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PREDICTIVE ANALYSIS OF SOCIO-ECONOMICS SCENARIO IN INDIA WITH SOLAR ENERGY

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A DISSERTATION REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

MBA

POWER MANAGEMENT

CENTRE FOR CONTINUING EDUCATION

UNIVERSITY OF PETROLEUM & ENERGY STUDIES, DEHRADUN

UPES Centre for Continuing Education

Acknowledgement

At the outset I would like to express my gratitude to the UNIVERSITY OF PETROLEUM & ENERGY STUDIES, DEHRADUN for the opportunity to gain knowledge in the domain of Power management.

I am deeply grateful to **Mr. Pawan Dua** for his assistance and guidance and for providing me with continual support in my dissertation work.

I would like to express my gratitude to the management of **Mrs. Suman Grover** for allowing me to carry out research work in their facilities.

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Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted to any other university or institution for award of any degree. In my opinion it is adequate in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA Power Management.

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Dear Sir,

With reference to the above subject, I hereby give my acceptance to guide the above student through Dissertation work in **"Non-Conventional Energy" Sector,** which is a mandatory requirement for the award of EMBA degree.

Thanking You

Regards

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Declaration by
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I **Sarada Prasad Pradhan** student of MBA in Power management SAP ID **500056233** of UPES, declare that dissertation titled "**Predictive Analysis of Socio-economics Scenario in India with solar Energy**" was carried out by me in partial fulfillment of the requirements for fulfillment of the requirements for

MBA (Power Management) of university of petroleum & energy studies Dehradun

It is my original work and has not been submitted to any other organization for any purpose.

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Abstract

India founded the Ministry of Non-Conventional Energy Resources (MNRE) as the world's first country in the early 1980s and is India's leading solar industry development company. The power department manages hydroelectricity independently and is not included in MNRE's goals. Cost-competitive, without incentives, is already wind or solar photovoltaic in tandem with four-hour battery storage, a power chain that draw on India's new coal and gas project. India is one of the highest producing clean energy countries. By 2019, 35% of India's electricity comes from renewables, which accounts for 17% of the region's overall electricity produced. In the Paris Agreement, India decided to achieve 40 % of total electricity output from non-fossil fuels by 2030, with a nationally specified target. This thesis explores the solar energy in Indian prospective and other renewable energy. This research used a secondary data and their interpretation alone with projected outcome in energy from solar.

Chapter 1

Introduction

The primary aim of implementing solar energy in India is to promote economic growth, strengthen energy stability, increase electricity connectivity, and mitigate climate change. Renewable growth is feasible by the usage of safe resources and ensuring people have access to effective, secure, renewable, and modern electricity. Powerful policy funding and the increasingly timely economic condition have propelled India to be one of the global performers on the most lucrative green energy markets in the world. The government has planned strategies, projects and a competitive climate to encourage foreign investment to scale up the nation at a fast pace on the demand for renewable energy. Solar energy field is expected to be able to generate a significant number of workers over the years.

1.1 Renewable Energy

Renewable technology is growing, as creativity drives prices down and starts delivering on the pledge of a sustainable future environment. American solar and wind generation break records and are integrated into the national electricity grid without compromising its reliability.

This means that renewables increasingly displace "dirty" fossil fuels in the electricity sector, offering the benefit of lower carbon emissions and other types of pollution. But not all the energy sources marketed as "renewable" are environmentally beneficial. When considering the impact on wildlife, climate change and other issues, it creates difficult compromise between biomass and large hydropower dams. This is what you will know regarding the different ways of renewable energy sources and how to utilize such emerging options domestically.

Renewable energy, often referred to as clean energy, comes from the constantly replenishing natural sources or processes. Sunlight or wind, for example, continues shining and flowing, even though its presence depends on temperature and time.

Although green energy is still seen as a modern invention, the heating, transportation, illumination, and more have long been used to harness the power of nature. Water propelled vessels to harvest grain and navigate the oceans, and windmills. During the day, the sun provided warmth and helped set fires on fire to last through the evening. Over the past 500 years or so, however, humans have increasingly turned to cheaper, dirtier sources of energy such as coal and fracked gas.

1.2 Dirty energy

Power contains non-renewable, or "dirty," fossil resources such as crude, gas, and sulfur. Non-renewable carbon sources are available only in small numbers, so they require a long time to replenish. When we pump gas at the station, we are using a finite resource that has been around since prehistoric times, refined from crude oil.

In fact, in some areas of the planet non-renewable forms of resources are typically located, rendering them more prevalent in other nations. In comparison, wind and sunlight are accessible to any region. Prioritizing non-renewable energy can also improve national security by decreasing a country's reliance on export-rich fossil-fuel nations.

Many non-renewable sources of energy could jeopardize the environment or human health. For starters, oil exploration may allow the boreal forest of Canada to be strip-mined, the fracking process can trigger earthquakes and water contamination, and the environment is foul of coal-fired power plants. All this contributes to global warming in addition.

1.3 Types of Renewable Energy Sources

1.3.1 Solar Energy

For thousands of years human beings have been harnessing solar energy to grow crops, stay warm, and dry food. According to the National Renewable Energy Laboratory, "more energy from the sun falls on the earth in one hour than everyone in the world uses it in one year." Today, we use the rays of the sun in many ways to heat homes and businesses, to warm water, or power devices.

Solar, or photovoltaic (PV), cells are made of silicon or other materials which directly transform sunlight into electricity. Distributed solar systems produce energy for homeowners and companies locally, either by panels on the rooftop or collective programs to fuel entire communities. Solar farms generate energy for thousands of households and spread sunlight by means of mirror-powered solar panels. The use of non-ecological sensitive wastewater systems and water bodies can be effective in floating solar farming or 'floatovoltaics.'

Solar provides only over 1 per cent of U.S. electricity production. But in 2017 almost one third of all new generating capacity came from solar, second only to natural gas. Solar energy devices do not contain carbon pollution or greenhouse gasses, so as long as they are properly sited, most solar panels have no effect on the atmosphere beyond the manufacturing phase.

1.3.2 Wind Energy

They come off old-fashioned windmills a long way. Now, turbines as large as skyscrapers with turbines about as big in diameter are at the forefront of focus worldwide. Wind energy turns the blades of a turbine which feeds and produces electricity from an electric generator. Wind, which represents just over 6 per cent of U.S. generation, has become the cheapest source of energy in many parts of the country. Top wind power states include California, Texas, Oklahoma, Kansas, and Iowa, although high wind speed turbines can be placed anywhere, for starters, in open water hilltops and open plains, or even offshore.

1.4 Other Alternative Energy Sources

1.4.1 Hydroelectric Power

Hydropower is America's largest electricity renewable source, although wind power is likely to take the lead in the near future. The hydropower relies on water normally quick-moving water from a wide river or swift water from a high point which transforms the energy of water into electricity through a generator's turning turbine blades. Big hydroelectric projects-or mega-dams-are also regarded as non-renewable resources domestically and globally. Mega-dams block and rising natural rivers, restricting exposure to river related animal and human communities. Carefully managed, small hydropower plants are not as harmful to the environment (a capacity installed below about 40 megawatts) as they only distribute a fraction of the flux.

1.4.2 Biomass Energy

Biomass is a plant and wildlife green resource, comprising crops, forest waste, and plants. As heat is released, biomass is consumed, and electricity is produced by a steam turbine. Biomass is often misrepresented as a smooth, renewable, and greener alternative to coal and other fossil fuels for generating electricity. Recent science shows, however, that many forms of biomass especially from the forest generate greater emissions of carbon than fossil fuels. Biodiversity is often negatively impacted. However, other biomass sources could be used as a low carbon alternative under the right conditions. For example, sawdust and chips from sawmills that would otherwise quickly decompose, and release carbon can be a low-carbon energy source.

1.4.3 Geothermal Energy

It has ever been sitting in a hot spring, this been using geothermal energy. Due to the slow decay of radioactive particles in rocks at the center of the planet, the Earth's core is about as hot as the Sun's surface. Drilling deep lakes, or hydrothermal coal, carry intense hot dark water to the surface and are then pumped to generate energy into a generator. When water and steam are injected into the reservoir, geothermal plants usually have small pollution. Geothermal planting is possible in places where no underground reservoirs exist, but there is concern that in already considered geological hot sites they may increase the risk of an earthquake.

1.4.4 Ocean

Wave and tidal energy still develop, but the ocean is always controlled by the gravity of the moon, which makes it an attractive option to use its power. Many tidal energy solutions, such as tidal dams, can damage biodiversity, which is just like dams in an ocean bay or lagoon. Wave control depends on systems or grounded equipment on or just under the surface of the ocean, such as tidal strength.

1.5 Renewable Energy in the Home

1.5.1 Solar Power

The use the energy of the Sun in a smaller scale to fuel the entire house whether photovoltaic or passive solar architecture. Passive solar homes are built to invite through south-facing windows into the light, and then maintain insulation by asphalt, bricks, tiles, and other heat-storing products.

Several solar-powered homes produce more than enough energy, enabling the homeowner to connect to the grid and sell surplus fuel. Often batteries can be used in the evenings and are an environmental attractive way of storing surplus solar energy. Scientists are working hard on new developments, such as solar skylights and roof shingles that combine shape and function.

1.5.2 Geothermal Heat Pumps

Geothermal technology is a new process the bowls behind the fridge are a mini heat pump, which removes heat from within so that foods are cool and fresh. The Earth's steady heat (a few feet below the surface) in a building, geothermal or geoexchange pumpe is used to cool summer homes and warm winter homes and even to cool water.

Geothermal systems may initially be expensive to construct, but usually pay back in 10 years. They are therefore smoother, have less issues with servicing and last longer than traditional air conditioning systems.

1.5.3 Small Wind Systems

A Wind farm in the backyard? Large wind generators are commonly used by vessels, ranchers and also by mobile phone firms. Dealers now also help homeowners to site, install, and maintain wind turbines though some DIY enthusiasts install turbines themselves. A wind turbine can minimize your dependence on the electrical grid, Wind rates and local rules based on the energy requirements.

1.5.4 Selling the Energy You Collect

Wind and solar-powered homes may either stand alone or link when supplied by their power supplier to the broader energy grid. For certain jurisdictions, electric utilities require consumers to pay just the difference between the grid-supplied power used and what they've produced a mechanism called net metering. If one are producing more electricity than you are using, your supplier may pay you the retail price for that power.

1.6 Solar Energy

In India solar power is a rapidly developing industry. As of 31 March 2020, solar installed capacity in the country reached 37,627 GW. Installing solar power plants worldwide, India has the lowest cost of capital per MW. Initial 20 GW capacity targets for 2022 were reached by the Indian government four years ahead of schedule. The goal in 2015 (including 40 GW from rooftop solar) for a total of 100 GW of solar electricity, was extended to 2022, with a USD 100 billion expenditure. Around 42 solar parks have been constructed in India for solar plant proponents to make the land open. India has increased its installed solar capacity by 233 times over the decade in 2020. India, in addition to its large grid-connected photovoltaic (PV) initiative, is developing off-grid solar power to meet local energy requirements. Solar products have been increasingly helping to meet rural needs; the country had sold only less than 1,000,000 solar lanterns by the end of 2015, reducing kerosene requirements. This year 118,700 domestic solar energy systems were built and 46,655 solar street lighting systems were funded by a national initiative; more than 1.4 million solar cookers were distributed in India. India's founding member, the International Solar Alliance (ISA), has its registered office in India.

1.6.1 Rural electrification

Lack of grid power is a barrier to rural development in India. The electricity system of India is under-developed and still survives off utilities by significant numbers. In 2004 there were only about 80,000 villages in the world without power; 18,000 could not be electrified as the existing network was difficult to enhance. The five-year plan 2002-2007 aims for 5 000 villages to be electrified. It may discourage (or alleviate) unreliable, centralized long-distance energy distribution networks that provide a significant percentage of the population with inexpensive electricity. In Rajasthan, 91 villages underwent solar electrification from 2016 to 2017, and more than 6,200 households have 100W solar house lighting networks. Nearly 1 million solar homes and 3 million solar lanterns are sold or shipped on the market in India and have nominated Asia's largest consumer of off-grid solar products.

1.6.2 Lamps and lighting

By 2012, 4,600,000 solar lanterns and 861,654 solar-powered home lights had been installed in general. Usually replacing kerosene bulbs, they can be bought with a slight loan at the rate of a few months' worth of kerosene. Lantern, house lights and tiny devices (up to 210 Wp) earn a 30 to 40 percent subsidy in the Ministry of New and Renewable Power.

By 2022 we predict 20 million solar lamps.

1.6.3 Agricultural support

For drinking water and irrigation, solar photovoltaic water pumping systems are used. Most of the pumps have a motor with 200–3,000 W (0.27–4.02 hp) of 1.800 Wp PV system which is capable of supplying approximately 140,000 liters (37,000 US gals) per day with a total hydraulic head of 10 meters (33 ft.). Under the PM Kusum system, a total of 181,521 PV systems were installed by 31 October 2019 and will reach 3.5 million by 2022, when there is a greater need for water on hot sunny days, solar pumps will maintain water coolers and cleaners Can improve their performance by maintaining the pumped water flow / slide on solar panels. Solar collectors are used for storing heat. For agriculture, low cost solar-powered bikes between fields and the village and so on are also available.

1.6.4 Rainwater harvesting

In addition to solar energy, rainwater is a major renewable resource in any region. Wide areas are filled with solar panels in India every year. Solar panels can be used for the harvest of the majority of rainwater and bacterial-free drinking water and breweries can be produced through simple processes of filtration and disinfection because the salinity of rainwater is very low. Healthy water supplies are growing highly limited and costly for the users and closer to urban areas. Use of rainwater for commodities like drunk water, as a valuable addition, allows solar photovoltaic energy plants to compete with the increased drinking water revenues even in heavy rainfall and rainy areas.

1.7 The Jawaharlal Nehru National Solar Mission

On 11 January 2010 our Prime Minister, Dr. Man Mohan Singh, unveiled the Jawaharlal Nehru National Solar Project. The Mission set the optimistic goal of 20,000 MW of grid-connected solar power by 2022 and intends to development the country's solar generation costs by

(i) long-term policies;

(ii) large-scale implementation targets;

(iii) vigorous R&D; and

(iv) domestic manufacturing of essential raw materials, parts, and goods. Achievement of grid tariff balance by 2022 was envisaged.

The Prime Minister has underlined the mission's importance as:

"The importance of this mission is not limited merely to the provision of connected power on a large grid. It has the ability to produce substantial multipliers in our efforts to change India's rural economy. Solar energy is already beginning to light the lives of tens of millions of energy-poor Indian citizens in its decentralized and distributed applications. The rapid spread of solar energy, solar water pumps and other rural uses focused on solar energy, changing the face of rural India's economy. One intend to considerably expand such applications through this mission. This would have a further impetus, a stimulus unknown before the trend towards open and disbursed industrialization.

Revision of cumulative targets under National Solar Mission from 20,000 MW by 2021-22 to 1, 00,000 MW

The Union Cabinet chaired by the Prime Minister, Shri Narendra Modi, today accepted a five-time rise in India's solar-power goal under the Jawaharlal Nehru National

Solar Mission (JNNSM) to 1.00,000 MW by 2022. The goal would consist mainly of 40 GW of rooftop and 60 GW of linked solar power projects across large and medium scale grid. With this optimistic goal, India will become one of the world's largest producers of Renewable Energy, surpassing many developing countries.

The total investment will be around Rs 6, 00,000 cr for setting up 100 GW. The Government of India is providing Rs 15,050 crore as capital subsidy in the first step to facilitate the country's introduction of solar power. This capital subsidy would be given for Rooftop Solar projects in different towns and cities, For Feasibility Gap Finance (VGF) projects that will be established through the Indian Solar Energy Corporation (SECI) and for small solar projects for decentralized generation. In order to meet the 1.00 000 MW target of the three 19200 MW schemes, the Ministry for New and Renewable Energy (MNRE) is planning to implement.

In addition, thermal energy bundling system will be used to build projects for solar power with expenditure of approximately Rs 90 thousand crore. Large public sector enterprises and IPPs must spend more than that. State policymakers have already established unique State solar policies to encourage the installation of solar energy.

1.8 Solar Park

In each of the countries with a solar plant potential of more than 500 MW, the Ministry of New and Renewable Energy (MNRE) has formed an agreement to set up various solar parks. In order to promote in a focused way the construction of the facilities needed to introduce new solar power projects in terms of land usage, transmission and evacuation lines, access roads, supply of energy, and more, the Scheme proposes to provide financial assistance for the Government of India to build solar parks.

Solar Energy Corporation of India (SECI) has initiated numerous schemes to grow the country's solar industry, a major public sector organization in the field of MNRE. These solar parks would be built under the program in collaboration with the State Governments. Solar Energy Corporation of India (SECI) will be the operating body on behalf of the

Government of India (GOI). In compliance with the plan, SECI must work with funds to be required on behalf of GOI. States will select a Solar Park nodal body.

Renewable Park is a focused growth site for solar energy ventures. The land needed to establish solar energy projects of a typical 500 MW capacity and above will be set up, acquired, and various infrastructures will be created as a part of the construction of solar parks, such as grids, power and road and communication networks. In order to reducing project danger and gestational time, the parks should be distinguished by well-developed facilities. At the state level, the solar park would allow states to make substantial contributions from Solar Power industry project investors, Comply with the requirements of their Solar Purchase Obligation (SPO), and create jobs for local residents. In fact, by limiting emissions equivalent to the generated power of solar parks the State would be able to minimize the carbon footprint.

1.9 Solar Photovoltaic

The technology PV is one of the fastest rising sectors of renewable energy, which converts directly from sunlight to electricity. This is now well known in several countries like India, and it looks likely to become one of the 21st century's main innovations. Certain factors driving growth in this sector are carbon emissions concerns, energy security and rising prices for fossil fuels. Traditional silicone solar cells are usually the most powerful. Thin-film solar cells produced with amorphous silicon or non-silicon materials such as cadmium telluride are solar cells of second generation, which are increasing a larger share of total installations.

For build high-efficiency PV products, solar cells of the third generation use a range of modern products and nanotechnologies etc. The cost-effectiveness of such programs for energy providers and business is projected to rapidly improve.

Grid Connected PV

For electricity generation that is fed into the grid, large-scale PV plants are used. Typically, such systems consist of one or more PV panels, a power converter / inverter, racks, installation devices and electrical connections. Such panels have a power converter / inverter. In other devices such as MPPT, the battery and charge networks, solar maps, energy storage tools, solar concentrators, etc., may also provide full energy point trackers. The produced electricity is either deposited, directly used for self-use, or fed into large power grids.

Projects linked to the grid could be either
i) Ground Mounted PV or ii) Rooftop PV

1.10 Potential of Solar Power in India

As the most recent estimation of its solar power, the aspiration of India to become the largest market in the world for solar energy has received a significant boost. The highest solar power would be scheduled for Rajasthan and Jammu & Kashmir. Rajasthan has a potential of approximately 142GW, with strong solar radiation and wild deserts in the form of the Thar Desert. The highest sunray concentration in India has been detected at Jammu & Kashmir and the Ladakh desert region is comparatively high. The government has an estimated potential of 111 GW. However, the calculation could also involve the land currently under the jurisdiction of Pakistan.
The strength of both Madhya Pradesh and Maharashtra is over 60 GW. We are among the biggest Indian nations and thus have substantial wastelands. Both these states have aggressive strategies on renewable power and proposals to undertake large-scale solar energy projects.

Madhya Pradesh, a state in India, currently has built 202 MW of solar PV power capacity. However, by mid-2015, it plans to ramp that up to 1,400 MW. That is very optimistic. India has much bigger solar ambitions than that, however, including a 4,000 MW project, which will be the biggest in the world. It has took a massive jump from April 2012's 2 MW PV power to 202 MW today, which is projected to grow to 220 MW by the end of 2013.

"In India, 191 MW of solar power was installed in the second quarter of 2013, of which 145 MW was built in Madhya Pradesh, nearly 80 per cent," Mohanty said. This is part of a much broader green energy programme, which includes the construction of

3,800 MW of solar energy projects scheduled for 2015 according to PV Website. In the 1,900 MW would be wind electricity. There would be 300 MW of biomass, and 200 MW of tiny hydroelectric power stations.

The cumulative installed solar power in India is roughly 3 GW, or less than 0.5% of its projected production. There is, of course, a tremendous incentive to exploit the power. As a consequence, the Indian government has quintupled the initial goal for solar electricity. The government is planning to add 100 GW of electricity from the initial target of building 22 GW of solar power by 2022. This comprises 20 mega solar plants with a power of 500 MW or more that span 12 nations.

1.11 Present Status of Solar Energy in India

When speaking at the United Nations Climate Change Summit in New York in September, Prime Minister Narendra Modi committed to developing 450 gig watts (GW) of non-fossil fuel capacity by 2022. For this, it more than twice the original renewable energy goal of 175GW set by its own government in 2018. "We have to recognize that if we are to solve a major problem like climate change, even what we are doing right now is clearly not enough," Modi told New York's crowd of assembled world leaders.

Yet back home the clean energy sector on which Modi expectations are focused is flailing. India's built renewable energy power currently stands at about 65GW. By December 2022, it was projected to reach 100GW, probably short of the Government's goal of 175GW and well behind 450GW. But even the forecast of 2022 that was planned now seems a little too ambitious.

All wants to jump into the renewable energy game over the last few years, when nuclear power gradually dropped out of fashion due to increasing coal prices and natural gas vanished from the domestic sector. And a significant portion of the recent renewable energy expenditures went into silicon screens, operated by the sun. The breakneck speed of the last few years is now flagging, though, and the solar / wind group is on the verge of a shutdown.

Indian solar energy tariffs are among the world's lowest, but state governments are looking to move them further lower. Such tariffs, which are extremely weak, are impractical for certain entrepreneurs, who in effect cut corners on price. Some state power delivery firms (discommends) often settle their energy bills about a year late.

Developers in Andhra Pradesh are facing an existential dilemma, as the state keeps them hostage with two similarly unfavorable options: either reducing the previous government's negotiated tariffs or fully stopping production. And where once there was a constant flow of investment into the market, the tap is switched off now.

1.12 Largest Solar Power Plants in India

1. Solar Park Pavagada, Karnataka;

Karnataka state's Pavagada Solar Park constructed in Tumkur district's Pavagada taluk and produce 2050 MW by Dec 2019

2. Ultra Super Solar Park in Kurnool, Andhra Pradesh

Kurnool Ultra Mega Solar Project is the largest solar park in the country, spread over a total area of 5,932.32 acres, in the Andhra Pradesh district of Kurnool.

3. Solar power plant in Kamuthi, Tamil Nadu

Kamuthi Solar Power Project is the world's largest single-site solar power plant in Tamil Nadu, situated at Kamuthi. The Kamuthi Solar Project is the second largest solar park in the world constructed by Adani Power, with a capacity of 648 MW.

4. Solar park Bhadla, Rajasthan

Bhadla Solar Park near Rajasthan district of Jodhpur is India's third largest solar farm, spread across a total area of 10,000 hectares. The park has a gross capacity of 2.255 MW and, on 22 February 2017, NTPC revealed it had installed 115 MW.

5. Solar Park in Charanka, Gujarat

Charanka Village Solar Park is one of the largest solar parks in Asia, situated on northern Gujarat. The location is the second largest photovoltaic power station in the nation and is located across 5,384 acres of unused land.

1.13 Advantages of Solar Energy in India

Any of the benefits of solar energy making it much more attractive for India are as follows:

• The only substitute to other non-renewable energy in India, this is an inexhaustible carbon source.

• Solar energy is eco-friendly. This does not release CO2 or other chemical toxins when in service. Therefore, India, one of the most contaminated nations in the world, is pretty good.

• Solar electricity, especially for rural areas of India, may be used to a broad variety of uses, including heating, cleaning, cooking or control. These may also be found in boats, aircraft, large-scale power structures, mobile systems, calculators etc., but are mostly appropriate for towns.

• Solar power that cannot be drained. Solar energy is the most powerful alternate means of power generation in an electricity-deficient nation like India, where energy development costs are high.

• To provide solar power, one don't require a gas or energy network. A solar power panel may be installed anywhere. For buildings, solar panels may be installed easily. It is therefore very cheap compared to other energy sources.

1. Renewable Energy Source

The most significant of all the advantages of solar panels is that solar energy is a completely sustainable form of electricity. It is available daily in any corner of the globe. We cannot run away from solar energy unlike some other green sources. Solar radiation will be available for at least five billion years before it fails in compliance with science. Sunshine would provide for humanity.

2. Reduces Electricity Bills

Because you can fulfill some of your energy needs with the electricity produced by your solar panel, your energy bills will go down. How much you receive on your bill depends on the solar panel and how much you use power or heat. Yes, you can not only save on the energy bill, but also receive credit for the excess capital that you offer to the grid. Whereas the solar panel network is connected to the grid if you produce more power than you are using.

3. Diverse Applications

A number of technologies may utilize solar power. It is possible to generate electricity (picturesque) or heat (solar thermal). Solar power will be used in places without power grid link to generate energy, distill water in places where there is little clean water and fuel satellites in space. In building materials solar energy can also be integrated. Sharp launched invisible solar energy windows not long ago.

4. Low Maintenance Costs

Solar systems typically do not need a lot of effort. You will keep them reasonably clean and sweep them many times a year. If you are interested, you should rely often on cleaning professionals that offer this service to £25 to £35. Many successful solar panel manufacturers have a guarantee of 20-25 years. Therefore, there is no wear and tear, because moving pieces are not present. The inverter is normally the only part which needs to be modified every 5-10 years, because it continues to work in a process which transforms the solar energy into electricity and heat. To order to sustain the overall performance of the solar power system, the cables need additional adjustment to the inverter. Therefore, once you have charged the initial solar device charges, you can expect very small prices for maintenance and reconstruction services.

5. Technology Development

In solar power industry, technology is constantly evolving and the potential should accelerate. Quantum mechanics and nano processing advances technically increase solar panel productivity and double or triple the electrical capacity of solar power systems.

1.14 Disadvantages of Solar Energy in India

• We cannot produce solar energy throughout the night period.

• Then, during daytime too, the atmosphere can be gloomy or snowy, with little to no sunshine. This also reduces the performance of solar power panels.

• Only such sunshine areas are suitable to produce solar energy.

• Solar panels allow inverters and battery storage to convert direct energy into alternating power for the generation of electricity. Whilst installing a solar panel is very inexpensive, it is costly to build other devices.

• The land space needed for the construction of a solar panel plant is very significant and the land space stays filled for several years and cannot be utilized for any other reason.

• Electricity usage is fairly small compared with other energy sources.

• Solar panels need extensive maintenance because they are delicate and can easily be destroyed. Therefore extra charges are paid as supplementary expenses for policies.

1. Cost

The initial expense of purchasing a solar panel is relatively small. The installation of solar panels, inverters, generators and pumping systems requires charging. Nonetheless, the rise in solar power is continuing, and cost in the future is safe to say.

2. Weather Dependent

Although solar energy can still be obtained during cloudy and rainy days, the output of the solar system decreases. Sunlight relies on solar panels for effective energy processing. So certain gloomy, rainy days may have a significant effect on the energy grid. You should remember that during the night you can't absorb solar energy. On the other hand, thermodynamic panels are an alternative if you also need your water heating solution to operate at night or in winter.

3. Solar Energy Storage Is Expensive

Solar power must be used or stored in massive batteries instantaneously. Such batteries can then be charged during the day, and the electricity is used at night, in off-grid solar systems. It is a fair way to use solar energy for the entire day, but is also very expensive. For most situations, the daytime use of solar energy and energy recovery from the grid during the night is more intelligent (you can only do that if your machine is connected to the grid). Fortunately, the energy needs are always greater during the day so that much of them can be met by solar energy.

4. Using a lot of resources

The more electricity you want to generate, the more solar panels you will need to collect as much sunlight as you can. Solar photovoltaic panels take a lot of room and some roofs are not big enough to accommodate the number of solar panels you would want. An option is to mount some of the panels in your yard, however they need sunlight exposure. If you do not have the space for all the panels you want, you can choose to install fewer panels to meet some of your energy requirements.

5. Related to emissions

Although solar energy systems are much less polluting than other power sources, solar energy can be associated with pollution. Greenhouse gas emissions are related to the transport and installation of solar systems. Photovoltaic solar systems during the development phase; some harmful materials and dangerous goods are often used and may potentially impact the climate. Today, solar energy pollutes even less than other sources of power for renewable energy.

1.15 Solar Energy Power in India: Future

In India several major ventures have been introduced in the solar energy market.

- Thar Desert, which will generate between 700 and 2,100 GW, has some of the biggest solar power plants in India.

- On 1 March 2014, Gujarat's then Chief Minister, Narendra Modi, inaugurated India's largest solar power plant, Madhya Pradesh, at Diken, in Neemuch.

• The Centre's announcement of the Jawaharlal Nehru National Solar Mission (JNNSM) aims 20,000 MW of solar power by 2022.

• Gujarat's innovative solar power program aims at generating 1,000 MW of solar energy.

• A solar power program of $19 billion, intended for 20 GW of solar power by 2020, had been launched in July 2009.

• Roughly 66 MW of solar lanterns, street lighting systems and solar water pumps are designed for different applications in rural areas.

Indeed, the Centre's extensive and ambitious state and solar policies and projects as well as its National Solar Mission are slowly gaining prominence in solar power production. In its 2014 budget, Minister for Finance, Jaitley, revealed the government's proposal to construct a total of 500 crore rupees in some mega solar projects in Gujarat, Tamil Nadu, Rajasthan and Ladakh. He also pointed out that a combined projected cost of $74 million and $18.5 million will be installed in the country at canal banks with solar-powered agricultural water pumping plants and 1 MW solar power plants. This face a shiny image of India's capacity to be a solar powered nation of the world, despite all this reality.

India to add 25,750 MW of solar power capacity under PM-KUSUM scheme by 2022

Under the aggressive Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) scheme by 2022, the Government is targeting 25,750 megawatts (MW) of modern solar power generation potential.

"Under the system, a total of 25,750 MW of renewable energy potential will be generated by 2022 with a total central financial assistance of Rs 34,422 crore including service charges to implementation agencies," said Minister for Electricity and Renewable Energy R K Singh in a written reply to the House. He also said installation of this solar capacity and savings in diesel consumption due to installation of 17.5 lakh standalone solar pumps under the PM-KUSUM scheme is likely to save carbon dioxide (CO_2) emissions of 27 million tons. Last year, the Ministry of New and Renewable Energy launched the scheme with three components installation of 10,000 MW capacity through small renewable-energy power plants with capacity up to 2 MW each on farmers' barren or fallow land; installation of 17.5 lakh standalone off-grid solar water pumps; and solarization of 10 lakh grid-connected agricultural pumps existing. In answer to a separate query, the minister said the country's clean energy sector has in the last three years drawn around Rs 1.34 lakh crore investments. "Based on the normal capital cost per megawatt, it is projected that an expenditure of about Rs 1.34 lakh crore has been made in the renewable energy sector over the past three years from 2017-18 to 2019-20 by January 2020," he added. A total of 8,004, 64 MW of renewable power is installed between April and January 2019 to 20, relative to 5,978.47 MW built over the same span of the previous year.

Chapter 2

Literature Review

Raphael, E., George, G., & Klaus, B. (2005), write an article on the idea of simultaneous desert reclamation, fuel growth, and socio-economic progress in depleted Indian regions. In India the concept of substituting bio-diesel produced for conventional diesel fuel from plantations on eroded soils has gained widespread attention. The Indian central government as well as some state governments have voiced their support in recent months for taking into cultivation for this reason marginal lands which cannot be used for food production. Jatropha curcas is an existing manufacturing plant in India. It grows oil-rich crops, is known to grow on degraded fields, and needs only small amounts of water, nutrients and inputs of resources. This plant provides the possibility both of growing wastelands and of processing vegetable oil suitable for bio-diesel conversion.

Sylvain, Q., M., O. Share their views on decentralized solar power for rural electrification: technical and socio-economic (2013). This paper addresses the development of renewable, small-scale solar Rankine cycles for rural electrification in remote Lesotho areas. It is divided into two parts. The first section discusses the success conditions of decentralized rural electrification projects. A literature review provides similar guiding principles and guidelines. The second section of the paper outlines the framework suggested, developed in accordance with the recommendations.

A methodology is being developed to benchmark the efficiency and expense of different micro-use platforms and delivery models for rural electrification. In this research, knowledge relevant to a variety of applied rural electrification projects has been synthesized in order to produce a collection of best practices or guiding principles for progress in projects delivering energy services. Although some difference of opinion exists when discussing concepts such as market implementation or subsidies, there is consensus among sources on acceptable strategies and these are summarized with respect to a proposed definition of micro-utility project involving micro-CSP technology.

Amar, R. S. S., Robin, T., Sushil, K., & Anil, K. (2008). (2013). A review of the energy-intensive integrated renewable energy system. As they perceive today's energy supply crisis, environmental control, and population growth, poverty and food and material shortages are closely interrelated. The Integrated Renewable Energy System discussed in this paper aims to mix potential renewable energy sources that take into account sector-specific demand for energy along with socio-economic and environmental aspects of energy use. The use of energy, whether renewable or non-renewable, and its effects lead to various kinds of arguments about its impact on the environment, social cost and economic viability. Solar energy is sustainable and socially appropriate when viewed on a human scale, but its usage is still limited in certain sections of the world primarily due to obstacles to the economy. Similarly, renewable energy is used in many areas around the world, but in most parts of the world the much appropriate eco-friendly types are still in premature stage. The present paper addresses the viewpoints of the interconnected clean energy program and other problems.

Adem, A., Murat, I.K., & Talat, S.O. (2010), write an article on Turkish energy consumption modeling and forecasting using socio-economic and demographic variables; This study focuses on modeling energy consumption in Turkey to foresee the future predictions based on socio-economic and demographic variables (gross domestic product-GNP, population, import-export volumes, and employment). Four separate frameworks and multiple variables were included in the experiments for this reason. As a result of the experiments, Model 2 proposes an appropriate ANN model for production estimates of Turkey 's energy uses (including four independent variables GDP, population, import and export). The proposed model had a higher energy consumption estimate than that of the regression models and the other three ANN models. Therefore, Turkey's potential energy use is estimated on different assumptions utilizing this model. The results of the ANN forecast were similar to the official predictions. Ultimately, the study showed a lower energy usage estimate in all the scenarios than the MENR estimates and reported that the potential power demand for Turkey in 2014 was going to range from 117.0 Mtoe to 175.4 Mtoe.

H., H. & Srinivasan, J. (2012), very researched land a restriction on solar energy usage in India. This paper contrasts land usage of renewable energy technology to traditional forms of electricity. This was done by adding two factors, terrestrial transition and land occupancy. The land area converted by solar power production has been found to be low relative to hydroelectric power generation, that competes with nuclear and coal generation where changes to the life cycle are taken into account. In conjunction with other renewable sources of energy, the development of 3400 TWh / yr. solar energy systems is expected to require 0.97% of the total land area, or 3.1% of the total uncultivable land area in India. In this analysis, solar plants require less land than hydropower plants, and are competitive with energy sources such as nuclear and gas when considering life cycle land transitions. In addition, attempts were made to demonstrate how solar sources differ in the way they use the earth from other types of energy. The suggestion was made that land scarcity should not, because of its specific land usage, be a limiting restriction to solar source. Furthermore, it is worth noting that solar energy 's competitiveness with regard to other power sources depends on tradeoffs with several variables, such as capital costs, cost of generation, carbon footprint, location, potential development harm, environmental friendliness and several other variables, but not just one metric.

C., & Subhendu, C. (2002), express their thoughts on the Rural Electrification System with Solar Power in Remote Region – an island case study. Based on a sample survey performed on an island named 'Sagar Dweep' in West Bengal , India, the research indicates that there have been substantial changes and major impacts on employment, commerce and trade, culture, health etc. as a consequence of power supply from SPV power plants within a limited time span of four years. The production levels of certain farming operations and the engagement of women in economic activities other than family businesses at night have clearly shown signs of change. The SPV method is therefore superior to other conventional systems and takes account of its environmental effects. Therefore, ultimately, there appears to be a good argument for the locally deployed SPV program given its present unfavorable role as regards direct development costs. For the whole electrification project, it has proved unfavorable and, more importantly, unmanageable in terms of supplies to rural areas and especially remote areas to be centralized power supply provided by the conventional methods used for exhaustible resources. On the other side, for different reasons, the decentralized solution centered on the production of electricity generated locally from renewable energy resources is increasingly recognized as a feasible option for these remote areas. The paper aims to analyze the feasibility of the decentralized solar photovoltaic network as a power supply compared with conventional sources in a geographically located island in particular with regard to socio-economic and environmental considerations.

Tobias, E., & Tilman, A. (2012), write an essay on renewable power growth rent management and policy learning: the case of solar energy in India. In the case of India's National Solar Project this article aims at rent control. The project has so far been surprisingly successful in stimulating solar investments and rendering the requisite subsidies manageable through a competitive reverse tariff bidding mechanism. In fact, policy formulation and development showed a lot of creativity and learning. There are some uncertainties, especially with regard to the enforceability of quotas on renewable energy at Indian state level. Yet, generally, first impressions show that "carbon rentals" were handled in a relatively successful manner. To avoid irreversible damage to global ecosystems, new “green” technologies are needed. Any of such tend to be far from market maturity. In these situations, governments can set up temporary rentals to render "artificially" desirable investments. Nevertheless, the development of these rents involves risks of misallocation and political capture.

D., Nilesh, Y.J., Swapnil, & Betka, Z. (2012), researched Socio-Economic and Environmental Impacts of Photovoltaic (PV) Technologies focused on Silicon. As per the Solar Photovoltaic (PV) system, in contrast with traditional energy sources, offers major social and environmental advantages, thereby adding to sustainable growth. In 2011 the installations on the worldwide PV sector experienced very strong growth (27.4 GW). This are promising reports, as PV generation of electricity emits no greenhouse gas pollution and as such offers a safe alternative to fossil fuels, leads to job growth and economic development even in less developed areas. However, during their life cycle, producing PV modules may have implications for employees and the atmosphere (from production and processing of raw materials to producing, disposal and/or recycling). Large-scale photovoltaic installation often requires land not accessible, or in conflict with other land uses. Such possible issues tend to be major obstacles to the continued expansion of PV technologies. Manufacturing methods for traditional PV (silicon based) have origins in the electronics sector, and many of the chemicals used in e-waste are often present in solar PV, including arsenic, brominated flame retardants, cadmium, and chrome. Solar cell production includes numerous poisonous, flammable, and volatile chemicals. Many of those elements presuppose a safety threat for staff engaged in solar cell production. Solar panels also interfere with livestock, which may cause soil erosion. In several countries the recycling of electronic goods is becoming an increasing environmental and health concern. Currently, recycling of PV panels is not commercially feasible because the amounts produced by the waste are too small; large volumes of photovoltaic end-of - life panels may begin to occur in 2025 or 2030. This paper provides an analysis of the social and environmental effects of PV technology, combined with possible benefits and disadvantages.

K. R. Prabhat, & K. R. Prashant, K. (2013), researched the natural and socio-economic effects of global climate change: a description of the solutions to mitigation. Throughout this way, the Indian Prime Minister laid out the "National Action Plan on Climate Change," which includes a broad and detailed spectrum of initiatives, focusing on 8 projects to be carried out as key components of the Sustainable Development Strategy. This includes the creation of a "Healthy India," the build-up of sustainable agriculture and the finally establishment of a global climate awareness platform, renewable energy projects, the management of land, the natural environment, water conservation, protecting the HIV program. Finally, multiple steps / approaches relating to renewable, eco-friendly and efficient development have been addressed with a view to reducing the effects of global environmental degradation induced by accelerated industrialization and thereby tackling this regional crisis, which is the root cause of the North-South conflict and the regional policy of climate.

T.V., Rishabh, J., Ramachandran, & Gautham, K. (2011), write an essay on Solar Capacity Hotspots in India. The study evaluates the country's development in solar power generation, especially with the establishment of an ambitious National Solar Mission (NSM), also known as 'Solar India.' The operational facets of solar power production with an emphasis on current policy elements are also discussed in order to evaluate the real capacity of the established solar hotspots in reaching and beyond the NSM goals. Solar hotspots are the areas with an outstanding solar power capacity ideal for decentralized industrial usage of electricity. Identifying solar hotspots with dense housing in a large geographical expanse helps to satisfy the growing demand for electricity in a localized, productive and sustainable way. This correspondence focuses on the evaluation of Indian resource resources with variation derived from insolation data derived from high resolution satellite. Data research reveals that approximately 58 per cent of the regional region actually reflects the country's solar hotspots with more than 5kWh / m2 / day of Global annual average insolation. A techno-economic study of the solar power technology and a prospective limited usage of the usable land inside these solar hotspots show their tremendous power production as well as their capacity for reducing pollution.

Ashwani, K., Naresh, K., Kapil, K., Satyawati, S., & Saroj, M. (2010), express their views on India's green energy: present situation and outlook for the future. Efforts have been made in this paper to sum up the quality, current state, key milestones and future prospects of clean energy options in India. This paper also explores concrete policy measures to address the hurdles and boost potential renewables rollout. Renewable energy options and developments have the ability to offer alternatives to the developed worlds' ongoing energy problems. Renewable energy options such as wind, sun, geothermal, ocean, biomass, and fuel cell technologies may be used to address electricity scarcity in India. India would need an assured supply of 3–4 times more energy than the overall energy produced currently to fulfill the energy demand for such a fast-growing economy. One choice for fulfilling this criterion is green energy. Renewable energy currently accounts for nearly 33 per cent of primary energy use in India. India is adopting more responsible green energy technologies and takes meaningful strides against carbon pollution, cleaning up the environment and creating a prosperous world for the country. In India, activities related to study, development, demonstration, production and implementation of a variety of renewable energy technologies for use in various sectors have been vigorously pursued over the last two and a half decades.

Singh & Vashishtha (2019), the study's aim is to address the pattern of transmission and distribution losses (T&D), plant load factor (PLF), power supply shortfall, and government policy measures that can help policymakers make decisions.

The findings of this article, Yadav et al. (2019), will enable the power sector to improve human capital skills and the standard of work life within the company by presenting a comparison model and helping to implement sustainable growth measures in its industry.

Singh (2019) This paper analyzes the economic and regulatory climate in the power sector in Argentina , Brazil and the People's Republic of China, India , Mexico and Thailand in a comparative way. They consider that the reform process's depth, speed, and sequencing has a direct impact on both private and foreign investment. Policy transparency and autonomous regulatory bodies that both investors and borrowers' view of the risk.

The goal of this article, Yadav & Naim (2017), is to capture the standard of work life (QWL) in the Indian power sector. However, the focus of this analysis is restricted to India, and does not generalize findings for other countries. Therefore, prospective experiments in various cultural environments will reproduce the research in the power Ector or the associated manufacturing field. Another drawback resides in the comparatively low sample size; hence the findings can be constrained in generalizability.

This article, Prakesh et al. (2017), offers a detailed overview of the theoretical statistical methodologies for both solar resource and PV capacity. Solar modeling solutions of smart grid electricity production are now under study of depth.

Dawn et al. (2016), India's electricity market is one of the world's largest developed technology markets. Because of the steady rise in day-to-day electricity demand, the Indian power sector interacts with certain difficulties to sustain the equilibrium between power production and consumption, suffering from supply restrictions and power shortages. Changing from traditional sources to non-conventional sources is not just an alternative for sustaining the generation ratio and power demand, it is a must. In India's perspective, the value of using solar as an energy source is not only to increase power production but also to extend energy efficiency with consideration of beneficial economic, physical, private, and financial resources. This paper analyzes the recent situation, approaches, supply, and outlook for the future, policies and solar energy growth in emerging Indian power market.

Sahu (2016), this paper highlights the growth of solar energy in the state of Odisha, the support policies of the state government, the support policies of the central government and the potential proposals for the deployment of solar energy.

2.1 Research Gaps

Exploring the solar results as a green energy has researched much as from the secondary evidence of numerous Indian researchers. The effect and statistical empirical methodology of India's growth and socio-economic situation shows a study holes.

Chapter 3

Research Design, Methodology and Plan

Sun radiation originates from other forms of life. The thermal route can use this energy in two ways, by using heat to produce power, heating, cooking or electricity, and by using the solar panels, which turn the solar energy into electricity which can be used for a variety of applications, such as lighting, pumping and electricity production. Solar power is an extremely attractive choice for electricity with the practically inexhaustible supply and global distribution.

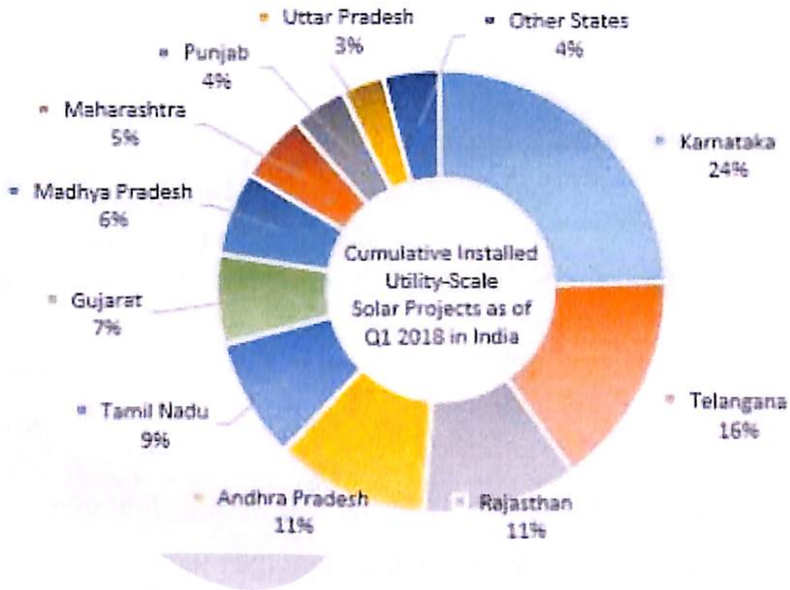

Figure 3. 1 Top solar states in the India

Global climate change is one of the major environmental issues of our day. The only way to surmount or reduce this disaster is to reduce greenhouse gas levels. Worldwide, a number of various steps have been taken to curb greenhouse gas pollution and thereby reduce the damage to the atmosphere. Several developed countries have placed on a competitive basis complex programs to reduce carbon dioxide emissions. The electricity sector is one of the major roots of greenhouse gas emissions. For rising greenhouse gas pollution, different measures have been set in motion around the world in the electricity sector. Use clean energies as a source of electricity is one of the most important strategies implemented by all parts of the world's power sectors. Solar is the most profitable and operationally viable renewable energy resource, and one of the largest renewable energy sources.

3.1 Essence of Solar

For different purposes Solar Power can be used. So the response to the question "Why Solar" can be found from two different viewpoints: solar energy usage for grid-interactive and off-grid output (including captive).

3.1.1 Solar for grid connected electricity

Grid integrated renewable electricity is a large-scale subset of solar photovoltaic cells and CSP plantations. For the following reasons: The grid relation is chosen: The highest generation time is solar energy every day.

- Solar power conversion equipment has a longer life and needs fewer servicing and therefore better reliability of the electricity system
- Small running costs & system resource returns (net metering)
- Like traditional coal-fired thermal power production, these produce no emissions and renewable energy
- Free energy is plentiful across the world (although gradually rising from equatorial, tropical, subtropical and polar regions). Can be used practically anywhere.

3.1.2 Solar for off-grid solutions:

While the areas with easy grid connections using grid connection, there is little alternative but to opt for their own generation in the locations where electric power is scarce or too costly to deliver. They are producing electricity from a combination of small local generators using fossil fuels (diesel, gas), and local renewables (solar PV, wind, small hydrocarbons, biomass etc.) with or without their own storage (batteries). This power is classified as off-grid. For the following reasons Remote power systems are installed.

• Choosing to use clean resources-socially friendly, emission free

• The fusion of multiple energy technologies-hybrid power production

• Demand for freedom from insecure, fault-prone and disconnected grid links

• The backup and back-up solutions are available

• No overhead wires- no risk of communication

• Specific applications and products: lighting, communication, cooking, heating, cooling, small-scale industrial use, and so on.

The Center has recommended an outlay of Rs 22,000 for the electricity and clean energy sector for 2020-21 to meet the needs of India 's rising economy , providing safe, inexpensive, stable, and sustainable energy includes exploring a variety of options including optimizing domestic output, diversifying the fuel mix and supply chain, and retaining adequate reserves where appropriate. This will ensure both price stability and supply security in the energy sector as well. Fluctuations in the energy supply market have a cascading impact on the cycle of development itself. Poverty remains strong amid accelerated economic growth. Expanding prospects for economic growth is therefore a crucial Policy priority.

In India, renewable energy industry is the fourth-largest green energy corporation in the world. As of October 2018, India has been ranked fifth for built-in renewable energy. According to 2018 Climate framework study India placed second among the developing economies to contribute the shift the renewable energy.

Installed capacity for renewable energy production has grown exponentially over the past few years, recording a CAGR (Compound annual growth rate) of 19.78 per cent during FY14–18. The sector has become attractive from an investor perspective, with increased government support and improved economics. Provided that India is aiming to satisfy its electricity demand alone, which is projected to cross 15,820 TWh by 2040, renewable energy is likely to play a significant role. The Government of India has set an aggressive target of producing 175 GW of renewable energy potential by 2022, as part of its Paris Agreement commitments. This involve an introduction of 100 GW of solar power, and 60 GW of wind power. The Government aims to build a 500 GW potential for renewable energy by 2030.

3.2 Market Size

The consumption capacity for renewable energy was 83, 37 GW as of October 31, 2019, of which 31, 7 GW and 37 GW are solar and wind, respectively. Biomass and hydroelectric capacities are reduced to 9, 80 GW, and 4, 6 GW. There has also been an increase in renewable power for off-grid electricity. As of October 2019, Biomass Gasifies produced waste-to-fuel capacity at 139.80 MW and 9.806.31 MW respective. Northern India is expected to become India's hub for renewable energy, with 363 gig watts (GW) in theory and policies aimed at the clean energy market.

3.3 Investments/ Developments

According to DPIIT, between April 2000 and June 2019, FDI inflows into the non-conventional Indian power sector stood at 8, 06 billion US dollars, according to data released by the Department for Industry Promotion and Internal Trade. In the Indian renewable energy industry over 42 billion dollars have been invested since 2014. In 2018 new renewable energy investments amounted to US$ 11.1 billion.

Throughout the Indian clean energy market, there are many big investments and innovations:

• Investing 800 million USD in Renew Energy at Brookfield.

• Re-Shapoorzhi Pallonji and Re-New power were going to spend nearly Rs 750 crore (USD 0.11 billion) on the floating 150 megawatt (mw) solar power plant in Uttar Pradesh.

• In November 2019, Renew Power, Avaada, UPC, Tata Group secured 1,200 MW of Solar Energy Corp of India's auction for renewable ventures.

• By 2019, India is constructing Bhadla Solar Park, Rajasthan's 2,255 MW solar energy project, the world's largest solar energy facility.

• In August 2018 the national delivery of wind power began.

• India deployed 1 MW of solar power per hour during the first half of 2018.

• With 28 sales, renewable technology accounted for 27% of US$ 4.4 billion in merger and acquisition (M&A) investments in India's 2017 power market.

A $1, 55 billion agreement to purchase Ostro Energy was reached in March 2018 by Renew Power, making it the larger clean energy company in India.

• In March 2018 the world's biggest solar parking lot opened in Karnataka, called Shakti Sthala, with expenditures of Rs 16.500 crore (US$ 2.55 billion).

• CY 2018 totaled US$ 9.8 billion in investment on the Indian solar market.

• Investments in Indian wind and solar energy by private equity (PE) rose by 47% in 2017 (January 1 to September 25) to US$ 920 million in nine transactions, compared to US$ 630 million in 10 deals in 2016.

• Ever source Capital, a joint partnership of ever stone and light source, plans to spend US$ 1 billion in clean energy in India by way of the Green Growth Equity Fund as of March 2019.

3.4 Government initiatives

The government of India has taken many steps to boost the clean energy sector in India: The following:

• India, such as Gujarat and Rajasthan, is ready to install 30 GW of renewable power across its western border area.

• The Delhi government has decided to shut down the thermal power station in Rajghat and convert it into a 5000 kW solar park

• The Government of Rajasthan exempted solar energy from electricity tariff in budget 2019-20 and focuses in the agriculture and health sectors on the use of solar energy.

• For hydropower companies in the region, an improved hydropower system has been adopted for 2018-28.

• The Indian Government has announced plans for the implementation of the US $238 million Ultra-super critic Advanced Coal Uses Programmed.

• Ministry of New and Renewable Energy (MNRE), which in turn will reduce installation costs and generate electricity, has agreed to provide a customized and excise gain for the solar rooftop market, thus boosting production.

• Indian Railways are making greater efforts to reduce pollution by 33% by 2030, through sustainable energy production and full use of renewable fuel.

3.5 Achievements in the sector

• As from October 2019, India has 83, 37 GW renewable energy of solar and 37, 09 GW of wind.

The 100 GW clean energy mark is projected to hit India by 2020. •

• Solar power increased by 8 times during the FY14-18 era. India has raised its renewable energy supply by 11,788 MW in 2017-18.

• Until November 2018 a total of 47 solar parks with a generating capacity of 26,694 MW were approved in India, with a capacity of 4,195 MW commissioned.

• In the period April 2018 to January 2019, renewable energy generation (excluding big hydropower) reached India on a historical 101.84 billion units and was above 107.22 billion units;

3.6 Road Ahead

India's government is dedicated to growing the usage of renewable energy options, and is currently implementing numerous large-scale solar energy initiatives and actively supporting green technology. Therefore, renewable energy has the potential to generate several job openings at all rates, especially in rural areas. The Ministry of New and Renewable Energy (MNRE) has set an aggressive goal of 175 GW of renewable energy capacities by 2022, of which nearly 100 GW are expected for solar, 60 for wind and another for hydro, bio, among others. By 2022, the Government of India aims to hit a potential of 225 GW of clean energy by June 2018, ahead of its 175 GW goal as described by the Paris Agreement. In the coming four years, the India market for renewable energy is expected to invest up to US$ 80 billion. By 2023, some 5000 plants in India are going to be built with compressed biogas. Renewable energy is expected to produce approximately 49% of total energy by 2040, with more efficient batteries used to store electricity which would further reduce solar energy costs by 66% relative to current energy costs. Per year, India Rs 54,000 crore (USD 8.43 billion) was saved by renewable energy instead of carbon5. The total installed power capacity by 2030 would represent 55% of renewable energy.

3.7 Data Collection and Methodology

3.7.1 Objective

· Review of the optimistic effect on the socio-economic effects of the new renewable energy growth project.

· To recognize solar energy-related wellness, protection and environmental risks.

· To determine the potential power of Indian solar energy prospective.

3.7.2 Methodology

This thesis work collect the secondary data of the renewable energy resource in India. The secondary data collected from the recognized government site or reliable source or depository. Further the analytical test for visualization and interpretation has been estimated. This research investigate impact of the solar with underlying economic condition. Over all analysis will be presented through MS Excel- Advance Analytic Tool pack.

Chapter 4

Analysis and Interpretation of Result

The chapter deal to collect the secondary data from authentic source and their interpretation as per the research needed to explore. The Solar and other conventional energy has to be analyzed in year wise and presented a growth model of solar along with other renewable source of energy.

4.1 Power sector in India

Table 4. 1 Power sector distribution in India

Sector	MW	% of Total
Central Sector	92,797	25.3%
State Sector	103,815	28.5%
Private Sector	170,668	46.6%
Total	3,67,281	

Source: Central Electricity Authority (CEA)

Table 4. 2 Contribution of different power supply in Total

Fuel	MW	% of Total
Total Thermal	2,30,701	62.8%
Coal	1,98,495	54.2%
Lignite	6,760	1.7%
Gas	24,937	6.9%
Diesel	510	0.1%
Hydro (Renewable)	45,399	12.4%
Nuclear	6,780	1.9%
RES* (MNRE)	86,321	23.4%
Total	368,690	

Source: Central Electricity Authority (CEA)

4.2 Contribution of Solar Energy Distribution in India

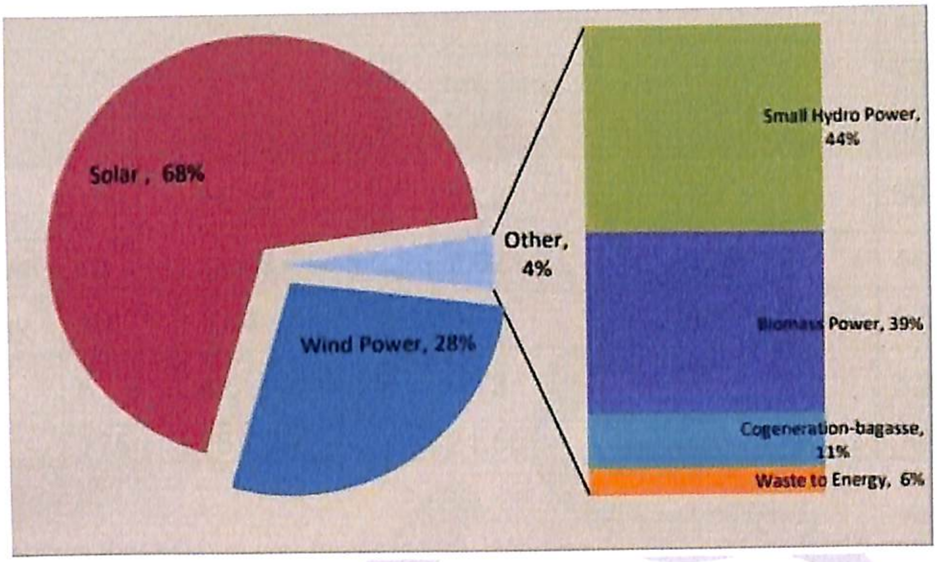

Figure 4. 1 *Estimated Potential of Renewable Power in India 2018*

India's government has set a goal of 100GW of installed solar power by 2022. Achieving this deployment target would be a collective endeavor on the part of the Indian governments. As for solar panel projects by the end of 2018, the states in the southern part of India are already clear.

Table 4. 3 Contribution of main resource of Power in India

Source	Installed Capacity (GW)	Percentage
Thermal	221.76 GW	-63.84%
Nuclear	6.78 GW	-1.95%
Hydro	45.48 GW	-13.09%
Renewable	73.35 GW	-21.12%
Total	**347.37 GW**	**-100%**

As per the above table 63.84% used as Thermal, 1.95% used for Nuclear, 13.09% used for Hydro and 21.12% for 21.12%.

Table 4. 4 Contribution of Solar and other Renewable Energy Source

Sector	Target (GW)	Installed capacity (GW) as on 31.10.2018	Under Implementation (GW)	Tendered (GW)	Total Installed/ Pipeline (GW)
Solar Power	100	24.33	13.8	22.8	60.93
Wind power	60	34.98	7.02	2.4	44.4
Bio Energy	10	9.54	0	0	9.54
Small Hydro	5	4.5	0.73	0	5.23
Total	175	73.35	21.55	25.2	120.1

Above table shows that solar power target is 100, Wind power 60, Bio Energy 10 and small Hydro 5 however achieved 24.33, 34.98, 9.54 and 4.5 respectively till 31.10.2018.

Table 4. 5 Participation of source material to energy in present scenario

S. No.	Sector	2014-15	2015-16	2016-17	2017-18	2018-19	Capacity (as on 31.10.2018)
1	Waste to Energy	12	14.13	12.21	5.5	3.13	175.28
2	Biomass Gasifies	6.76	12.54	4.3	0.92	0	163.37
3	SPV Systems	60	87.67	115.5	216.63	96.11	767.51

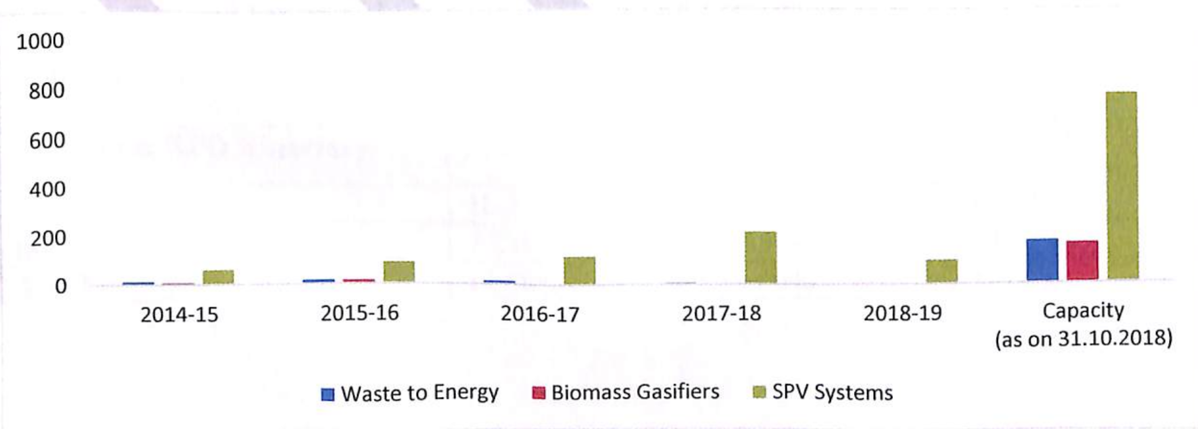

Figure 4. 2 Participation of source material to energy in present scenario

Above table shows capacity and achieved target year wise, in 2014-15 Waste to Energy 175.28, Biomass Gasifies 163.37 and SPV systems 767.51.

Table 4. 6 Year wise growth for Overall Generation

Year	Overall Generation (in BU)	Renewable Generation (in BU)	% share of RE
2014-15	1110.18	61.78	5.56
2015-16	1172.98	65.78	5.6
2016-17	1241.38	81.54	6.56
2017-18	1303.37	101.83	7.81
2018-19(up to Aug 2018)	**590.04**	**62.66**	**10.62**

Above table describe year wise growth for Overall Generation, Renewable energy and % share of RE in 2014-15 Overall Generation 1110.18, Renewable Generation 61.78 and % share of RE 5.56. 2015-16 1172.98, 65.78, 5.6. 2016-17 1241.38, 81.54, 6.56. 2017-18 1303.37, 101.83, 7.81 respectively.

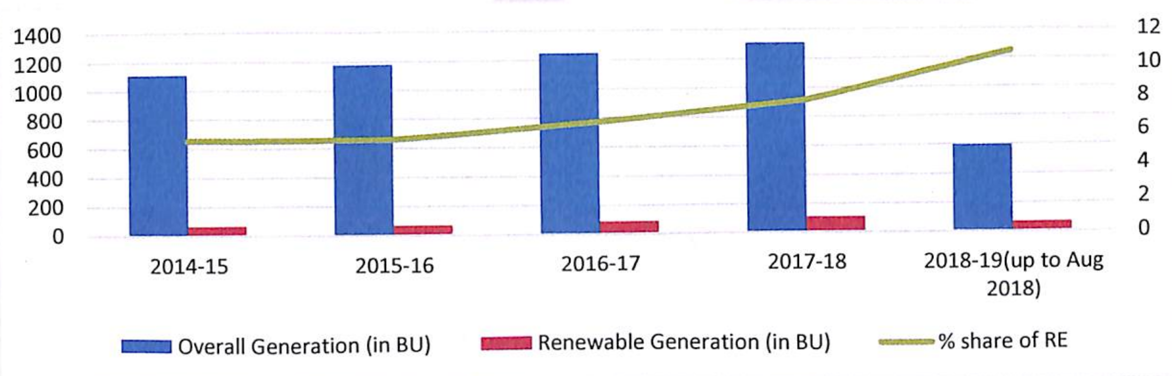

Figure 4. 3 Year wise growth for Overall Generation

Table 4. 7 Comparison of Solar and Non Solar

Long term RPO trajectory	2019-20	2020-21	2021-22
Non-solar	10.25%	10.25%	10.50%
Solar	7.25%	8.75%	10.50%
Total	17.50%	19.00%	21.00%

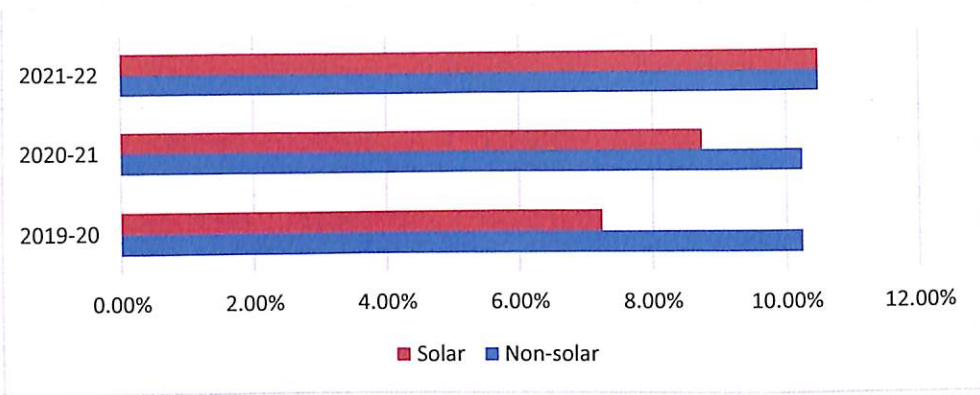

Figure 4. 4 Comparison of Solar and Non Solar

Table shows that Solar vs. Non-solar growth till 2022, Non-solar energy 10.25 in 2019-20, 10.25% in 2020-21, 2021-22 in 10.50% however Solar 7.25% in 2019-20, 8.75% in 2020-21 and 10.50% in 2121-22.

Table 4. 8 State Wise Distribution of Solar in India

State	Solar Potential (GWp)	Cumulative Installed
Andhra Pradesh	38.44	968.05
Arunachal Pradesh	8.65	0.27
Assam	13.76	10
Bihar	11.2	95.1
Chhattisgarh	18.27	128.56
Delhi	2.05	23.87
Goa	0.88	
Gujarat	35.77	1,138.19
Haryana	4.56	17.39
Himachal Pradesh	33.84	0.2
Jammu & Kashmir	111.05	1
Jharkhand	18.18	16.84
Karnataka	24.7	340.08
Kerala	6.11	13.05
Madhya Pradesh	61.66	811.38
Maharashtra	64.32	386.06
Manipur	10.63	
Meghalaya	5.86	
Mizoram	9.09	0.1
Nagaland	7.29	
Odisha	25.78	66.92
Punjab	2.81	571.2
Rajasthan	142.31	1,301.16
Sikkim	4.94	
Tamil Nadu	17.67	1,555.41
Telangana	20.41	963.79
Tripura	2.08	5
Uttar Pradesh	22.83	143.5
Uttarakhand	16.8	41.15
West Bengal	6.26	11.77
Union Territories	0.79	16.69

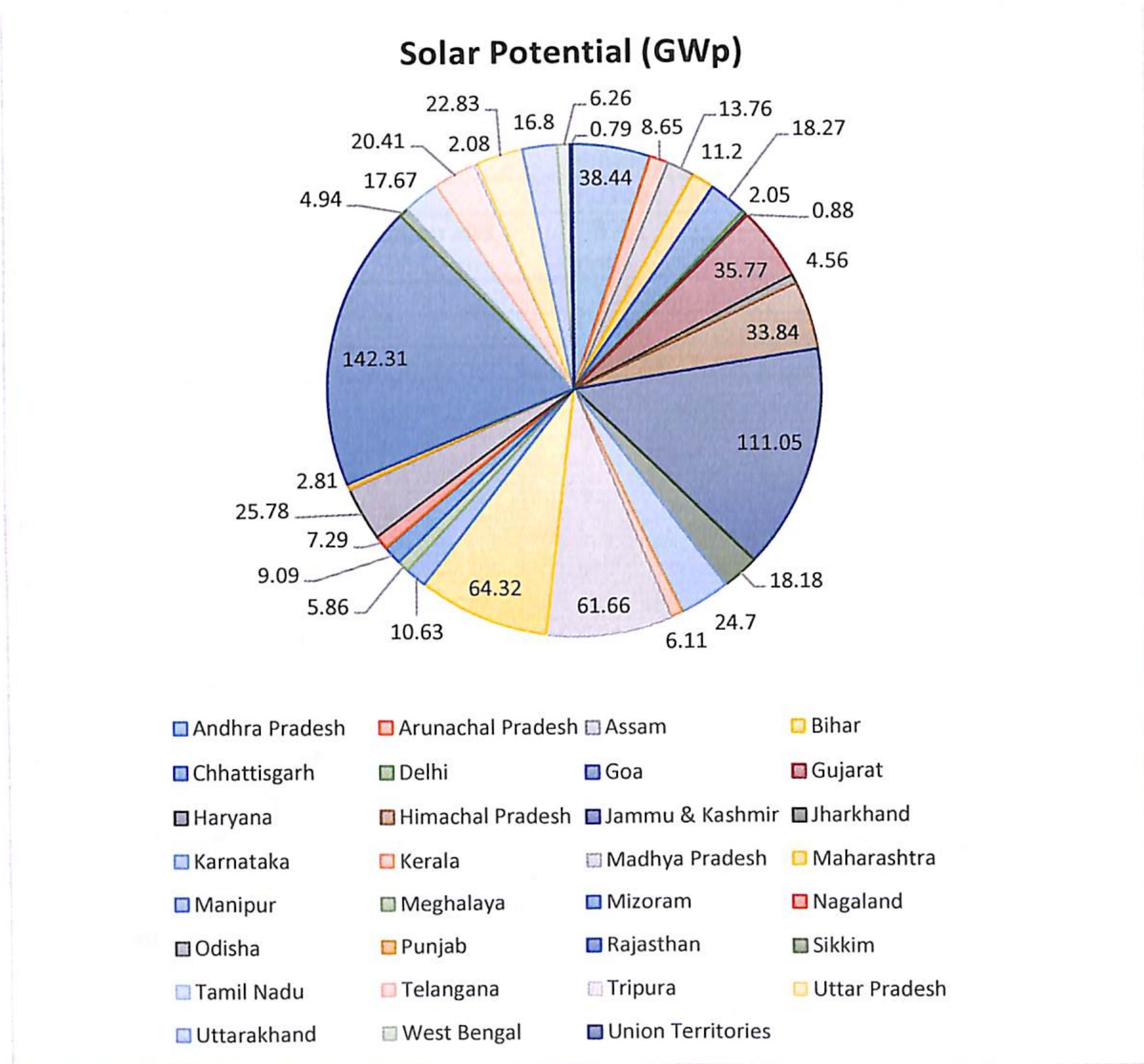

Figure 4. 5 State Wise Distribution of Solar in India

As the above table presented that the state wise distribution of solar in India. This table clearly shows that the solar presence is highest in Rajasthan follows behind J & K , Madhya Pradesh and Maharashtra. Other state contribution is very low as in solar implementation.

Table 4. 9 State wise Solar potential (GWp) and Cumulative Installed in India

Source	Total Installed Capacity (MW)	2022 Target (MW)
Wind Power	34046	60000
Solar Power	21651	1,00,000
Biomass Power (Biomass & Gasification and Bagasse Cogeneration)	8701	10000
Waste-to-Power	138	
Small Hydro Power	4486	5000
TOTAL	**69022**	**1,75,000**

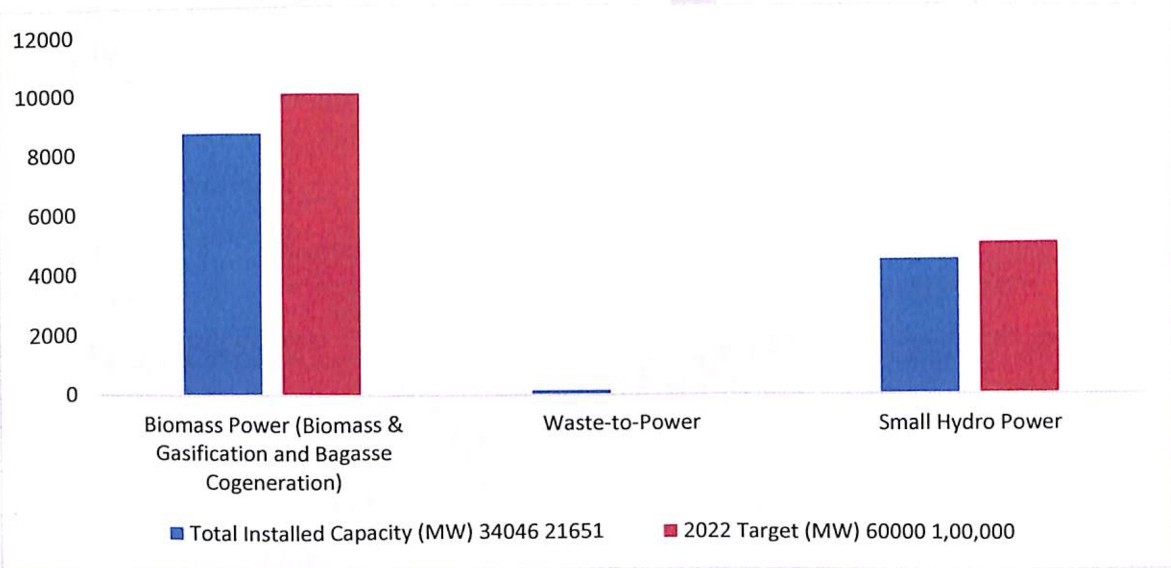

Figure 4. 6 Solar potential and Cumulative Installed in India

Above table shows state wise Solar potential (GWp) and Cumulative Installed, same has been shown in below graph. As per the above table Wind power total installed capacity (MW) 34046 however target till 2022 is 60000, Solar power 21651, target 100000, Biomass power 8701 target 1000, Waste to power 138, and Small Hydro power 4486 however target is 5000.

Table 4. 10 Categorical Distribution of Solar capacity in India

Sl. No.	Name of State	Capacity MWp
Northern States		
1	Punjab	9
2	Haryana	9
3	Uttar Pradesh	20

4	Delhi/NCR	6
5	Rajasthan	9
Sub Total		**53**
Eastern States		
6	Odisha	6
7	Bihar	6
8	Jharkhand	5
9	West Bengal	10
Sub Total		**27**
Southern States		
10	Andhra Pradesh	9
11	Telangana	10
12	Tamil Nadu	18
13	Karnataka	10
14	Kerala	5
Sub Total		**52**
Western States		
15	Maharashtra	26.5
16	Goa	0.5
17	Gujarat	12
18	Madhya Pradesh	11
19	Chhattisgarh	5
Sub Total		**55**
Special Category States & Islands		
20	J&K	2
21	Uttarakhand	1.5
22	Himachal Pradesh	2
23	North-Eastern States / Sikkim	4.5
24	Lakshadweep	0.5
25	Andaman & Nicobar Islands	0.5
26	Daman & Diu	0.5
27	Pondicherry	0.5
28	Dadar & Nagar Haveli	0.5

29	Chandigarh	0.5
Sub Total		**13**
GRAND TOTAL		**200**

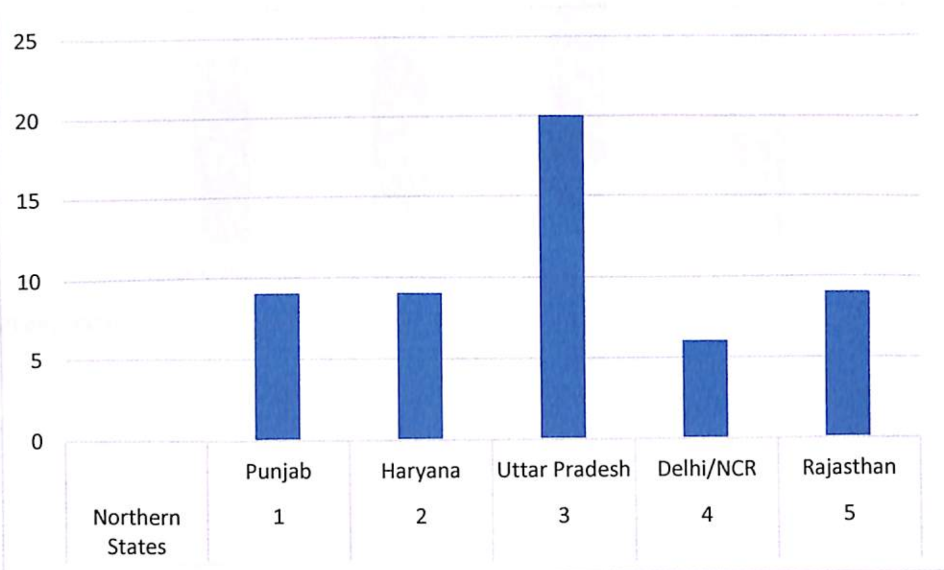

Figure 4. 7 Northern State for Solar Distribution

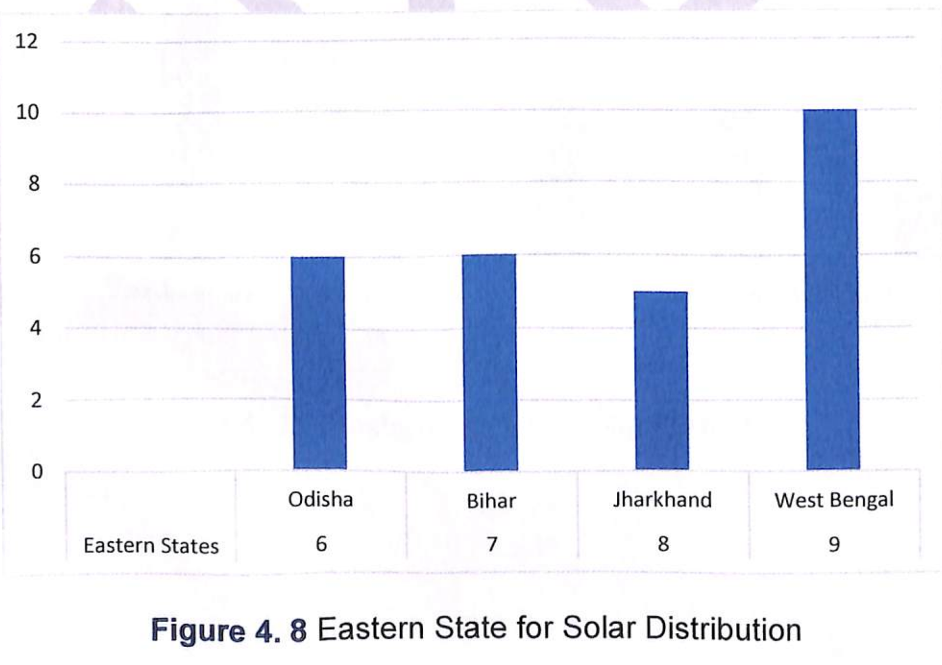

Figure 4. 8 Eastern State for Solar Distribution

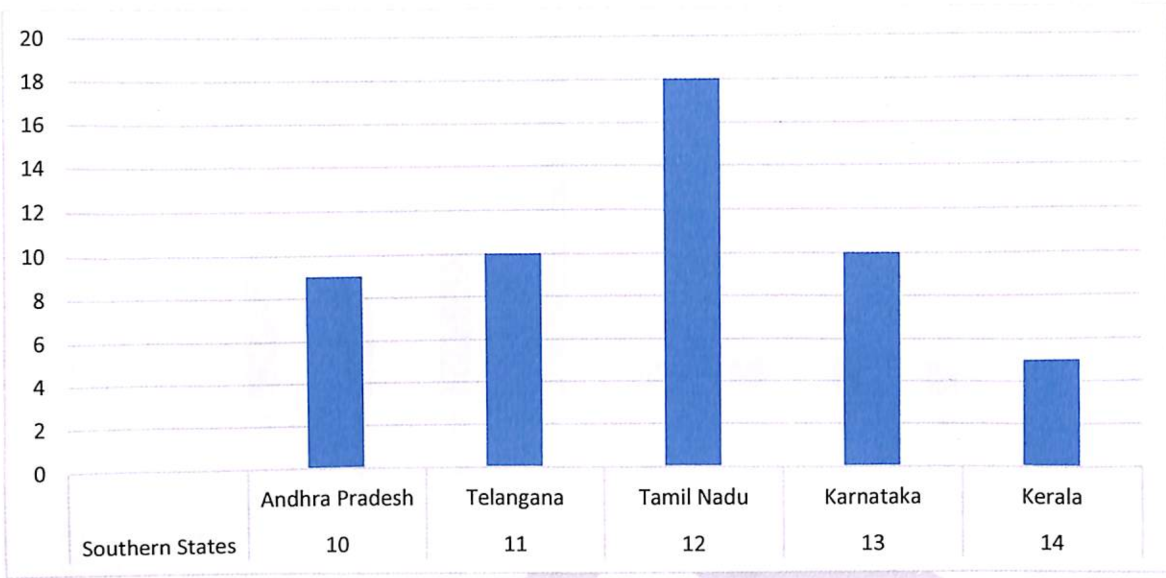

Figure 4. 9 Southern State for Solar Distribution

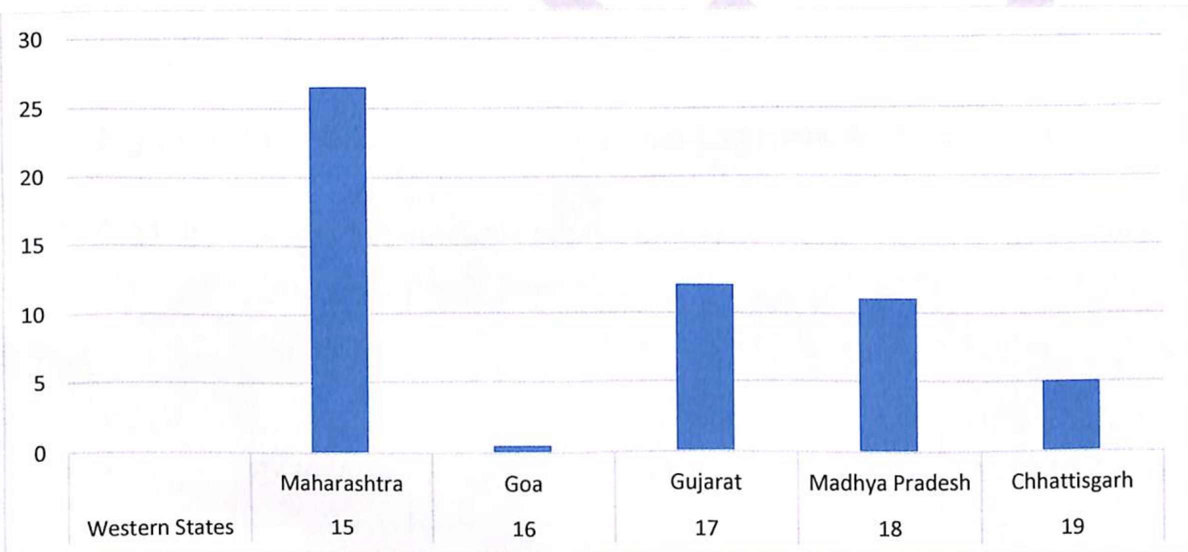

Figure 4. 10 Western State for Solar Distribution

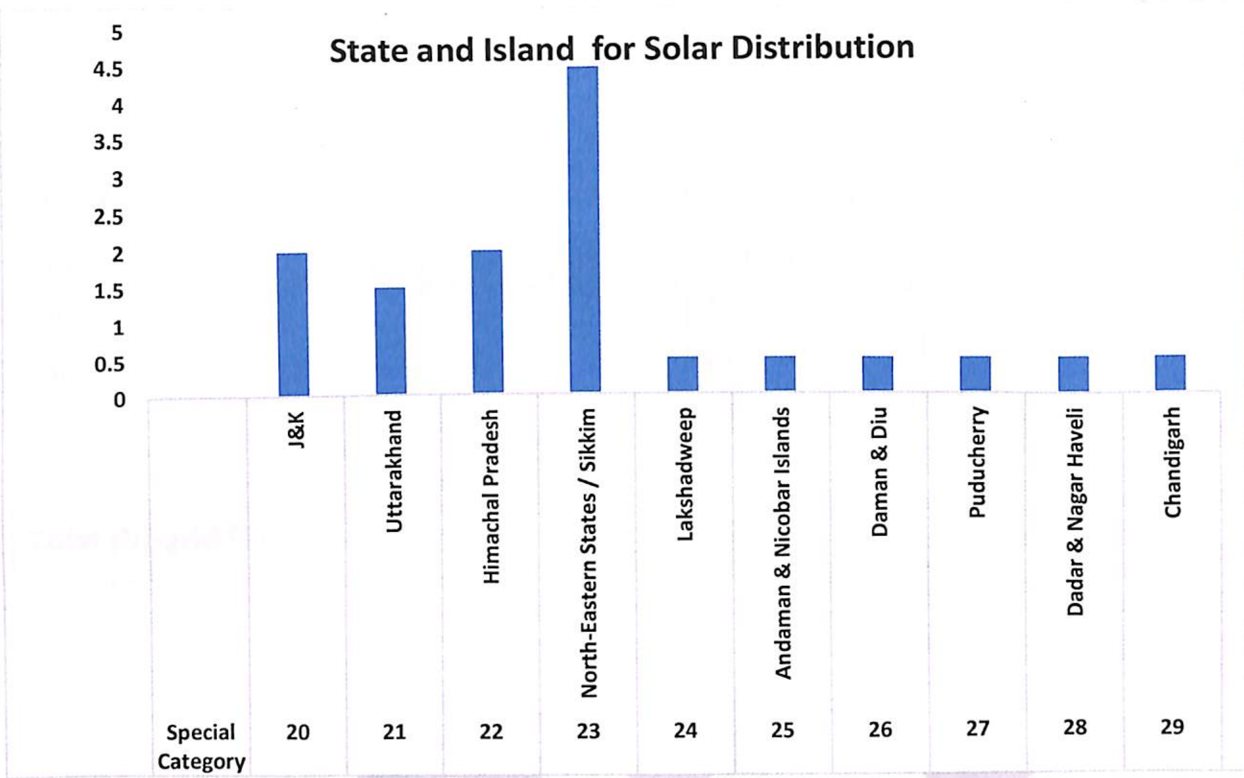

Figure 4. 11 Special Categories and state and Island for Solar Distribution

Table 4. 11 India's Existing and Estimated capacity of Renewable Energy in India

(GW)	**Installed Capacity as of**	**Capacity Additions**	**Estimated Capacity Additions**			
Source	**FY2018/19**	**FY2018/19**	**FY2019/20**	**FY2020/21**	**FY2021/22**	**Total**
Utility Scale Solar	26.7.	6.5.	7.5.	11.6.	14.0.	59.8.
Rooftop Solar	3.9.	1.6.	2.0.	3.0.	4.0.	12.9.
Wind	35.3.	1.7.	5.0.	6.4.	6.4.	53.1.
Biomass+ RoR	13.8.	0.5.	0.5.	0.5.	0.5.	15.3.
Floating Solar				0.1.	1.4.	1.5.
Hybrid Wind & Solar	0.1.			0.4.	0.7.	1.2
Total	**79.8.**	**10.3.**	**15.0.**	**22.0.**	**27.0.**	**143.8.**

Above table shows that installed capacity vs. additions capacity year wise, it's clearly shows that Utility scale solar 59.8, Rooftop solar 12.9, Wind 53.1, Biomass+RoR 15.3, Floating Solar 1.5 and Hybrid wind & Solar 1.2.

Table 4. 12 India on-grid capacity Additions FY2017/18 VS. FY2018/19

Source	18-Mar	19-Mar	Change GW
Renewables	69	77.6	8.6
Large Hydro	45.3	45.4	0.1
Nuclear	6.8	6.8	0
Thermal	222.9	226.3	3.4
Total On-grid Capacity	**344**	**356.1**	**12.1**

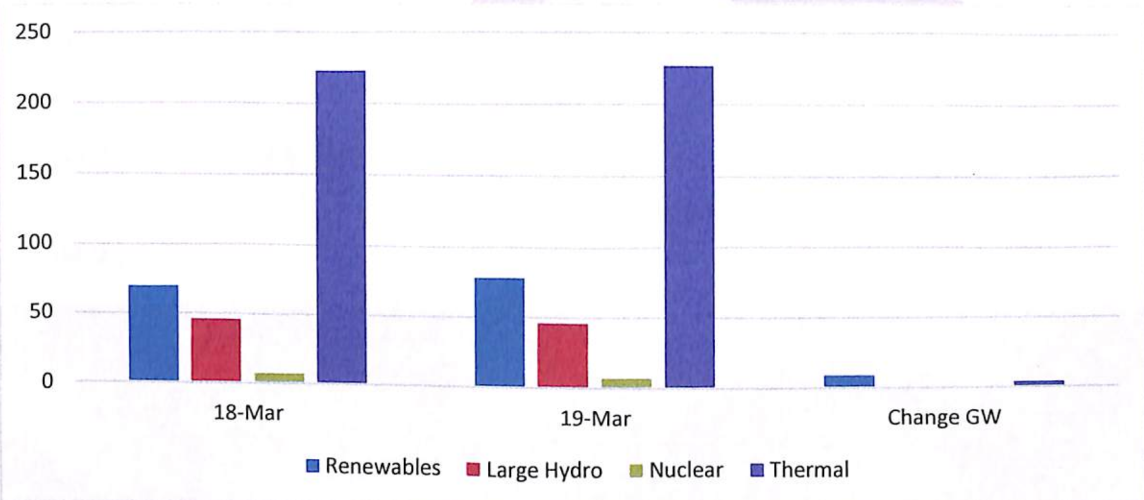

Figure 4. 12 India on-grid capacity Additions FY2017/18 VS. FY2018/19

As per the above table India on-grid capacity Additions FY 2017/18 vs. FY2018/19, for Renewables energy 69 in Mar'18, however 77.6 in Mar'19, Large Hydro 45.3 in Mar'18, 45.4 in Mar'19, Nuclear 6.8 in both year, Thermal energy 222.9 in Mar'18 however 226.3 in Mar'19. Hence we can conclude change in GW 8.6 for Renewables, 0/1 Large Hydro, there is no any changes in Nuclear however for Thermal 3.4.

Table 4. 13 Year wise renewable energy generation (GWH)

Installed solar PV on 31 March	Year cumulative capacity (in MW)
2010	161
2011	461
2012	1,205
2013	2,319
2014	2,632
2015	3,744
2016	6,763
2017	6,763
2018	21,615
2019	28,181
2020	37,627

As the above figure and table demonstrate that the level of solar PV and their capacity in MW from year 2010 to year 2020 presented. This table presented that the tremendous growth in subsequent year.

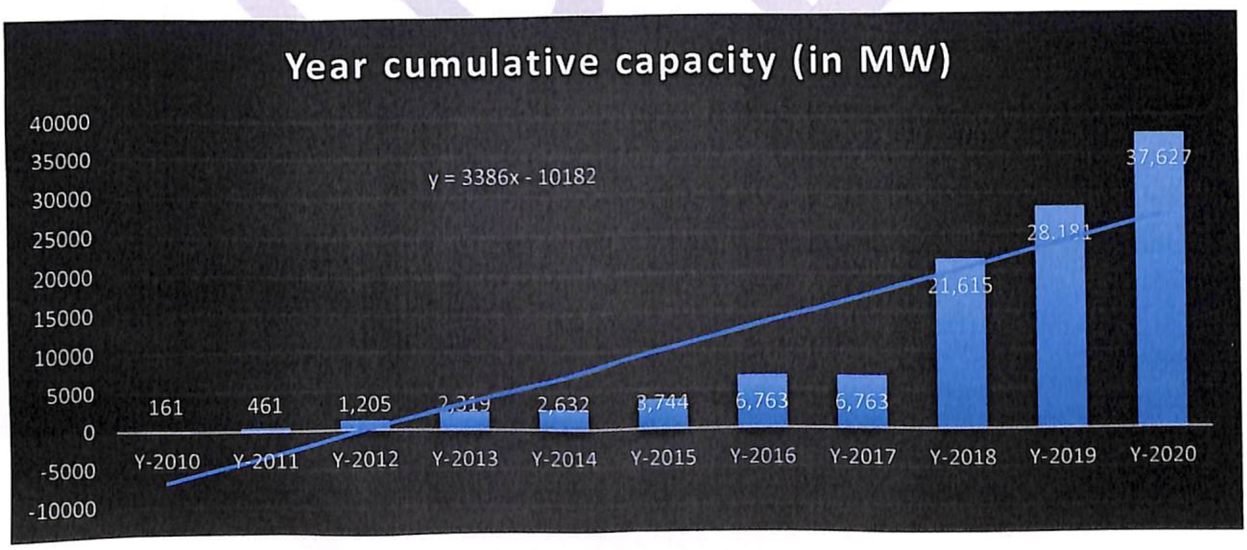

Figure 4. 13 Year wise renewable energy generation (GWH)

As the above figure show how the solar in subsequent year progress. The linear growth model shows the growth of solar with inclination more that 300% time.

Chapter 5

Finding of Study

- India is one of the highest producing clean energy countries.
- India's government has set a goal of 100GW of solar power deployed by 2022.
- The states in the southern part of India are already clear as for solar panel projects by the end of 2018.
- India established the Ministry of Non-Conventional Energy Resources (MNRE) as the world's first country in the early 1980s and is India's leading solar industry production business.
- India has 20 manufacturers of 53 specific foreign wind turbine specifications up to 3 MW, marketed to Europe, the United States and other nations, and a wide base of wind energy output.
- By 2019, 35% of India's energy comes from renewables, which accounts for 17% of the region 's overall electricity produced.
- In the Paris Agreement, India agreed to achieve 40% of total electricity generation from non-fossil fuels by 2030, with a nationally defined goal.
- In the Central Electricity Authority 's strategy program, the nation is aiming for an even more ambitious target of 57% of renewable energy production by 2027.
- India plans to provide 275 GW of solar power, 72 GW of hydropower, 15 GW of nuclear power and nearly 100 GW of zero-carbon energy as per the 2027 roadmap.

Chapter 6

Conclusion & Future Scope

India has founded the Ministry of Non-Conventional Energy Resources (MNRE) as the first country in the world in the early 1980s and is the responsible company in India for the development of the Indian solar energy industry. The power department manages hydroelectricity independently and it is not included in MNRE's objectives. India is home to 20 producers of 53 different international wind turbine requirements up to 3 MW, exported to Europe, the United States and other nations and has a large wind energy production base. Cost-competitive, without subsidies, is now Wind or solar photovoltaic in combination with four-hour battery storage, a source of supply that can deliver on a new coal and gas plant in India.

India is one of the countries with the highest clean energy production. As of 2019, 35% of the power produced by India comes from renewables, which accounts for 17% of the entire electricity produced in the region. India decided in the Paris Agreement that it would achieve 40 % of total electricity output from non-fossil-based fuels by 2030, with a nationally specified target.

In the policy plan of the Central Electricity Authority, the nation is looking for an even more optimistic goal of 57 per cent of the overall energy output from renewable sources by 2027. India aims to provide 275 GW of solar power, 72 GW of hydropower, 15 GW of nuclear power and approximately 100 GW of null carbon electricity as per the 2027 roadmap. Indian total renewable (including full hydro) power capacity was 130, 68 GW in the quarter ending September 2019. It constitutes 35.7 per cent of the country's overall installed power for energy production, which is about 366 GW.

83 GW are currently in operation for the 175 GW interim target in October 2019, 29 are under construction and 30 GW is being tendered, the remaining 43 GW are being planned. The interim target of 175 GW is 100 GW of sunlight, 60 GW of wind, 10 GW of bio and 5 GW of hydroelectric potential.

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