1.70 Rs. in Vidhyanchal and Talcher are only a few examples of coal-fired plants. Only Solar is charged at 2.5 Rs per Unit.

Earlier it was a little higher at 3 Rs/ Unit for solar compared to wind on an average of 4.5 Rs. / Unit., and that's the reason SLDC wanted to shut down

“Must-run” status and solar power plants where they can get cheaper electricity from coal-fired power plants.

These challenges could be removed, and the tariff cost can be reduced to an affordable rate for harnessing the sector. Further government must promote green energy more and no subsidies would be given to conventional power plants so that the people's approach towards green energy is changed from conventional coal power-fired plants.

D. Solutions

This can be reduced by implementing multiple tariff systems and more than one tariff for solar and wind electricity generators like hydro. In RE the calculation of variable costs is a challenge and it is important to set a balance between variable and fixed costs. The Advantage of the FIT system is, it will provide revenue even when it’s not in operation at certain hours, likewise with fossil and hydro. In a single-part system when RE was shut down to make a balance in the grid nothing is paid to RE producers. And to achieve 450-500 GW by 2030, it must ensure to provide more and more revenue to RE producers for further Investments in the RE sector.

A good Infrastructure can give good results and in the electricity sector, other than the generation of electricity transmission of electricity is also important as a certain amount of electricity losses during the transmission because of poor infrastructure. Unless this infrastructure is improved, even the electricity generated as per the demand, even then there is no electricity at affordable cost to the citizens, due to the cost of generating is too high. Whatever the losses are there during transmission from one place to another it was added to the generating value and the burden is on the consumers.

4.3. CONCLUSION

This chapter focused on the RPO and its effectiveness in all states with current targets and the challenges faced during the practical implementation. This could be one of the essential aspects of flourishing India's solar sector. Still, it was always suppressed by the Discoms and electricity generators by avoiding fulfilling the targets set by the Government of India. This chapter also emphasised some vital rulings on RPOs, and the challenges faced by them. This chapter also provided the legal reasoning on how the Discoms and Generators have avoided these targets by purchasing the REC from other capable high-generating States and evaded themselves from any monetary punishments in India.

For a better understanding of the scope of existing policies and legislation, and subsidies provided by the Government of India, a survey was conducted among law professionals from various professions.

Further, this chapter also specified the Electricity Sector in Germany and the RE laws and policies implemented there for harnessing the RE sector. In Germany, there is a specific Act for Renewable where one policy, Feed-in-tariff, is the sole reason for developing the Solar sector in Germany even after having critical geographical conditions and many more challenges. The laws are amended as required for the RE sector's betterment, which is why the sector is appreciated in many nations globally. Even India and Germany have an alliance to develop the Solar Sector, which can be used to develop and strengthen the Solar sector by formulating policies and laws specifically for Renewable Energy.

Electricity generation from solar is not only an option but generation at a cheaper cost. This could be possible only when the cost of electricity generation is proper without Transmission and distribution licensees.

Further, this chapter also emphasises FIT policy targets in India and their effectiveness and challenges. This FIT has its challenges to calculate the tariff cost and for some sources, it's very difficult to calculate like in Hydro, Solar, and Wind where the amount of electricity generation is not fixed except in Nuclear in which the generation of electricity is constant. This research provides the solution for it in terms of providing multiple tariff systems and more than one tariff for solar and wind etc in the future. The need is for better implementation of the policy.

CHAPTER 5

5.1. WAY FORWARD FOR SOLAR ENERGY IN INDIA, ITS BENEFIT, AND CHALLENGES.

"All energy is ultimately derived from the Sun and harvesting it directly through solar power seems to be the best way to transition to renewable energy."

—Peter Rive

5.1.1. Introduction.

The future of electricity in India is Solar energy because this sector has a lot of potential in generating electricity as the raw material required for electricity generation is solar energy which is available in abundance in our country. Besides clean fuel, it's also environmentally beneficial and fulfils the international obligation of sustainable development. Further electricity generation from Solar energy also reduces carbon emissions, which is a significant concern (*Solar Energy in India: Challenges, Opportunities and the Way Forward*, n.d.).

As per the reports of IREDA, India has the capacity to generate 5000 trillion Kilowatt of green energy. India is blessed with more than 300 sunny days in a year in many parts of the nation, and solar isolation is 4 to 7 kWh per sq. m daily (*Solar Energy in India: Challenges, Opportunities and the Way Forward*, n.d.). If the exploitation of solar energy is appropriately done, then the dependence on conventional fuels will be reduced, and carbon emissions in a generation. Further, harnessing solar energy will reduce the gap between generation and demand among end users in urban and remote areas.

5.1.2. Solar Energy Future potential in India

India is one of the biggest consumers, and around 85 percent of the energy out of 100 percent is imported into India. But now, India is seeking to purchase crude oil from Brazil, Canada, Gabon, Guyana, and Columbia (Baruah, 2022). Although countries like Columbia, Brazil, and Gabon are supplying crude oil to India, due to High demand, India now needs to increase its import of Crude oil. According to some reports from the Ministry of Commerce, crude oil was imported worth $ 0.72254 Billion from Brazil from April to July 2022, from Columbia, $ 0.71740 Billion was imported, and from Guyana, $0.10606 Billion of oil in India in FY-23. India aims to be self-reliant and secure its energy security and fulfil its domestic oil demand. The recent Russia and Ukraine conflict speed up the process (Baruah, 2022). The scope of Development in Solar energy, if developed efficiently for a year will surpass the total fossil fuel energy reserves in India. Many states in India have already started to develop the solar sector, and states like Raj., Guj., and T.N., are one of them are doing tremendous work.

Solar energy will soon play a significant part in helping India satisfy its energy needs across various industries, including power, transportation, manufacturing, and commerce. The electricity generation from solar energy may fulfil all its electricity demands if exploited effectively and efficiently in India.

A. **Use of Technology in Harness of Solar energy in India.**

Solar has reached every household for cooking, Electricity, and fulfilling the other electricity demands for protecting the Environment. However, there has been significant development in the past few years in solar energy. Still, the generation is not even met 10 percent of electricity generation wholly.

Recent development in Solar energy technology can Improve the sector conditions:

1. **Solar Photovoltaics**- Photovoltaic (PV) cells directly convert solar radiation into electricity. These cells are installed on rooftops and ground to generate electricity, and they can be off-grid and On-grid.
2. **Solar Thermal** – This technology converts heat for heating purposes, sometimes for direct use, and for creating steam to generate electricity through turbine motors.

3. **Floating Solar Technology** – This is a very new technology for electricity generation. The PV cell is installed on floating water like rivers, seas, Ponds, etc., instead of on Land. This technology helped where the land was not available or near to sea area. The first largest floating solar power plant is now working in the city of Ramagundam in Telangana (IANS, 2022). This Plant was set up by NTPC with the collaboration of BHEL. This type of Plant also helps in conserving fresh water to Evaporate.

Clean energy is not only the advantage of harnessing Solar, but it also has a positive impact on environmental protection and the economy of the nation.

B. **Advantages of Solar Energy**

For decades sun has been worshipped in India as a creator of life. It provides solar radiation for generating electricity, which is the purest and clean form of energy, without generating any pollution in the environment. Further, the advantages of harnessing the Solar sector are mentioned below;

i. **Prevent Climate change:** With the increase in pollution and generating electricity from a conventional source and emitting a lot of pollutants into the environment, the gradual change in the climate and temperature is increased. However, the shift from conventional to Renewable will help to reduce greenhouse gas and carbon emission into the environment. (*What Are the Benefits of Solar Energy? | ACCIONA | Business as Unusual*, n.d.)

ii. **Cleaner and Green Energy:** Generating electricity from Solar does not create any toxic compounds in nature. Electricity generation from a conventional source releases toxic compounds in nature. It pollutes the environment and increases the acidic level in Land, water, and Air. Air pollution also increases the risk of many human diseases like respiratory diseases, skin cancer, heart problems, etc.

iii. **No Toxic waste, only energy:** Electricity generation from Solar has the benefit of not polluting water or any sources, unlike Nuclear and Coal power plants (*What Are the Benefits of Solar Energy? | ACCIONA | Business as Unusual*, n.d.).

iv. **Saves Money:** If anyone installs a Solar rooftop, it will help to save money on the electricity bill, which will be reduced because most of the electricity is generated from solar only. The amount of money saved because of solar rooftops depends on the size of the plant and the usage of electricity.

v. **Earn Money:** If the rooftop generates more electricity and is connected to the grid, electricity will be supplied to the grid too. And if there is a specific agreement between the generators and suppliers, suppliers may pay you for whatever electricity is generated and supplied to the grid.

vi. **Zero cost in Maintenance**: The other good reason for using solar energy is that solar panels used in a generation are low maintenance costs, with less effort. No need to spend the whole day cleaning solar panels. Sometimes rain itself cleans the dust and debris from panels. The only thing to be taken care of is to check solar panels received maximum radiation and are free from any Snow or Debris.

vii. **Using Renewable Energy Source:** Solar panels use sunlight. Solar energy is a renewable energy source that will not end anytime soon. So, you can rest assured knowing you'll probably never run out of fuel to supply your electricity needs.

viii. **Job security**: This solar sector also creates jobs. Job creation is always beneficial to the nation and makes it self-reliant. More demand for solar energy will also create jobs in different fields like the Production of solar panels, installation of solar panels, Maintenance of solar panels, etc.

ix. **Ensuring Grid Security:** If an area is equipped with many solar panels, then the chances of Blackouts and Brownouts are less when connected to the grid. These connections are considered electricity production centres and improve the efficiency of the grid in a case where demand is high and causes blackouts.

x. **Different Uses:** Solar energy is not only used for electricity generation but also for generating heat. All the satellites in space take power from the sun only through solar panels.

xi. **Used as an Alternate to the Grid:** when there is a high demand for electricity in summer during peak hours, the prices per unit are also increased. Solar can be proven effective and can reduce Electricity bills by using Electricity generated from solar. The best part is during daytime; solar radiation is also very high to generate maximum output.

xii. **Easy Installation:** Installation of Solar panels is easy and can be installed anywhere, like rooftops, ground-mounted, floating panels, etc. Further, some movables tools are also there which are equipped with Solar panels like Solar Water Pumps in rural areas, etc.

xiii. **Grid-Free:** If the installation of solar panels generates sufficient electricity, then the connection from the grid can be detached.

xiv. **Storage system:** During the day, solar is a good choice, but it can be proved good at night, also by storing electricity in batteries and used at night when there is no sunlight. Further, this can also connect our grid internationally with other nations.

xv. **Increase the Value of the home:** Solar panels not only fulfil your electricity demands but also increase the price of the home too; it's like an additional facility attached to the home. Many people want to use solar, but they don't know how to install it and approach experts (Lavaa, 2022).

5.2. CHALLENGES IN SOLAR ENERGY.

"Solar energy is going to be a major source of energy needs not only today but in the 21st century, because solar energy is Sure, Pure and Secure."

-Prime Minister Narendra Modi

Even After the newly installed Solar power plants in India solar sector is only accountable for 13.22 percent (Team, 2022) solar energy's contribution to the country's power generation has not grown at the same pace. In FY 2021-22, the total capacity of electricity generation from solar is 73.48 billion units (Team, 2022).

But every sector has its challenges; in the solar sector, Solar Photo Voltaic faces land troubles for installing solar panels because land costs are high, there are high Transmission and Distribution losses, infrastructural inefficiency, and grid challenges. Other challenges are tribals and Biodiversity issues. Further, India has a low power tariff in the solar sector, but still, it was not converted into cheaper electricity prices for consumers (Jairaj and Tagotra, 2022). Furthermore, some of the challenges are mentioned below;

I. Environmental Challenges

Significant growth can be seen in the Solar sector over the past few years. Earlier it was only an alternate, but now it's become the only feasible and practical choice for everyone. This sector will be a reason for the enhancement of the power sector in India. But still, a long way to go as there are specific challenges that need to be addressed and removed from the betterment of the sector. Some of them are mentioned below (*Environmental Impacts of Solar Power,* n.d.).

- **Imports Solar Panels from other Countries:** In India, solar panels used in the solar sector are primarily imported from countries like China; India needs to import solar cells, and accountable to the United States $ 578 million, after China with Malaysia is in second with a worth of 20 million US$, and Thailand is on number three with a worth of 16 million US$. India also Imported Solar cells from the US worth $ 2.5 billion worth. From Malaysia, Hongkong, and Singapore, the solar cell was imported in India, with a worth of Hong Kong accounting for US$ 25.3, US$ 201, and US$ 20.
- **Increasing Domestic Manufacturing:** NDA Government is focusing more and more on domestic solar panels produced by locals. The Government is also giving subsidies for promoting Domestic Country solar panels under the initiative of Self-reliant. The initiatives Production-Linked Incentives scheme seeks to incentivise domestic manufacturing. This scheme will help India to establish and support a market for domestic manufacturers, to harness the solar sector. Further, China is India's biggest competitor in producing Solar cells to make self-reliant.
- **Reduced tariffs:** Tariffs are very low in the solar sector. Many manufacturers compromise the Quality of solar panels and make them unsustainable to earn and make profits.
- **No Financial support:** Solar sector also requires huge investment in purchasing solar cells and set-up infrastructure, even though the

Government provides subsidies for the installation of the solar plant but only when a user uses country-made solar cells, which have a low output in generating electricity. In rural areas, many users are farmers who do not have good sources to invest a hefty amount in installing solar cells. Government of India initiatives like **PM-KUSUM** Yojana is helping to get solar pumps at affordable prices.

- **Losses in Cost and T and D (Transmission and Distribution):** India is equipped to fulfil its electricity demand by solar only, but the problem is during the transmission of electricity, around 40 percent of electricity is lost every time during transmission and Distribution because of the old infrastructure used in the electricity sector, and no steps are taken to improvise it. The Government is doing R and D to reduce the cost of solar cells and upgradation of T and D lines with minimal cost to prevent losses.
- **Critical Fluctuation in the weather and solar radiation:** changes in weather and temperature would also affect the quantity of electricity generated in summer compared to winter.
- **Impact on natural Habitat or Endangered species:** Apex court in the case of *M.K Ranjit Singh V. Union of India and Ors* (2020) held that Great Indian Bustard is an endangered species and installation of high electricity lines in any specified area is a threat to the species. Supreme court in its ordered union of India to put all the transmission lines underground in such areas and if not possible then usage of bird repellents or diverters must be used in such areas, this order increased the cost of RE projects.

II. Land Use

- **A paucity of Land:** Land availability in India is also an issue for installing ground-mounted solar cells in India because ground-mounted solar cells require colossal land. In India, people are very sentimental about their land, and the Government also faces challenges in acquiring it. Government must pay massive compensation while obtaining land from people under the "*Right to Fair Compensation in Land Acquisition Rehabilitation and Resettlement Act, 2013*."

- Further, even if the Government got land for installation, then land degradation and natural surrounding will also get disturbed. The total land requires for installation depends on the requirement of electricity and solar radiation and the site's location. Approximately the land is required from 3.5 to 10 acres per megawatt.
- After Installing the ground mount, solar land is of no other uses like in Winds power plants. However, this can be avoided by installing those solar at abandoned low-quality locations, Barron lands, brownfields, abandoned mining areas, etc (Hand et al., 2022).

III. USAGE OF WATER

- No water is required to generate electricity from solar. However, in all solar cell manufacturing plants, some water is required to clean components, etc. However, water usage depends on the site location, technology, and weather conditions. "Concentrating Solar Thermal Plants (CSP)" require water to reduce the temperature and cooling effects (*Water Use Management*, n.d.). CSP plants require water to cool towers and need a high volume of water but with less consumption because water is only used to cool the towers and not lost in the steam. Further, water usage can also be eliminated by using dry cooling technology (*Water Use Management*, n.d.)

IV. HAZARDOUS MATERIALS

- Manufacturing and cleaning of Photovoltaics cells (semiconductors) require chemical components that are hazardous in nature, like HCL, H_2SO_4, HNO_3, HF, $C_2H_3CL_3$, and C_3H_6O. The quantity and volume of acid depend on the type, quality of cell, and silicon wafer size (Hand et al., 2022). The human force employed in these industries also faces some health risks like inhaling silicon dust. It's the manufacturer's responsibility to provide safety gadgets to their workers and follows all environmental compliances to dispose of their waste.

- “Thin-film” type cells contain more hazardous chemicals used in “Traditional Silicon” PV cells, including “gallium arsenide”, “copper-indium-gallium-diselenide”, and “cadmium-telluride” (Fthenakis and Bulawka, 2004). These chemical poses a serious threat to public health or environmental threats if not handled with due care and must be disposed of properly. Further, Manufacturers also ensure that these materials must be appropriately recycled (Hand et al., 2022).

V. CARBON EMISSIONS

- Solar Energy is one of the purest forms of energy, and there is no carbon emission when generating electricity from solar. Still, there are other stages involved where the carbon is emitted, like manufacturing of solar panels, transportation, maintenance, installation, decommissioning, and dismantlement. The approximate value of carbon emission in the solar sector is between 50g of CO_2 per kilowatt-hour, which is twenty times less than conventional sources of Energy (Amplus Solar, 2022).
- The initial years of electricity generation only emit carbon. After three years, Solar PV cell plants are carbon-free, and emission is reduced to zero and rest of the years, it will be carbon neutral. Installing solar in will reduce carbon footprints and usage of fossil fuels (Edenhofer et al., 2011).

VI. OTHER CHALLENGES

- Among all the challenges, lack of awareness regarding the solar sector initiatives and policies among the public is also one of the leading causes of slowing down the growth of the solar sector. Government must educate and organise awareness programs for the public in Urban and rural areas so that people should know how and whom to approach for installing solar rooftops.

5.3. WAY FORWARD TO THE SOLAR SECTOR

In 2021, 10 GW was added to the generation capacity of solar energy. This is the highest capacity addition in a year, approx. 200 percent. This can be proven to be the most powerful electricity generator in India. Many Government reports say that in the next 25 years, renewable energy will be responsible for 85percent of total electricity generation from clean energy sources. This will make India's market consumer bases self-reliant globally. The new developments in the Government of India's solar sector are appreciable and benchmark for others. Some of the initiatives are mentioned below;

5.3.1. Solar Power Operated Projects in India

A. **Mumbai Local Metro:** *'Mumbai city of dreams with a high population has only one best way to commute is Mumbai local. Every day many people travel through Mumbai local. Many Platforms are getting solar-generated electricity. For this, India and Germany have collaborated under bilateral plants in urban development sectors, a senior official of Germany's Ministry of Economic Cooperation said on November* 27th, 2019 ("India, Germany to Collaborate on Mumbai Metro and Solar Energy Projects: German Official | Economic Times," n.d.). Further, "Claudia Warning," Director General of Bilateral Cooperation under the Federal Ministry for Economic Cooperation and Development, said, *"Government-to-Government negotiations were held on Wednesday, and it was decided that 25 concrete projects related to energy cooperation and urban development would be carried out between the two countries."* Further, *"Germany has pledged an amount of 1.6 billion euros for projects in energy and energy efficiency and natural resource management as well as urban development and urban re-motorisation," "We decided on concrete 25 projects in concrete areas where we would like to work together which is about working together for the next 3-5 years." "One example is that we will be taking part in the Metro of Mumbai, which will be erected very soon, so we will finance this. We are also going to finance solar* *water plants for the agriculture centre. We are going to finance a soil knowledge centre which is very important for small-scale farmers,"*.

This **Government-to-Government (Between India and Germany) negotiation** is a result of a visit by 'German Chancellor Angela Merkel' to India in Nov. 2019. Her two days visit was to strengthen the bilateral ties between the two nations for the 5th Indo-German Inter-Governmental Consultations. Around Seventeen pacts were signed between India and Germany in various fields like Ayurveda and yoga, agriculture, and maritime technology ("India, Germany to Collaborate on Mumbai Metro and Solar Energy Projects: German Official | Economic Times," n.d.).

B. **Guwahati railway station:** Guwahati railway station (after Mumbai metro Stations) in the capital city of Assam is the very first railway station in India fully solar-empowered (Sushma N, 2018). This railway station allows the commuting of 20,000 passengers every day. This railway station building Infrastructure has On-grid-connected rooftop solar panels with a total capacity of 0.7 MW that at least fulfil the electricity demands of the station, the coach depot, and the railway colony area, informed by the Northeast Frontier Railway, an arm of the Indian Railways. That will help to save some money spent on electricity bills, around Rs. 67.7 Lakhs yearly. The State-run engineering company Central Electronics executed the Rs. 6.7 Crore project, funded by the Container Corporation of India (CONCOR), a subsidiary of the Indian Railways (Sushma N, 2018).

The country's largest consumer of Power and Fuel is Indian Railways of electricity and diesel, which spent around Rs. 31,854 Crores on fuel in 2022 (*Demand for Grants 2022-23 Analysis: Railways*, n.d.). To reduce these huge bills on fuel, railways are taking steps to fulfil some of the demand from RE in the coming years. Installing solar for generating stations is a new initiative for the railway's broader plans to install 5,000 MW of solar power capacity to fulfil approx. 25 percent of its energy needs through RE by 2025.

In July last year, the Indian Railways rolled out the first train coaches with rooftop solar panels that powered the lights, fans, and information display systems inside. The coaches were used for suburban transit in New Delhi, and the railways estimate that each train with six solar-powered coaches could save around 21,000 litres of diesel annually, worth around Rs. 12 lakhs (*Demand for Grants 2022-23 Analysis: Railways*, n.d.).

Other railway stations in small cities across the country, such as Mangaluru, Thiruvananthapuram, and Jaipur, are also powered partially by solar and wind energy.

C. **Guntakal railway Station, Andhra Pradesh:** Indian Railways has started installing solar panels on trains to fulfil some of the Electricity demand inside the coach (Gupta, 2020). And rooftops installed on railway buildings fulfil in-house station demand for electricity and power requirements of non-traction loads at Railway Stations, etc. In contrast, land-based solar plants will fulfil both traction and non-traction requirements.

South Central Railway is one of the zones leading in energy conservation by installing solar panels at stations, service buildings, level crossing gates, etc (Ministry of Railway, 2020).

"For the first time, all the stations in a particular section of the South Central Railway have been provided with solar panels at one stretch to tap the natural energy. This will not only help in meeting power needs of all the stations in the section but also save expenditure for the Railways"— statement by the Ministry of Railways (Ministry of Railway, 2020).

The Nandyal-Yerraguntla section in Guntakal Division has been declared the first solar section on the South-Central Railway, with all its eight stations fully powered by solar power. The stations are equipped with 37 KWp off-grid rooftop solar plants using 250/125 Wp solar panels along with inverters and 12V 150 AH battery banks to power the total connected load on an average of 30 KWp (Ministry of Railway, 2020).

Around 152 panels have been mounted at these stations, saving around Rs. 5,00,000 yearly and reducing carbon emissions by approximately forty-nine metric tonnes per annum.

In all Railway zones, 16 stations are declared Green and fulfilling their needs entirely through Renewables (Specifically Solar and wind); Some of the railway stations are mentioned below (Ministry of Railway, 2020).

Table 5.1 Railways station equipped with solar and Wind Energy.

Railway Zone	Stations
Central Railway	Roha, Pen, and Apta
East Central Railway	Niamatpur halt, Kanhaipur halt, Teka Bigha halt, Mai halt, Garsanda halt, Niyazipur halt, Dhamaraghat
Northern Railway	Shri Mata Vaishno Devi, Shimla
Western Railway.	Unhel, Khanderi, Bajud, Ambli Road, Sadanapura and Sachin.

5.3.2. Entirely Solar-Powered Village in India

Modhera is known as the Sun temple with the Pushpavati River built by Bhima-I of the Chalukyas dynasty during 1026-1027. Our current P.M. Modi declared Modhera village in Mehsana district as India's first solar empowered in India. It's essential in terms of Renewable energy.

Around more than thousands of solar panels have been installed on the rooftop of many homes. This was a great initiative of the Gujarat Government to provide electricity 24*7. Ultimately everyone is receiving free electricity in the village. As per the mandate of sustainable development goals, the Gujarat Government is working very well for the usage of Solar. Other states can also adopt Modhera as a role model for their remote village to generate electricity from solar.

5.4. CONCLUSION

India is at the forefront of solar energy adoption, considering the challenges like the limited availability of natural resources needed for power generation, rising demand for power, increasing prices of fuels, distribution difficulties in rural areas, and more. With this rate of development and investment in the solar sector, many businesses are switching to renewables (mainly solar) because of their user-friendly mechanism and environment-friendly nature. But there are certain challenges in the solar power sector that should be removed for the betterment of the sector. Unless all these, challenges were eradicated from the sector it could not beat flourished effectively and efficiently. The solar power sector is developing with the developed technology the challenges would be more and from time to time these challenges would be addressed in future research. Further, if the existing solar power plants are not appropriately monitored, then the efficiency and output of the plant will be very less. Certain agencies must be formed to monitor the existing solar power plants regularly.

India has already achieved 5th position globally in electricity generation through solar, and usage has increased by in the last five years by 11 percent. It has significant potential and requires innovative policies with efficient separate legislation to govern. Opting for Solar is not necessary but shall become a mandate in India. However, the Government of India has already started to install solar panels in sectors like Railways, where the electricity consumption is higher than in any other sector, to save money and reduce carbon emissions. Electricity consumption is very high in the railway sector irrespective of intrastate transport through rail or local metros. And if by any chance any fault arises in the electricity transmission whole system were shut down for a time being. Even at railway stations, electricity consumption is very high. And if, the electricity demand at stations is fulfilled through solar during daytime and the night from other renewable sources the load of the existing grid would be less. As of now very few railway stations in Northeast have installed solar panels at their stations, India will only fulfil 75 percent of its electricity demands through solar by 2050, and its carbon emission would be zero by 2070. These commitments can be fulfilled once the electricity infrastructure is improved at its optimum level then only all these commitments be fulfilled. in years to come the demand for electricity is going to be very high in every part irrespective of the rural and urban classification. With the increase of change in climate and increasing of the atmospheric temperature the demand in summers will be very high and fulfil this, the electricity generation will be more from renewables compared to conventional sources of energy.

CHAPTER 6

CONCLUSION AND SUGGESTIONS

6.1. CONCLUSION

The current research is focused on identifying the existing barriers in the renewable energy segment especially related to solar energy with a comparative analysis related to existing laws and policies between Germany and India.

The research also dwells on the upliftment of the solar power sector by seeking reference from various policies prevalent in Germany as well as eradicating the barriers which are faced in India by various entities which are involved in the transition and adoption of solar energy as a viable alternative to conventional methods of electricity generation.

The central research questions are mentioned below.

1. What are the Renewable Purchase Obligations (RPO) and their relevance in the Solar Sector?
2. What are the barriers to the development of the solar energy sector in India?
3. Whether the existing legislation and policies are viable enough to promote, develop and enhance the levels of consumption of solar power energy in India?

Based on the research findings, it was concluded that the barriers to the Solar Energy Regime in India, made the researcher perform a comparative study. Sustainable Development and Protection of Natural resources are the keys to preventing and protecting mother earth from ever-depleting natural resources. Our research reveals that the need for energy is paramount for the growth and development of any nation, wherein electricity plays a vital role as an asset in the portfolio of energy resources.

The analysis of this research depicts that electricity usage is one of the cardinal requirements for human life. With the upcoming digital electronics and automatic tools, weak communication devices, as well as appliances, require the free flow of energy in the form of electricity as a user.

Another sector dependent on Energy resources is the transport sector which is dependent on clean energy resources for the protection of the environment as well as for better health of human beings.

Taking the above into consideration, this researcher has deeply analysed the existing legal provision as well as the guidelines given by the Government of India to remove the bottlenecks and take into consideration the best practices in Germany to ensure that within two to three decades from now onwards India is a self-reliant on Renewable Sources of Energy.

The growth and development of the nation have been murderous to mother earth, with resources being vandalised and even the natural forest and rivers giving way to the greed's of human growth. It is in this context that the research on renewable resources of energy and the other availability of fuels, especially in the field of power generation.

Further, our research also revealed that from the very first legislation on electricity, the E-Act 1903 was incorporated to govern the generation, supply, and use of electricity, and it was replaced by IEA 1910, whose emphasis on a steady supply of electricity was not enough to tackle the challenges of the electricity sector. Further, it was replaced by the ES Act 1948, which mandated the establishment of electricity boards in every state. Power reforms were started in the 1990s, and for that, the ERC Act 1998 was incorporated. It was the founding stone of E-Act 2003, where the generation, transmission, and distribution were separated. So far, the E Act 2003 only specified the provision of electricity generation through conventional sources and hydropower, and no provision was there relating to solar energy.

The Solar sector started flourishing after JNNSM 2010 in India. Many studies show that our existing legislation the E -Act of 2003 is not affecting the solar sector in any way. So far as the E Act, 2003, is concerned, it does not depict any development in solar energy, as there is no specific provision about the same. This is because there are numerous challenges in both the RE and Non-RE sectors. Many barriers were pointed out and the reason behind them.

In the Absence of specific laws on any issues, International Law/ Conventions/ Conferences will play a vital role in taking a reference. Vienna Convention, Montreal protocol, Kyoto protocol, and UNFCCC, etc.; are examples, and domestic laws can be developed regarding international law to give maximum output.

Many studies revealed that this International Law is just like a toothless tiger without having any obligation to comply with. These International obligations are essential in every aspect for developing and Developed countries to mitigate climate change and environmental concerns.

Further, regarding E-Act 2003, our research also reveals that there is no coordination between the state agencies and central Agencies for any development as per E-Act 2003 since all states have formulated their policies and set up their targets for the purchase of RE by setting up guidelines and policies for their RPO to achieve targets in respective regions.

That means there are no coherent policy guidelines for using RE at the national level. This is because despite there being many solar power plants, they have been established in various cities and are working efficiently, but their optimal utilisation still needs to be found. Therefore, the present research suggests meeting the current requirements. There is a need to have comprehensive legislation by which both RE and NON-RE can be used in the national grid with an emphasis on increased production of RE and reduction in Non-RE in a progressive manner so that before the vanishing of the fossil fuels generating the Non-RE energy vanishes in totality.

One of the Key reasons for the transmission of electricity is transmission loss which do happen when electricity in the form is carried from one place to another. An example of the Netherlands can be taken into this consideration. Wherein the emphasis is on the development of the local area and its utilisation. Some countries are also in the process of using begin Infrastructure towers like microwave towers to transmit electricity from one source to another with minimal transmission loss. No doubt use of a repeater station is a universal concept which boosts up the transmission loss; however, the more the repeater stations will lose the credibility of cost-effectiveness in this situation, there is also a need to remove this barrier of transmission loss by taking a clue from the German experience as analysed in our research with a comparative analysis with an emphasis on infrastructure development. This is possible once there are policy guidelines for infrastructure and investment in this sector in a planned way to achieve the call for development, production, and utilisation of energy by the Indian Rural and Urban population.

When the E- Act was introduced, the only mode of Electricity Generation was from conventional sources and Hydro Power without any mention of Solar Energy. However, with the increase in demand, tapping alternative sources of energy became paramount and solar energy, one of the forms of energy, started increasing in current day lives as one of the energy sources. Although to begin with, solar panels, including solar cells, are very costly; therefore, the viability of the same is one of the factors which need to be optimised before taking solar energy as an effective tool.

In this direction, to remove these barriers, our research depicts how all such barriers can be removed, and each barrier the modus operandi utilised in Germany has been suggested in the respective chapters of the research, which briefly suggests as under.

Gone are the days when the development of state activities falls within the domain of state functions. With the upcoming of privatization and liberalisation, the role of private players is significant and relevant for development, which can be mainly by the private entrepreneur, public-private partnership, and by the state public sector undertaking. In accordance with Universal service obligation, it also suggests that for any country to develop, the development must be both in rural and urban sectors and for the development of the economy, the energy sector. The advantage of solar energy is its free and continuous availability in India, and therefore if bottlenecks are removed, development can increase in a harmonic progression.

After that, the Government started giving the Electricity sector to private players to generate, transmit, and distribute, and as a result, the conditions became better wherever private players controlled it. Private players started to invest in infrastructure development, and the E- Act 2003 has formulated some comprehensive provisions to protect the interest of investors. At that moment, the RE sector was at its initial development stage, and many loopholes were not known to the makers. Since the Government left everything to private players, even the Government buys electricity from them and does not pay them on time. Because of this, every state has pending dues against Discoms. Their revenue generation is also affected to meet their expenses incurred, loan payments in generation, and other activities, resulting in no confidence in investing in the Solar Sector.

Further, the government has come up with many policies like National Solar Mission, Viability Gap Funding Scheme, RPO, UDAY, and PM-KUSUM, etc., which are some of the policies initiated where the government focused is to harness solar development in rural and urban areas respectively. On-Grid and Off-Grid Solar power plants are installed as per the power disruption and fluctuation in any area. When power fluctuation is more in any area, or any remote places Off-grid plants are preferred. However, in urban areas where power disruption and fluctuation are not much there On-Grid solar power plants are preferred.

Though the Government is promoting more and more solar use, no proper and direct subsidy is provided to the generators. Further, the authorities established under the Act to monitor, regulate, and govern the sector do not intend to promote and fulfil sustainable goals and are not aligned with the objectives of MNRE. Sometimes the State Government and SERC failed to coordinate with the National Renewable energy Development Program. Because of this, improper coordination and bad planning create more problems in the RE sector.

The case analysis on the subject analysed during the research depicts that the current form of RPO is ineffective, and Discoms are utilising the current provisions for their benefit without taking into consideration the public mandate. Based on our research findings it is also concluded that Section 86 (1) (e) of the electricity requires amendment concerning RPO mandate, and it should be made mandatory with some rigorous fine on Discoms for non-fulfilment of it.

Further, it was also concluded that the Electricity Act must include specific provisions of FIT policies for the betterment of the sector.

Electricity falls under the concurrent list under Item 38, which empowers states to legislate any legislation and policy guidelines to provide facilities for Power generating entities in the form of Bank loans, concessions, subsidy, so as to improve their generation capacity and contribute significantly to the national grid.

Our research suggests that only a few states are found to have sufficient resources to make the best use of solar energy based on their geographical conditions, financial capacity, and investment. Therefore, for this reason, our research points out that only a few States could fulfil the desired targets and purchase electricity beyond the specified targets under RPO.

In view of the foregoing, the experience of different states of Germany who could not come to the desired targets can be taken into consideration, as the experience of other states and implemented in those states who could not come up to the desired level. The only thing which is required is the intention to develop the law for RE by the legislature. As it is mentioned in the preceding para, the Item under the Concurrent List can succeed only if the states and the union work together coherently and modify the existing legislation to ensure that solar energy contributes effectively to national development. Further, Germany help could be taken for making efficient policies and in terms of technology Transfer as per the MoU signed between the two countries.

6.2. TESTING OF HYPOTHESIS

At the beginning of the research, the following below-mentioned hypothesis is formed to find out the results.

H1: There is a huge potential in the Solar Energy Sector in India and the same can be achieved through mandatory Region-Specific Renewable Purchase Obligation (RPO).
H2: Increased Focus on the feed-in tariff system in India may help in the development of the Solar Energy Sector in India.

The various states which have already achieved their set targets of RPO and are generating much more electricity than their demand and fulfilling their requirements. RPO not only helps Discoms but also helps small-scale Renewable energy generators. In many states, this was not executed properly and with zero targets for a whole year and the remaining states are fulfilling their targets by utilising Renewable Energy Certificates. This is primarily due to the lack of coordination between MNRE and various Discoms. If the law is made for the same and executed appropriately the results will be much better. The advantages of the fulfilment of RPO is already being discussed in chapter 4 as necessary steps for the betterment of the solar sector in states.

Hence H1 hypothesis is proved.

The Feed-in-Tariff (FIT) which was first incorporated by Germany in their Renewable Energy Act, 2000 and has enabled Germany to receive huge investments for the RE sector and has appreciated in the fact that more than 40 percent of electricity generated is from RE sources, especially the solar sector. Post this, many nations like India too incorporated FIT in the RE sector in some of the states. The main objective of this FIT program is to provide financial independence to small-scale RE generators for a specific period. This has been given to almost all RE generators without discrimination, irrespective of their generation capacity. The major reason for the Gujarat model is FiT which provides tariffs to small-scale generators and helps in injecting electricity into the grid as and when required. The tariff is fixed for 25 (12 years for higher prices + 13 for lower prices) years in all types of projects. It was also categorised into two levels from 2010-2022 and 2023-2036 respectively. Tamil Nadu and Gujarat are the two states where rooftop price is calculated based on rooftop solar tariffs and the individual users get more subsidies from the grid which is paid by various operators like TANGEDCO in Tamil Nadu.

The future lies in the solar sector and if a proper system could be built to channelise and implement these policies till the time laws are framed, then only it will be good to focus more on developing such types of policies which increase the investment in the current solar sector like FIT has done. Hence H2 hypothesis is also proved.

The point-wise detailed suggestion for removing the bottlenecks and suggesting the way forward as under.

6.3. SUGGESTIONS

6.3.1. Infrastructure Development

- **"Infrastructure Development in the Electricity Sector":** India has a tremendous potential to generate electricity through solar power if appropriately utilised. Post-Electricity Act 2003, there are many stones which are unutilised for further development. The Government should realise that E-Act 2003 is insufficient to govern both the renewable and non-renewable power sectors. RE sector. Various International conferences and conventions mandate every developing nation for sustainable development; India, too, is focusing on RE as a viable source of energy. Furthermore, when the pandemic (COVID-19) had hit globally, all the nations had got affected sectors. then only it realised that the need for development in many fields, and every sector required electricity to run. The infrastructure in the Electricity department needs colossal investment and advancement for better generation and transmission of electricity. Our Hon'ble PM, Shri Modi Ji, gave a motto to make India self-reliant in every sector, especially the Electricity Sector. In this sector, every consumer can become a producer of electricity post-installation of Solar panels, which may be mounted either on rooftops or at the ground level.

- **“Import more productive and high-quality solar panels” (Allan, 2020):** Solar panels converting heat and radiation into electricity are, therefore, a most vital component in this sector. Solar panels manufactured within India could be more efficient, as compared to imported solar panels. The efficiency of various panels which are imported primarily from China to the tune of approx. 96 percent. followed by Hongkong, Malaysia, Switzerland, and Singapore (Joshi, 2022). The panel efficiency is a percentage of the conversion of heat-induced into electricity which, Over the past five years, has been enhanced by 15 to 20 percent in their efficiency. All solar panels do not adhere to the same quality and materials, with their efficiency being variable. The tax structure also varies on solar cells from 25 %, and 40 % on solar modules (Baruah, 2022).

- In that league, Sun power is leading in solar cells efficiency with a maximum efficiency band in their N-type solar cells. The expenses in solar sector are very high because of the huge imports of solar cells, wherein the maximum efficiency is approx. 22.8 percent (Svarc, 2022).

- **“Replacement of Traditional solar panels with High Concentrated Photovoltaic (CPV) Cells”:** The highly concentrated PV cells have a very high-efficiency bandwidth compared to traditional solar cells. Conventional cells have an efficiency of a mere 22 percent compared to high PV cells, where the efficiency is up to 46 percent. They are highly expensive as the CPV comes almost four times more expensive than the existing solar cells. Despite higher CPV prices, the other limitation is that there are fewer options, but it is still worth investing in CPV cells.

- **“Avoid shaded areas to install panels”:** Electricity generation through solar power requires uninterrupted solar radiation on cells throughout the day, and if shade obstructs the sunlight at any point, it negates power generation. Many people are unaware of the procedures for installing solar power panels, as even if one of the cells is in the shade, it will affect the output for the entire panel. Tress and high-rise buildings also affect and obstruct the power generation by the solar cell. The precautions while installing the solar panels are to ensure that no shade falls on the panels during the entire day and they receive full radiation from the sun.

Image Source **(Allan, 2020)**

- **Panel Installation through Skilled:** A qualified expert in this field should install solar power panel installation because, ultimately, the maximum amount of electricity generation depends on the maximum amount of solar radiation which falls on these cells and panels. The placement and angle of cells, along with their orientation, are very critical. The Experts state that the panels should be aligned at an 18 to 36 degrees angle for maximum output. If the installation is in the northern hemisphere, the panels must be aligned in the southern hemisphere and vice versa. The next important thing to remember is the temperature of the panels', because, with the temperature rise, there is a drop in the efficiency of the solar panels. The need to have an appropriate gap is a must between the solar panels and the floor, which facilitates air movement and also cools down the temperature behind the panels.

- **"Clean panels, Maximum Level":** Solar panels are installed in open areas; therefore, the risk of depositing dust on the panels is very high, which will also affect efficiency. The cleaning of Solar panels should be done at regular intervals for maximum efficiency. The need for routine inspection is to be done for better results. In case of failure to maintain the solar panels, there can be a decline of up to 5 percent in the output. If it is cleaned regularly, even by the rain, there could be an increase of up to 20% in its efficiency; therefore, cleaning is a good idea for better output.

Image Source (Allan, 2020)

- **"Monitoring the efficiency of panels through software and devices.":** Most of the people, after installing solar panels, forget about them. This is a significant problem if the user is not monitoring the output of the solar panels, which can be checked through software and hardware devices for its efficiency.

6.3.2. Legislative Reforms.

- **Separate legislation for the Solar Sector**: The Government of India should formulate new policies with competitive tariff barriers specific to the Solar under Renewable energy sector to achieve its global commitment of 450 GW by 2030. The Government must also consider providing a subsidy to set up R&D infrastructure under the manufacturing units, which will help propagate the use of solar power and its generation. The need to formulate a robust framework which fills the gap in the solar sector and makes it cost-competitive to achieve the Government mission of self-reliant ("Atmanirbhar Bharat") India. This policy must also provide financial support in the long term and grant incentives directly to the consumer. The policy must also overcome the tariff and non-tariff barriers, as said by Saibaba Vutukuri, CEO of Vikram Solar (Sharma, 2021). Further, he added, *"The finance ministry should consider 5 percent interest subvention on the term loan and working capital, upfront Central financial assistance of 30 percent on Capex, and increase export incentive from 2 percent to 8 percent under Remission of Duties or Taxes on Export Product (RoDTEP), which will aid indigenous solar manufacturing,".*

There is a need to develop the market for RPO and REC. This market will help in to trace the generation and cost of it. Further, the focus must be on developing the electricity market in such a way that consumers may have many options to purchase electricity from various distributors of their own choice, through prepayment or any post-payment. This can be only possible by developing the transmission sector so that many suppliers can use one transmission system in any area. When the generation is high during daytime from solar, the network must deploy all the electricity to the grid and the consumers through transmission. The legislation or policy should be drafted so that it can handle a situation like a pandemic and boost the Indian economy and provide for a system to make India a global hub in the solar sector.

- **EV Market:** In the coming future, when traditional car engines run on fossil fuels like petrol, diesel, or gas get replaced by EV's system which is estimated by the year 2030, it will require a robust network of charging stations. All the existing fuel pumps will be transitioned to fuel cell replacement across the whole nation. All these stations can be powered by solar energy or have the capacity to store electricity generated from solar cells. It is further suggested to expand the EV market in which the Government should earmark separate funds to develop the market for E-Vehicles.

- **Tariff Revisions:** The Tariff must be revised as per the demand and required among the consumers, through reviewing of existing tariffs and on advice of the experts. This revision may have effective impact if done properly in the RE sector. RE Generators could get more benefits if tariffs are revised and they could more emphasis on RE Electricity generation.

- **R&D investment in Solar Sector:** India must offer super deductions to the tune of approximately 200 percent of R&D expenditure for enhancing the technology in solar energy production, as it is provided in the fields like biotechnology, which has resulted in tremendous growth in the Pharma sector. More research must be carried out to develop the RE sector and establish one central council at a national level to formulate and govern the RE power sector. The policy should be drafted to handle a situation like a pandemic, boost the Indian economy, and provide a system to make India a global hub in the solar sector.

6.3.3. **Institutional Reforms in the Solar Sector**

- **Autonomy to State owned Discoms**: The State-owned power utility service providers must have operational and financial autonomy, and there should be a clear-cut separation of power between the utility provider and the State. The Practices like Corporate Governance and Independent Directors will also help in the separation of powers. The revised tariff by SERC has also positively impacted the performance of state-owned utility Discoms.
- **Electricity Distribution Subsidiary**: As a pilot project, the power distribution franchisee model can help to take care of all the functions of electricity distribution. Many private distributors will not show a keen interest in being a licensee in rural areas as they don't want to take part in the associated risks, where the franchisee models can be fruitful. Bhiwandi, in Maharashtra, is the best example of this project. This pilot project has become a colossal success in distribution, metering, billing, and collection of bills. The same distribution franchisee system has also improved the situation in Orissa, where most of the bulk load is in rural area and agricultural farms.
- **Distribution licensee:** The Government has delicensed the distribution licensees and has instead suggested that companies must allow access to distribution facilities to various stakeholders equally. This licensee model

requires a colossal investment for setting up, and only private investors can do that. This licensee model could be a good decision where the consumer has a high capacity to pay, but this is possible only in metropolitan cities.

- **Equal opportunities and Fair Competition:** Many Discoms have enjoyed a monopoly in their distribution areas. Delicensing may govern fair competition in the market, and consumers may have many options. This is very challenging and can be executed appropriately for better results. Fair competition depends on factors like demand, market size, potential, and efficiency.
- **"Ministerial Reforms":** SERC plays a vital role in the electricity sector in India. For the efficient functioning in the distribution sector, every State Government must promote working, functioning, and Transparency of its working, and the tariffs should be adequately revised continuously to ensure fair costs. Fuel costs are also controlled through fuel surcharges and are to be displayed in a transparent manner. The new assets must not be created, and all the existing assets must be cleared within a period of 3 to 5 years with proper tariff regulations. The most important issue is that the political pressure should not interfere with regulatory functions and must create an area wise Regulatory Commissions. Direct Benefit Transfer (DBT) Scheme may improve efficiency. In some parts of Madhya Pradesh, it has been implemented as a pilot project and has done immense work. All the State Governments must provide details of DBT for transparency, and DBT should not be a burden on the consumers. The proposal should be that it must be the consumer's opinion whether to opt for the same or not. The Electricity, which is on subsidised rates, must be continued for the consumers who do not go for the scheme. The DBT scheme has more potential, but it needs to be appropriately restructured so that consumers should not lose their existing benefits and should be paid a little more for efficient usage. It has been seen in the State of Punjab the scheme of the 'Save water and Earn Money' ("Paani Bachao Paise Kamao") under the DBT has helped the farmers to earn money while saving water and electricity.

6.3.4. **Functional Reforms**

- **Reducing the Cost of Electricity:** All the Discoms must monitor their Power Purchase from the generators and be awarded for their efficiency. The Discoms should also develop the infrastructure and add human power to utilise the facility. All of this depends on the market capacity to provide low-cost electricity to the consumers, and the Discoms should avoid entering in to a long-term PPA. The States like Gujarat, Uttar Pradesh, Chhattisgarh & Maharashtra have already banned the setting up of any thermal PPAs by the year 2022. The Discoms may use Time of day tariffs to profitably monetise the usage of power demand during the peak surge hours. These tariffs can be reduced by advanced metering and adapting to the intelligent grid system. This will benefit by lowering the purchase costs and manage the demand during peak hours.
- **Improvements in Billing:** Most of the time, due to improper billing and rudimentary meters, it's very difficult to recover the Electricity Bills. The Discoms should improve and replace all the old meters with newer ones for efficient metering of the usages. They must also use the schemes provided by Central Government for achieving hundred percent metering in all the area. It is suggested to use smart meters or prepaid meters, keeping in mind of various cyber threats.
- **"Money Collection":** All the Discoms must develop Consumer friendly mechanisms for the users to pay their Electricity bills. The cases of theft can also be reduced with the joint venture of the State, and Discoms in some states like Maharashtra, Uttar Pradesh, Delhi NCR, and Manipur, which have already started the use of prepaid meters. This has helped to reduce the theft of electricity and has also helped to recover the balance payments in a quick and effective manner. Despite this advancement in many areas, the traditional way of billing is being practised, which needs to be replaced.
- **"Lowering Transmission losses"**: In India, comparatively, electricity generation is not a major issue as compared to the distribution of power supply. If the electricity could be generated as per the demand, it will never be fulfilled because of the transmission losses. This is primarily due to the pathetic condition of the infrastructure which has not been upgraded and still is in usage.

The transmission sector requires a robust development and the investment to improve the grid which includes the High-tension wires. The usage of good-quality smart transformers is also highly recommended. The monitoring system of flow of electricity should be constantly monitored for with the help of newer technologies for the best possible results. The State of Gujarat is currently using this technology, with the Central Government requesting every state to clear their financial dues to the various Discoms. This has been done primarily to help the Discoms to invest more in the improvement and upgradation of the transmission network and to replace antiquated infrastructure.

- **“Electricity demand management in the agriculture sector”:** India is a nation where most of the population is dependent on agriculture for their livelihood. The electricity demand is also very high in the rural areas because of high-voltage water pumps which are used in farming. The States like Rajasthan, Andhra Pradesh, Gujarat, Karnataka, and Maharashtra have experienced many benefits when they have separated the feeders for the agricultural usage from the non-agricultural usage. The Investment in feeders is supported by the Government of India under DDUGJY scheme. The Distribution of solar pumps has also increased because of the PM-KUSUM scheme where the usage of Solar water pumps in rural areas has also improved the financial conditions of the users and helped the Discoms to save costs.

6.3.5. **RE Reforms**

- To make RE affordable and accessible, there is a strong need to reduce production and purchase costs. The Discoms should establish some hybrid systems of solar and wind energy. Electricity generated from wind and solar energy is vital in contrast to traditional sources like coal, gas, hydropower, and nuclear power. They all have distinct features related to their abilities, rates, and output levels. The storage of electricity generated from RE can be accumulated with the help of a panel of batteries or through the pumped hydro-storage systems. The efficiency of RE can also be improved by improving the transmission sector.

- The technological advancements are also critical in enhancing the efficiency of old thermal power plants, which may help in reducing the load on the power grid. The grid has connected many households in some or the other way, but the quality and availability to achieve 24*7 supply is still a milestone in many remote areas. These areas can be managed by mini-grids and microgrids. The Mini grids still require a hefty investment compared to the power purchased from various Discoms.
- It is suggested to manage the remote areas with a PPP model, which can be adopted with the help of the Government's supporting schemes like the Viability Gap Funding (VGF) scheme. These Mini-grids can also be used as a distribution subsidiary, with another possibility being that a well-capacitated local Government could run the mini-grid with the support of the State Government.

6.3.6. **Operation And Management Reforms**

- It is further suggested that the Discoms should improve their relations with consumers and provide some helpline numbers where the consumers can call and access the various facilities. The Discoms should also set up facilities for accurate and easy bill payments, which will help increase the revenues of the Discoms. The Discoms should manage their workforce for the success of their operations and enhance efficiency. The dolling out of timely incentives and appreciation letters and enhancements in terms of promotion as per their performance must be given to eligible employees in the organisation's interest. This will also help to enhance the level of trust between the employer and the employee, which will be beneficial in the long run.
- The various Discoms require professionals from areas like administration, finance, engineering, billing collection, human resources, etc., and many organisations provide training programs to their technical members regularly. Some institutes like National Power Training Institute and the Tata Power DDL Learning Centre are set up to train new professionals who wish to join the power energy sector.

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APPENDICE 1

NATIONAL RENEWABLE ENERGY ACT, 20XX

An Act to promote the production of energy from renewable energy sources, in order to reduce dependence on fossil fuels, ensure energy security and reduce local and global pollutants, keeping in view economic, financial, social and environmental considerations,and for matters connected therewith or incidental thereto.

WHEREAS it is expedient to increase the proportion of renewable sources of energy in India's energy mix, and to reduce the reliance on fossil fuels, in order to achieve economic and environmental objectives;

AND WHEREAS it is necessary to facilitate a transition from fossil fuels to renewable sources of energy with an appropriate legal, regulatory and institutional framework;

AND WHEREAS increased use of renewable energy sources raises important issues relating to electricity systems infrastructure, land allocation, cost of access and finance; and these issues require inter- ministerial coordination and expert assistance to seek resolution;

AND WHEREAS there is need to move towards Integrated Energy Resource Planning;

AND WHEREAS in view of the above, it is considered expedient to clearly identify the role of the Central Government and the State Governments, and to establish a National Renewable Energy Committee and National Renewable Energy Advisory Group to ensure inter-ministerial coordination and expert assistance;

Be it enacted by Parliament in the --- year of the Republic of India as follows:

PART I: Preliminary

1. Short title, extent and commencement

This Act may be called the Renewable Energy Act, 20XX.
Be it enacted by Parliament in the XX Year of the Republic of India as follows:

Index (to be inserted once draft is finalized):

2. Standard clauses about applicability of Act and notification

Version -1 of Clause 1 and 2:

(1) The electricity sector including electricity generation from renewable resources is covered under the Electricity Act, 2003. It is presently being amended to give an impetus to the development of electricity generation and consumption from renewable energy sources apart from a push for open access and choice of supplier.

(2) Hence the proposed Renewable Energy Bill does not cover any issues already covered under the E-Act, 2003 and its proposed amendments.

DRAFT

Version-2 of Clause 1 and 2

(1) The electricity sector including electricity generation from renewable resources is covered under the Electricity Act, 2003. It is presently being amended to give an impetus to the development of electricity generation and consumption from renewable energy sources apart from a push for open access and choice of supplier. However, some critical issues which will have serious implications for aggressive RE deployment are still not covered adequately in E Act such as principles of grid planning, grid operations and grid management, including cost sharing of each of these aspects. Other key aspect is concept of national target and its compliance by utilities.

(2) The proposed Renewable Energy Bill therefore covers such issues which ideally shouldbe covered under the E-Act, 2003, however are not yet covered in the draft publicly available. Such issues therefore need to be read along with the proposed modifications to E Act and this Bill, and are captured in last Part (Part VI).

Common Clauses

(3) A particular focus of this Act is Decentralised Renewable Energy and some facilitating and coordination related aspects with regard to grid connected renewables to bring in synergy and harmony in RE development.

(4) The proposed RE Bill is written with consideration of provisions in other existing legislations such as Electricity Act, 2003, polices thereunder, and other relevant acts such as Environment Protection Act 1986, Land Acquisition, Rehabilitation and Resettlement Act, 2013.

(5) It also has linkages with NAPCC and its missions such as NMEEE, National Solar Mission and other missions such as National Electric Mobility Mission, National Wind Energy Mission and Waste to Energy Mission. Other key linkages are with National Manufacturing Policy and National Skill Development Programme.

3. Definitions: In this Act, unless the context otherwise requires,

1) ―Appropriate Government‖ means

2) ―Association of State Nodal Agencies‖ is the association of state level Nodal Agencies created by the Ministry of New and Renewable Energy, Government of India

3) ―Behind-the-meter‖ generation refers to a generation unit that delivers energy to load without using the transmission system or any distribution facilities unless the entity that owns or leases the distribution facilities has consented to such use of the distribution facilities and such consent has been demonstrated to the satisfaction of the authority responsible for granting interconnection

4) ―Central Electricity Authority‖ (or ―Authority‖) as constituted through the Electricity Act2003

5) ―Critical Component‖ refers to a material or equipment that serves an essential function in the manufacture of a product – the absence of which would cause economic or social consequences – and whose supply is vulnerable to disruption

6) ―Corporation‖ means

7) —Distributed and Decentralised Renewable Energy‖ means

8) —Hybrid Systems‖ refer to any power or energy generation / conversion facility which makes use of two or more types of technologies utilizing both conventional and/or renewable energy resources, such as, but not limited to, integrated solar-wind systems, biomass/fossil-fuel systems, hydro/fossil-fuel systems, integrated solar/biomass systems, integrated wind/solar/biomass systems, with a minimum of percentage of totalelectricity/energy output provided by the Renewable Energy component of the system, asmay be notified by the Ministry from time to time.

9) Integrated Energy Resource planning (IERP) is a strategic plan for securing reliable and cost-effective energy resources. The plan is an exhaustive, research-based examination ofpotential risks and opportunities in procuring future energy supplies. Such a planning exercise:

- Examines all available energy-resource options, including supply side as well asdemand side options
- Makes a thorough, objective assessment of the benefits, co-benefits, direct andindirect costs, cost of externalities, and risks associated with each energy option
- Evaluates all resources to maximize energy, environmental, and economicsecurity

10) —Market Based Instruments‖ mean various financial or policy instruments introduced to promote development of renewable energy through the mechanism of the open market, and not involving direct government subsidies

11) –Ministry‖ means the Ministry of New and Renewable Energy or its successor

12) —National Renewable Energy Plan‖ means the National Renewable Energy Plan asnotified under sub-section XX of section XX of this Act

13) —National Renewable Energy Policy‖ means a National Renewable Energy Policy as notified under sub-section XX of section XX of this Act

14) —Net-Metering" refers to a system, appropriate for distributed generation, in which a distribution grid user has a two-way connection to the grid and is only charged for his net electricity consumption and is credited for any overall contribution to the electricity grid.

15) —Net system cost of grid integration‖

16) —Nodal Entity‖ refers to any agency designated, nominated, authorized or appointed by the Ministry, or governments of the States or Union Territories, through an order in writing, to carry out any particular functions as defined in the said order under this Act orunder the rules, regulation or notifications issued under this Act.

17) —National Renewable Energy Committee‖ means a committee established under Clause 7of this Act

18) —Obligated Entities‖ refers to the regulated distribution companies and open access consumers as per the provisions of the Electricity Act 2003

19) —Off-grid system‖ means a system set up to generate electricity

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from renewable energy resources and distribute electricity in a specified area, ordinarily without connection tothe distribution grid

20) ―Resource Assessment‖ means

21) ‒Regional Power Committee‖, as defined by the Electricity Act 2003

i. ―Renewable Energy‖ (RE) Sources‖ means energy derived from non-depletingresources and includes the following sources-Wind

ii. Solar radiation;

iii. Mini hydro;

iv. Biomass;

v. Biofuels;

vi. Landfill & Sewage gas;

vii. Municipal solid waste;

viii. Industrial waste;

ix. Geothermal energy;

x. Ocean energy;

xi. Any other energy source, as may be notified by the Ministry; and

xii. Hybrids of above sources

[In this definition: solar radiation include photovoltaics and solar thermal generation; biomass comprises solid, liquid, and gaseous fuels from crop residues, including timber and harvest residues as well as wastewood and organic waste from food production and animal husbandry. It also includes feedstock from dedicated biomass plantations grown on degraded/waste lands deemed suitable for this purpose by relevant authorities; ocean energy includes wave, tidal and marine sources based on coastal land and/or shallow coastal waters; and industrial waste includes all solid, liquid and gaseous byproducts/effluents which can be used for energy generation, including agro-industrial wastes and by products.]

22) ―Renewable Energy Fuel‖ means any fuel which is used to replace or reduce quantity of fossil fuel present in a fuel mix andis produced from grain, starch, oilseeds, vegetable, animal, or fish materials including fats, greases and oils, sugarcane, sugar beets, sugar components, tobacco, potatoes, or other biomass; or natural gas produced from industrial and agro-industrial waste including a biogas source, a landfill, sewage waste treatment plant, feedlot, or other place where decaying organic material is found

23) ―Renewable Purchase Obligation (RPO)‖ means the requirement as specified under clause (e) of sub-section (1) of section 86 of the Electricity Act 2003 for the obligated entity to purchase electricity from renewable energy sources

24) ―State Nodal Agency‖ means the state level agency designated by the State Governmentsfor renewable energy development in the respective state;

25) "Utility grid" means

26) "Utility-scale Renewable Energy" means a renewable energy project and/or facility which generates electricity and feeds it into the grid, supplying a utility with energy under a valid Power Purchase Agreement (PPA), guaranteeing a market for its electricity for a fixed term of time. PART II: INSTITUTIONAL STRUCTURE

Chapter I: General Powers of the Central Government

4. Power of the Central Government to take measures to encourage the development and deployment of renewable energy:

(1) Subject to the provisions of this Act, the Central Government shall have the power to takeall such measures as it deems necessary or expedient for the purpose of development and deployment of renewable energy in the country.

(2) Notwithstanding the generality of sub-section (1), the Central Government shall perform the following functions in particular:

i. Formulate, monitor and review implementation of National Renewable Energy Policy and National Renewable Energy Plan;

ii. Plan and execute nation-wide programmes for the deployment of renewableenergy;

iii. Carry out research and development and provide technical assistance relating to renewable energy technologies, including through the establishment of laboratories, testing centres and research institutes;

iv. Administer and monitor the utilization of funds allocated for development of renewable energy, including the National RE Fund;

v. Develop {and coordinate the development of} standards and norms for resource assessment (of various renewable energy resources), technologies and products;

vi. Facilitate the proper functioning of the National Renewable Energy Committee, the National Renewable Energy Advisory Group, and any other body or agency set up under the provisions of the Act{through the provision of adequate fundsfor coordination, meetings and research, access to the MNRE's data and resources and salaries for permanent staff.}

vii. Issue Guidelines for the formulation of State level Renewable Energy Policiesand State level Renewable Energy Plans and provide necessary support to the State Governments to formulate the same.

(3) The Central Government may, if it considers necessary or expedient, set up authority/iesor institutions for the purpose of exercisingits functions laid down in thisAct, including setting up educational institutions, and provide necessary assistance to existing institutions and agencies that work in the area of renewable energy.

Chapter II: ***Powers of State Government***

5. State level Renewable Energy Policy and State level Renewable Energy Plan:

(1) The State Government shall, from time to time,formulate, monitor and implement State level Renewable Energy Policy and State level Renewable Energy Plan.

(2) The State Government shall take into consideration the National Renewable Energy Policy and the National Renewable Energy Plan in force at the time, as well as appropriate Guidelines issuedby the Central Government under Clause 4(2)(vii) while formulating the State level Renewable Energy Policy and State level Renewable Energy Plan.

(3) The State Governments may also establish a State Green Fund for the promotion of renewables asfurther outlined in Clause 24.

(4) During the formulation of the State level Renewable Energy Policy and State level Renewable Energy Plan, the State Government shall consult the designated State Nodal Agency.

(5) The State Government may develop policies or plans with a particular focus on issues including,but not limited to:

i. Setting renewable energy targets,
ii. Sharing of incremental costs,
iii. Facilitating framework for deployment,
iv. Establishment of renewable energy parks,
v. Development of transmission infrastructure,
vi. Establishment and utilization of State Green Funds,
vii. Energy data management,
viii. Resource assessment and
ix. Inclusive land use policy for renewable energy projects.

6. State level implementing agencies and State Nodal Agencies

(1) The State Government may/shall establish a State-level implementing agency that will beresponsible for implementing renewable energy projects in the State.

(2) The State Government may/shall designate State Nodal Agencies within {three} months from thedate of coming into force of this Act.

(3) Provided that a State Nodal Agency designated before the coming into force of this Act shall continue as such, unless the State Government designates a different agency as the State Nodal Agency.

(4) The State Government may/shall take necessary measures to continually enhance the technical,financial and administrative capacity of State Nodal Agencies.

Chapter III: Authorities to be appointed/constituted under the

Act

National Renewable Energy Committee (NREC)

7. The Central Government shall constitute a body to be known as the National Renewable EnergyCommittee within {three} months from the date of commencement of this Act.

8. Composition of the ***NREC***

(1) Chairperson – Secretary, Ministry of New and Renewable Energy
(2) Members –

i. A Joint Secretary of Ministry of New & Renewable Energy will be the MemberSecretary.
ii. Representatives of level not below Joint Secretary of Ministry of Power, Ministryof Rural Development, Ministry of Agriculture, Ministry of Heavy Industries,
Ministry of Petroleum & Natural Gas, MoEFCC
iii. Two representatives of level not below Joint Secretary or equivalent from States.
iv. A representative of level not below Joint Secretary equivalent or the head of theNational Load Dispatch Centre /Power System Operations Company (POSOCO) Limited
v. One representative of each of the Regional Power Committees formed underElectricity Act 2003
vi. A representative not below the rank of Joint Secretary of Central ElectricityAuthority established under E. At 2003
vii. A representative of level not below Joint Secretary equivalent or the head of theCentral Transmission Utility (CTU)/ Power Grid Corporation of India Limited
viii. A representative of level not below Joint Secretary equivalent or the head of thenewly formed Renewable Energy Corporation of India – see SECTION ________
ix. A representative of level not below Joint Secretary equivalent or theadministrative head of Indian Renewable Energy Development Agency

(3) Special invitees/ experts invited by the Chairperson on behalf of the Committee/ on advise of the Committee

9. Appointment process:

Option 1:There could be a provision along the following lines: *the term of office of the Chairperson and the members of the Committee, other than those who are members ex officio, and the procedure to be followed in the discharge of their functions by the members of the Committee shall be such, as may be prescribed.*

Option 2:Put details in this Act itself: Appointment could be through notification in the Official Gazette; term of the Chairperson and members has to be specified.

10. Functions of the ***NREC***:

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(1) The ***NREC*** shall enable inter-ministerial coordination relating to the implementation of this Act, and advise the Central Government accordingly.

(2) In pursuance of sub-section (1), the Committee shall perform, *inter alia*, the following functions:

i. Review the implementation of the National Renewable EnergyPolicy {and National Renewable Energy Plan}, and advisethe Central Government in discharging its functions under this Act and in accordance with the Energy Policy;

ii. Facilitate the development and deployment of renewable energy sources in the country by developing of fiscal, financial, regulatory, policy, and institutional mechanisms;

iii. Identify measures for development of indigenous technology, manufacturing base, capacity development, skill development,export of technologies, and establish / coordinate related technology missions created under this Act;

iv. Coordinate on matters relating to grid integration of renewable energy;

v. Identify and set research and development priorities for the sector;

vi. Monitor the development and progress of RE Investment Zones;

vii. Such other matters as the Central Government deems necessary or expedient for the purpose of securing the effective implementation of the provisions of the Act.

(3) The Committee shall consult the Advisory Group set up under Clause 8 and may undertake consultation processes with other stakeholders, as deemed necessary and expedient by it, while performing its functions.

(4) The Committee shallperform its functions in a transparent manner, and make information relating to its functioning, including advice rendered to the Central Government and agenda and minutes of meetings, publicly available.

(5) The Committee shall meet at least four times in a financial year and there shall not be a gap of more than four months between any two meetings.

National Renewable Energy Advisory Group

11. The Central Government shall appoint a National Renewable Energy Advisory Group within {three} months from the date of commencement of this Act.

12. Composition of the National Renewable Energy Advisory Group

(1) Chairperson[s] – An/Two eminent person[s] in the field of renewable energy such as, butnot limited to technology, finance, law, policy

(2) Members –

i. A Joint Secretary of Ministry of New & Renewable Energy

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will be the Member Secretary.

ii. Three members amongst representatives of Association of State Nodal Agencies, Central Electricity Authority, PowerGrid Corporation of India Limited, Power System Corporation of India Limited, (or the head of) Renewable Energy Corporation of India, (or the administrative head of) Indian Renewable Energy Development Agency

iii. Six non-government members representing various stakeholders such as producers and users of renewable energy sources, distribution utilities, academia,research institutions and think tanks.

(3) Special invitees/ experts invited by the Chairperson on behalf of the Committee/ on advise of the Committee

13. Appointment process:

Option 1:There could be a provision along the following lines: the term of office of the Chairperson and the members of the Committee, other than those who are members *ex officio*, the manner of filling of vacancies of positions referred to in {sub-sections for non-ex office}, and the procedure to be followed in the discharge of their functions by themembers of the Committee shall be such, as may be prescribed.

Option 2: Put details in this Act itself: Appointment could be through notification in theOfficial Gazette; term of the Chairperson and members

14. Functions of the Advisory Group:

(1) The Advisory Group may, based on its expertise, knowledge and research, advise the Central Government on the effective implementation of this Act.

(2) Notwithstanding the generality of sub-section (1), the Advisory Group shall perform the following functions in particular:

i. Act as a Technology Watch Group to keep track of latest global developments and their relevance to Indian conditions and also help set research priorities for the sector;

ii. Identify measures required to create awareness and educate the citizens for adoption of renewable energy technologies and promote private sector and community participation;

iii. Advise on utilisation of the National RE Fund, based on development needs ofthe RE sector;

iv. Constitute sub-committees as may be required for specific issues, including butnot limited to off-grid access, grid integration, and biofuels;

v. Develop a long-term vision for integrated energy resource planning;

vi. Such other functionsas the Central Government deems necessary or expedient forthe purpose of securing the effective implementation of the provisions of the Act.

(3) The Advisory Group shall:

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i. Publish an annual report highlighting the state of affairs of the RE sector in the country

ii. Publish issue-based reports from time to time on key challenges facing the RE sector and appropriate solutions thereto

(4) The Advisory Group may undertake consultation processes with various stakeholders, as deemed necessary and expedient by it, while performing its functions.

(5) The Advisory Group perform its functions in a transparent manner, and make information relating to its functioning, including advice rendered to the Central Government and agenda and minutes of meetings, publicly available.

(6) The Advisory Group shall meet at least four times in a financial year and there shall not be a gap of more than four months between any two meetings.

Additional section for discussion:

1. Constitution and Roles of RE Corporation of India (RECI):

a. Central Government shall, within {one year} of the notification of the Act, create or designate {/ cause} one of its existing corporate entities as the ―Renewable Energy Corporation of India‖.

b. The Renewable Energy Corporation of India shall be incorporated under the Companies Act 2013.

c. The Renewable Energy Corporation of India shall perform the following functions:

i. Act as a national level RE procurement entity

ii. Support development of Renewable Energy Investment Zones across the country (Project development)

PART III: DEVELOPMENT OF SUPPORTIVE ECOSYSTEM FOR RE DEPLOYMENT

15. National Renewable Energy Policy

(1) Within six months of this Act, the Ministry shall, in consultation with the State governments, prepare and publish, the National Renewable Energy Policy

(2) Provided however that such RE Policy shall be formulated keeping in consideration the appropriate provisions of the Electricity Act 2003, as amended from time to time, and the provisions of this law, aimed at the optimum and integrated development of the renewable energy sector, and its applications, including electricity, heating, lighting, cooking, cooling, transport, irrigation, and combinations of the same. Specifically, the policy shall

i. Build upon and be complementary to the National RE

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Policy notified from timeto time under the Electricity Act 2003

ii. Be based on the priorities set by the National Energy Policy (NEP) and on the principles of integrated energy resource planning (IERP)

iii. Establish broad principles for medium and long term RE targets building uponthe targets specified by the RE policy notified under the Electricity Act. Thisshall include electricity as well as non-electricity, pricing, target compliance and facilitate a move towards a market based mechanism for RE in the long run.

iv. Focus on development of supportive ecosystem for RE development and deployment such as but not limited to resource assessment plan, indigenous manufacturing of critical resources, availability of financial resources, commercial viability of the technologies, eliminating barriers to deployment of renewable technologies and adequacy of energy infrastructure.

v. Include national targets for next five years, and indicative targets for additional ten years period, for the development of all renewable energy resources and applications.

vi. Specify regulatory, policy, institutional and incentive frameworks required for achieving the objectives of this Act and national targets

vii. Lay out the vision for Research, Development and Demonstration (RD&D) in thecountry.

viii. Be followed by a National RE Plan, to be prepared and implemented by the Ministry after due consultation with the National RE Advisory Group

(3) Provided that a mid-term assessment of the National Renewable Energy Policy and the National RE Plan shall be undertaken by the Ministry in accordance with Part *****

i. Provided that the review shall not allow a downward revision of firm targets specified for next five years unless a carefully examined set of reasons is established after due consultation with the National RE Advisory Group

(4) The Ministry shall publish a comprehensive National RE Plan over a timeframe consistent with the horizon of the National RE Policy.

i. Provided that such National RE Plan may be further split into plans over shorter time periods for effective and time-bound implementation

(5) The Central Government shall work together with its Nodal Entities, other agencies and with State Governments to implement the National Renewable Energy Policy and National Renewable Energy Plan.

16. Renewable Energy Resource Assessment

(1) The Ministry shall, within one year from the notification of this Act, complete a detailed resource assessment study for all renewable energy resources including all electric and non-electric applications such as utility scale electricity generation, distributed and decentralized electricity and energy generation (such as rooftop PV, solar pumping), heating, cooling, transportation, fuels etc.

(2) The Ministry shall designate Nodal Entity(s), the task of assessing

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the potential, for everyrenewable energy resource, both mature and emerging, and techno-economic feasibility of decentralized and distributed RE technologies and applications provided that

i. At least one entity per RE resource shall be designated

ii. If required, more than one Nodal Entities may be notified per RE resource

iii. Same organization may be notified as Nodal Entity for more than one RE resource

iv. The entity may use the services of other agencies, public or private, to collect andmaintain the data

v. Nodal Entities will need to ensure that such assessments are carried out with modern techniques for all renewable energy applications and are updated and published at least once in every two years.

vi. These assessments will be available in the public domain in an open-data format in compliance with the National Data Sharing and Accessibility Policy (NDSAP) or the appropriate policy in effect at the time, and should be accompanied by high-resolution GIS layers of transmission lines, substations, roads, forest areas etc. to assist in planning and easier project development.

17. Technical and safety standards

(1) The Ministry in consultation with its agencies shall ensure publishing updated set of technical, safety and quality standards by which all manufactured RE equipment, RE products and RE fuels shall comply.

18. Testing / Monitoring and Verification

(1) The Ministry shall have the right to designate an entity in each state, which will be responsible to ensure adherence to notified standards at all times according to provisions of the National RE Policy

i. Provided that such designated entity may appoint independent and suitably qualified third parties to undertake such regular and time bound testing

(2) The Ministry shall have the right to set up an accreditation program for all renewable energy manufacturers, system integrators, developers, operation and maintenance service providers, consultants etc to enable the adherence to required regulations. Provided that the Ministry shall be guided by the

i. Inputs received from the National RE Advisory Group for all RE technologies/equipment

ii. Field capacity of the enterprises for decentralised renewable energy sector

(3) The Ministry may also consider setting up/ notifying labs for testing of renewable energyequipment.

(4) The Ministry may set up protocols for certification including random checks formonitoring and verification.

19. Manufacturing and Skill Development

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(1) The Ministry shall, in consultation with the National RE Advisory Group,

i. Create a facilitating framework with appropriate incentives for supporting the indigenous renewable energy manufacturing sector for cost reduction/ strategic purposes/ customization for Indian conditions.

ii. Strengthen the supply chain through expanding domestic manufacturing of critical components as notified in the National Renewable Energy Plan, to achieve energy security, and macro-economic benefits for the country

iii. Focus on improvement of efficiency and actual performance of equipment/system/machinery

iv. Promote export of renewable energy products and devices from the country

(2) For this purpose, the appropriate government may set up dedicated renewable energy manufacturing zones which will be provided with adequate infrastructure facilities.

(3) The Central Government shall identify key focus technologies, components and materialsfrom time to time including as a part of National RE Policy and Plan.

i. Provided further that Ministry shall formulate specific schemes to promote manufacturing / formation of such identified technologies, components and materials.

(4) The Central Government and the State Governments shall promote skill development and entrepreneurship in the field of renewable energy through measures including,

i. inclusion of renewable energy technologies in education curriculum and occupational education curriculum,

ii. provision of technical and entrepreneurial assistance to current and potential project developers

iii. establishing or supporting institutes dedicated to renewable energy innovation and studies in order to promote fundamental research and talent development in the renewable energy sector

iv. focusing on entrepreneurship development, incubation of start-ups and for providing knowledge and capital support to existing or new ventures based on renewable energy technologies, in the National RE Plan.

20. Renewable Electricity Investment Zones: The Ministry shall through RECI or any other identifiedagency, work with State Governments to identify and develop RE investment zones to meet the goals under the National RE Development Plan. The Ministry shall oversee and monitor the development and progress of these zones.

21. Data Management: The Ministry shall designate a nodal agency (ies) for timely and dis- aggregated Renewable Energy technical, performance and financial data collection and analysis, including database of existing and upcoming RE projects,

(1) Provided that such data shall be made available in the public domain in an open-data format in compliance with the National Data Sharing and Accessibility

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Policy (NDSAP) or the appropriate policy in effect at the time.

22. Model Guidelines by the Ministry

(1) Authority to issue guidelines: The Ministry shall issue standard/ model guidelines to states and other stakeholders on various issues to streamline and bring in synergy and harmony in existing legal statues and the specific requirements of Renewable Energy development across the country

(2) Such model / standard guidelines could include but would not be limited to

i. Promotion of Distributed Renewables (electricity and energy) through effective and monitorable incentive structures

ii. Land use for renewable energy projects, applications and fuels, including procurement and/or use of revenue land, private land, and forest lands, its fair compensation and land databases.

iii. A process for informed local consent for projects in letter and spirit and a formalinstitutional structure for revenue/benefit sharing with the community

iv. Renewable Energy Infrastructure parks for faster and planned projectdevelopment

v. Best practices on streamlining of project permits, clearances and institutionalstructure etc.

vi. Best practices for state grid codes, RE integration practices for SLDCs, data management. Etc

vii. Standard Bidding guidelines and SBDs under section 63 of the Electricity Act, 2003.

PART IV – ECONOMIC AND FINANCIAL FRAMEWORK (INCENTIVES AND FINANCING)

23. National RE Fund: The Ministry shall establish a National Renewable Energy Fund

(1) Provided that the Fund shall be operated by the Central Government

(2) Provided further that the initial corpus and regular revenue to the Fund shall come from the National Clean Energy Fund, at least XX% of annual proceeds of which shall be routed to the Fund.

(3) Provided further that the Fund may be additionally supported on an ongoing basis through appropriate cess/levy and through international finance, including funds receivedunder any climate agreement.

(4) The Fund may be used for supporting all the objectives of this Act,

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such as but not limited to R&D, resource assessment, demonstrations and pilot projects, low cost financing, investments for skills development, supporting RE technology manufacturing, infrastructure development, promoting all forms of decentralised renewable energy etc. provided such activities are selected in a transparent manner, and in line with the provisions of the National RE Policy/Plan.

24. State Green Fund: The State Governments may also establish a State Green Fund for the promotion of renewables. The Ministry may offer a starting corpus to such State Green Fund(s) from the National Renewable Energy Fund. Other sources of funds to the State Green Funds may include but not limited to State-level public benefits charges, state-level green cess, electricity duties, government and private sector grants, and funds through corporate social responsibility (CSR)

25. Such CSR contributions shall account for compliance with the organisation‘s CSR obligation

26. The National RE Fund and the State Green Funds shall be applied for meeting the expenses incurred for implementation of the objectives and provisions of this Act, as specified by the National RE Policy and National RE Plan, and may be used inter alia, for:

i. Lowering risk and cost of capital for investments in RE projects

ii. Financially supporting users, primarily distribution companies in case of electricity, and direct users of other RE technologies and applications, such that they become indifferent in the choice between conventional and renewable electricity and between conventional energy and RE resources, until parity is achieved

iii. Infrastructure development for renewable energy;

iv. Research and development;

v. Equity participation in renewable energy projects;

vi. Promotion and launch of such programmes for adoption of international best practices.

(2) Provide further that the State Green Funds created under this Act shall be administered by the State Nodal Agencies in the respective states, in such manner as may be specified in the rules made by the State Government or the Governing bodies of the State Nodal Agencies in this regard.

27. The Ministry and/or its agencies shall endeavour to raise low-interest finance for providing soft loans to renewable energy projects, renewable equipment manufacturers, renewable component manufacturers etc.

28. The Ministry shall encourage development of innovative financing instruments or synthesized financial products to facilitate provision of low-cost debt to renewable projects

29. Capacity Building of Banks & Financial Institutions – The Ministry in consultation with the Department of Financial Services of the Ministry, shall within

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one year from the commencement of this Act, launch a programme for training and capacity building of banks and financial institutions in the techno-economics of renewable energy. Such programme may be implemented through selected reputed specialist non-government organizations in the renewable sector in the country.

PART V – DISTRIBUTED RENEWABLE ENERGY APPLICATIONS AND ENERGY ACCESS

30. The Central and State Governments shall promote the use of decentralised and stand-alone renewable energy applications in rural and urban areas, including

(1) Electricity generation and use, including cost-effective grid interactive renewable electricity generation options primarily for self-consumption by individuals andcommunities.

(2) Off-grid systems for electricity generation and use, including mini- or community grids and distributed, individual energy services for residential, commercial, industrial and agricultural applications.

(3) Heating and cooling applications such as water heating, drying, space cooling/heating, other residential, commercial, industrial and agricultural applications

(4) Renewable energy fuels for transportation sector with due considerations for sustainability of such fuels and implications for food security of the country

31. The Ministry shall designate Nodal Entity (ies), the task of assessing regions and applications where decentralised resources are more technically and economically attractive than grid- connected options.

32. Within six months of this Act coming into force, state governments shall specify / publish a list ofvillages and hamlets, where grid-extension is technically and economically unfeasible in the next 5 years. A resource assessment should be undertaken in these villages to study the best-suited technologies to provide electricity to these villages through decentralised renewable electricity sources.

33. Appropriate government (National or State or both) may provide an incentive and facilitation framework for promoting use of decentralised RE

(1) Provided that while providing incentives and facilitating framework the appropriate government shall consider following factors:

i. Need to ensure that tariff / cost of such DRE payable by consumers is reasonable

ii. Reliable and safe supply/use of DRE to consumers

iii. Viability of business models and investments in the DRE sector

iv. Grievance redressal mechanisms for consumers as well as project developers

v. Such Decentralised RE projects should be able to connect and interact with utilitygrid

34. The Ministry shall make competitive, merit-based grants to deserving research agencies for the development of decentralised and stand-alone energy technologies.

35. The Ministry shall work with its agencies and other ministries concerned and regulators to encourage renewable energy applications in domestic or commercial sectors by introducing net metering and gross metering arrangement while also scaling up use of smart meters.

36. Decentralised Energy Technology Development & Demonstration Programmes

(1) The Ministry shall carry out programmes of research, development, demonstration, and commercial application on decentralized energy resources and systems reliability and efficiency, to improve the reliability and efficiency of decentralized energy resources andsystems.

(2) The Ministry may provide financial assistance to deserving institutions for demonstrations designed to accelerate the use of decentralized energy technologies.

(3) The Ministry shall establish a research, development and demonstration programme to develop working models of decentralised technologies for various applications.

(4) The Ministry shall undertake programmes in association with local governments (Zilla Panchayats, Gram Panchayats), to spread awareness on decentralised and off-grid electrification technologies.

37. Monitoring and Evaluation: The Ministry shall create a framework for monitoring and evaluation of systems which have been installed through the use of central financial assistance and other government subsidy schemes.

38. The Ministry shall provide financial incentives for proper maintenance of decentralised systems.

PART VI – GRID CONNECTED RENEWABLE ELECTRICITY

39. Renewable Electricity Targets and compliance

(1) A person who intends to generate and supply electricity from renewable energy sources shall not require any license, but shall comply with the measures which may be specified by the Central Electricity Authority under sections 53 and 73 of the EA 2003.

(2) To ensure higher off-take of renewable electricity and to ensure an equal contribution by all obligated entities in doing so, the Ministry shall, within one year of the notification of the Act, under the National RE Policy create a national,

uniform and mandatory renewable electricity purchase obligation trajectory for all obligated entities. Such obligation shall be met through purchase of renewable electricity from RE generators located anywhere in the country and/or renewable electricity certificates

(3) RE resources eligible to meet renewable purchase obligation (RPO) include

i. Utility-scale RE generation

ii. Behind-the-meter RE

iii. Off-grid systems based on RE providing electricity or equivalent services e.g. solar pumps / lighting etc

(4) The Ministry shall work with its Nodal Agencies, other agencies, and State Governments to enforce the mandated RPO through appropriate mix of incentives, penalties, and legal action as defined in National RE Policy and Plan

i. Provided that the Ministry may/shall provide appropriate financial support to distribution companies such that they become indifferent in the choice between conventional and renewable electricity resources until grid parity is achieved

(5) The Central and State Electricity Regulatory Agencies constituted under the Electricity Act shall have the responsibility and authority to ensure compliance to such electricity purchase obligations by the obligated entities.

(6) Provide further that to ensure compliance monitoring, the State Nodal Agencies; Central, Regional and State level Load Dispatch centers; State Energy Departments, open access customers, captive power generators and any other obligated entities shall provide all requested data and information on generation, transmission, purchase or consumption of electricity to the relevant regulatory and/or designated agency, on regular basis as per process laid out by the relevant regulatory commission.

(7) Renewable Generation Obligation: Any generating company may establish, operate and maintain a generating station without obtaining a licence under the EA 2003, if it complies with the technical standards relating to connectivity with the grid referred to in clause (b) of section 73 of EA 2003:

i. Provided that any generating company establishing may be required by the system operator to build and maintain a spinning reserve of such capacity as may be notified by the Central Government from time to time:

ii. Provided further that any generating company before establishing or expanding the capacity of a generating station shall submit a detailed project report and dulyinform about the same to the Authority.

iii. Explanation.—For the purposes of sub-section (i), the expression ‗‗spinning reserve‘‘ means the backup capacity of a generating station which shall be made

available on the directions of the system operator, within a time limit as may be notified by the Central Government, to maintain grid safety and security.

iv. Notwithstanding anything contained in sub-section (i), any generating company establishing a coal and lignite based thermal generating station after a date and ina manner to be notified shall be required to establish a Renewable Energy Generation capacity as prescribed by the Central Government from time to time which shall not be less than five percent of the thermal power installed capacity.

v. In case any existing coal and lignite based thermal power generating station, withthe concurrence of power procurers under the existing Power Purchase Agreements, chooses for setting up additional renewable energy generating capacity, the energy produced from there shall be allowed to be bundled and pass through shall be allowed in such cases by the Appropriate Commission and the Obligated Entities who finally buy such power shall account the same towards their renewable purchase obligations.

(8) Non-compliance of RPO: In case any complaint is filed before the Appropriate Commission by any person or if that Commission is satisfied that any generating company or licensee has contravened any of the provisions of this Act or the rules or regulations made thereunder, or any direction issued by the Commission or has not complied with the renewable purchase obligation or renewable generation obligation as specified, the Appropriate Commission may after giving such generating company or licensee an opportunity of being heard in the matter, by order in writing, direct that, without prejudice to any other penalty to which the generating company or licensee may be liable under this Act, such generating company or licensee shall pay, by way of penalty, which shall not exceed one crore rupees for each contravention and in case of continuing failure with an additional penalty which may extend to one lakh rupees for every day during which the failure continues after contravention of the first such direction:

i. Provided that in case of non- compliance of by a generating company generating

ii. Renewable Energy, such generating company shall be liable to a penalty notexceeding

iii. rupees ten lakhs contravention and in case of continuing failure with anadditional

iv. penalty which may extend to ten thousand rupees for every day during which the

v. failure continues after contravention of the first such direction.

(9) Whoever, fails to comply with any order or direction given under the EA 2003, within such time as may be specified in the said order or direction or contravenes or attempts or abets the contravention of any of the provisions of this Act or any rules or regulations made thereunder, shall be punishable with imprisonment for a term which may extend to three months or with fine which may extend to one crore rupees, or with both in respectof each offence and in the case of a continuing failure, with an additional fine which may extend to one lakh rupees for every day during which the failure continues after conviction of the first such offence:

i. Provided that nothing contained in this section shall apply to the orders, instructions or directions issued under section 121 of the EA 2003:

ii. Provided further that in case of non-compliance of by a generating company generating Renewable Energy, any person in charge of such generating company shall be liable for imprisonment for a term which may extend to three months or such generating company shall be liable to pay fine which may extend to ten lakhrupees, or with both in respect of each offence and in the case of a continuing failure, with an additional fine which may extend to ten thousand rupees forevery day during which the failure continues after conviction of the first such offence.

40. Procurement of Renewable Electricity and payment guarantee

(1) Regulated Obligated Entities shall within one year of the establishment of the RPO trajectory, develop five-year Renewable Electricity Procurement Plans towards meeting RE targets

(2) Over a period of time, such RPO shall be net at least cost to the consumers and submit them for approval to the respective State Electricity Regulatory Commissions

(3) The Central Electricity Authority shall review all Regulated Obligated Entities‘ Renewable Electricity Procurement Plans in order to identify and report to respective SERCs opportunities for cost reductions through coordination and cooperation among all Regulated Obligated Entities across the country.

(4) The Ministry shall, within one year of notification of the Act, establish clear guidelines for procurement mechanisms including but not limited to competitive bidding processes

(5) Provided that the risks of the procurement mechanisms are identified and mitigation strategies are developed

(6) Until such guidelines are adopted, the price of Renewable Electricity shall be established as per the approval of the Appropriate Commission

(7) The open access consumers procuring electricity from renewable energy sources not to pay the surcharge for open access. <EA amendment: Section 42>

41. Timely Payments for RE Procurement:

(1) Regulated Obligated Entities shall within one year of the notification of the Act, create adequate and sufficient payment security mechanisms that ensure timely payments for RE power procured

(2) SERCs shall ensure that the tariff for renewable energy shall be paid by obligated entities
/ procurers, in a timely manner. The payment for procured RE shall get same priority as payment for other procured power, from any source whatsoever. The SERCs shall be responsible to ensure equitable treatment to renewable energy payments.

42. Access to Grid and Forecasting

(1) Grid connectivity:

i. Notwithstanding anything contained in this Act or any other enactment, theoperators of the transmission and / or the distribution system, as the case may be, shall be obliged to connect the renewable energy generator to the system.

ii. Provided that the operator of the transmission and /or distribution system shall doso within 30 days from the date of application or commencement of generation, whichever is later

iii. Provided further that the operator of the transmission and /

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or distribution system,as the case may be, shall upgrade the network in advance and on time to ensure reliability of the interconnection as per specified standards.

(2) Cost of Grid connectivity:

i. Provided also that the renewable energy generator shall bear the expenses associated with the interconnection of their facility to the network provided that in relation to wind power projects and solar photovoltaic projects interconnection point shall be line isolator on ongoing feeder on HV side of the pooling substation and in relation to Solar thermal, SHP, biomass power and non fossil fuel based cogeneration power projects the interconnection point shall be line isolator on outgoing feeder on HV side of generator transformer.

ii. The costs associated with strengthening the grid beyond the interconnection pointshall be borne by the operator of the network system whose grid needs strengthening

iii. Deemed Generation: Provided further that if the grid is not available for power evacuation after the project has commenced generation or is already operational, the power will considered to be deemed generated and sold, with charges being payable to the RE generator. Detailed guidelines in this respect shall be issued as part of RE Policy

(3) Forecasting of RE generation as input to system operation

i. The Ministry shall, within one year of the notification of the Act, designate an entity (the Power System Corporation of India) as the Nodal Entity for the task ofdeveloping forecasts for all RE generation connected to the grid

ii. All new renewable electricity generators will provide all production data to the Nodal Entity. The data collected by the Nodal Entity will be collected using techniques which have been internationally tested and recorded in Internationallyaccepted formats, made available to the public on a single platform and updated regularly

(4) The Nodal Entity shall share the production data and other technical data from renewable electricity generators with the Nodal Entity responsible for conducting Renewable Energy Resource Assessments

(5) The Nodal Entity may use the services of other agencies, public or private, to develop theforecasts. The selection of such an agency will be carried out through a transparent and competitive route

(6) The Ministry shall allocate funds for activities relating to RE generation forecasting.

PART VII – MISCELLANEOUS

43. Enforcement of the Act – The Ministry should within six months from the commencement of this Act, identify the amendments that are required to various other Central or State legislation to facilitate implementation of the provisions of this Act.

44. Power of the Ministry to Issue Direction – The Ministry may give directions to the StateGovernment or any such other state instrumentality to carry out execution of this Act in the state.

45. Protection of Action taken in Good Faith – No suit, prosecution or other

legal proceeding shall lieagainst the Ministry or Secretary or State Government or any officer of those Governments or State Commission or its members or any member or officer or other employee for anything whichis in good faith done or intended to be done under this Act or the rules or regulations made hereunder.

46. Delegation – The Ministry may, by general or special order as to be prescribed in writing, delegate to any member, members of the National RE Committee or any other person or agency, subject to such conditions, if any, as may be specified in order, such of its powers and functions under this Act as it may deem necessary.

47. Power of the Ministry to Make Rules – The Ministry may, by notification, make rules for carrying out the provisions of this Act.

48. Power of the State Government to Make Rules – The State Government may, by notification, make rules for carrying out the provisions of this Act not inconsistent with the rules, if any, made by the Ministry.

49. Rules and Regulations to be laid before Parliament and State Legislature

(1) Every rule made by the Ministry and every regulation made under this Act shall be laid, as soon as may be after it is made, before each House of Parliament while it is insession, for a total period of thirty days which may be comprised in one session or in two or more successive sessions, and if, before the expiry of the session immediately following the session or the successive sessions aforesaid, both Houses agree in making any modification in the rule or regulation shall thereafter have effect only in such modified form or be of no effect, as the case may be; so, however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under the rule or regulation.

(2) Every rule made by the State Government shall be laid, as soon as may be after it is made, before each House of the State Legislature where it consists of two Houses, or where such Legislature consists of one House, before that House.

50. Application of Other Laws not Barred – The provisions of this Act shall be in addition to and not in derogation of, any other law for the time being in force.

51. Provisions of the Act not to Apply in Certain Cases – The provisions of this Act shall not apply tothe Ministry or Department of the Ministry dealing with Defence, Atomic Energy or such other similar Ministries or Departments or undertakings or Boards or institutions under the control of such Ministries or Departments as may be notified by the Ministry.

52. Power to Remove Difficulty

(1) Upon any difficulty arising in giving effect to the provisions of this Act, the Ministry may, by order, published in the Official Gazette, make such provisions not inconsistent with provisions of this Act as may appear to be necessary for removing the difficulty.

(2) Provided that no such order shall be made under this section after the expiry of five years from the date of commencement of this Act.

(3) Every order made under this section shall be laid, as soon as, may be after it is made,before each House of Parliament.

APPENDICE 2

Renewable Energy Act (Germany)

Part 3

Payment of market premium and feed-in tariff

Division 1

Types of entitlement to payment

Section 19 Entitlement to payment

(1) Operators of installations in which only renewable energy sources or mine gas areused have an entitlement to claim from the grid system operator for the electricity generated in these installations

1. the market premium pursuant to Section 20,

2. a feed-in tariff pursuant to Section 21 subsection 1 and 2 or

3. a landlord-to-tenant supply premium pursuant to Section 21 subsection 3.

(2) The entitlement pursuant to subsection 1 shall exist only to the extent that the installation operator does not claim an avoided grid system fee pursuant to Section 18 subsection 1 sentence 1 of the Electricity Grid Fee Ordinance.

(3) The entitlement pursuant to subsection 1 shall remain in place if the electricity has been placed in temporary storage before being fed into a grid system. In this case, the entitlement shall refer to the quantity of electricity which is fed from the electricity storage system into the grid system. The level of the entitlement per fed-in kilowatt-hour shall be determined by the level of the entitlement which would have existed had the electricity been fed in without temporary storage. The entitlement pursuant to subsection 1 shall also apply inthe case of mixed use with storage gases. Sentences 1 to 4 shall be applied *mutatismutandis* for the entitlement pursuant to subsection 1 number 3.

Section 20 Market premium

(1) The entitlement to payment of the market premium pursuant to Section 19 subsection 1number 1 shall exist only for calendar months in which

1. the installation operator or a third party sells the electricity directly,

2. the installation operator grants the grid system operator the right to label this electricity as "electricity from renewable energy sources or from mine gas, financed from the EEGsurcharge",

3. the electricity is generated in an installation which can be remotely controlled, and

4. the electricity is balanced in a balancing or subbalancing group in which only the following electricity is balanced:

a) electricity from renewable energy sources or from mine gas which is sold directly in the form of sale of the market premium, or

b) electricity which is not covered by letter a and the inclusion of which in the balancing or subbalancing group is not the responsibility of the installation operator or the direct seller.

The precondition pursuant to sentence 1 number 3 does not have to be met before the commencement of the second calendar month following the commissioning of the installation.

(2) Installations can be remotely controlled if the installation operators

1. maintain the technical devices required for a direct seller or another person to whomthe electricity is sold to be able at all times

a) to call up the current level of feed-in and

b) to curtail the feed-in by remote control, and

2. grant to the direct seller or the other person to whom the electricity is sold the authority at all times

a) to call up the current level of feed-in and

b) to curtail the feed-in quantity by remote control to an extent which is necessary for a needs-based feed-in of the electricity and which is not proven to be excluded under the obligations imposed under licensing law.

The requirements pursuant to sentence 1 number 1 shall also be fulfilled if joint technical devices are maintained for several installations which are connected to the grid system viathe same connection point, with which devices the direct seller or the other person can at anytime call up the total current feed-in from the installations and curtail the total feed-in from theinstallations by remote control. If the electricity is sold directly by the installation operator to a final consumer or directly to an electricity exchange, sentences 1 and 2 shall be applied mutatis mutandis with the proviso that the installation operator shall assume the powers ofthe direct seller or the other person.

(3) The calling up of the actual feed-in and the remotely controlled curtailment of the feed- in quantity pursuant to subsection 2 must take place via a smart metering system in the case of the following installations if remote control technology which is compatible with the smart metering system and is secure, and which disposes of the functionalities required for direct selling, is available on the market in return for an appropriate fee:

1. in the case of installations in which a smart metering system is installed at the latest at the commencement of the second calendar month following the commissioning of the installation,

2. in the case of installations in which a smart metering system has been installedfollowing the commencement of the second calendar month following the commissioning of the installation, at the latest five years after its installation, and

3. in the case of installations in which a metering system has been installed pursuant to Section 19 subsection 5 of the Metering Point Operation Act, when a smart metering system is installed if the installation takes place after the end of the deadline pursuantto number 2.

In the case of other installations, taking account of the relevant standards and recommendations of the Federal Office for Information Security transmission technologies and routes shall be admissible which are in accordance with the best available technology when the installation is commissioned.

(4) The use of the technical devices to call up the actual feed-in and to remotely control thecurtailment of the feed-in volume and the power to use this must not restrict the right of the grid system operator to manage feed-in pursuant to Section 14.

Section 21
Feed-in tariff and landlord-to-tenant supply premium

(1) The entitlement to payment of the feed-in tariff pursuant to Section 19 subsection 1 number 2 shall exist only for calendar months in which installation operators feed electricity into a grid system and make it available to the grid system operator pursuant to Section 11 subsection 1, for

1. electricity from installations with an installed capacity of up to 100 kilowatts whose value to be applied has been determined by statute; in this case the entitlement shallbe reduced in line with Section 53 sentence 1, or

2. electricity from installations with an installed capacity of more than 100 kilowatts for a period of two to three successive calendar months and up to a total of six calendar months per calendar year (shortfall remuneration); in this case the entitlement shall be reduced in line with Section 53 sentence 2 and, should one of the maximum periods pursuant to the first half-sentence be exceeded, in line with Section 52 subsection 2 sentence 1 number 3.

(2) Installation operators which claim the feed-in tariff

1. must make available to the grid system operator all of the electricity generated in this installation which

a) is not consumed in the immediate vicinity of the installation and

b) is fed through a grid system, and

2. may not participate in the balancing energy market with this installation.

(3) The entitlement to payment of the landlord-to-tenant supply premium pursuant to Section 19 subsection 1 number 3 shall exist for electricity from solar installations with a total installed capacity of up to 100 kilowatts which are installed on or in a residential building as long as it has been supplied to a final consumer and consumed

1. within this building or in residential buildings or ancillary facilities in a direct spatial relationship with this building and

2. without being fed through a grid system.

Section 3 number 50 shall be applied with the proviso that at least 40 percent of the area of the building serves residential purposes. If a storage installation is used, the entitlement pursuant to Section 19 subsection 1 number 3 shall not exist for electricity fed into the storage installation. The quantity of electricity pursuant to sentence 1 must be determined as precisely as is permitted by the measuring technology to be used pursuant to the Metering Point Operation Act.

Section 21a Other direct selling

This shall be without prejudice to the right of the installation operators to sell the electricity generated in their installations directly without claiming the payment pursuant to Section 19 subsection 1 (other direct selling).

Section 21b

Allocation to a form of sale, switching

(1) Installation operators must allocate each installation to one of the following forms of sale:

1. the market premium pursuant to Section 20,
2. the feed-in tariff pursuant to Section 21 subsection 1 and 2, including in the form of the shortfall remuneration,
3. the landlord-to-tenant supply premium pursuant to Section 21 subsection 3, or
4. other direct selling pursuant to Section 21a.

They may switch each installation between the forms of sale on the first calendar day of a month only. If the installation operator allocates the installation to the landlord-to-tenant supply premium pursuant to Section 21 subsection 3, it shall also be necessary to select the form of sale for the electricity fed from this installation into the grid.

(2) Installation operators may divide up the electricity generated in their installations into percentages for different forms of sale pursuant to subsection 1; in this case, they must document that they comply with the percentages at all times. Sentence 1 shall not apply to the shortfall remuneration and to the landlord-to-tenant supply premium pursuant to Section 21 subsection 3.

(3) The allocation of an installation or a percentage of the electricity generated by an installation to the form of sale of direct selling shall only be admissible if the entire actual feed-in from the installation is metered and balanced every quarter-hour.

(4) Without prejudice to subsection 1, installation operators can

1. switch their direct seller at any time or

2. subject to Section 27a pass on the electricity fully or *pro-rata* to third parties as long as

a) the latter consume the electricity in the immediate vicinity of the installation,

b) the electricity is not fed through a grid system, and

c) no case covered by subsection 1 sentence 1 number 3 exists.

Section 21c Procedure for the switch

(1) Installation operators must inform the grid system operator before the beginning of the preceding calendar month when they first sell electricity in a form of sale pursuant toSection 21b subsection 1 sentence 1 or when they switch between the forms of sale. In derogation of sentence 1, in the case of the shortfall remuneration, it is sufficient for the switch to or from the feed-in tariff to be communicated up to the fifth-last working day of the preceding month.

(2) In the case of the communications pursuant to subsection 1, the installation operators must also cite:

1. the form of sale pursuant to Section 21b subsection 1 sentence 1 to which the switch istaking place,

2. in the case of a switch to direct selling the balancing group to which the directly sold electricity is to be allocated, and

3. in the case of a percentage breakdown of the electricity between different forms of sale pursuant to Section 21b subsection 2 sentence 1 the percentages to which the electricity is allocated to the forms of sale.

(3) To the extent that the Federal Network Agency has made a stipulation pursuant to Section 85 subsection 2 number 3, grid system operators, direct sellers and

installationoperators must use the stipulated procedure and format for the undertaking of the allocation and the switch in the form of sale.

Division 2

General provisions on payment

Section 22

Competition-based determination of the market premium

(1) The Federal Network Agency shall determine by auctions pursuant to Sections 28 to 39j, also in conjunction with the ordinances pursuant to Sections 88 to 88d, and the Offshore Wind Energy Act, the entitled parties and the value to be applied for electricity from onshore wind energy installations, solar installations, biomass installations and offshore wind energy installations.

(2) In the case of onshore wind energy installations, the entitlement pursuant to Section 19subsection 1 shall apply to the electricity generated in the installation only as long as and to the extent that an award issued by the Federal Network Agency to the installation is effective.The following onshore wind energy installations shall be exempted from this requirement:

1. installations with an installed capacity of up to and including 750 kilowatts,

2. installations commissioned before 1 January 2019 if

a) they were approved pursuant to the Federal Immission Control Act before 1 January 2017,

b) the approval pursuant to letter a) has been notified to the register before 1 February 2017 with all the necessary information and

c) the holder of the approval has not made a written declaration to the Federal Network Agency before 1 March 2017 referring to the notification pursuant to letter b), waiving the statutory entitlement to payment, and

3. pilot onshore wind energy installations with an installed capacity totalling up to 125 megawatts a year.

(3) In the case of solar installations, the entitlement pursuant to Section 19 subsection 1 shall apply to the electricity generated in the installation only as long as and to the extent thata payment authorisation issued by the Federal Network Agency to the installation is effective.Solar installations with an installed capacity of up to and including 750 kilowatts shall be exempted from this requirement.

(4) In the case of biomass installations, the entitlement pursuant to Section 19 subsection 1 shall apply only to the electricity generated in the installation from biomass within the meaning of the Biomass Ordinance in the version in force at the

time of the announcement of the auction and only, as long as and to the extent that an award issued by the Federal Network Agency to the installation is effective. The following biomass installations shall be exempted from this requirement:

1. installations with an installed capacity of up to and including 150 kilowatts, unless they are an existing biomass installation pursuant to Section 39f,

2. installations commissioned before 1 January 2019 if they

a) require approval pursuant to the Federal Immission Control Act or require an approval for their operation pursuant to another provision of federal law or requirean approval pursuant to construction legislation and

b) were approved before 1 January 2017.

This shall be without prejudice to the entitlement pursuant to Section 50 in conjunction with Section 50a.

(5) In the case of offshore wind energy installations, the entitlement pursuant to Section 19subsection 1 shall apply to the electricity generated in the installation only as long as and to the extent that an award issued by the Federal Network Agency to the installation is effective.The following offshore wind energy installations shall be exempted from this requirement:

1. installations which

a) were given an unconditional grid connection confirmation before 1 January 2017 pursuant to Section 118 subsection 12 of the Energy Industry Act or connection capacities pursuant to Section 17d subsection 3 of the Energy Industry Act in the version in force on 31 December 2016 and

b) were commissioned before 1 January 2021, and

2. pilot offshore wind energy installations in line with the Offshore Wind Energy Act.

(6) For onshore wind energy installations, solar installations and biomass installations, whose entitlement to payment pursuant to Section 19 subsection 1 is not dependent on the successful participation in an auction pursuant to subsections 2 to 5, no consideration will be given to bids in an award procedure. For installations pursuant to sentence 1 and forinstallations to generate electricity from hydropower, landfill gas, sewage treatment gas, minegas or geothermal energy, the level of the value to be applied shall be determined by statute via Sections 40 to 49.

Section 22a

Pilot onshore wind energy installations

(1) If in a calendar year pilot onshore wind energy installations with an installed capacity totalling more than 125 megawatts have been commissioned and this has

been notified to the register, the entitlement to payment pursuant to Section 19 subsection 1 cannot be claimed in that calendar year for all pilot onshore wind energy installations the commissioning of which is subsequently notified to the register. The Federal Network Agencyshall inform the installation operators and the grid system operators to whose grid system theinstallations are connected about this. The operators of installations for whose electricity the entitlement pursuant to sentence 1 does not apply can claim their entitlement on a priority basis and in the temporal sequence of their notification to the register from the following calendar year as long as the limit of installed capacity of 125 megawatts is not exceeded. In this case the entitlement pursuant to Section 19 subsection 1, in derogation of Section 25 sentence 3, shall not commence until the installation operator is permitted to claim the entitlement pursuant to Section 19 subsection 1.

(2) The proof that a pilot onshore wind energy installation complies with the requirements pursuant to Section 3 number 37 letter a double-letter bb and cc shall take the form of a confirmation by a certifier accredited pursuant to DIN EN ISO/IEC 17065:20132; apart from this, the existence of an onshore pilot wind energy facility pursuant to Section 3 number 37 letter a shall be documented by entry in the register.

(3) The documentation that an installation is a pilot wind energy installation pursuant to Section 3 number 37 letter b shall be held by the installation operator in the form of a certificate from the Federal Ministry for Economic Affairs and Energy. The Federal Ministryfor Economic Affairs and Energy can issue the certificate on application from the installation operator if the applicant submits appropriate documents demonstrating that the requirementspursuant to Section 3 number 37 letter b are met.

Section 23

General provisions on the level of the payment

(1) The level of the entitlement pursuant to Section 19 subsection 1 shall be determined bythe values to be used as a calculation basis for electricity from renewable energy sources or from mine gas.

(2) Turnover tax shall not be included in the values to be applied.

(3) The level of the entitlement pursuant to Section 19 subsection 1 shall be reducedgiving consideration to Sections 23a to 26 in the following sequence, whereby the entitlementcannot assume a negative value:

1. in accordance with Section 39h subsection 2 sentence 1 or 44b subsection 1 sentence 2 for the proportion cited there of the quantity of electricity from biogas generated in a calendar year,

2. in accordance with Section 51 in the case of negative prices,

3. in accordance with Sections 52 and 44c subsection 3 and number I.5 of Annex 3 in thecase of a violation of a provision of this Act,

4. in accordance with Section 53 in the case that a feed-in tariff or landlord-to-tenantsupply premium is claimed,

5. in accordance with Section 53a in the case that the statutory entitlement pursuant toSection 19 subsection 1 is waived,

6. in accordance with Section 53b in the case of usage of a guarantee of regional origin,

7. in accordance with Section 53c in the case of an exemption from electricity tax and

8. for solar installations whose value to be applied is determined by auctions,

a) in accordance with Section 54 subsection 1 in the case of delayed commissioningof a solar installation and

b) in accordance with Section 54 subsection 2 in the case of transfer of the paymentauthorisation for a solar installation to another site.

Section 23a

Special provision on the level of the market premium

The level of entitlement to the market premium pursuant to Section 19 subsection 1 number 1 shall be calculated for each calendar month. The calculation shall take place retrospectively on the basis of the values calculated for the respective calendar month pursuant to Annex 1.

Section 23b

Special provision on landlord-to-tenant supply premium

(1) The level of the entitlement to the landlord-to-tenant supply premium shall be calculated from the values to be applied pursuant to Section 48 subsection 2 and Section 49,whereby 8.5 cents per kilowatt-hour shall be deducted from these values to be applied.

(2) The entitlement to the landlord-to-tenant supply premium for electricity from the solar installation shall exist at the earliest

1. from the date on which both the solar installation pursuant to Section 21b subsection 1 in conjunction with Section 21c has been allocated to the form of sale of the landlord- to-tenant supply premium for the first time and the preconditions of Section 21 subsection 3 have been met for the first time,

2. as soon as the date pursuant to number 1 has been entered into the register and

3. to the extent that subsection 3 does not prevent this.

(3) If in a calendar year the total of the installed capacity of solar installations for which the information pursuant to subsection 2 number 1 has been newly entered into the register first exceeds the annual quantity of 500 megawatts, no entitlement to the landlord-to-tenant supply premium shall exist for the operators of solar installations for which the day pursuantto subsection 2 number 1 lies after the last calendar day of the first calendar month following the exceeding of the said annual volume. The Federal Network Agency shall publish the datefrom which the entitlement no longer exists on its website. If the annual quantity of 500 megawatts is exceeded in a calendar year, the annual quantity pursuant to sentence 1 shall be reduced in the following calendar year by the total of installed capacity exceeding 500 megawatts of solar installations for which an entitlement to the landlord-to-tenant supply premium arose for the first time in that calendar year.

(4) For operators of solar installations for whose electricity the entitlement to the landlord- to-tenant supply premium did not exist in the preceding calendar year pursuant to subsection 3, the entitlement to the landlord-to-tenant supply premium shall arise in the time sequenceof the date pursuant to subsection 2 number 1 in the register from the following calendar yearto the extent that in that calendar year the annual quantity pursuant to subsection 3 is not exceeded. This shall be without prejudice to Section 25.

Section 23c Pro-rata payment

If electricity enjoys an entitlement pursuant to Section 19 subsection 1 in line with the rated capacity or the installed capacity, this entitlement shall be determined

1. for solar installations or wind energy installations in each case on a pro-rata basis inline with the installed capacity of the installation in relation to the respective threshold value to be applied and

2. in all other cases on a pro-rata basis in line with the rated capacity of the installation.

Section 24

Payment entitlements for electricity from several installations

(1) Several installations, irrespective of the ownership situation, for the purpose of determining the entitlement pursuant to Section 19 subsection 1 and determining the size of the installation pursuant to Section 21 subsection 1 or Section 22 for the most recently commissioned generator, shall be regarded as one installation if

1. they are located on the same plot of land, the same building, the same commercial site or are otherwise in immediate spatial proximity,

2. they generate electricity from the same type of renewable energy sources,

3. the entitlement pursuant to Section 19 subsection 1 exists for the electricity generatedin them in line with the rated capacity or the installed capacity of the installation and

4. they have commenced operations within twelve consecutive calendar months. In derogation of sentence 1, several installations, irrespective of the ownership situation, and solely for the purpose of determining the entitlement pursuant to Section 19 subsection 1 anddetermining the size of the installation pursuant to Section 21 subsection 1 or Section 22 for the most recently commissioned generator, shall be regarded as one installation if they generate electricity from biogas with the exception of biomethane and the biogas originates from the same biogas generation installation. In derogation of sentence 1, ground-mounted installations shall not be counted together with solar installations in or on buildings and noise protection walls.

(2) Without prejudice to subsection 1 sentence 1, several ground-mounted installations shall, irrespective of the ownership situation and solely for the purpose of determining the size of the installation pursuant to Section 38a subsection 1 number 5 and pursuant to Section 22 subsection 3 sentence 2 for the most recently commissioned generator, be deemed equivalent to one installation if they

1. have been constructed within the same municipality that is or would have been responsible for issuance of a binding zoning plan and

2. have been commissioned within twenty-four consecutive calendar months, spaced upto a linear distance of two kilometres apart measured from the outside edge of the respective installation.

(3) Installation operators can invoice electricity from several installations which use the same type of renewable energy sources or mine gas via a joint metering device. In this case, the calculation of the feed-in tariff or market premium for several onshore wind energy installations shall be based on the allocation of the electricity quantities to the wind energy installations in relation to the respective reference yield pursuant to Annex 2 number 2 of the Renewable Energy Sources Act in the version in force on 31 December 2016 for onshore wind energy installations, the value to be applied of which is determined by Section 46, andin relation to the site yield pursuant to Annex 2 Number 7 most recently calculated foronshore wind energy installations, the value to be applied of which is determined via Section 36h; in the case of all other installations the allocation of the electricity quantities shall take place in relation to the installed capacity of the installations.

Section 25

Start, duration and end of entitlement

Market premiums, feed-in tariffs or landlord-to-tenant supply premiums shall be paid for a period of 20 years. In the case of installations whose value to be applied is determined by statute, this period shall be extended until 31 December of the 20th year of payment. The commencement of the period pursuant to sentence 1 shall be the point in time of the commissioning of the installation unless this Act states otherwise.

Section 26

Advance payments and settlement date

(1) Appropriate advance payments are to be made towards the expected payments pursuant to Section 19 subsection 1 on the 15th calendar day of each month for the preceding month.

(2) The entitlement pursuant to Section 19 subsection 1 shall be due as soon as and to theextent that the installation operator has fulfilled its obligations to transmit data pursuant to Section 71. Sentence 1 shall not be applied to the entitlement to monthly advance payments pursuant to subsection 1 until March of the year following the commissioning of the installation.

Section 27Offsetting

(1) The offsetting of entitlements of the installation operator pursuant to Section 19 against a claim by the grid system operator shall be permissible only to the extent that the claim is undisputed or has been determined in a final and binding judgement.

(2) The prohibition of offsetting contained in Section 23 subsection 3 of the Low Voltage Connection Ordinance shall not apply to the extent that entitlements deriving from this Actare offset.

Section 27a

Payment entitlement and self-supply

The operators of installations whose value to be applied has been determined by auctions may not use the electricity generated in their installation for self-supply throughout the entire period in which they claim payments pursuant to this Act. This shall not apply to the electricity consumed

1. by the installation or other installations which are connected to the grid system via thesame connection point,

2. in the auxiliary and ancillary installations of the installation or other installations whichare connected to the grid system via the same connection point,

3. to balance physically occasioned grid system losses,

4. in the hours in which the value of the hourly contracts for the price zone for Germany isnegative on the spot market of the electricity exchange in the day-ahead auction, or,

5. in the hours in which the feed-in quantity is reduced when the grid system isoverloaded pursuant to Section 14 subsection 1.

APPENDICE 3A

Table 3.2. Data of all States Capacity Sanctioned from 2019-2022.

S.No.	State	Component -A (MW)	Component - B(Numbers)	Component -C (Numbers)	
				Individual pump solarization	Feeder level solarization
1.	Andaman & Nicobar	0	0	0	0
2.	Andhra Pradesh	0	0	0	0
3.	Arunachal Pradesh	0	50	0	0
4.	Assam	0	0	0	0
5.	Bihar	0	0	0	0
6.	Chandigarh	0	0	0	0
7.	Chhattisgarh	0	20,000	0	0
8.	Dadra & Nagar Haveli	0	0	0	0
9.	Daman & Diu	0	0	0	0
10.	Delhi	62	0	0	0
11.	Gujarat	500	2,199	7,000	0
12.	Goa	10	200	7,000	0
13.	Haryana	65	37,000	468	0
14.	Himachal Pradesh	20	1,550	0	0
15.	Jammu & Kashmir	5	5,000	0	0
16.	Jharkhand	50	11,000	500	0
17.	Karnataka	500	10,500	1,000	50,000
18.	Kerala	40	100	100	0
19.	Ladakh	0	600	0	0
20.	Lakshadweep	0	0	0	0
21.	Madhya Pradesh	300	60,000	0	25,000
22.	Maharashtra	500	1,00,000	0	50,000
23.	Manipur	0	150	0	0
24.	Meghalaya	5	700	0	0
25.	Mizoram	0	0	0	0
26.	Nagaland	0	50	0	0
27.	Odisha	500	6,000	0	0
28.	Puducherry	7	0	0	0
29.	Punjab	220	9,500	0	12,500
30.	Rajasthan	1,200	75,000	37,500	0
31.	Sikkim	0	0	0	0
32.	Tamil Nadu	75	6,500	20,000	0
33.	Telangana	500	0	0	30,000
34.	Tripura	5	3,900	2,600	0
35.	Uttar Pradesh	225	23,000	0	0
36.	Uttarakhand	0	0	200	0
37.	West Bengal	0	0	700	0

APPENDICE 3B

Table 3.4 Currently Established Solar parks in States of India

State	Solar Park	Capacity (MW)	Solar Power Parks Developer (SPPD)
Andhra Pradesh	Ananthapuramu-I Solar Park	1500	AP Solar Power Corporation Pvt. Ltd. (APSPCL), JVC of SECI, APGENCO and NREDCAP
	Kurnool Solar Park	1000	
	Kadapa Solar Park	1000	
	Ananthapuramu-II Solar Park	500	
	Hybrid Solar Wind Park	160	
Arunachal Pradesh	Lohit Solar Park	20	Arunachal Pradesh Energy Development Agency (APEDA)
Gujarat	Radhnesada Solar Park	700	Gujarat Power Corporation Limited (GPCL)
	Harsad Solar Park	350	
	Dholera Solar Park Ph-I	1000	

	Dholera Solar Park Ph-II	4000	Solar Energy Corporation of India (SECI)
Himachal Pradesh	Kaza Solar Park	1000	JVC of SJVN & Govt of HP
Jharkhand	Floating Solar Park	150	Solar Energy Corporation of India (SECI)
Karnataka	Pavagada Solar Park	2000	Karnataka Solar Power Development Corporation Pvt. Ltd. (KSPDCL), JVC of KREDL & SECI
Kerala	Kasargod Solar Park	105	Renewable Power Corporation of Kerala Limited (RPCKL), JVC of SECI
Madhya Pradesh	Rewa Solar Park	750	Rewa Ultra Mega Solar Limited (RUMSL), JVC of MPNRED & SECI
	Mandsaur Solar Park	250	
	Neemuch	500	Rewa Ultra Mega Solar Limited (RUMSL), JVC

			of MPNRED & SECI
	Agar	550	Rewa Ultra Mega Solar Limited (RUMSL), JVC of MPNRED & SECI
	Shajapur	450	Rewa Ultra Mega Solar Limited (RUMSL), JVC of MPNRED & SECI
	Omkareswar Floating Solar Park	600	Rewa Ultra Mega Solar Limited (RUMSL), JVC of MPNRED & SECI
	Chhattarpur Solar Park	950	Rewa Ultra Mega Solar Limited (RUMSL), JVC of MPNRED & SECI
	Barethi Solar Park	550	NTPC
Maharashtra	Sai Guru Solar Park (Pragat)	500	M/s Sai Guru Mega Solar Park Pvt. Ltd. (formerly M/s Pragat Akshay Urja Ltd.)
	Patoda Solar Park (Paramount)	150	M/s Paramount Solar Power Pvt.

			Ltd. (formerly M/s K. P. Power Pvt. Ltd.)
	Dondaicha Solar Park	250	Maharashtra State Electricity Generating Company Ltd. (MAHAGENCO)
Manipur	Bukpi Solar Park	20	Manipur Tribal Development Corpn. Ltd. (MTDCL)
Meghalaya	Solar park in Meghalaya	20	Meghalaya Power Generation Corporation Ltd (MePGCL)
Mizoram	Vankal Solar Park	20	Power & Electricity Department
Odisha	Solar Park by NHPC	40	NHPC Limited
	Solar Park by NHPC	100	NHPC Limited
Rajasthan	Bhadla-II Solar Park	680	Rajasthan Solar Park Development Company Ltd. (RSDCL)
	Bhadla-III Solar Park	1000	M/s Surya Urja Company of Rajasthan Ltd

			(SUCRL) JVC of State Govt
	Bhadla-IV Solar Park	500	M/s Adani Renewable Energy Park Rajasthan Limited (AREPRL) JVC of State Govt
	Phalodi-Pokaran Solar Park	750	M/s Essel Surya Urja Company of Rajasthan Limited (ESUCRL) JVC of State Govt
	Fatehgarh Phase-1B Solar Park	421	M/s Adani Renewable Energy Park Rajasthan Limited (AREPRL) JVC of State Govt
	Nokh Solar Park	925	Rajasthan Solar Park Development Company Ltd. (RSDCL)
Uttar Pradesh	Solar Park in UP	440	Lucknow Solar Power Development Corporation Ltd.

			(LSPDCL) JVC of UPNEDA & SECI
	Jalaun Solar Park	1200	BSUL

APPENDICE 4A

Table 4.6. Descriptive statistics of all the responses (APPENDICE 4A).

Descriptive Statistics							
	Mean		Std. Deviation	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Statistic	Std. Error	Statistic	Std. Error
SE1	4.52	.073	.786	-2.522	.225	8.508	.446
SE2	4.08	.083	.896	-.376	.225	-1.158	.446
SE3	4.52	.116	1.254	-2.353	.225	3.813	.446
SE4	4.66	.055	.589	-2.095	.225	5.710	.446
SE5	4.54	.075	.806	-2.218	.225	5.241	.446
SE6	4.75	.055	.588	-3.021	.225	10.590	.446
SE7	4.68	.056	.599	-2.221	.225	5.914	.446
SE8	4.60	.085	.913	-2.618	.225	6.752	.446
SE9	3.44	.102	1.098	-.185	.225	-1.057	.446
SE10	4.02	.081	.875	-1.383	.225	2.730	.446
SE11	3.84	.114	1.223	-1.075	.225	.175	.446
SE12	4.03	.089	.959	-1.452	.225	2.296	.446
SE13	4.41	.070	.757	-1.566	.225	2.867	.446
SE14	4.51	.064	.692	-2.038	.225	6.650	.446
SE15	4.57	.097	1.049	-2.419	.225	4.919	.446
SE16	4.33	.072	.778	-1.212	.225	1.436	.446
SE17	4.22	.073	.789	-.945	.225	.748	.446
SE18	4.24	.073	.787	-.893	.225	.459	.446
SE19	3.81	.073	.790	-.293	.225	-.263	.446
SE20	4.16	.080	.861	-.889	.225	.248	.446
SE21	4.14	.135	1.450	-1.359	.225	.291	.446
SE22	3.57	.109	1.174	-.152	.225	-.535	.446
SE23	3.57	.114	1.232	-.261	.225	-.602	.446
SE24	3.98	.126	1.358	-.987	.225	-.231	.446
SE25	3.16	.145	1.564	-.137	.225	-1.345	.446
SE26	2.98	.119	1.278	.007	.225	-.502	.446
SE27	3.15	.110	1.189	.375	.225	-.684	.446
SE28	3.10	.138	1.483	-.099	.225	-1.531	.446
SE29	2.64	.135	1.459	.260	.225	-1.442	.446
SE30	2.71	.129	1.390	.106	.225	-1.462	.446
SE31	3.36	.143	1.540	-.280	.225	-1.557	.446
SE32	1.93	.115	1.242	.964	.225	-.438	.446
SE33	2.03	.093	1.004	.298	.225	-1.325	.446
SE34	1.97	.107	1.153	.778	.225	-.539	.446
SE35	2.53	.129	1.386	.167	.225	-1.473	.446
SE36	2.34	.141	1.516	.554	.225	-1.283	.446
SE37	2.11	.122	1.317	.766	.225	-.812	.446
SE38	3.00	.110	1.180	.194	.225	-.619	.446
SE39	2.78	.105	1.135	.127	.225	-.587	.446

SE40	2.80	.110	1.181	.136	.225	-.693	.446
SE41	3.06	.119	1.281	.012	.225	-1.021	.446
SE42	2.97	.108	1.164	.102	.225	-.679	.446
SE43	2.70	.113	1.217	.247	.225	-.762	.446
SE44	2.76	.098	1.060	.143	.225	-.374	.446
SE45	3.43	.158	1.705	-.431	.225	-1.494	.446
SE46	3.15	.154	1.659	-.389	.225	-1.600	.446

APPENDICE 4B

Questionnaires for Survey

https://docs.google.com/spreadsheets/d/1tEAKbalSHftSGOSyfw3xBW4KeC0_TO_MyJXguYmnoVo/edit#gid=244784395.

Empirical Survey on Solar Energy Sector in India(Demographic Data)

Dear Respondent,

My name is Yatish Pachauri, Doctoral Research Scholar at the School of Law, University of Petroleum and Energy Studies Dehradun. Your assistance, in completing the online questionnaire, would be greatly appreciated.

This study aims to understand the Solar Sector in India along with the role of policies like RPO, REC and FIT in India. This will help us understand, support, and identify areas for improvement in the Sector.

You are a part of a selected sample of respondents whose views on the research topic are important and therefore I am respectfully requesting that you complete the questionnaire. The questionnaire should not take more than Ten minutes to complete.

Please note that there are no correct or incorrect answers. Please answer the questions as accurately as possible. Select the option that best describes your experience or perception of each statement. For example, if you strongly agree with the statement, select the "Strongly Agree" option. If you strongly disagree with the statement, select the "Strongly disagree" option. Please answer all questions, I guarantee that all information will be handled with the STRICTEST CONFIDENTIALITY.

By clicking on the next button, you agree to give your consent to participate in this survey.

Thank You in Advance!

Name *

....

Profession *

- ○ Academician
- ○ Advocate
- ○ Industry Experts
- ○ Student
- ○ Others

Organization

....

Whether Solar Energy is an Alternate Source to generate Electricity in coming years? *

Whether Solar Energy is an Alternate Source to generate Electricity in coming years? *

- Strongly Agree
- Agree
- Strongly disagree
- Disagree
- Don't know

Considering the current use of fossil fuels, what year do you think there will be a scarcity of energy in India? (choose the closest answer) *

- 2022
- 2030
- 2040
- There will never be scarcity of energy as India will be Shifting from Non Renewables Energy to Renewable Energy.
- Don't Know

Are you aware of the Conventional sources of energy and Non-Conventional sources of energy? *

- Yes
- No
- Maybe

How do we combat Climate Change. *

	Strongly Agree	Agree	Strongly Disagree	Disagree	Don't Know
Reduce Emission	○	○	○	○	○
Save Energy	○	○	○	○	○
Save forest	○	○	○	○	○
Shift from Non Renewables Energy to Renewable Energy	○	○	○	○	○

Why does the state shifting more on promoting Non- conventional sources of Energy, i.e. Solar Energy? *

- To Reduce Carbon Emission
- To fulfil the Sustainable development Goals by 2030
- It is Environment Friendly
- To get Clean Energy
- All of the Above

Please state your level of agreement to the following: *

	Strongly Agree	Agree	Strongly Disagree	Disagree	Don't Know
Renewable energy is Limited	○	○	○	○	○
Fossils Fuels are the Source of Energy	○	○	○	○	○
Gas is more environment friendly than Coal	○	○	○	○	○

Gas is more environment friendly than Coal	○	○	○	○	○
Not Enough is being done to reduce Carbon Emissions	○	○	○	○	○
Better Incentives Should be given for consumption for Renewable Energy.	○	○	○	○	○
The change to Renewable Energy is an urgent Need	○	○	○	○	○

Have you heard about Green and Clean Solar energy? *

- ○ Yes
- ○ No
- ○ Maybe

At what extent the following points influence your decision to switch to green and clean Solar energy? *

	A Lot	Somewhat	Not at all	Don' t Know
Cost of Purchasing	○	○	○	○
Maintaining Cost	○	○	○	○
Ease of Switching	○	○	○	○
Appearance of the devices	○	○	○	○
Incentives for Switching	○	○	○	○

State your Opinion for the following. *

	Yes	No	Don't Know
Does your government promote use of renewable energy?	○	○	○
Do you use renewable energy at home?	○	○	○

State your Opinion for the following. *

	Yes	No	Don't Know
Does your government promote use of renewable energy?	○	○	○
Do you use renewable energy at home?	○	○	○
Are you satisfied with the Government of India's efforts to encourage Solar Energy?	○	○	○
Are you aware of any energy saving schemes that the government/energy supplier is running?	○	○	○
Are you aware if your energy supplier is using at least some renewable sources?	○	○	○
Existing Legislation, the generation, distribution, & supply to the End User are sufficient for Electricity Act.	○	○	○

To what extent are the following a barrier to switch from fossil fuels to renewable * energy to you?(on a scale of 1 to 5, 1 being the lowest)

	1- lowest	2	3	4	5- Highest
Very Costly	○	○	○	○	○
Transmission system still doesn't work on renewable energy	○	○	○	○	○
Political vested interests	○	○	○	○	○
Lack of information on Renewable Energy	○	○	○	○	○
Return on investment is very slow	○	○	○	○	○
Technology may become obsolete quickly	○	○	○	○	○
IPR issues is creating a barrier.	○	○	○	○	○

How Germany Accelerated the Growth of Solar energy Sector? *

- [ ] ODD Geographical Condition
- [ ] Feed In tariff Policies for Solar
- [ ] Legal Enactments
- [ ] Political Agendas
- [ ] Industrial Support
- [ ] Financial Support by Government to Improve Infrastructure

What are your suggestions to be considered for the betterment of Solar Energy? *

- [ ] Providing benefits on Installation of Solar Panels
- [ ] Enactment of New Renewable Energy Legislation
- [ ] Subsidy provided directly into Consumer account
- [ ] Motivate people to Install Solar Panels at Remote Locations

What is the role of Public Sector Undertaking/ Private organisations of establishment in Solar Panel. *

- [ ] Financial Support

What is the role of Public Sector Undertaking/ Private organisations of establishment in Solar Panel. *

- [ ] Financial Support
- [ ] Infrastructure Development
- [ ] Cheaper Solar panels
- [ ] Subsidies

Are you aware of any Airport facilities run through Solar Energy? *

- ( ) Yes
- ( ) No
- ( ) Maybe

Do you Know the plans of Indian Railway to run on Solar energy? *

- ( ) Strongly Agree
- ( ) Agree
- ( ) Disagree

Are you aware of any Airport facilities run through Solar Energy? *

- ◯ Yes
- ◯ No
- ◯ Maybe

Do you Know the plans of Indian Railway to run on Solar energy? *

- ◯ Strongly Agree
- ◯ Agree
- ◯ Disagree
- ◯ Strongly Disagree
- ◯ Don't know

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