UPES Centre for Continuing Education

A Study on Renewable Energy Project Risk Factors and Ways to Mitigate Them

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A DECLARATION BY THE GUIDE

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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 be submitted in any other University or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA.

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EXECUTIVE SUMMARY

As of not long ago, the take-up of renewable energy innovation for power age has been moderate, with most projects being bigger scale advancements. The presentation of new administrative approaches in the course of recent years has helped empowered improvement in this segment. Nonetheless, as it were the ongoing presentation of Feed-in Tariffs has made the market genuinely open to substantial numbers of little scale makers. Albeit little scale, these new participants require budgetary sponsorship to understand their improvements from both capital venture and protection viewpoints, similarly as the large scale advancements do.

Tragically, the monetary administrations industry has restricted involvement also, comprehension of renewable energy projects and their related risk factors. This project condenses the specialized risk factors relating to the renewable advancements of most enthusiasm to new division participants. By considering the idea of the renewable asset being utilized by each innovation and inspecting both the financially accessible and model gadget innovation, it is conceivable to understand the innovation explicit risk factors, just as the more nonexclusive specialized issues basic crosswise over advancements amid development and operational periods of an improvement.

Once gathered, the discoveries are organized to frame a reasonable model, outlining the applicable mechanical risk factors as a reason for protection guaranteeing purposes, with the potential for further actuarial advancement prompting a full model and in this manner improved protection items.

The execution of renewable advances to produce control has expanded at an exponential rate over the previous decade. Research led by the Massachusetts Institute of Technology has appeared without precedent for history, licenses for developments in renewable energy are presently ascending at a quicker rate than licenses for innovation situated in petroleum derivatives.

Interest in renewable advances has expanded over the globe in both set up and new regions. While OECD nations still record for most of renewable energy generation, in the course of recent years non-OECD development has surpassed OECD development in rate terms. Development in a wide range of renewable advances is now being found in South America, Turkey, Eastern Europe, Southeast Asia, Southern Africa and China. In the Middle East, Africa furthermore, portions of Asia specifically, there is expanding enthusiasm for photograph voltaic establishments. Financing an inland renewable energy project has one of kind complexities. By the very idea of the advancements required, there are various risk factors which must be considered from early periods of arranging, through development to conclusive activity.

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

The execution of renewable advances to create control has expanded at an exponential rate over the previous decade. Research led by the Massachusetts Institute of Technology has appeared without precedent for history, licenses for developments in renewable energy are presently ascending at a quicker rate than licenses for innovation situated in petroleum products. Interest in renewable advancements has expanded over the globe in both built up and new regions. While OECD nations still record for most of renewable energy creation, in the course of recent years non-OECD development has surpassed OECD development in rate terms. Development in a wide range of renewable innovations is as of now being found in South America, Turkey, Eastern Europe, Southeast Asia, Southern Africa and China. In the Middle East, Africa and parts of Asia specifically, there is expanding enthusiasm for photovoltaic establishments. Financing a coastal renewable energy project has one of kind complexities. By the very idea of the innovations required, there are various risk factors which must be considered from early periods of arranging, through development to conclusive task.

Arranging a Project

Every establishment project offers diverse risk difficulties from ecological dangers, characteristic calamities, arranging, to gear harm and breakdown and loss of benefits. Including guarantors and their designers toward the beginning of a renewable energy establishment is a fundamental part in the risk the executive's procedure. Normal dangers, atmosphere, etcIn any renewable energy project, it might entice assemble an establishment on undeveloped land without thought being given to why the land is accessible. What's more, the common habitat and climate conditions, the reasonableness of the innovation to withstand those conditions, and the risk-lessening factors which can be built into the plan should all be considered. For instance, wind turbines must be reasonable for normal breeze speed, choppiness esteems and extraordinary blast levels.

Working time nearby can be limited by the atmosphere and introduction to the components. In certain locales, winters are unreasonably unforgiving for work to proceed. This ought to be given

due consideration in the arranging stage alongside measures to safeguard somewhat constructed gear and material on location amid site lay-off periods. Given the size and weight of present day wind turbines, it is fundamental that the geotechnical conditions are fitting and the establishment configuration is solid.

There are various instances of insufficient establishments prompting breakdown, for example, wind turbines being raised over mining shafts or on insecure soil. Establishment configuration ought to be attempted by a certified auxiliary specialist. Development in renewable energy has provoked contractual workers with little involvement in this segment to enter the market. Drawing in the administrations of an accomplished contractual worker with solid project the board aptitudes and past involvement in comparative renewable energy projects is subsequently pivotal to guarantee its prosperity. Access to the site is an imperative thought amid the arranging stage. Wind ranches are frequently raised in remote areas, making it troublesome for trucks to move along tight streets. Arranging consent might be required to broaden and augment streets for the term of the project, and it might be important to expel overhead links, traffic lights and other road furniture on the course. When the project has been finished, this framework should be reestablished to its past state. For remote development projects where foundation changes were required, the cost, time factor in acquiring arranging authorization and remaking of access streets should be calculated into any return to the site for support, breakdown and harm fix. Having the correct development hardware close by for the project is additionally basic.

For example, no less than one crane is expected to raise a breeze ranch. It is in this way prescribed to design ahead of time the accessibility of proper cranes of appropriate size, just as to orchestrate substitutions in case of any issues. Likewise, the activity of cranes and the arrangement of hard standing are extra interesting points in the arranging stage.

Building the Project

When a project has begun extra risk factors should be considered to guarantee fruitful finishing of the establishment. A few to consider:

- **Site Security**: Proper site security is an essential issue for all renewable energy establishments. Robbery, especially of copper links and other metal segments, is a worry, and a few destinations might be defenseless against vandalism and fire related crime. Great site security, observing frameworks and 'in the nick of time' conveyance of materials to the site all assistance to diminish these security exposures. Where conceivable links ought to be covered underground as opposed to keep running superficially between establishments. This will help diminish the rate of robbery.

- **Testing and Charging**: Following establishment, the hardware is tried and authorized. Amid this stage the risks and exposures can be decreased using demonstrated apparatus and strategies, and by choosing a skilled temporary worker. At this phase of the project, it is critical that proper protection security is set up and risk engineers with learning and experience of the innovation can instruct on the insurability concerning the hardware being considered.

When an establishment starts to work and deliver control, development stage exposures, for example, establishment plan and site get to are supplanted by new exposures, for example, breakdown, fire and business interference risks.

- **Flame Risks**: Fire, albeit rare, as a rule causes broad harm and turns into an a lot more prominent peril for all renewable energy establishments once testing and commission initiates.

Biomass establishments specifically face much more serious risk from flames and blasts. Flames in these advances for the most part begin in water power, flumes, channels, transports or gearboxes, yet can likewise begin in fuel sources because of sudden ignition.

Flame discovery and concealment frameworks are imperative apparatuses for fighting the risk of flame. Having all around planned and introduced frameworks together with proper power back up, for example, on location generators, is a basic piece of alleviating fire risks.

Note: A full flame risk appraisal might be vital as per nearby administrative prerequisites to guarantee that an appropriate site explicit 'Flame Safety Plan' is made.

Operating an Installation

After fruitful development and authorizing the establishment stays at risk from harm brought about by flame, robbery and regular perils. Furthermore, harm brought about by breakdown currently likewise should be considered.

Hardware Breakdown: According to HSB Engineering Insurance, 69% of misfortunes including wind turbines identify with mechanical and electrical breakdown, with the most widely recognized disappointments happening in transformers and gearboxes. Transformer breakdowns may come about because of over-burdening singular fare transformers.

From a business intrusion perspective, lodging numerous fare transformers is a standout amongst the most ideal approaches to lessen this risk. Guarantees have a critical task to carry out in new establishments. In the event that a guarantee is still set up, it can help secure against the material expense of gear disappointment, yet it doesn't generally bear the cost of insurance against business intrusion.

At the point when a breakdown happens, sourcing the right parts can once in a while be troublesome. A strong parts stock should be structured around a decent risk evaluation to guarantee that the right new parts are accessible rapidly in territories where breakdowns are normal.

For instance, access to save parts for high-risk things, for example, transformers limits downtime. All apparatus and hardware requires support. Having a powerful protection support program set up can help moderate the risk of hardware breakdown. Observing gear with deformity warning frameworks can likewise assume a key job in recognizing potential issues ahead of schedule to kill or alleviate potential harms.

Alternative Plans

Over the world, new renewable energy limit is going ahead line each day. Huge future speculations are arranged and development will proceed as governments endeavor to meet their renewable energy duties and expand from progressively settled advances. It is unavoidable that with an expanded spotlight on renewable energy, these kinds of projects will turn out to be progressively appealing to financial specialists.

With every establishment bringing diverse risk difficulties, access to master learning on risk the board can help control and diminish potential risk exposures and help speculation choices. Cooperation with customers is the way to a fruitful association and back up plans can include an incentive by working with installers, administrators and risk directors to control and relieve risk from the development stage directly through to activity. We trust that guarantors assume a fundamental job and are reacting to the test of offering protection items for renewable energy advances that spread the developing risks.

Traditional and RES projects contrast predominantly in the development of the business sectors and the related reputation as far as organization of innovation and the quantity of set up projects: Petroleum product control plants have been created over numerous years; the risks included are surely known through past understanding, structure determinations or factual records. This inevitably permits smooth arranging and allowing techniques.

Then again because of the similarly short reputation of RES, certain risks probably won't have been experienced already; for example risks that happen toward the finish of the lifetime of a

RES project probably won't be noticeable, yet. Indeed, even innovations with a reputation of over 20 years, for example, inland wind energy, have experienced a quick innovation improvement; the turbine estimate has expanded essentially in the previous decade and totally new structures (for example direct drive turbines) have entered the market. In contrast to RES, ordinary creation techniques have effectively experienced cost decreases through innovation organization (project expectation to absorb information).

Under these conditions the working edges for traditional energy are higher than for RES. Anyway ordinary projects experience a higher money related effect from generation downtime or changes in worldwide energy costs. Fast improvement of RES permits brisk advancement towards higher efficiencies and yields, in the end improving the money related suitability of the part/innovation all in all. This, be that as it may, rapidly renders frameworks and advances obsolete and resource esteem toward the finish of the project may be fundamentally lower than at first foreseen.

The quantity of providers for cutting edge advances is generally constrained, which results in various risks identified with the accessibility of parts (for example inventory network bottleneck) and expands the likelihood of postponement in finishing. To moderate the effect of the quick moving mechanical condition and low edges, governments venture in with sponsorships to encourage the execution of and invigorate speculations towards RES advancements.

Nonetheless, the projects financed under appropriation plans are innately coupled to political desire and motivation – this presents an extra factor and includes additional risks other than those for traditional energy. A noteworthy distinction among traditional and RES framework is simply the wellspring of energy.

Normally petroleum products are dispatched from everywhere throughout the world to the power plants, and it is conceivable to set up a different inventory network. Along these lines the supply risk can be spread over various providers from various worldwide locales.

For most RES sources such techniques are unimaginable because of the nearby idea of the asset (wind, sun, flows, waves and so forth) and the way that the essential energy can't be put away. Singular projects in this manner depend especially on the accessibility of a solitary asset. As appeared in this part different risks for both regular and RES exist. For the last a substantial level of vulnerability emerges from the shorter reputation, the fast speed of advancement and the neighborhood idea of the source. Anyway past these general contrasts between customary energy and RES, there are risks identified with a particular innovation; these are talked about in the following area.

Project Risk Matrix

Where a few associations are involved with the renewable energy project, paying little mind to the financing structure or size of the project, various risks emerge. The best projects dispense the risks to the suitable gatherings.

Risk Category	Control / Mitigation Mechanism	Risk Allocation
Project Investors	Credit Assessment Competence and knowledge of the industry Credit Assessment of Sponsors Understanding between the investors' differences	Sponsors / Lenders
Construction Risk	Fixed price engineering Procurement and Construction contracts (EPC) Completion guarantees and progress reports Equity in advance Penalty Payments: up to cap of 20% for any delay on daily basis (except *Force Majeure*) Delivery date in advance of off-take agreement Performance Tests Use proven technology from well-known vendors **Against Force-Majeure:** Insurance **Against Land Ownership Risks:** Agree to completion criteria between construction and operating companies. Exclusivity Agreement Environmental indemnities Long lease that coincides with useful life of plant.	Equipment Suppliers, Insurance Companies, Landowners
Operational Risk	Performance Warranty Operating & Maintenance Agreement Manufacturer performance warranties	Plant Operators, Equipment Suppliers and sponsor
Market Risk	Off-take agreement (PPA) for the whole lifetime of the plant. Although this reduces the market risk, a PPA introduces credit risk with regards to the purchaser. Hedge the risk (up to 5 - 8 years only)	Power off-taker (utility) Hedge provider Sponsor
Transport Risk	Consideration transport alternatives Agree on pricing terms	Sponsor
Environmental Risks	Long-term contracts Include expenditure for disposal in business plan	Sponsor
Financial and Cryptocurrency Risk	Interest Rate and Currency Hedges	Bank
Country and Political Risk	Political risk insurance through state sponsored agencies (range: 0.2% pa to 2% pa): Won't cover all events and based on book values. Keep part of the technology secret Debt finance preferred, as dividends are more likely to be blocked than interest payments. Use of local debt Use joint venture with local investors. Joint financing with international lenders.	Export Credit Agency Development Banks Insurance Companies Investments in local markets
Credit Risk	Appropriate credit risk management	All parties

1.2 RENEWABLE ENERGY

As per the International Energy Agency (IEA), coal/peat represent almost 40 percent of India's absolute energy utilization, trailed by about 27 percent for burnable renewable and waste. Oil represents about 24 percent of absolute energy utilization, petroleum gas six percent, hydroelectric power right around 2 percent, atomic almost 1 percent, and different renewable under 0.5 percent. Albeit atomic power involves an exceptionally little level of all out energy utilization as of now, it is relied upon to increment in light of global common atomic energy collaboration bargains . As indicated by the Indian government, about 30 percent of India's absolute energy needs are met through imports. Current introduced base of Renewable energy is 16,492.42 MW which is 10.12% of all out introduced base with the southern province of Tamil Nadu contributing almost 33% of it (5008.26 MW) to a great extent through wind control.

India is world's sixth biggest energy purchaser, representing 3.4%. of worldwide energy utilization. The economy of India, estimated in USD conversion scale terms, is the twelfth biggest on the planet, with a GDP (Gross Domestic Product) of around $1 trillion (2008). Gross domestic product development rate of 9.0% for the financial year 2007– 2008 which makes it the second quickest huge rising economy, after China, on the planet. There is an extreme interest for energy, which is presently fulfilled principally by coal, outside oil and oil, which are separated from being a non-renewable.

- **Solar Energy**

Brilliant light and warmth from the sun, has been saddled by people since antiquated occasions utilizing a scope of consistently advancing advances. Sun oriented radiation, alongside optional sun based controlled assets, for example, wind and wave power, hydroelectricity and biomass, represent a large portion of the accessible renewable energy on earth. Just an infinitesimal portion of the accessible sun based energy is utilized. India is both thickly populated and has high sun based insolation, giving a perfect mix to sunlight based power in India. In sun oriented

energy division, some expansive projects have been proposed, and a 35,000 km² zone of the Thar Desert has been put aside for sunlight based power projects, adequate to create 700 to 2,100 GW.

India is supplied with rich sun powered energy asset. The normal power of sun based radiation got on India is 200 MW/km square (megawatt per kilometer square). With a geological territory of 3.287 million km square, this adds up to 657.4 million MW. Be that as it may, 87.5% of the land is utilized for farming, woodlands, neglected terrains, and so on, 6.7% for lodging, industry, and so forth, and 5.8% is either desolate, snow bound, or for the most part inhabitable. In this manner, just 12.5% of the land region adding up to 0.413 million km square can, in principle, be utilized for sun based energy establishments.

Regardless of whether 10% of this territory can be utilized, the accessible sun oriented energy would be 8 million MW, which is proportional to 5,909 MTOE (million tons of oil counterparts) every year. In July 2009, India disclosed a $19 billion arrangement, to create 20 GW of sun based power by 2020.Under the arrangement, sun based fueled gear and applications would be required in all administration structures including emergency clinics and lodgings. On November 18, 2009, it was accounted for that India was prepared to dispatch its National Solar Mission under the National Action Plan on Climate Change, with designs to create 1,000 MW of intensity by 2013. India has a tremendous potential for renewable energy sources, particularly in territories, for example, sun based power, biomass and wind control. The current introduced limit of renewable energy is around 92204 MW, establishing about 7.3 percent of India's all out introduced age limit. Mechanical achievements for financially savvy photovoltaic innovation could create a quantum jump in the renewable energy part since India is blessed by the gods with sun powered insolation (normal of 6 KWH/sq.mt./day).

India plans to declare expanded appropriations for sun based power age, as the nation hopes to scale up generation of renewable energy and show it is focused on alleviating environmental change. India simply had 2.12 megawatts of framework associated sun powered age limit. As a component of the National Solar Mission, the service intends to support the yearly photovoltaic

generation to no less than 1,000 megawatts per year by 2017. With an introduced limit of 123 GW, the nation at present faces energy deficiency of 8 percent and a pinnacle request lack of 11.6 percent. So as to continue a development rate of 8 percent, it is estimated36 that the power age limit in India would need to increment to 306 GW in the following ten years which is 2.5 occasions current dimensions. Be that as it may, as of October 2009, India is at present positioned number one alongside the United States regarding introduced Solar Power age limit.

The Karnataka Power Corporation Limited (KPCL) has introduced India's biggest sun powered photovoltaic power plant at Yalesandra town in Kolar locale of Karnataka. Worked at the expense of about $13 million, the plant utilizes measured crystalline innovation to produce sun based energy

- **Wind Energy**

The advancement of wind control in India started during the 1990s, and has altogether expanded over the most recent couple of years. In spite of the fact that a relative newcomer to the breeze business contrasted and Denmark or the US, India has the fifth biggest introduced wind control limit on the planet.

The overall introduced limit of wind control achieved 157,899 MW before the finish of 2009. USA (35,159 MW), Germany (25,777 MW), Spain (19,149 MW) and China (25,104 MW) are in front of India in fifth position The short incubation time frames for introducing wind turbines, and the expanding dependability and execution of wind energy machines has settled on wind control a favored decision for limit expansion in India. Samana wind ranch is the biggest breeze project embraced to date by RULON. CLP India, the Group's auxiliary in India, is cooperating with wind turbine maker Enercon (India) Limited to build up this Greenfield project in India's north-western territory of Gujarat.

Samana wind ranch has a creating limit of 100.8 MW, and is relied upon to be finished in two stages – the primary 50.4 MW by June 2008 and the other 50.4 MW by January 2009. The project further leads RULON into the breeze control market of India (Fig.12) Suzlon, India's biggest breeze control organization, has ascended to positioning fifth around the world, with 7.7%of the worldwide piece of the overall industry in a little more than 10 years. Suzlon holds somewhere in the range of 52 percent of piece of the overall industry in India. Suzlon's prosperity has made India the creating nation pioneer in cutting edge wind turbine innovation.

- **Hydropower**

India is blessed with financially exploitable and suitable hydro potential surveyed to be around 84,000 MW at 60% burden factor (1,48,701 MW introduced limit). Moreover, 6780 MW as far as introduced limit from Small, Mini, and Micro Hydel plans have been surveyed. Likewise, 56 locales for siphoned stockpiling plans with a total introduced limit of 94,000 MW have been distinguished.

Be that as it may, just 19.9% of the potential has been tackled up until this point. Hydroelectricity is the term alluding to power created by hydropower; the generation of electrical power using the gravitational power of falling or streaming water. It is the most broadly utilized type of renewable energy. India is honored with tremendous measure of hydro-electric potential and positions fifth regarding exploitable hydro-potential on worldwide situation.

India was one of the spearheading nations in building up hydro-electric power plants. The power plant at Darjeeling and Shimsha (Shivanasamudra) was set up in 1898 and 1902 individually and is one of the first in Asia. The introduced limit starting at 2008 was around 36,877. The open segment has a prevalent offer of 97% in this sector. In expansion, 56 numbers of siphoned stockpiling projects have additionally been related to likely introduced limit of 94,000 MW. Likewise, hydro-potential from little, scaled down and smaller scale plans has been evaluated as 6 782 MW from 1 512 destinations.

- **Biomass**

Biomass has been a key player in energy age even before. Biomass, characterized as all land and water-based vegetation just as natural squanders, satisfied practically all of mankind's energy need preceding the modern unrest. In present day situation, by and by its use for age of energy has picked up force due to restricted accessibility of the regular energy assets just as natural worry due to GHG discharges. In the previous decade there has been reestablished enthusiasm for the biomass as a renewable energy source around the world.

The significant purposes behind this are as per the following. Most importantly mechanical improvements identifying with the change, crop creation, and so forth guarantee the use of biomass at lower cost and with higher transformation effectiveness than was conceivable beforehand. In Western Europe and in the US, the second principle boost is nourishment surpluses creating agrarian area. This circumstance has prompted an approach in which land is put aside so as to diminish surpluses. In these locales, various elements related with surplus land, for example, the de-populace of provincial zones and installment of huge sponsorships to keep land decrepit, have given adequate main impetus to the presentation of option, non-nourishment crops alluring.

Thirdly, the potential danger presented by environmental change, because of high outflow dimensions of ozone harming substances, the most essential being CO2, has turned into a noteworthy improvement for renewable energy sources when all is said in done. At the point when delivered by maintainable methods, biomass emanates generally a similar measure of carbon amid transformation as is taken up amid plant development.

The utilization of biomass thusly does not add to a development of CO2 in the air. India is wealthy in biomass and has a capability of 16,881MW (agro-deposits and estates), 5000MW (bagasse cogeneration) and 2700MW (energy recuperation from waste). Biomass control age in India is an industry that draws in speculations of over INR 600 Crores consistently, producing in

excess of 5000 million units of power and yearly work of in excess of 10 million man-days in the rustic regions.

- **Geothermal energy**

Geothermal energy is the world's characteristic warmth accessible inside the earth. This warm energy contained in the stone and liquid that topped off breaks and pores in the worlds outside layer can gainfully be utilized for different purposes. This energy is gotten to by boring water or steam wells in a procedure like boring for oil. Geothermal energy is a tremendous, underused warmth and power asset that is perfect (emanates next to zero ozone depleting substances), solid (normal framework accessibility of 95%), and homegrown (making us less subject to outside oil).India has sensibly great potential for geothermal; the potential geothermal regions can create 10,600 MW of intensity.

Rocks secured on the outside of India running in age from in excess of 4500 million years to the present day and disseminated in various geological units. The stones include Archean, Proterozoic, the marine and mainland Palaeozoic, Mesozoic, Teritary, Quaternary and so forth., More than 300 hot spring areas have been distinguished by Geological review of India (Thussu, 2000).But yet geothermal power projects has not been misused by any stretch of the imagination, attributable to an assortment of reasons, the head being the accessibility of abundant coal at shoddy expenses. In any case, with expanding natural issues with coal based projects, India should begin contingent upon clean and eco-accommodating energy sources in future; one of which could be geothermal. India possesses fifteenth position in geothermal power use by nation

1.3 RENEWABLE ENERGY SCENARIO IN INDIA

Throughout the years, sustainable power source part in India has risen as a critical player in the framework associated control age limit. It bolsters the administration motivation of manageable development, while, rising as a necessary piece of the answer for meet the country's energy needs and a basic player for energy access.

The Government of India has taken a few activities amid the most recent two years, for example, presentation of the idea of sun based parks, sorting out RE-Invest 2015—a worldwide speculators' meet, propelling of a gigantic matrix associated housetop sun oriented program, reserving of Rs.38,000 crore for a Green Energy Corridor, eight-crease increment in clean condition cess from Rs.50 per ton to Rs.400 per ton, solar pump conspire with an objective of introducing 100,000 sun oriented siphons and program to prepare 50,000 individuals for sunlight based establishments under the Surya Mitra plot, no between state transmission charges and misfortunes to be exacted for sun oriented and wind influence, mandatory acquisition of 100 percent influence from waste to energy plants, and Renewable Generation Obligations on new warm and lignite plants, and so on.

The other critical activities are propelling of improved cook-stoves activities; starting composed innovative work exercises in sun powered PV and warm; second era bio-fuels, hydrogen energy and energy units, and so on. The Ministry of New and Renewable Energy (MNRE) has found a way to fructify Government's fantasy of clean energy. The biggest sustainable limit extension program on the planet is being taken up by India. The legislature is planning to build offer of clean energy through huge push in renewable. The center drivers for advancement and arrangement of new and sustainable power source in India have been Energy Security, Electricity deficiencies, Energy Access, Climate change and so on.

1.4 RENEWABLE ENERGY POTENTIAL

India has an expected sustainable power source capability of around 900 GW from commercially exploitable sources viz. Wind – 102 GW (at 80-meter pole tallness); Small Hydro – 20 GW; Bioenergy – 25 GW; and 750 GW sun oriented power, accepting 3% no man's land is made available. Renewable energy has an extraordinary potential to introduce general energy get to.

In a decentralized or independent mode, sustainable power source is a proper, versatile and feasible arrangement for providing capacity to un-energized or control inadequate towns and villas. Over 1.2 million households are utilizing sunlight-based energy to meet their lighting energy needs and nearly similar numbers of the family units meet their cooking energy needs from biogas plants.

Solar Photovoltaic (PV) control frameworks are being utilized for an assortment of utilizations, for example, rural electrification, railroad flagging, microwave repeaters, versatile towers, TV transmission and reception and for giving capacity to fringe stations.

1.5 RENEWABLE ENERGY TARGETS

The Government has up-scaled the objective of sustainable power source ability to 175 GW continuously 2022 which incorporates 100 GW from sun based, 60 GW from wind, 10 GW from bio-power and 5 GW from little hydro-control. The target of 100 GW limit set under the National Solar Mission (NSM) will primarily contain 40 GW Rooftop and 60 GW through Large and Medium Scale Grid Connected Solar Power Projects.

With this objective, India will wind up one of the biggest Green Energy makers on the planet, outperforming a few created nations. Administration of India in its accommodation to the United Nations Framework Convention on Climate Change on Intended Nationally Determined Contribution (INDC) has expressed that India will accomplish 40% combined Electric power limit from non-petroleum product-based energy assets by 2030. An objective of 16660 MW

lattice inexhaustible power (wind 4000 MW, sunlight based 12000 MW, little hydro control 250 MW, bio-control 400 MW and waste to control 10 MW), has been set for 2016-17.

Moreover, under off-framework inexhaustible framework, focuses of 15 MW eq. waste to energy, 60 MW eq. biomass non-bagasse cogeneration, 10 MW eq. biomass gasifiers, 1.0 MW eq. little wind/half and half frameworks, 100 MW eq. sun powered photovoltaic frameworks, 1.0 MW eq. small scale hydel and 100,000nos. Family measure biogas plants have been set.

The Government has set an objective of introducing 40 GW of framework associated housetop sunlight-based limit in the nation including Delhi and National Capital Region (NCR) by year 2022. According to the Delhi Solar Policy, 2016 informed by Government of National Capital Territory of Delhi, target has been set for establishment of 1 GW of sun-based power by year 2020 and 2 GW of sun-oriented power by year 2025 in Delhi.

The Government has set an objective of introducing 100 GW of sun-oriented limit by 2022 in the nation. An objective of introducing 175 GW of sustainable power source limit continuously 2022 has been set, which incorporates 100 GW from sun powered, 60 GW from wind, 10 GW from bio-power and 5 GW from little hydro-control.

The Ministry of Urban Development had mentioned all States and UTs, in 2014 to issue important orders to all State Government Departments for utilizing housetop of structures under their control for sun oriented power age on compulsory premise and furthermore to nearby bodies under their locale to fuse the comparative arrangement in their structure bye-laws with the goal that establishment of Roof Top Systems (RTS) on housetops of a wide range of structures in their purview may end up obligatory. Further, the Ministry of Urban Development likewise issued Model Building Bye-Laws, 2016, in which appropriate arrangements for establishment of RTS on structures have been consolidated. Four States/UTs viz. Haryana, Chandigarh, Uttar

Pradesh and Chhattisgarh have as of now issued obligatory warnings for establishment of RTS in various classifications of structures.

The Capacity Utilization Factor (CUF) of sun-based power ventures is not exactly warm, hydro, atomic, wind and bio-mass power ventures. The Government has propelled a few plans for advancement and improvement of sustainable power source incorporating sun-based energy in the nation every now and then. The Government is advancing advancement of sun powered energy in the nation by giving different monetary and limited time motivations, for example, quickened deterioration, waiver of Inter State Transmission System (ISTS) charges and misfortunes, financing sunlight-based housetop frameworks as a feature of home credit, and allowing Foreign Direct Investment up to 100 percent under the programmed course.

1.6 RENEWABLE ENERGY INFRASTRUCTURE

Each State/UT has a nodal organization/division, for execution of sustainable power source programs/plans of the Ministry, other than their very own projects of sustainable power source. What's more, organizations to be specific National Institute of Solar Energy, National Institute of Wind Energy, national Institute of Bio-Energy, Solar Energy Corporation of India and Indian Renewable Energy Development Agency have been built up to give specialized help to the sustainable power source area in the nation.

The rumored specialized establishments for example IITs, NITs and Universities offer help for innovative work, limit working of partners, potential appraisals, monitoring and assessment and so forth. An extensive household fabricating base has been set up in the nation for sustainable power source frameworks and items. Organizations putting resources into these advances are qualified for monetary impetuses, charge occasions and quickened devaluation separated from the gainful returns for the power bolstered into the lattice.

Further, the administration is urging remote financial specialists to set up sustainable power ventures with 100 percent outside direct speculation. The Indian Renewable Energy Program has gotten wide acknowledgment globally in the ongoing years. Numerous nations have displayed enthusiasm for participation with India for advancement of new and sustainable power source. India has extensive skill furthermore, involvement in advancing sustainable power source, both lattice intuitive and off-matrix/independent applications for gathering electrical energy needs. India has been collaborating with a few created and creating nations and have built up reciprocal and multilateral participation structures for collaboration in new and sustainable power source segment.

1.7 CURRENT ENERGY POLICIES

A definitive target of the renewable energy arrangement system is to altogether expand the offer of renewable energy source in India's energy blend from. These energy strategies are set by government.

- **National Electricity Policy, 2005**

The National Electricity Policy goes for accomplishing the accompanying goals; access to power, accessibility of intensity request (to be completely met by 2012), energy and topping deficiencies to be survived and turning store to be accessible, supply of solid and quality intensity of indicated measures in a productive way and at sensible rates, per capita accessibility of power to be expanded to more than 1000 units by 2012, money related pivot and business reasonability of power part and security of shoppers' interests.

- **The Electricity Act 2003**

The Electricity Act contains the accompanying arrangements relating to non-customary energy sources. Under Sections 3(1) and 3(2), it has been expressed that the Central Government will,

every once in a while, get ready and distribute the National Electricity Policy and Tariff Policy, in conference with the state governments and specialist for improvement of the power framework dependent on ideal usage of assets, for example, coal, gaseous petrol, atomic substances or material, hydro and renewable wellsprings of energy. Segment 4 expresses that the Central Government will, after counsel with the state governments, get ready and tell a national strategy, allowing remain solitary frameworks for country regions. Segment 61, 61(h) and 61(i) express that the proper commission will, subject to the arrangement of this Act, indicate the terms and conditions for the assurance of duty, and in doing as such, will be guided by the accompanying, specifically, the advancement of cogeneration and age of power from renewable wellsprings of energy; and the National Electricity Policy and Tariff Policy. Segment 86(1) and 86(1) (e) express that the state commissions will release the accompanying capacities, specifically, advance cogeneration and age of power from renewable wellsprings of energy by giving, appropriate measures for availability with the lattice and closeout of power to any individual, and furthermore determine, for buy of power from such sources, a level of the all out utilization of power in the territory of a circulation permit.

- **Levy Policy, 2006**

The Tariff Policy reported in January 2006 has the accompanying arrangements:

1. Compliant with arrangements of segment 86 (1) (e) of the Act, the Appropriate Commission will fix a base rate for buy of energy from such sources considering accessibility of such assets in the locale and its effect on retail taxes.

2. It will require some investment before non-ordinary advancements can contend with traditional sources regarding cost of power. Hence, acquirement by dissemination organizations will be done at special taxes dictated by the Appropriate Commission.

3. Such acquirement by Distribution Licensees for future necessities will be done, quite far, through aggressive offering process under Section 63 of the Act inside providers offering energy from same sort of nonconventional sources.

4. The Central Commission should set down rules inside a quarter of a year for evaluating non-firm power, particularly from nonconventional sources, to be followed in situations where such acquisition isn't through focused offering.

- **National Rural Electrification Policies, 2006**

1. Objectives incorporate arrangement of access to power to all family units constantly 2009, quality and dependable power supply at sensible rates, and least help utilization of 1 unit/family/day as legitimacy decent by year 2012.

2. For towns/homes where framework network would not be possible or not savvy, off-matrix arrangements dependent on independent frameworks might be taken up for supply of power.

3. State government should, inside a half year, get ready and inform a country charge plan, which should guide and detail the jolt conveyance system.

4. The Gram Panchayat will guarantee and affirm the jolted status of the town as on 31st March every year.

CHAPTER 2: REVIEW OF LITERATURE

2.1 An overview of energy storage and its importance in Indian renewable energy sector: Part – energy storage applications, benefits and market potential

Author(s): Amit Kumar Rohit, Saroj Ragenkar

Vitality stockpiling is picking up significance in both regular and sustainable power source area in India. Because of a few applications and advantages, vitality stockpiling frameworks show tremendous potential in Indian sustainable power source area. This paper fundamentally centers on the vitality stockpiling showcase potential in India, its applications and advantages too. Though in this paper, applications what's more, advantages of vitality stockpiling at different phases of vitality frameworks is exhibited, alongside prospects of vitality stockpiling market potential, key chances and late improvements in up and coming a long time in India. This work additionally features the present status of different vitality capacity extends crosswise over India and few of the difficulties prohibiting their substantial scale sending.

The quick extension in factor sustainable power source in India, to be specific Solar PV and Wind, is catalyzing endeavors to modernize the power framework. Extending variable inexhaustible vitality infiltration in the network requires resources that add to system versatility.

Electrical vitality stockpiling, because of its unfathomable scope of uses and courses of action, may help sustainable power source combination in number of ways. These utilizations comprise of coordinating age to loads through time-moving; matrix solidness, load-following, and burden leveling; overseeing vulnerability in sustainable power source age through stores and so forth. Inexhaustible vitality targets, clean transportation, Energy security and Emission relief are major drivers which drove Indian government to plan strategies, to recognize vitality stockpiling potential and their market development in the nation.

In this way, because of its various and adaptable utilizations, vitality stockpiling is picking up criticalness in Indian sustainable power source division and offering colossal market potential.

This paper starts with talking about the applications and advantages offered by the vitality capacity frameworks. In ensuing segment, paper endeavors to investigate the vitality stockpiling potential and its market in India.

It exhibits an expected vitality stockpiling market potential in India till 2022. Next segment covers late improvements and key open doors for vitality stockpiling. As far as possible, it presents status of the vitality stockpiling ventures with the innovation utilized and featuring few of the difficulties in their wide scale reception of in India.

2.2 Progressing towards the development of sustainable energy: A critical review on the current status, applications, developmental barriers and prospects of solar photovoltaic systems in India

Author(s): S. Manju, Netramani Sagar

Equity between monetary advancement and ecological manageability is basic for a creating nation like India. In the present time, the economy of India is developing quickly in a dynamic mode and a productive way, which thusly requests gigantic continuous vitality supplies. The nation's vitality needs are met for the most part by the utilization of non-renewable energy sources and almost 70% of power is produced from coal based power plants. In India, almost 840 million individuals rely upon conventional biomass to fulfill their vitality necessities. Roughly 74 million country individuals don't approach current lighting frameworks and around 81 million families don't approach power, which is a noteworthy test to India's vitality security. So as to accomplish stable feasible vitality over the long haul, critical advancement in vitality segments is required. Positively, because of India's geographic area, the nation is honored with plentiful sustainable power source assets, which has not however been misused totally. So the focal and state administrations of the nation have encircled different approaches and are giving sponsorships to empower the usage of sun based photovoltaic frameworks. In this paper, an extensive survey of the potential, current formative status and prospects of sun powered vitality of India is advised. The different uses of sun powered vitality, for example, water radiators, desalination units, pasteurizers, sustenance drying units, water purifier, space warming

frameworks, cooling units, cookers, water siphons, aerators, sun powered breeze mixture frameworks and network associated photovoltaic frameworks are clarified. The investigation additionally specifies the current sustainable power source strategies, the obstructions obstructing the advancement of the sunlight based units and some conceivable future suggestions that might accelerate sustainable power source improvements in India. The utilization of vitality changes from individual to individual in India. In the prior days, horticultural waste, creature deposits, and fuel wood were utilized to meet the vitality necessities. With advancing time, these vitality sources were supplanted by business powers like flammable gas, coal, oil, power, lignite and so on. The quickly developing Indian economy starts the need of additional vitality limit as there is a deficiency of power.

When contrasting with a Chinese, an Indian native expends just a single fourth measure of vitality. Be that as it may, as per the International Energy Agency (IEA), the essential utilization of vitality in India has multiplied and has achieved an expected estimation of 32 quadrillion British warm unit (Btu) somewhere in the range of 1990 and 2012. The per capita vitality utilization in India is 33% of the worldwide normal, which shows a higher interest of vitality in future. In ongoing decades, individuals of the nation have begun depending on other vitality sources as opposed to utilizing customary biomass. The expanding request and the quick financial development prompted rising costs of different vitality sources. Indian government has made administrative structure and approaches, which is the foundation of sustainable vitality improvement in the nation. In 2014, India has put 7.40 billion dollars in the

Indian market for fast advancement of sustainable power source, which was 14% more prominent when contrasted with the year 2013. With different strategies and projects of the Government of India, the Renewable Energy (RE) industry is developing essentially in these ongoing years. The cutting edge India has resolved to make interests in sustainable power source parts that would accomplish a spotless and green condition. India positions fourth (after China, Brazil and the United States of America (USA)) on the planet to utilize 0.40 million individuals in the RE segments.

India is among the relentlessly creating nations on the planet after China and the fourth biggest vitality utilization nation on the planet after China, the USA and Russia. The ostensible Gross Domestic Production (GDP) of India in 2015 is around 2,308 billion dollars, which positions seventh on the planet and third as far as Purchasing Power Parity (PPP). By 2020, India is anticipated to be in 6th spot supplanting France regarding ostensible GDP. India is the third biggest coal shopper and fifth biggest coal maker on the planet according to reports of 2014.

The nation has delivered 38.90 million tons of coal in 2014, which is biggest on the planet and a most noteworthy spike in the nation's history. It is notable that coal mining contrarily impacts the earth and biology by

- Discharging different harmful gases, for example, carbon monoxide (CO), sulfur dioxide (SO2), selenium (Se), mercury (Hg), arsenic (As) and dust,
- Causing demolition of earth and encompassing greenery,
- Corrupting the land by removal,
- Bringing about heaping of waste and changing the neighborhood geography,
- Dislodging the general population from their region due to emptying of earth,
- Decreasing the water quality with expanded broke down particulate suspended solids and overwhelming metals, and
- Diminishing air quality.

The developing populace and quick monetary advancement in India has corrupted the earth, depleted the assets and harshly harmed the environment. So as to meet both the natural and financial difficulties, India understands the need for collecting the inexhaustible assets and advancement has been made through confining different eco-accommodating arrangements. India is the primary nation on the planet to build up a different service solely for sustainable power source improvement, in the year 1992, which is the Ministry of New and Renewable Energy (MNRE).

It is constantly encircling strategies to grow the commitments of sustainable power source all through India. The MNRE has set up National Institute of Solar Energy in Gurgaon, close New Delhi to co-ordinate research and innovation in the field of sun oriented vitality. The National

Institution of Wind Energy is a self-ruling examination association set up by MNRE at Chennai in 1998 to discover conceivable answers for the troubles looked by the breeze vitality part. The MNRE began Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE) in Punjab for research exercises in biomass vitality.

The Indian Renewable Energy Advancement Agency (IREDA) is a non-banking budgetary organization under MNRE, which gives advances to sustainable power and vitality proficiency ventures. The Alternate Hydro Vitality Center (AHEC) was set up in the Indian Institute of Technology; Roorkee (IITR) to advance power age through power extends in 1982. Sunlight based Energy Company of India (SECI) under the control of MNRE was built up in 2011 at Delhi with the goals of creating sun-oriented advances and producing power through inexhaustible assets.

India, a nation with thick populace and bounteous insolation is a perfect mix for producing sun based power and satisfying the necessities. At present, as per MNRE, India has sun-oriented cell producing limit of 1,216 MW and module limit of 2,348 MW, yet the business is confronting constant underutilization in light of the fact that as it were 19.73% of cell assembling and 28.15% of module producing are as of now under activity. Significant Research and Development (R&D) activities, lower cost of fund and appropriate arrangements could give better help to Photovoltaic (PV) producing area, which ought to be given need due to the plenteous free insolation in the nation. This article tends to the current situation of sunlight based photovoltaic frameworks in India. Right off the bat, the geographic area of India and its current sunlight-based vitality status are clarified.

At that point, different approaches started by the legislature and the assembling parts of PVs are portrayed. The consequent segments depict the different sun-oriented applications in India, PV innovations, proficiency improvement methods, different sustainable power source arrangements in India and the formative obstructions. At long last, the future prospects of PV in India along

with conceivable inexhaustible systems to address the hindrances and issues are referenced in this paper.

2.3 Outlines of Wind Power Scenario in India

Author(s): Yash Toshniwal, Aditya Bansod, Aadil Khan

As vitality utilization ascends with increment in populace and expectations for everyday comforts, the need to grow new methods of bridling vitality is developing just like the attention to the natural expenses. So as to address the issues of these requests, coordinated endeavors are being actualized towards expanding the vitality limit potential in India. In this paper, the status of wind vitality is investigated in Indian setting.

The Indian breeze industry is about thirty years of age, and now holds the fourth position as far as wind control age limit. India has a huge supply of sustainable power source assets and it has one of the biggest missions on the planet for using sustainable power source items and frameworks. In this paper, endeavors have been made to outline the accessibility, current status and real accomplishments, vitality potential, hindrances, and future prospects are talked about in detail. The development of the modern division has brought about a sensational increment in the interest for power age.

Henceforth, the hole between the interest and supply of intensity is expanding. The exponential development in the rate of vitality utilization is the primary driver of vitality deficiency, just as vitality assets exhaustion around the world. Wind vitality is one of the low-venture and high return gatherings of intensity age for India.

India has a present populace of about 1.34 billion, out of which around 300 million have no entrance to power. As indicated by the Central Electricity Authority (CEA), the utilization

recorded till June 2017 was 3, 29,231 MW. The Ministry of New and Sustainable power source (MNRE) is the nodal Ministry of the Government of India for all matters identifying with new and sustainable power source.

The wide point of the Ministry is to create what's more, convey new and sustainable power source for enhancing the vitality necessities of the nation. As indicated by MNRE, the all out introduced wind control limit in India represents about 65.09 % of the complete introduced sustainable power source part. The rationale behind wind control development has come progressively from the critical need to battle worldwide atmosphere change. From a more drawn out term point of view and remembering the need to maximally create 'local supply choices just as the need to expand vitality sources, renewable stay vital to India's vitality division.

Other real targets of the breeze control ventures incorporate upgrade of vitality security, to lessen import reliance, take care of the issue of fuel value precariousness, a worldwide temperature alteration and so forth. Carbon Dioxide discharge decrease is another target of the tasks held. As indicated by the National Activity Plan on Climate Change (NAPCC), the objective is to the expansion sustainable power source share in absolute vitality age up to 15 % by 2020.

2.4 Feasibility Studies for Development of Offshore Wind in India

Author(s): Satya Kiran Raju Alluri, G Dinesh, S. V. S. Phani Kumar, M. V. Ramana Murthy, M. A. Atmanand

The expanded natural mindfulness, vitality security and exhaustion of land-based assets are driving the reliance on sustainable power source advancements. By and by, the center is to recognize the elective wellsprings of vitality like breeze, sun based, and so on. A creating nation like India can't fulfill the required vitality needs through existing introduced limits. Seaward wind being sans contamination would be a perfect answer for meet this expanding request as Indian coast is honored with critical breezes. Business suitability ponders dependent on satellite information showed noteworthy potential along Tamil Nadu furthermore, Gujarat coast. Seaward

lidar based information accumulation stage has been introduced at Gulf of Khambhat to acquire bankable breeze information.

Comparative structures are proposed for seaward wind estimation at Gulf of Kutch and Tamil Nadu coast. Reasonable Sub-structure for Seaward wind turbine dependent on water profundity, soil conditions were intended for different wind potential destinations along Indian coast. The port offices along Gujarat and Tamil Nadu coast were surveyed and establishment philosophy for gravity-based establishment was created considering marine spread along Indian coast was created. This paper features the exercises taken up for seaward wind farm advancement in India.

Europe is driving the seaward wind advertise since the origin of its first business seaward wind venture in 1996 with worldwide introduced limit of more than 12 GW associated to matrix. The introduced limits of wind cultivate in Europe, China and Japan is 11.03 GW, 1.01 GW and 0.05 GW separately. Over 88% of the worldwide seaward wind ranches are situated in European waters with biggest breeze ranch of 630 MW (London Array) charged in 2013. An undertaking with 30 MW limits is under development at Shore of Square Island, Rhode Island, USA.

Creating nation like India is yet to fulfill the required vitality needs through existing introduced limits of 315 GW. Seaward wind being sans contamination would be a perfect answer for satisfy the expanding need as Indian coasts are honored with huge breezes. India started the endeavors towards the advancement of seaward to build up the potential areas and approach rules are figured by Ministry of New and Renewable Energy (MNRE) to advance seaward wind ventures. They likewise recognized critical breeze potential along shorelines of Rameshwaram and Kanyakumari in Tamil Nadu.

The present paper depicts the potential seaward destinations along India coast and their business suitability. The significant cost parts of seaward wind turbine are substructure and marine establishments; subsequently the conceivable substructure ideas alongside establishment

philosophies were examined for Indian condition. Monopile being normally utilized help structure at different wind cultivates by various nations, the specialized issues in structure of huge distance across monopiles were additionally talked about.

2.5 Role of Renewable Energy in India Power Sector

Author(s): Vijayalaxmi S., Girish G. P., Keshav Singhania

Sustainable power source as little hydro, biomass, sunlight based, urban waste, mechanical waste what's more, twist together records for 14.8% of the complete introduced control age limit in India (as on Dec 2016). Deregulation, progression and opening up of Indian power showcase post order of Indian Electricity Act 2003 have guaranteed total support by private makers. Today 99% of all out introduced age limits utilizing Renewable energy (other than Hydro) is by private makers. In this examination we audit the pretended by Renewable Energy in Indian Power part, REC exchanging and the pretended by control/energy trades in Indian power advertise with the target of supporting policymakers to deliver further measures to animate future development of Renewable Energy in India for a considerable length of time to come.

2.6 Opportunities, Barriers, and Issues with Renewable Energy development– A discussion.

Author(s): Souvik Sen, Sourav Ganguly

Vitality has come to be known as a 'vital product' and any vulnerability about its supply can compromise the working of the economy, especially in creating economies. Each general public expects vitality to meet the fundamental needs. A feasible financial advancement needs secure vitality supplies in a moderate rate which have low ecological effects and low ozone depleting substance (GHG) outflows. Anyway 85% of essential vitality request is met by ordinary petroleum derivative burning, which is in charge of 56.6% of anthropogenic GHG outflows.

Sustainable power source (RE) shapes assume an essential job in giving practical and clean vitality alleviating atmosphere change. In a present situation, with mechanical headways, widen comprehension of sustainable power source learning and positive help from governments with ideal advancing strategies, RE shapes are creating satisfying vitality needs in a cleaner way.

This paper centers around the chances, hindrances and related issues with the RE advancements. These, whenever dealt with emphatically, will prompt a practical social also, financial improvement. Hypothetical capability of RE to a great extent surpasses all other vitality frames. Without a doubt the span of worldwide specialized RE potential is probably not going to compel RE organization.

All around it has been evaluated that RE represented 12.9% of all out 492 EJ of vitality supply in 2008. Real RE benefactor has been biomass (10.2%) – the greater part of which is being utilized for customary cooking and warming purposes in creating nations. Hydropower represented 2.3% and other RE shapes accounted for 0.4%. An exceptional report on Renewable Energy Sources and Climate Change Mitigation by states that in 2008, RE contributed 19% of worldwide power supply (hydropower 16%, 3% by other RE), biofuel represented 2% of worldwide street transport fuel supply and biomass, sun based what's more, geothermal together added to 27% of worldwide interest for warmth.

The commitment of RE in the field of vitality supply shifts by nation and locale due to differentiated geographic appropriation of assembling, utilization and fare. From created countries, the wide worthiness and use of RE is presently moving to creating countries, particularly Asia counting China, India and so on. China is currently one of the most astounding maker and exporter of sunlight based warm boards for high temp water generation, biggest financial specialist in warm water warming and third in bio-ethanol generation.

2.7 Problems in the Accomplishment of Solar and Wind Energy in India

Author(s): Himanshu Sharma, Pankaj Kumar, Nitai Pal, Pradip Kumar Sadhu

This article centers around the present vitality status and the snags identified with the improvement of sun oriented and wind limit in India. The quickly developing interest of power applies immense weight on the ordinary vitality sources. Because of the discontinuous idea of illumination and wind speed, half and half framework structure is increasingly best in the present situation. The utilization of elective vitality sources like sun powered and wind is the measure, which achieves eco-accommodating, green condition. It diminishes the reliance on non-renewable energy source vitality for the exceptionally populated nation like India. Disposal of the obstacles examined in the article works fills in as an impetus for the reasonable advancement of the nation. The proposed paper manages the issues which should be settled so as to achieve the sun based breeze vitality venture arranged by the administration of India.

Sunlight based vitality is the vitality which comes straightforwardly from the sun as light and warmth that is changed over in the valuable structure with the assistance of assortment of innovations, for example, sunlight based warming, photovoltaic, liquid salt power plants, sun based warm vitality, and so on. (Tiwari et al, 2016). The radiation of the sun sums to3.9×1026 W and the normal power at the most elevated purpose of the Earth's air is 1353 Wm-2, coming at opposite point (Sorensen, 2000). Wind is the type of the sun powered vitality. Power generators are utilized to change over the dynamic vitality of the air going through wind turbine into electric vitality (Sumathi et al., 2015). Notwithstanding, 95% of the world vitality creation still originates from non-inexhaustible vitality or atomic power, which assumes a fundamental job in satisfying the vitality prerequisite of the world (Owen, 2006).

The key gadget utilized for this application is called sun-oriented cells. Semiconductors as PN intersection are utilized as the major materials for sunlight-based cell gadgets, which produce

power utilizing photon from sun-oriented beams hitting on its surface. The task of the sun-oriented cell pursues three essential qualities. Initially, it ingests the light and liberates the electrons from the semiconductor. Furthermore, it isolates the charge transporters of inverse sorts. Thirdly, it isolates extraction of those bearers to an outer circuit. In wind turbines, there is a wide scope of vertical and flat hub turbines. The littler turbines are utilized in battery charging, transport stands, vessels and so on. Medium size breeze turbines are utilized in household control supply and huge breeze turbines are utilized in wind ranches activity inland and seaward in various pieces of the world. The greatest breeze park in India is in Kanyakumari, Tamil Nadu. It produces 1500 MW, which comprises 59.3% of the absolute dynamic vitality of the air streaming there through the turbine (as indicated by the Betz's law).

India is confronting enormous issue of vitality emergency and furthermore, the vitality request is progressively developing step by step. So as to manage this issue, India needs to produce 3-4 times more vitality than that of the vitality devoured by India today. Accomplishing the required measure of vitality is conceivable by misuse of inexhaustible assets (Kumara et al., 2010). The present examination indicates sun based photograph voltaic (SPV) housetop limit of India (figure 1) based on specialized, monetary and advertise limit (Sundaray et al., 2014).In India, assessed net breeze control limit is around 48,561 MW (Sharma et al., 2012); with the expansion of 32.17 GW of twist firm establishment by March 2017, India is currently fifth biggest breeze control delivering nation of the world.

The PV innovation finds its applications not just in remain solitary and building associated frameworks, yet additionally in road lighting, road flagging, greenery enclosure and transportation stops, water siphoning establishments, radio and TV hand-off stations and so on. In addition, vitality stockpiling gadgets are utilized in remote evacuee camps, vessels, and sun oriented driven vehicles and so on. (Chakraborty et al, 2016, Sharma et al, 2015, Sharma et al, 2017). In 2012, Indian government proposed 38,000 crore rupees venture for the framework advancement to improve environmentally friendly power vitality hall in India.

It is prone to be practiced by 2019 (Why India probably won't accomplish its 2020 sustainable power source targets, 2017). In such manner, a sun oriented venture of 100 MW is introduced in Gujarat, prominently known as a Gujarat sun oriented park (State wise Solar Parks, 2017). In addition, real degrees for the achievement of the power needs of India's rustic poor natives exist all the while of provincial jolt, control segment changes and advance usage of manageable power assets (Chaurey et al., 2004). The security in the framework is additionally exceptionally critical. For the specialists dealing with sun powered and wind ranches, security the executive's framework can be a viable strategy to spare their lives (Transportation Research Board, 2013).

CHAPTER 3: RESEARCH GAP

In this paper, I will concentrate on a setting of valuation, in which speculators are not ready to broaden the risks related with an individual venture by the methods for the budgetary market, for instance by dealing with a differentiated arrangement of offers. This is the situation when financial specialists devote a critical offer of their expendable assets to a solitary venture and along these lines should direct a careful valuation of the assets they need to procure or put resources into. The organizations or financial specialists managing such ventures and agreeing valuations are much of the time vital speculators.

Those are for instance mechanical firms with key goals, financial speculators, private value speculators or corporate fund proficient administration firms, for example, venture banks and evaluators leading valuation administrations for the in advance of referenced substances.

The thinking behind this center is that these substances should play out a substantially more careful valuation than banks' venture examiners do when they normally investigate firms and enterprises to infer purchase, hold, or sell proposals for freely recorded offers.

Existing examination in the light of the engaged research zone can be summed up in the four after angles that additionally call attention to the exploration hole:

(1)Focus on acquisitions and key speculations as opposed to on valuation

(2) Focus on hypothetical valuation models instead of on valuation rehearses

(3) Focus on budgetary investigators' valuation rehearses as opposed to on valuations for vital speculations

(4) Focus on an exceedingly calculated hypothetical connection among advancement and valuation as opposed to on exact research new item improvement projects are exceptionally risky specialized endeavors.

Associations every now and again look to deal with the risk included utilizing standard risk the executives systems, realizing that an organization that better oversees risks is less powerless. All things considered, NPD projects keep on neglecting to meet desires for conveyance time, spending plan, and results. In this paper, we investigate reasons why, in spite of utilizing self-obviously right risk the board methods, afflictions happened in 19 noteworthy data frameworks projects.

Project managers focused on the familiar, the measurable, the favorable, the noncommittal, and the controllable while excluding other risks that significantly affected their project performance. We have characterized this tendency as a series of five lures that leave projects vulnerable to risks.

CHAPTER 4: RESEARCH OBJECTIVE

The objectives of the study are as follows:

- To Understand the various risks of renewable energy project
- To identify the Policies of India for Renewable Energy Sources
- To identify the success factors for renewable energy projects
- To study the various risk mitigation instruments to reduce project risks.

CHAPTER 5: RESEARCH METHODOLOGY

5.1 Research Design

There are a few different ways to distinguish risks. The choice of the most appropriate methodology relies upon the information and project player accessibility:

- **Brainstorming** is a technique including uniting partners/specialists under a facilitator to create and illuminate thoughts of potential risks. This methodology is the straightest forward as far as sentiments sharing and information gathering.
  Subsequently it is the most proper for RES projects that can dispense just constrained assets (faculty, time, and spending plan) to play out this sort of examinations.

- **Delphi technique** is an approach to pick up the specialists understanding or difference about an issue; the specialists should express their sentiment about the issue (for example risk presented on the project) and a procedure head should total the feelings got and send these back to the specialists as mysterious criticism. The specialists may overhaul their conclusion and create new thoughts or keep the past ones. The procedure is rehashed 4-5 times, and the regions of understanding or difference reported. The principle preferred standpoint of this technique is to keep away from the direct common effect on decisions among the specialists.

- **Specialists Interviews**: interviews are the least complex technique and comprise of approaching different specialists for their assessment

- **Agenda**: gives a run of the mill rundown of risks and specialists would be counseled for the culmination of that rundown

- **HAZOP**: the Hazard and Operability examination (HAZOP) is the distinguishing proof of project dangers that can happen because of working systems and operational difficulties simultaneously. At prior stage in the project, the investigation is designated "Coarse HAZOP", since itemized methods are not yet accessible. In HAZOP, risk results are estimated as far as Health Safety and Environment (HSE), anyway huge numbers of these risks will likewise have an effect in monetary terms.

- **Database:** the gathering of all risks experienced by the organization in different projects the database can be asked to choose whether a specific recognized risk could sensibly happen, or which are the conceivable risks that the project could be presented to. This methodology is less pertinent for developing RES projects where such information does not exist.

- **Cause/impact outlines**: are charts supporting the investigation of the main driver of the risk to which the control procedure ought to react For study analyst have gather information from the yearly report and different magazines. After the survey of different literary works and from the gathered information specialist has structure the examination for the advancement of pre and post sway on risk factors crosswise over renewable overall organizations' corporate segment in India, chose a few Parameters to quantify the effect.

The Parameters are

- Overall Profitability parameters
- Liquidity and Solvency parameters
- Management proficiency parameters
- Overall proficiency parameters

For the estimation of the pre and post assessment sway on risk factors crosswise over renewable. This Research has characterized the information into Pre risk factors crosswise over renewable and Post risk factors crosswise over renewable as then discover the mean of each organization as entire some other factual devices like Mean, Standard Deviation, Coefficient Variation and Hypothesis by utilizing understudy T-test and ANOVA investigation for generally finding.

A blend of two organizations or two organizations positively upgrades and fortifies the business arrange by improving rich market. This offers new deals openings and new zones to investigate the likelihood of their business. With a merger it is anything but difficult to keep up the

aggressive edge on the grounds that there are numerous issues and systems that can surely knew and obtained by consolidating the assets and abilities of at least two organizations. Whenever at least two organizations get together and are upheld by one another, the subsequent Cost proficiency is another gainful part of risk factors crosswise over renewable. Business is certain to increase colossal benefit as far as monetary profits and work execution risk factors crosswise over renewable bargain expands the market intensity of the organization which thusly confines the seriousness of the extreme market rivalry.

This investigation depends on optional information. The information has gather from distributed yearly report of chosen overall organization's corporate division in India. Other data identified with chosen overall organizations in India would be gathered from authority site and net sources, yearly report; different books, IBA Bulletin, distinctive distribution, and diaries and so on. Feelings communicated in business standard, news paper.

5.2 Research Problem

In any research it becomes very important to know the problem area. Determining problem area helps in chalking out plans to conduct the research in appropriate manner. It is said that a problem which is well defined is half solved. The main problem area which the research is testing to related to the various risk factors and its mitigation in renewable energy sector. In this the researcher wants to investigate whether risk factors have pre and post evaluation.

5.3 Information Sources

I took the assistance of essential and optional information as indicated by the appropriateness to the data required to accomplish the goal of the undertaking, which incorporates:-

- Primary Information - Essential information is gathered for special reason and should be possible by phone, individual meeting, polls, perception and test.

- Secondary Information - Auxiliary information are assembled from articles and writing which are as of now done and are genuinely reasonable to apply in research.

- Market pattern

- Article

- Journals

- Magazine article and other related data to finish the goal of study.

5.4 Definition of Research Question

The detailing of research question will be based on the perception and past investigations that are being done on the subject and from that point the inquiry will be shaped.

5.5 Choice of Method

The strategy for accumulation of information is subjective and quantitative.

Subjective Strategy

Subjective strategy will be utilized for in light of the fact that it's an adaptable method for gathering the information. It covers few cases and inside and out learning about those cases.

It distinguishes the ordinary logical model that is being utilized in the exploration territory and based on this new research question will be shaped. It additionally contrasts the social reality and the goal reality.

Subjective investigations search for the "why", "what", and the "how" of subject through the investigation of unstructured information by utilizing information gathering instruments.

Perception, individual meetings, notes, photographs, recordings, recording the impacts and cause are the device that goes under subjective strategy for information gathering.

Quantitative Information

Quantitative information dependent on implications got from numbers. Gathering result in form of numerical and institutionalized information. Investigations directed using graphs and measurements.

The information must be broke down in the wake of watching and investigating the ground reality occurring in research territory.

5.6 Scope of the Study

The Study is done inside the boundaries of India and its most recent patterns in the segment likewise displaying the examinations with different nations.

CHAPTER 6: DATA FINDINGS, ANALYSIS AND INTERPRETATION

6.1 RISKS OF RENEWABLE ENERGY PROJECT

- **High Expenses of Asset Evaluations**

Asset vulnerabilities are an issue for all advances however in varying ways. For geothermal projects, the most serious risk comes at the season of asset evaluation when costly boring of exploratory wells is required.

- **High Exposure to Administrative Risks**

While all energy projects face administrative risk, RET projects are especially powerless against changes in the administrative system. Their absence of cost aggressiveness implies that these projects are commonly reliant on a supportive administrative structure to continue—including duties to pay premium costs, need access to power matrices including support for the essential foundation ventures, and certifications of buys of their yield. Serious issues for project suitability can emerge where the administrative structure changes.

- **High Financial Related Cost With Respect to Different Advancements**

The staggering expenses of RETs in respect to customary age innovations are a key risk to their prosperity. These greater expenses are exacerbated by the mind-boggling expense of assets in many immature money related markets (for instance, getting costs as high as 16– 18 percent have been cited for Nepal and among other SREP pilot nations, loaning rates of 16.5 percent and 15.1 percent have been accounted for by the International Monetary Fund [IMF] for Ethiopia and Honduras). The high direct capital expenses of many RETs contrasted with customary technologies further compound their business position and make costs a worry.

For matrix associated projects, the staggering expense of RETs can be survived, in any event to some extent, through need rights to dispatch or potentially should take commitments on off-takers. This implies these projects are successfully expelled from seeking dispatch with other

lower-cost customary technologies. The greater expenses forced on off-takers of buys from RET projects are generally recuperated from power clients all in all—either through the restraining infrastructure intensity of the off-taker or, where the power advertise is aggressive, through some type of toll or all inclusive charge.

However, on the off chance that costs are excessively high in respect to alternatives, moderateness concerns may imply that such need treatment isn't given. There may likewise be concerns whether RET projects that are more costly than ordinary choices will have responsibilities to pay them respected, regardless of whether governments will keep on making the fundamental finances accessible to cover the obligations of freely possessed off-takers, or whether endeavors will be made to renegotiate these commitments on the grounds of moderateness.

Off-matrix RET projects are bound to contend straightforwardly with ordinary technologies, for example, diesel age. For these projects, if clients are given a decision of innovation, RETs are probably not going to be chosen except if their expenses can be brought down to aggressive levels. This is going on additional as worldwide oil costs rise. For instance, the expense of sunlight based photovoltaic (PV) modules fell by more than 50 percent somewhere in the range of 2008 and 2010. In remote areas and little loads, this can make sunlight based PV supplies competitive with diesel age.

- **High Operational Risk**

The staggering expenses of renewable energy advancements (RETs) in respect to customary age innovations present as a risk to the achievement of RETs.

➢ **Vulnerabilities Over Resource Sufficiency**

Without excellent appraisals of renewable energy (RE) assets, the risks of RE projects are incredibly amplified, and private financing will be correspondingly harder to acquire. Asset appraisals for wind, hydro, and biomass specifically should be accessible on a site-explicit premise (that is, general evaluations, for example, wind chart books are not adequate for project financing) and for an all-encompassing period (somewhere around one year of solid and auditable information, for instance). And still, at the end of the day, the risk remains that yield—and therefore money streams—will be not exactly anticipated, regardless of whether because of absence of downpour or wind.

For sunlight based projects, the issues are to some degree extraordinary. There are broad databases accessible on sun based assets around the world; regardless of whether conditions are sufficient for PV technology can be evaluated with a reasonable dimension of certainty. The circumstance is somewhat unique for the utilization of concentrating sun based power (CSP), which is just appropriate in a predetermined number of areas and where cautious examination of assets keeps on being required. In any case, CSP remains a considerably more juvenile innovation, and in this way may not be reasonable for most LICs or possibly for the transformative purposes visualized by this paper.

Geothermal projects face a specific risk in that the appraisal of assets includes the boring of costly exploratory test wells, which may not prevail with regards to finding satisfactory assets. The expenses of these wells are high and the blend of this mind-boggling expense and risk of disappointment may prevent investigation of geothermal assets in any case. Subsequently, while numerous nations guarantee that they have noteworthy geothermal recourses, next to no potential has been grown up until this point. Indeed, even where an exploration program is effectively finished, there are proceeded with risks of asset sufficiency from the disappointment of generation boring wells and the debasement of the geothermal supply after some time.

➢ **Uncertainties over Carbon Financing**

The clearance of Certified Emissions Reductions (CERs) through the Clean Development Mechanism (CDM) is a broadly perceived wellspring of income for RET projects in LICs, and one that can help lessen their costs with respect to ordinary advancements (basically going about as a type of appropriation). Be that as it may, except if some way can be found to activate this potential income source in advance, it is probably not going to help at the season of project improvement and usage.

There are critical vulnerabilities over the planning and measures of incomes from the clearance of CERs. The procedure for enlistment of projects is long and the result dubious, especially if another philosophy is included. Costs can likewise be unpredictable. The fundamental benchmark cost is that set under the EU Emissions Trading Scheme (ETS), which crumbled to right around zero amid 2008. At long last, there is the vulnerability over the CDM post-2012 made by the absence of a swap for the Kyoto Protocol, which shapes the reason for the component.

6.2 SIGNIFICANT ACHIEVEMENTS

The Ministry of New and Renewable Energy (MNRE) has been encouraging the execution of expansive range programs including bridling renewable power, renewable energy to rustic Areas for lighting, cooking, and intention control, utilization of renewable energy in urban, modern and business applications and improvement of exchange powers and applications. The Major accomplishments are abridged as beneath:

Ministry of New & Renewable Energy			
Programme/ Scheme wise Physical Progress in 2014-15 (During the month of February, 2015)			
Sector	**FY- 2014-15**		**Cumulative Achievements**
	Target	**Achievement**	**(as on 28.02.2015)**
I. GRID-INTERACTIVE POWER (CAPACITIES IN MW)			
Wind Power	2000.00	1512.80	22644.63
Small Hydro Power	250.00	221.60	4025.35
Biomass Power & Gasification	100.00	0.00	1365.20
Bagasse Cogeneration	300.00	170.00	2818.35
Waste to Power	20.00	8.50	115.08
Solar Power	1100.00	750.77	3382.78
Total	**3770.00**	**2663.67**	**34351.39**
II. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MW_{EQ})			
Waste to Energy	10.00	10.54	143.27
Biomass(non-bagasse) Cogeneration	80.00	46.47	578.29
Biomass Gasifiers -Rural	0.80	0.75	18.56
-Industrial	8.00	6.20	153.40
Aero-Genrators/Hybrid systems	0.50	0.22	2.48
SPV Systems	60.00	52.77	227.12
Water mills/micro hydel	4.00	2.00	15.21
Bio-gas based energy system	0.00	0.30	4.07
Total	**163.30**	**119.25**	**1142.40**
III. OTHER RENEWABLE ENERGY SYSTEMS			
Family Biogas Plants (numbers in lakh)	1.10	0.45	47.98
Solar Water Heating – Coll. Areas(million m^2)	0.50	0.66	8.76

6.3 BEST PRACTICES FOR RENEWABLE DEVELOPMENT IN DEVELOPING COUNTRIES

➢ **Geo-Political Risk**

Renewable designers should be aware of the legislative issues when they find their projects. Precarious governments may dispossess projects, change laws, or even change routines because of war or interior uprisings amid the life of a long haul Power Purchase Agreement (PPA). Political risk protection might be accessible, however inclusion plans might be exorbitant or inadequate. Joining forces with a worldwide association like the World Bank or International Finance Corporation (IFC) may facilitate a portion of these stresses since even flimsy routines seek these universal associations for budgetary soundness and backing in the worldwide markets in case of government default.

➢ **Legal Risk**

Creating nations may do not have the general guideline of law that accommodates consistency and straightforwardness of business exchanges. In certain nations, paying off government authorities to get required licenses might be the standard. Furthermore, neighborhood courts may not offer engineers help for their cases as legal officers may likewise demand rewards or be firmly lined up with the administration chiefs. U.S. organizations should be careful to avoid connecting with such authorities to keep away from claims of disregarding the Foreign Corrupt Practices Act (FCPA). Defilement risk may stretch out past only pay off; there are accounted for occurrences of neighborhood counsel compromising projects and blackmailing outside engineers to pay expanded lawful charges.

➢ **Currency Risk**

A building up nation's neighborhood cash may vacillate extraordinarily, and if their money blows up the project's income stream loses its incentive in global markets. To secure against cash risk, engineers ought to either arrange their PPAs to get installment in anticipated money or support this risk. Albeit, money related foundations offer swapping scale supporting instruments,

for example, cash swaps or money prospects choices, the upkeep on these understandings might be costly if the engineer arranges a decent position on unstable cash.

- **Physical Risk**

In arranging the terms of PPAs and obligation financing understandings, project patrons ought to think about the potential effect on their projects of unfavorable climate/atmosphere conditions or other catastrophic events. In this manner, designers should be careful that, if for instance consummation or continuous activity of their projects could be deferred or hindered by flooding or different effects from a noteworthy tempest, they may need to summon a power majeure condition because of an unavoidable occasion or event.

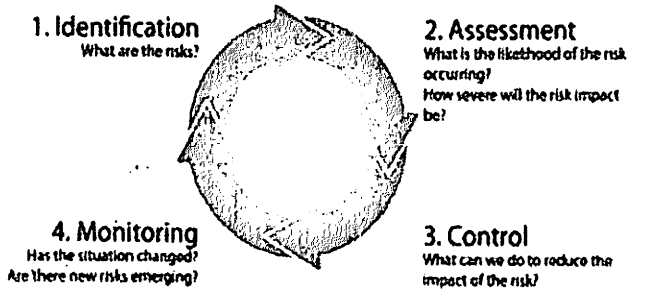
- **Counterparty Risk**

The off take in huge numbers of these nations might be the legislature supported utility. In the event that the utility won't acknowledge the project's renewable power or neglects to make installments, designers could end up looking for help in an administration supported court. Engineers ought to guarantee that their PPA understandings accommodate discretion in an unbiased scene to help lighten this worry. Also, contribution by the World Bank or IFC could enable designers to explore such circumstances.

On the off chance that you have any inquiries in regards to surveying risk or creating risk the board procedures for renewable energy projects in creating nations, if it's not too much trouble contact our Energy Finance practice. Due perseverance is an expansive term, and comprises of specialized, lawful and business contemplations. By and by, it implies building up a full comprehension of the proposed project, finding any risks that could anticipate its prosperity, and profiting by the project's qualities. Not all risks will be 'masterpieces', however recognizing any potential risks, passing judgment on the probability and effect of those risks, and distinguishing mitigations will empower more prominent certainty that the project is a reasonable speculation.

Whatever the renewable energy project – a sun oriented homestead, wind ranch, hydro conspire, half and half arrangement, siphoned hydro energy storeroom or other developing choice – specialized due ingenuity contemplations need to investigate all out energy yield, project vulnerabilities, innovation decisions, social and ecological ramifications, authoritative terms, the business case and furthermore non-money related objectives.

6.4 GENERIC RISK MANAGEMENT PROCESS



I. QUANTIFY ENERGY YIELD AND UNCERTAINTIES

For any project, a basic necessity of loan specialists is a bankable energy yield appraisal. Renewable assets, for example, daylight and wind create control with a variable yield that can be gauge, yet isn't really accessible on interest. This prompts every day, quarterly and yearly varieties in age and to vulnerabilities in income that should be considered in. In spite of this variable yield, renewable projects don't cause the risks of variable fuel costs which influence other energy projects. To stay away from lower-than-anticipated income age, the project should almost certainly send out power into the power framework without requirement. This makes the network association game plans and understanding the risks related with the possible operational routine basic to the achievement or disappointment of a project.

II. JUSTIFY TECHNOLOGY CHOICES

Project banks require trust in the capacity and unwavering quality of the proposed innovation for the project. For wind ranches and hydropower projects utilizing gear from a provider with a long operational history or huge introduce base, this is less inclined to present obstacles than for rising renewable energy choices, for example, crossover frameworks utilizing batteries. A project engineer would be very much encouraged to acquire significant documentation from providers, for example, sunlight based board's appraisals results from perceived testing establishments. Nonattendance of data is probably going to result in moderate presumptions for financing purposes, so endeavors to extricate and legitimize all parameters is regularly well advantageous.

III. ENSURE SOCIAL ACCEPTANCE AND ENVIRONMENTAL REPUTATION

Renewable energy projects work inside networks. There will be a scope of frames of mind towards any project and numerous partner connections to oversee. The relationship set up with the project's locale can have a considerable effect to the accomplishment of the project. A noteworthy risk to social acknowledgment of the project and advancement endorsements is natural effects. Best-practice distinguishing proof, mitigation and the executives of the natural ramifications of the project is basic to the long haul achievement of a project and to corporate notoriety.

IV. TAKE CARE WITH CONTRACTS

Renewable energy projects require an expansive forthright capital use. Contingent upon the financial specialist's risk craving, presentation to risk can be overseen through the legally binding courses of action with the engineer, hardware providers and the development temporary worker. Land-proprietor understandings; association applications; designing, obtainment and development contracts; supply and establishment contracts; and tasks and support contracts of different structures will be required to create, build and work the project. While a lawful consultant should search over these, numerous specialized angles can change fundamentally in their favorability to a buyer or financial specialist. Recognizing and evaluating these things will

require contribution from a specialized counsel. Ventures that are generally solid can endure due to delays in development, which can impact sly affect use and income profiles, and the terms of any obligation arrangement. The financial specialist can alleviate some risk through postpone harms in EPC contracts, in any case, the unfriendly effects of projects delays are once in a while completely relieved by legally binding courses of action. For tasks and support, exhaustive long haul understandings offered by the first hardware maker are a successful technique for exchanging risk related with plant unwavering quality onto the provider or EPC temporary worker. In any case, the conviction managed will accompany a cost premium, and it is basic to welcome that a far reaching tasks and upkeep understanding does not ensure energy yield.

V. UNDERSTAND MARKETS, POLICIES AND REGULATION

Renewable energy projects are regularly upheld by government arrangements that perceive the natural advantages of clean energy age. It is basic to comprehend both the business advertise for the energy and the strategy condition so as to arrange control buy understandings or to oversee trader risk if the energy is being sold on the spot showcase. It is likewise indispensable to comprehend the pertinent administrative structures – arranging, natural, power matrix, corporate administration, tax collection, monetary, business, or word related wellbeing and security. Every one of these variables should be viewed as while surveying the expense of the project and the risks related with the venture. Another potential risk – or opportunity – is change in the market, both present moment and longer term. Think about how predictable or unforeseeable market developments, (for example, changes in mechanical loads, or moving dimensions or examples of interest) may influence execution and reasonability of the project over its life.

VI. ASSESS THE BUSINESS CASE AND OTHER GOALS

A definitive inspirations and objectives of the financial specialist will impact the evaluation of risk. The project may not just be about money related return, yet in addition a longing to constrain carbon introduction or to increment corporate social duty. Understanding the objectives of the project will give a more clear point of view to the due ingenuity examination. Whatever the inspirations of the speculator, the money related substances of the business case will be basic.

Specialized suitability and ecological advantages won't be sufficient to get projects over the line in the event that they can't exhibit their long haul money related soundness and capacity to climate the aggressive weights of the market. Organizations are probably going to increase considerable advantages from trying organized and efficient endeavors to predict and measure risks over the range of business, specialized, social and ecological issues. The more point by point a due industriousness process is, the more precisely risks can be evaluated, and the more outlandish it is that potential risks will be disregarded. An exhaustive due steadiness will require some serious energy and ability; however it is a basic interest in the achievement and versatility of each renewable energy improvement.

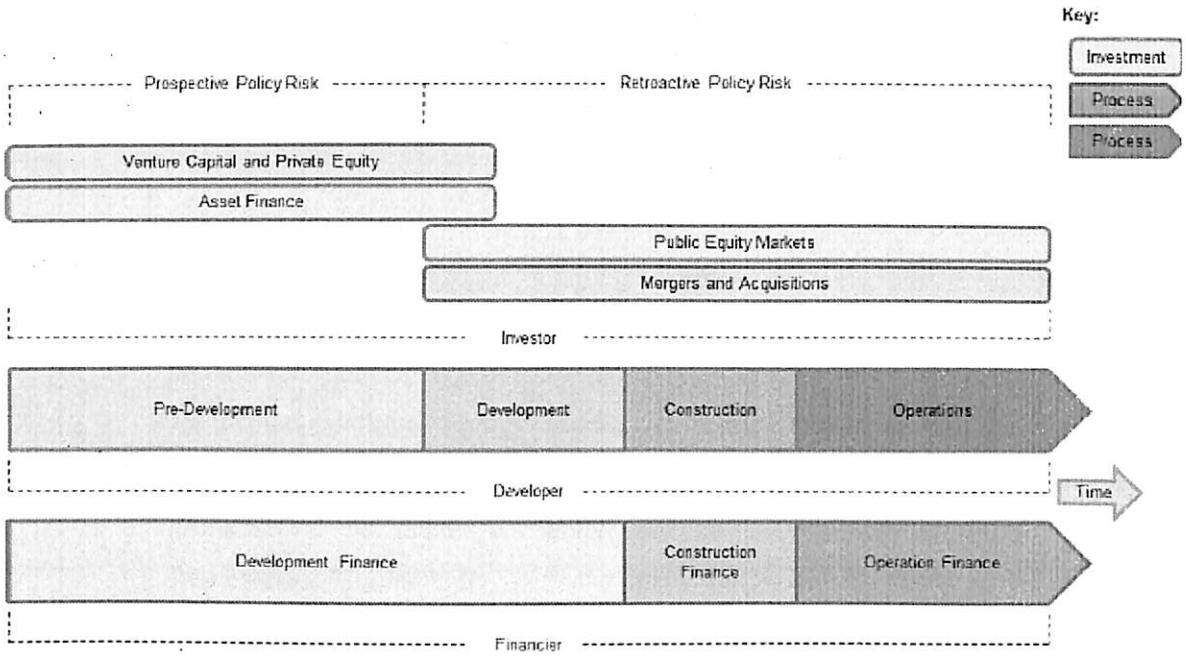
6.5 RISK MANAGEMENT OF RENEWABLE ENERGY POLICY

Renewable Energy Policy Risk-Political risk alludes to the risk of venture misfortune in a given nation brought about by changes in approach or political structure. There are two principle classifications of political risk which are full scale level and miniaturized scale level political risks. Approach risk has a place with smaller scale level political risk and is characterized as project explicit risk. Renewable energy approach risk is the risk of venture misfortune in a given nation brought about by changes in renewable energy strategy. Forthcoming approach risk and retroactive strategy risk are two orders of renewable energy arrangement risk.

Forthcoming approach risk considers the effect on the arranging of new project brought about by the general vulnerability and flimsiness of the administrative structure, while retroactive arrangement risk considers the effect on the money related dependability of existing projects because of strategy changes. Of the two kinds of arrangement risks, the effect of retroactive changes is higher on the grounds that the progressions straightforwardly separate the presumptions and estimates made by engineers, financers and investors.

The three gatherings are three key gatherings engaged with renewable energy project and they face renewable energy strategy risk diversely as indicated by the course of events of project.

Figure demonstrates an ordinary course of events of renewable energy project from the points of view of engineers, agents and speculators.



6.6 POLICIES OF INDIA FOR RENEWABLE ENERGY SOURCES

The couple of critical advances taken by the Ministry of India for improvement of sustainable power sources are recapitulated below: India has among the world's largest programs for sustainable power source. India's exercises spread all major sustainable power wellsprings important to us, for example, biogas, biomass, sun-oriented vitality, wind vitality, little hydro control and the other developing advances.

In every one of these territories, India has projects of asset evaluation, R&D, innovation advancement and exhibition. A few sustainable power source frameworks and items are currently monetarily accessible, but on the other hand are financially feasible in contrast with non-renewable energy sources, especially when the natural expenses of petroleum derivatives are

considered. Realizing the requirement for amassed endeavours in this area, The Government of India set up a Commission for Additional Sources of Energy (CASE) in the

Sustainable power Sources – Policies in India295Department of Science and Technology, in 1981. The order of CASE is to advance research and development exercises in the field of sustainable power source.

- CASE was formally consolidated in 1982, in the recently made Department of Nonconventional Energy Sources (DNES). In 1992 DNES turned into the Ministry for Nonconventional Energy Sources, generally known as MNES. India has a tremendous supply of sustainable power source assets, and it has one of the biggest projects on the planet for conveying sustainable power source items and frameworks. Undoubtedly, it is the main nation on the planet to have a select service for sustainable power source improvement, the Ministry of Non-Conventional Energy Sources (MNES).
- MNES was renamed the Ministry of New and Renewable Energy. India has spearheaded on the planet in numerous managerial activities of sustainable power source advancement, for example, 1) Electricity administrative commission inside changed market-1991 2) Mandatory ecological reviews for power ventures - 1992 3) Energy preservation bill - 2000 4) Renewable Energy advancement bill-2005
- The Ministry is empowering the setting up of framework intelligent power ventures dependent on sustainable power source through private speculation course.
- The State Nodal Agencies are in charge of advancement and improvement of private area extends by method for giving fundamental clearances, designation of land, assignment of potential locales if there should arise an occurrence of SHP extends and encouraging force buy understandings and so on.
- State Electricity Regulatory Commissions (SERCs) are deciding duties by considering the entries everything being equal, including customers various driving

budgetary organizations and banks are financing sustainable power source-based power.

- Legal Provisions: - Under the Electricity Act, 2003, the Central Government, occasionally, is in charge of setting up the national power approach and levy arrangement, in discussion, among others, with the State Governments for the ideal usage everything being equal, including inexhaustible wellsprings of vitality. The Act 2003 has a few empowering arrangements, so as to advance quickened improvement of non-ordinary vitality-based power age, as outlined underneath

6.7 SUCCESS FACTORS OF RENEWABLE ENERGY PROJECTS

1. Strong Government Support For Renewable Energy

Institutionalized renewable energy delicate terms of reference, documentation and valuing made a proficient and straightforward procedure for the designers of the Jordanian sun based projects. These endeavors can be connected to numerous agreements influencing renewable energy advancement, including PPAs, offering and due industriousness prerequisites. Institutionalization additionally quickens improvement and lessens due perseverance costs for financial specialists, which are particularly essential to expand advertise interest. By instituting an immediate proposition process, Jordan had the capacity to permit more prominent adaptability amid the offering procedure, which upgraded productivity and supported engineer investment. This encourages quickened and lower-cost renewable energy improvement forms, which was additionally a vital factor expanding engineer investment.

2. Effective Utilization of Accessible Devices and Instruments to Relieve Risk and Lessen Project Cost

Long haul, fixed-value PPA taxes gave engineers and financial specialist's security in Jordan. The legislature additionally gave PPA certifications to control off-takers, which alleviated speculator worries about installment defaults related with utilities in the nation. What's more, a few designers utilized the equivalent EPC organizations crosswise over projects, accordingly

getting mass limits. With the accumulation of assets, certain energy framework and administrations (for example transmission station and security) could likewise be shared crosswise over projects, prompting additionally cost reserve funds.

3. Effective Utilization of Complementarily Between Private Area Speculators and DFIS

The IFC helped engineers institutionalize terms and contract layouts over all projects, with varieties allowed just to address one of a kind project attributes. MIGA offered political risk protection for Jordan's sun oriented projects, which diminished financial specialists' worries about political risks amid the development and operational stages. In general, Jordan's sun powered program indicates how institutionalizing terms of reference and money related and lawful documentation can decrease exchange costs, disentangle due steadiness for financial specialists, and encourage accumulation. Together with risk ensures like those for the sun based projects offer by DFIs, which decreased different political risks, and buy ensures, such a program can altogether improve the credit nature of renewable energy projects and make projects alluring to speculators.

6.8 UTILIZATION OF RISK MITIGATION INSTRUMENTS TO REDUCE PROJECT RISKS

A few risk mitigation instruments were utilized to diminish project risk and pull in venture to the projects. This incorporates PPA ensures, political risk ensures, liquidity offices and money supports. Each is talked about quickly beneath.

PPA assurances (or energy administration contracts). The Indonesian Ministry of Finance furnished Sarulla Operations with a business reasonability ensure letter for the power off-taker PLN (Wolf and Gabbay, 2015). Considering PLN had a venture grade rating of BA2 as an independent substance, the assurance displays a critical credit improvement to the arrangement (Moody's, 2014). It gave speculators critical confirmations that the energy administration contract would be respected over the arrangement term.

- Risk ensures. The Japan Bank for International Cooperation gave an all-inclusive political risk ensures. This shields financial specialists from a scope of political risks, incorporating those related with break of agreement by government gatherings, confiscation or nationalization, political brutality and cash non-convertibility (Norton Rose, 2012).

- Liquidity offices. The consortium put aside a tranche of unexpected value to alleviate fruition risk amid the exploratory boring period of the (Project Finance International, 2014). The unforeseen value is to be sent if, for instance, wells are penetrated in the wrong spot and greater speculation is required to take care of the expenses of the boring system.

- Currency supporting. PLN's incomes come principally from ratepayers who pay in nearby cash. Be that as it may, as commanded by the energy administration contract, the PLN tax equation incorporates parts ordered to USD, and in this manner PLN bears the money risk. Partners note that the administration ensure backing up PLN's energy administration contract (if there should be an occurrence of default) was of incredible significance to financial specialists.

- Interest rate swap. The Sarulla consortium supported against financing cost vacillations by buying a loan fee swap. This spreads financing cost vacillations for up to 90% of the LIBOR-based tranches of the advance (Wolf and Gabbay, 2015). Since geothermal projects more often than not have stable incomes (they are considered base load control age, and the rate of the energy administration contract is fixed), they regularly utilize a loan cost swap to guarantee obligation installments additionally stay stable notwithstanding when financing costs change.

6.9 ADVANCE RENEWABLE ENERGY PROJECTS FROM INCEPTION TO FULL SPECULATION DEVELOPMENT

An enduring progression of monetarily practical and monetarily stable projects is fundamental if renewable venture is to be scaled up. Beginning period project advancement activities can bolster pipeline improvement. IRENA's Sustainable Energy Marketplace (marketplace.irena.org) offers a component to unite projects and financial specialists. The stage's proficient pursuit capacities improve renewable energy advertise straightforwardness and liquidity. The intelligent web based office gives access to project advancement devices and capacities, including project planning offices. It empowers governments to advance national venture structures or activities. Utilizing this and different devices ought to encourage further activity to help renewable energy projects advance from commencement to speculation development. Specifically, governments and DFIs can:

- Bolster project arrangement through limit constructing and devoted gifts. Governments and DFIs can offer hands on preparing for getting ready practicality studies or project proposition for project supports applying for advances. Devices like IRENA's Project Navigator (https://navigator.irena. organization/) furnish project engineers with a structure to compose superb project recommendations by supporting the arrangement of composed project documentation and strategic agreements. Business hatcheries and business visionaries can likewise help improve the nature of project recommendations and risk evaluation. Project readiness offices giving specialized help and concedes to project arrangement ought to get all the more subsidizing help to improve viability and grow their geographic reach.

- Assess risks and boundaries amid project advancement from the perspective of financial specialists. Strategy producers and multilaterals must comprehend financial specialists' impression of risk and return over the lifecycle of renewable energy projects. The FICO assessment system is valuable evidence based intermediary for the speculator's expected perseverance process. It can fill in as the 'most widely used language' for the assortment of partners (for example strategy creators, DFIs and designers) occupied with renewable

energy financing. By review the risks and rewards of renewable energy projects against the setting of FICO assessment drivers, partners connected over the advancement procedure can extend their comprehension and the subsequent discourse. In doing as such, the FICO score procedure can likewise empower the use of the correct blend of nation arrangements and market structures to drive renewable speculation.

- Facilitate association between project designers and financial specialists. Improving the straightforwardness and liquidity of renewable energy markets can help kick-begin a project by enabling financial specialists to distinguish investment ready renewable energy projects. The Sustainable Energy Marketplace gives a virtual stage to interface project designers and proprietors with agents, speculators, and administration and innovation suppliers, so as to encourage putting resources into and financing renewable energy. In the event that project engineers, DFIs, private fund foundations and arrangement producers utilize the Marketplace, the stage can help support worldwide market liquidity.

6.10 ENGAGE LOCAL FINANCIAL INSTITUTIONS IN RENEWABLE ENERGY FINANCE

Improving access to reasonable account catalyzes venture. Nearby money related organizations are at the bleeding edge of capital arrangement, frequently with built up neighborhood systems and skill. Indeed, even in the wake of distinguishing an appealing project pipeline, they may come up short on the capacity to change advance tenors to suit the venture skylines required by renewable energy projects. Joined by specialized help, on-loaning structures increment the accessibility of financing for engineers and decrease the neighborhood banks' risk. DFIs ought to in this manner increment such on-loaning offices accessible to neighborhood monetary establishments by utilizing their high credit quality and market access to obtain assets at low rates. The accompanying strides to structure and execute compelling on-loaning offices devoted to renewable expand on the exercises gained from existing offices.

- Design and plan on-loaning offices dependent on the financing needs of renewable energy projects. Structuring and arranging a viable on-loaning office requires a strong comprehension of nearby financing limit and the privilege empowering arrangements. On-loaning offices ought to have the capacity to give fluctuating credit sizes or tenor fitting for various renewable energy advances and scales. IRENA can work with DFIs and governments to recognize reasonable markets for experimental runs programs in nations where the fundamental strategy system for creating on lending structures is set up.

- Develop devoted assets and construct limit at nearby money related establishments. Fruitful on-loaning offices require committed bank staff that can catch advertise openings and evaluate the speculation appeal of renewable energy projects. Limit working for accomplice banks can incorporate preparing on qualification criteria for the office, specialized parts of project recognizable proof and assessment, and contextual investigations. IRENA can bolster on-loaning offices with formats for appraisals that are less difficult and simpler for littler scale renewable energy projects. The experience of the IRENA/ADFD (Abu Dhabi Fund for Development) Project Facility can help build up a far reaching screening procedure of conceivably encouraging renewable energy projects.

6.11 ALLEVIATE RISKS TO PULL IN PRIVATE FINANCIAL SPECIALISTS

Approach producers and DFIs ought to efficiently utilize existing risk mitigation instruments to address renewable energy risks and hindrances, accordingly drawing in private speculation. Proposed activity incorporates data battles to bring issues to light of existing risk mitigation instruments in creating nations and streamlining the application methodology for these instruments. It would likewise reorient institutional impetuses to drive the arrangement of more risk mitigation instruments for renewable energy. Moreover, new instruments, structures, assets or offices ought to be framed and issued to cover risks not usually tended to for renewable energy speculations at present. These can incorporate, for instance, liquidity offices (to address

off-taker risks) and cash risk ensures reserves. Such activities require wide cooperation among speculators, DFIs, neighborhood budgetary organizations, national governments and others. Explicit activity prescribed incorporates:

- Increase familiarity with existing risk mitigation instruments. Approaches to expand mindfulness incorporate showcasing or mindfulness raising efforts. This educates national strategy producers, engineers, financial specialists or other important partners of the advantages of existing risk mitigation instruments for renewable energy projects. The contextual analyses give a few models. With this impact, IRENA could work with the Global Clearing House to refresh and impart its database on risk mitigation instruments.

- Streamline institutional systems. There is critical potential for streamlining institutional systems that oversee access to money related The Global Clearinghouse for Development Finance ('GLOBAL DF') is a non-benefit association focused on preparing the private segment for advancement and to upgrade help adequacy. One of its database indexes incorporates the Risk Mitigation Product Directory, which records various assurance and protection instruments from both open and private area (The Global Clearinghouse, n.d). Opening Renewable Energy Investment instruments. Streamlining the exchange prerequisites could help creating nations specifically increment access to risk mitigation components and in this manner private part capital. Explicit exercises incorporate setting essential prequalification necessities to help project designers assess the appropriateness of risk mitigation instruments for their projects. What's more, DFIs could make more straightforward risk appraisal layouts and additionally risk rating philosophies that are replicable and effectively connected crosswise over projects. Joined with the proposal, this could help total projects with comparative risk profiles, therefore decreasing by and large exchange costs.

- Redirect institutional motivators to empower more noteworthy arrangement of risk mitigation instruments. Risk mitigation instruments offer backers a cost efficient

approach to give open money. Nonetheless, ensure issuance is normally not supported by open fund foundations since its volume isn't caught in the Official Development Assistance streams. DFIs could modify interior motivations, for example, quantitative loaning targets, nation loaning points of confinement or scoring ensures at equality with credits (AFDB, 2013a). This would expand their capacity to send a more extensive scope of risk mitigation instruments. For example, the World Bank Group is arranging separate focuses for certifications and credits so as to energize the issuance of assurances.

- Promote the significance of renewable energy speculation to the backers of risk mitigation instruments. A few associations issuing open risk ensures don't have a solid institutional spotlight on renewable. Most risk mitigation instrument suppliers have shaped a group devoted to environmental change when all is said in done yet not many have built up a committed unit for renewable energy. Having a focused on group not just demonstrates the foundation's advantage and ability to back renewable energy projects yet in addition a dimension of mastery inside the group to effectively process renewable energy bargains. DFIs can build their attention and mastery on renewable energy projects by setting up devoted renewable energy targets and additionally part need, to react to showcase request as well as to proactively invigorate it. In the meantime, IRENA can offer help by encouraging more noteworthy correspondence between renewable energy industry partners and associations issuing existing risk mitigation instruments.

- Raise attention to renewable energy projects and on-loaning offices among market members. Presenting an on-loaning office out of the blue is critical particularly if the nation concerned has never made budgetary components devoted to renewable energy. In such cases, few accomplice banks would have on-loaning alternatives on their rundown of loaning needs. They may not know about renewable energy showcase openings. To bring issues to light, driving open account establishments and neighborhood money related foundations can mutually grow direct advertising materials, for example, sites or recordings and sort out advancement occasions. Higher interest made by these exercises can prompt increasingly effective dispensing through the on-loaning offices.

6.12 CREATE FACILITIES DEDICATED TO SCALING UP RENEWABLE ENERGY INVESTMENT

The activities expected to activate capital require committed financing offices to issue risk mitigation instruments and bolster the plan and usage of organized money components explicitly focused at renewable. The offices could subsidize exchange costs and continuous assurance expense components through open concessional financing and offer specialized help. While governments must help such offices and in the long run submit spending plans, IRENA can work with DFIs to propel the ideas for such renewable energy risk mitigation offices at a worldwide or provincial scale. Open atmosphere account sources, for example, the Green Climate Fund could be utilized to back a risk mitigation office of this sort. All the more explicitly, the office could assume the accompanying jobs:

- Deploy risk mitigation instruments and organized account systems. The office can straightforwardly issue risk mitigation instruments and actualize organized fund ways to deal with assistance account renewable energy projects amid the development arrange. Specifically, it could target new monetary instruments, for example, an off-taker risk ensure or a cash risk ensure finance, or encourage neighborhood money loaning . These systems could be made accessible through nearby or global business banks or account foundations willing to give advances to neighborhood project designers and service organizations.

- Provide support for exchange expenses and assurance charges. The office could likewise take care of exchange costs identified with risk mitigation instruments through open concessional subsidizing. A give subsidizing devoted to renewable energy inside this office could fund charges related with a certification (starting expense, duty expense, forthright charge and remain by expense) of business bank credits to renewable energy project engineers at decreased or no expense.

- Provide specialized help by means of gifts. The office could utilize allow financing to give specialized help to creating nations, conquering boundaries amid the project improvement organize and subsequently helping nations fabricate a solid pipeline of renewable energy projects.

Risk mitigation offices committed to renewable could be set up in a few different ways, every one of which may utilize an alternate financing source to accomplish national, provincial, or worldwide renewable energy needs:

- Create a worldwide risk mitigation office for renewable. Alliances of nations can lead the advancement of a worldwide risk mitigation office. This was exhibited at the G20 Energy Ministers Meeting on 2 October 2015 in Istanbul, where energy clergymen from the G20 nations asserted their pledge to renewable energy and received a renewable energy toolbox. This furnishes G20 nations with the choice to take a long haul, coordinated and practical methodology towards the improved arrangement of renewable energy. One choice in the toolbox is a worldwide risk mitigation office explicitly went for renewable energy which would expand on G20 nation experience. » Establish local/national risk mitigation activities. A local assurance store or office might be set up to meet explicit territorial improvement needs and position renewable energy deliberately in the provincial plan.

- For instance, the European Fund for Strategic Investments is giving EUR 21 billion under the EU Juncker plan for a certification subsidizes expected to prepare EUR 315 billion. By 2017, this will go into framework projects in the EU; including renewable The European Fund for Strategic Investments (EFSI) is a joint activity propelled by the European Investment Bank, the European Investment Fund and the European Commission to help defeat the present speculation hole in the EU by activating private financing for vital ventures (EIB, 2016).

- Energy projects (European Commission, 2016b). The EFSI plans to utilize the assurance store to help renewable energy projects bearing a higher risk profile than projects bolstered by the typical tasks of the EIB. The activity gathered solid help from numerous European national governments, which have vowed budgetary commitments.

This provincial methodology could be connected to different areas or nations by means of associations among governments and open account foundations.

- Fund a risk mitigation office through atmosphere money. Atmosphere fund can go about as an impetus for the financing of renewable energy projects in creating nations. A few devoted atmosphere money activities, for example, World Bank's Global Environment Facility (GEF) and Climate Investment Funds (GIF), have just been diverting atmosphere account to creating nations.

Before the finish of 2015, more than USD 10 billion had been promised to the Green Climate Fund (GCF) made by the UN Framework Convention on Climate Change to help creating nations execute environmental change adjustment and mitigation measures. The GCF's Private Sector Facility could be utilized to make a risk mitigation office devoted to supporting renewable energy either at a worldwide scale or at local dimensions. The activities illustrated in the proposals above make a complete plan for quickening interest in renewable energy, expanding on its solid business case and supporting open strategy destinations.

Speculation would thus be able to move rapidly from specialty to standard even in business sectors where it has been falling behind. The worldwide energy progress will rely upon the capacity of creating renewable energy markets to draw in monstrous dimensions of venture. In coming years, arrangement creators, open fund establishments, designers and financial specialists must catch the chances to open renewable energy venture at scale.

CHAPTER 7: CONCLUSION AND SCOPE FOR FUTURE WORK

7.1 CONCLUSION

At present, a wide scope of risk the executive's instruments are offered by private and open foundations. Explicit risks which are credit risk, advertise risk, operational risk, liquidity risk and political risk, have made a substantial interest by financers and engineers for risk the executives instruments to relieve the risks.

The primary difficulties for the suppliers of risk the board instruments in supporting renewable energy advancements are in the accompanying three zones:

- Further improvement of risk the board instruments and advancement in their utilizations to make them increasingly compelling in dealing with the particular risks of renewable energy advancement

- Expansion and institutionalization of the utilization of risk the executives instruments, specifically to renewable energy strategy risk, to advance joint effort with policymakers, agents and designers

- Enhanced risk the board help to agents, engineers and financial specialists to get ready renewable energy projects and draw in private and open ventures

In this paper, the master plan of market risk, credit risk, liquidity risk, operational risk and political risk of renewable energy advancement and market has been considered.

A careful survey has been given to partners in renewable energy projects, for example, policymakers, agents, engineers and risks the executive's instrument suppliers. Besides, current scope of manners by which risk the board instruments can differentiate, fence and exchange renewable energy arrangement risk has been uncovered.

7.2 RECOMMENDATION

Following recommendations are given for arrangement creators for advancement, scattering and better and productive utilization of renewable energy innovations in the nation:

1. Establishment of biomass/sun oriented/wind control age frameworks and energy sparing in each administration office to empower and rouse individuals.
2. Strenuous commendation of renewable energy by government offices, open area, corporate, scholastic establishments and so on
3. Foundation of national-level body to expand consciousness of renewable energy at far reaching level.
4. Research and improvement of renewable energy advances get gave the money related help and sponsorship.
5. Setting up hopeful objectives and focuses for power age non-regular sources.
6. Making it necessary to introduce sun oriented water warming frameworks for all urban private and business foundations.
7. Imperative renewable energy frameworks arrangement for new private, business and mechanical structures.
8. Restricting utilization of vast battery energy stockpiling frameworks and advancing utilization of bio fuels in vehicles.
9. Abrogating obligations/charges on import of little scale renewable energy creating gear and giving sensible advances to setting up renewable energy ventures.
10. Handsome impetuses and endowments for establishment and fruitful activity of renewable energy gear and extra motivating forces for purchasers and producers of renewable energy supplies in rustic territories.
11. Cultivation of energy crops on negligible and corrupted land

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