INDIA'S ENERGY PLANNING AND MANAGEMENT: A PERSPECTIVE VIEW

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ABSTRACT
The paper's primary contribution is to identify power management and planning in India that promotes energy efficiency through eco-friendly system approaches to power generation. This chapter is divided into seven sections. The introduction is followed by energy planning in India in section A. Power generation grid management is discussed in section B. RES based power generation planning and management in India are described in section C. In section D, grid management with integrated RES power generation, such as solar energy generation with conventional power generation for CO_2 emission reduction, is described. Off-grid RES power management is covered in section E. In section F, conclusions are discussed.

A) INTRODUCTION
India is made many attempts to action toward a low CO_2 other GHG emissions passage as cumulatively endeavour to obtain total the progressive challenges. The Honorable Prime Minister of India eyesight is taking work onward with Intended Nationality Determined Contribution (INDC) for a sustainable lifestyle and climate justice to protect the terrible and porous from the aversive effect of climate change. Coal is the main and most dominant fossil fuel for energy generation in Indian thermal power plants (TPP). The major pollution emissions are NOx, CO_2, CO, SO_2 and HC by-product of coal combustion. But the CO_2 is a major pollutant emitted from TPPs in India. CO_2 is responsible for over 60% of the increased greenhouse impact. This research work has attempted to supply the reduction of CO_2 emission from coal-based TPPs in the country. RES is fully favourable, and energy integration in this reference of GHG impact with now-a-day research. The coal-based electricity generation has 56% of India‘s capacity and 66% of power generation during the 12thfive-year plan. The electricity generation in coal-based TPP is discouraged due to the reducing cost of renewable energy power generation, the pressure of reducing carbon emission and increased fossil fuel prices. The installed capacity of coal-based TPP grows slowly up to 270 GW in 2032 and will reduce up to 253 GW due to integrated energy policy.

According to the conference of parties (Paris COP 21), India set a voluntary goal of reducing environmental impact by 33-35% by the year 2030, in terms of Gross Domestic Product (GDP) from 2005 levels. It is a multilateral treaty, known as the United Nations Framework Convention on Climate Change (UNFCCC), signed by the 195 member states to address the matter of global-warming crisis and restore the climate. There are advantages in dealing with fossil fuels or electricity from traditional, non-renewable energy sources such as nuclear and coal. In 2015, India's non-fossil fuel share of total capacity was estimated to be 30% of the total but is projected to jump to 40% by 2030. Raising renewable energy output to an estimated annual level of 175 gigawatts and CO2 reduction at an equivalent rate of 32.2 million tonnes per year, or about 2.22 million tonnes per day, per year. Several industries deal with renewable fuels (PV, thermal, hydro, tidal, and wave) and biogas. Agriculture, environment, and climate change: Solid waste management, water management, and recycling: Perpetuating a healthy lifestyle by environmentally conscious design (greenhouses, mass transit, green vehicles, etc.). The constant and exhausting work to support renewable energy generation isn't helped by the price of electricity and by the weather in the winter and rain. Another method would be to switch away from less active/off-peak hours or offer utilities for peak use only when disconnecting from renewable energy sources.

Subsequent climate conferences acknowledged the importance of integrating emerging renewable energy sources into electricity production as one of the most cost-effective and rapid ways to minimize carbon dioxide emissions. Proper siting, installation, and operation of sustainable and non-traditional energy sources would aid in reducing,

replacing, and avoiding negative environmental impacts [4]. — Each unit of solar energy produced prevents 800 grammes of carbon dioxide (CO2).

B) ENERGY PLANNING IN INDIA

Energy challenges in India and other developing countries include overcoming a heavy dependence on traditional energy sources, which account for more than 90% of total energy consumption, resulting in rapid deforestation and disforestation, reduced soil fertility, etc. As a consequence, a large amount of data is required to represent their interactions. Numerous instruments are used to analyze several issues and produce the mixed results necessary for the planning process. Apart from the unusual population growth, the marvels of digital technology have raised people's aspirations for a higher standard of living. One measure of improved quality of life is the steady increase in per capita energy consumption over the last few decades. As a result, energy demand has risen exponentially and can no longer be met by obsolete energy technologies reliant on a few local resources. Before the 1970s oil crisis, Third World planners and politicians fantasized about bringing rural areas up to par with developed countries' energy standards. They hoped to create energy models that would aid in energy planning, forecasting, and optimization. Over the last decade, research in India has shown that decentralized energy technologies based on locally available resources can be viable alternatives to various commercial energy sources for a variety of energy end-uses. The models include industry-standard energy planning tools. Recent years have seen significant progress in establishing and enforcing energy planning policies in developing countries. Appropriate energy survey methodologies are developed to estimate and project sector-specific useful energy requirements [1].

India's energy demand is constantly growing due to population growth, and conventional energy supply options could not keep up. Due to advancements in efficiency, carrier replacement, and renewable energy as alternative energy sources, it is implausible to adhere to only macro-level energy planning. Sustainable construction at the local scale (district/taluk) becomes conceivable in these circumstances to achieve sustainable development goals and maximize the use of locally available energy resources [2].

Global warming has intensified into a major global crisis, prompting all nations to make various attempts to reduce their greenhouse gas emissions, according to the United National Action Plan on Climate Change (UNFCCC). Additionally, the Indian government is attempting to minimize CO2 and other greenhouse gas emissions by spearheading the Green-School Project. This project aims to establish an energy-saving strategy for out-of-date school buildings by renovation. CO2 emission reduction scenarios are proposed in this study using energy-saving techniques (ESTs) in educational facilities. An optimal scenario is created by performing a life cycle cost (LCC) analysis on each scenario. To this end, we analyzed the reductions in energy consumption and CO2 emissions in two schools using Design Builder models focused on 15 scenarios involving combinations of four ESTs.

Furthermore, an LCC study was performed. The findings indicate that replacing existing lighting with light-emitting diode (LED) lighting is the most cost-effective choice in energy efficiency, CO2 emission reduction, and life-cycle cost analysis. Additionally, the results suggested that energy efficiency, carbon pollution reduction, and life cycle cost analysis differ according to the design and size of the school building. Suppose the results of this study are integrated into the policy-making efforts of the Indian Ministry of Electricity. In that case, New and Renewable Energy, Education, Science, and Technology, CO2 emissions from the maintenance process of Indian educational institutions should be minimized. A sophisticated processing mechanism with a limited budget should also be feasible [3].

Rural India's Low-Cost Bioenergy Options is achieved by implementing a distributed generation planning (DEP) approach to environmentally sustainable energy generation. This approach shows that biomass-based energy systems can meet rural areas' entire energy demand, from village to district. DEP was developed and implemented in an Indian district with a long history (Tumkur). This analysis's primary objective is to ascertain the economic viability of bioenergy for rural applications. According to model study, the cost of producing biomass at the household level is extremely low. Energy crop plantations may be established on available marginal lands or wastelands. Through the use of plantation

gasification technology, it has been demonstrated that biomass feedstock produced from plantations is sufficient to meet all of the rural areas' electricity needs. Electricity needs can be met by using biomass-based energy generation systems on available wastelands [4].

India has been humiliated at the ongoing climate change talks in Copenhagen. Government data indicate that the frequency with which Indian nuclear power plants emit carbon dioxide (CO2) has improved after years of decline.

New CEA emissions figures show that the plants released 0.82 tonnes of CO2 per thousand mega (MT-1,000) per year compared to the previous year, rising by approximately 4 per cent over the year before that accounts for nearly 60% of global warming's carbon dioxide.

Coal-fired power plants emitted more than 60% of India's total carbon dioxide emissions. The country's power plants emit more than 540 million tonnes of CO2 each year. India has proposed a 20-25 significant decrease in emission intensity by 2025. The country's policy has already committed approximately Rs 74,000 crore over the next five years to reduce carbon emissions from the country's power sector.

This investment would support a range of initiatives to lower the domestic economy's energy intensity, including improving the efficiency of existing power plants and implementing clean coal technologies. The Bureau of Energy Consumption and the power ministry estimate that these steps would reduce 98.5 million tonnes of CO2 emissions over the century.

India is thought to have one of the world's least energy-intensive economies. The Planning Commission reports that the country's energy-GDP (gross domestic product) elasticity index has decreased to 0.8 from more than one in the early 1990s. According to the CEA, the increased CO2 emissions from power plants are mainly due to lower nuclear and hydropower output in the previous fiscal year. While India's per capita greenhouse gas emissions, at 1.02 tonnes, remain well below the global average of 4.25 tonnes, the country still relies heavily on coal-fired power plants to produce most of its electricity. Another obstacle to future emissions reduction is the inefficiency of older power plants. India's installed capacity of over 5,000 Mw is currently running at less than 5% capacity utilization. Although these systems are being phased out during the current Plan period, the government plans to phase out an additional 10,000 Mw of power during the Twelfth Plan period (2012-17) [5].

By 2022, India intended to put old thermal power plants' emission levels up to national standards and renovate them. According to a senior Environment Ministry official, which will begin next year. Union Environment Ministry Secretary CK Mishra also stated that some of the country's very old plants could be closed. When it comes to solving climate change problems, the first step is to recognize a problem. In light of the Paris agreement, India's NDCs (Nationally Determined Contributions) are already audacious. However, there are development imperatives, and India is one of the fastest-growing economies, which means that as growth occurs, emissions levels are constrained from increasing. By 2022, it is planned that all existing power plants will meet national emission requirements. Some will be closed due to their age, but the remainder will be completed "According to Mishra [9]-[10]. The state-run National Thermal Power Corporation (NTPC) is investing heavily in retrofitting older plants, the secretary said. "It's a lengthy process that takes about 18 months for one of these additions, he said. Mishra said that the pollution scenario would improve if emission standards for boilers and emission-reducing technologies were introduced. Thermoelectric and other fossil fuel-fired power plants are a significant source of air pollution.

According to the minister, Delhi's Badarpur Thermal Power Plant remains "closed" and will be used only in the event of a "highly critical power situation" in the national capital. The gas power plant in Bawana is operating at 20% capacity. It consists of two 750 MW units, Mishra explained. "By the end of next month, the first 750 MW unit will be completely operational on gas at maximum range. Gas is a much more environmentally friendly fuel source,"'He said. Although the Paris agreement has its own set of modalities, Mishra asked, "what about the pre-2020 commitments?" — The 2015 Paris accord is a United Nations Framework Convention on Climate Change (UNFCCC) agreement that addresses greenhouse gas emissions reduction, adaptation, and financing beginning in 2020. The agreement details a global action plan to put the planet on track to prevent serious climate change by

keeping global warming far below two degrees Celsius. "There are two critical factors in the context of the Paris accord: technology transfer to developing countries must be unrestricted, and climate finance must be novel and distinguishing," Mishra said. Energy control has long been a focal point of India's development planning. In most cases, this has taken the form of increasing the generation and availability of energy through increased coal, gas, nuclear, and renewable energy sources, among others. Current energy plans emphasize this trend on coal (with a domestic output goal of 1.5 billion tonnes by 2020) and on renewable energy generation (to generate 175 gigatonnes of renewable energy by 2022) [6].

(i) COMMONLY USED APPROACH:

The expanded method of emphasizing supply is consistent with the Indian energy planning tradition, as shown by the 11th and 12th Five-Year Plans and a slew of national modelling studies. However, there is a lesser-known background of an eco-friendly solution that focuses not just on energy supply but also on energy consumption, thus reducing CO2 and other environmental impacts.

Such a narrative break was first advocated in the mid-1980s by Amulya Reddy, who shifted the traditional focus away from energy sources and toward energy services. From this vantage point, the energy system - and the practises associated with its supply and use - exist to provide energy services such as illumination, pleasant interior temperatures, refrigeration, transportation, and pollution to achieve development goals. However, Reddy's interventions remained unimplemented in part due to the necessity of reimagining how energy policy is produced. Numerous government policies are now refocusing their efforts on energy demand, specifically through end-use renewable energy technologies.

These efforts are encouraging, even though they are not completely conceptualized. However, the transformational change would necessitate the rediscovery of a broader understanding of energy planning that considers the interconnections between energy supply.

(ii) IN THE DIRECTION OF IMPROVED PRODUCTIVITY:

There are three main reasons why it would be more efficient for India's energy novelette to directly address the supply of energy and its use and distribution. First, the Indian economy is experiencing a series of transformations, which means that the implications for its future requirements are massive and unpredictable and potentially resilient. Demographically, India is expected to add approximately 10 million jobs per year for the next two decades, resulting in increased energy consumption, especially from manufacturers and generation. Simultaneously, urbanization would result in an additional 200 million people moving into cities, increasing demand for infrastructure to support towering lifestyles.

Infrastructure changes are imminent, with forecasts indicating that two-thirds of India's buildings in 2032 will remain unbuilt. In terms of energy, these transitions present a significant risk of unintentional lock-in to consummation trends since most growth has yet to occur.

Suppose the end-use of energy-inefficient technology (for example, inefficient structures and gadgets) or cities with high electricity needs (for example, private transport) becomes the norm in yet-to-exist infrastructures and improved lifestyles. In that case, it can result in a set of path-dependent outcomes that render consumption reduction extremely difficult for decades to come.

Second, integrating demand as a central component of energy planning simplifies energy supply management and, therefore, reduces the number of supplies required and, consequently, carbon emissions emitted. Indeed, the quondam Planning Commission estimates that sectors such as construction, transportation, and industry will contribute the majority of the reduction in the emissions intensity of up to 23-25 per cent from 2005 levels by 2020.

More importantly, demand understanding is needed for good supply-side planning. Consider India's international climate commitment to increase its non-fossil fuel electricity generation to 40% of total capacity by 2032. India must prepare for both fossil and non-fossil energy sources to meet this target.

However, the magnitude of supply in any proposal is contingent on the grid's size or total capacity in 2030, which is eventually determined by potential demand. We do not yet have an exact estimate for India's potential grid size, and study forecasts vary between 650 and 1000 gigawatts, implying a range of supply requirements on either end. Inaccurate demand forecasts could jeopardize energy security or result in a series of stranded fortunes, both of which cause concern.

(iii) GOING AGAINST THE GENERAL TRADITION:

Finally, the conventional supply-dominated orientation has been insufficient to correct India's energy diagnosis. Despite increased electricity output and a maze of policy priorities, the sector is fashionable despite various systemic inefficiencies and economic losses.

Lack of access to energy continues to be a good characteristic. According to the 2011 Census, over 400 million people lack access to electricity, and even though there is availability, there are serious concerns about fuel quality. Power shortages continue to haunt the grid, with polluting diesel generators increasingly being used to compensate.

Coal-fired thermal power plants are often used to meet peak load demands, resulting in economic and resource waste and environmental implications. India's compelling case is to reconsider its current energy planning imagination, which is primarily motivated by an incomplete narrative of deficiency and its related solution of increased availability.

Alternatively, a different conceptualization would emphasize the importance of comprehending demand trajectories as an input to supply requirements. It should, preferably, also consider the energy strategy's broader ultimate goals, such as energy efficiency and socio-environmental benefits. This transition will not be effortless or automatic - all the more so because demand-side solutions are often embedded in a complex network of social structures and behaviours and can require explicit normative roles [7].

C) POWER GENERATION GRID MANAGEMENT

Electricity cannot be safely or reliably stored in large amounts. In an energy grid, power generation and consumption must always be closely balanced. Some fundamental principles are essential for our understanding of electricity. When energy generation and consumption become unmanageable, blackouts and other structural failures occur. Electricity must be produced on a demand basis. Demand, of course, fluctuates over the day, month, and year. Demands are met by a combination of continuous-operation power plants (baseload) and peak-load power plants. They must be able to meet available supply in real-time collectively.

This is expensive and uncertain. When the demand is low, expensive facilities are idle, which are planned to serve peak capacity. When the market is high, all available resources are placed under pressure, impairs the system's dependability. The power grid can be built and run more cost- and energy-efficiently when supply doesn't fluctuate widely.

(i) REQUEST RESPONSE:

A concerted effort is being made to involve the customers in the planning process. If you prefer to demand a response, you are speaking of partnering with customers to get them to use less energy. Communication with the only method is important to notify the customer when a change in requirements is required (supply is low, useless or supply is high, a good time to use more). Many techniques and technologies exist under supply-side approaches known as the supply side (DSM).

"In this context, DSM refers to eliminating end-use facilities or processes. DSM minimizes the client demand during times of high availability and scarcity. On the one hand, the DSM has big, and immediate programmes, such as construction of equipment such as the power utility takes on average for large customers, which minimizes energy consumption. On the other, it, it has tailored and intensive programming projects for the industries such as power production, including temporary stops for the industry's most demanding processes."

(ii) STORAGE OF ENERGY ON THE GRID:

The Electric Energy Association claims that storage plays a vital role in the grid. "Energy storage can fundamentally alter how electricity is produced, distributed, and consumed. Energy storage is advantageous in emergencies, such as blackouts triggered by earthquakes, system failures, personal injury, or even terrorist attacks. However, the game-changing potential of energy storage is its ability to rapidly balance energy supply and demand – within milliseconds – making power networks more resilient, secure, and safer than ever before. [8].

Additionally, we know that a vast quantity of energy is not easily or effectively processed. The Electricity Storage Organization classifies energy storage technologies into six groups.

Solid-State Batteries: Solid-state batteries are electromechanical energy storage devices that include lithium-ion batteries and capacitors.

Flow Batteries: Flow batteries store energy directly in the electrolyte solution, resulting in longer cycle life and faster reaction time.

Flywheels: mechanical devices that convert rotational energy into instantaneous electricity.

Compressed Air Energy Storage: Thermochemical energy storage is a method of storing energy by compressing air.

Thermal: Thermal energy is produced by capturing heat and coal and converting it to electricity on demand.

Pumped Hydropower: Electricity generated using dams Water reservoirs, constructed on a wide scale, can be used for energy production. The most primitive but extremely simple way to store energy involves building water elevators and pumping them to a higher location to be put under pressure. Then, sitting it in the clouds, which is considered an energy technology of last resort, has the greatest potential for increasing energy yields. Pumped water is used to convert to kinetic energy when pumped back up to a higher elevation to produce hydroelectricity. Due to the enormous storage size, this is currently the most common type of grid-level energy storage. When the water-pumping capacity of a power plant is increased, it allows the plant to power itself uphill. When the plant is at its most effective, pumping storage provides the greatest economic advantage and power costs are the lowest.

(iii) NATIONAL GRID EVALUATION:

There are five regional grids for grid control in India, namely the Northern, Eastern, Western, North Eastern, and Southern regions, which are all synchronously linked to the country's transmission system. In October 1991, the NER and ER grids were linked, and in March 2003, the WR and ER-NER grids were connected. In 2006, the ER and NR grids were linked. Operating at a single frequency enables establishing a central grid in which the NR, ER, WR, and NER grids are synchronously linked, thus achieving the Central government's goal of ONE NATION'-'ONE GRID'-'ONE FREQUENCY. SR was connected to the CR grid in synchronous mode on 31 December 2013, completing and commissioning the 765 kV Solapur-Raichur transmission line [9].

D) RES BASED GENERATION PLANNING AND MANAGEMENT

India is rapidly expanding its investments in renewable energy sources such as wind and solar. With such volatile energy sources feeding the grid, it is critical to have a highly adaptive grid (supply and demand). A reliable electricity supply is a critical component of the infrastructure required to sustain overall growth. As a result, the prospects for developing smart grids in India are enormous. Apurva Jain and Navneet Gupta [10].

Infrastructure is greatly influenced a nation's economic growth and well-being. Infrastructure is needed to support economic growth in India and vice versa. One of the world's most powerful and interesting power markets is India's. Although conventional energy sources such as coal, natural gas, and nuclear have been used to provide electricity in the past, newer methods include renewable energy, such as wind, solar, and domestic resources. The electricity demand has increased over the last few years, and it is anticipated to do so in the

future. A massive increase in generating capacity is needed to meet the country's energy needs, particularly to power new buildings and vehicles. According to creative capital, the global ranking of countries was determined in May 2018 and placed India at No. 4 in the country. 4, out of 25.

India's power market is experiencing drastic change, altering the industry's outlook. India's electricity demand has been sustained by economic development. The Indian government's focus on achieving 'Power for all' has resulted in a major increase in regional capability addition. Simultaneously, both the supply and demand sides of the equation are becoming more dynamic (fuel, logistics, finances, and workforce). India's gross installed capacity of power plants stood at 343.79 Gigawatts in April 2018. (GW). Between April 2000 and December 2017, the industry attracted US$ 12.97 billion in Foreign Direct Investment (FDI), or 3.52 percent of total FDI inflows into India.

Several major investments and developments in India's power sector include the following:

Energy Efficiency Services Ltd (EESL) has received US$ 454 million in funding from the Global Environment Facility (GEF) to support energy efficiency initiatives in India, accelerating the country's transition to a low-carbon economy.

IL&FS Financial Services Ltd has partnered with Jammu and Kashmir (J&K) Bank Ltd to finance nine hydropower projects in J&K with a combined capacity of 2,000 megawatts (MW) and a funding requirement of approximately Rs 20,000 crore (US$ 3.12 billion).

Sterlite Power has been granted one of Brazil's largest 1,800-kilometer transmission projects, worth US$ 800 million. This is the Company'sCompany's third project in the country and the largest that an Indian company has ever won in Latin America.

In April 2018, ReNew Power concluded the largest M&A deal to date, acquiring Ostrow Energy for US$ 1,668.21 million.

The Indian government has identified the power sector as a priority sector for long-term industrial growth. The Indian government has taken several measures to bolster the Indian power market, including the following:

Energy Efficiency Services (EESL) programmes have resulted in energy savings of 37 billion kilowatt-hours (kWh) and greenhouse gas (GHG) emissions reduction of 30 million tonnes.

The Union and state governments have agreed to implement a Direct Benefit Transfer (DBT) scheme in the electricity sector to boost subsidy targeting, according to Mr Raj Kumar Singh, Minister of State for Power (Independent Charge).

The Indian government has approved the 2018 National Biofuels Policy, which is expected to benefit health, the environment, job development, reduced dependence on imports, increased rural infrastructure investment, and increased farmer income.

The Indian government has set a target of 175 gigawatts of renewable energy capacity by 2022, including 100 gigawatts of solar and 60 gigawatts of wind. The Indian Union Government is designing a'rent a roof' strategy to assist it in meeting its goal of 40 gigawatts (GW) of rooftop solar energy production by 2022."[11].

E) GRID MANAGEMENT WITH INTEGRATED RES:

Initially, environmental effects were viewed as constraints on the operation of the power grid, with tolerance limits set for the maximum allowable emission rates. Another conventional solution included external costs associated with the system's multiple power plants' environmental impacts [12].

The smart grid allows an integrated and reliable end-to-end intelligent two-way delivery system from source to sink by incorporating renewable energy sources, smart transmission, and distribution. Thus, Smart Grid technology will contribute to efficiency and sustainability by ensuring the reliability and highest possible quality of energy supply in response to increasing energy demand. Additionally, a smart grid enables real-time

monitoring and control of the power system and aids in the reduction of AT&C losses, demand response and demand-side management, power quality management, and failure management, among other benefits. Apart from providing more resilient and stable energy grids and tariff regimes, the Smart Grid will act as the foundation for evolving business models such as smart cities, electric vehicles, and smart societies. Recognizing the importance, Power Grid pioneered the implementation of Smart Grid technology through the entire value chain of electricity supply, including establishing a smart grid pilot project in Puducherry through open collaboration on all aspects of smart grid distribution[13].

According to the Power Grid Corporation of India Limited (POWERGRID), approximately 43GW of capacity has been installed, primarily via wind and solar, under the 12th plan with integration for renewable energy-rich states such as Himachal Pradesh, Rajasthan, Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu, Jammu& Kashmir, and Karnataka as part of Green Energy Corridors. Recognizing the critical need for large-scale production of alternative energy sources such as solar and wind, POWERGRID prepared a report on the development of desert power in India's desert regions of Rajasthan (The Thar), Gujarat (Rann of Kutch), Himachal Pradesh (Lahul & Spiti valley), and Jammu & Kashmir (Ladakh), for a time horizon of 2050. The report forecasts approximately 300 GW of renewable energy potential in Indian deserts, mainly through solar and wind energy and its development over the medium and long term. It discusses, among other items, transmission infrastructure requirements for renewable energy integration in desert regions, grid balancing and spinning reserve infrastructure requirements, desert power production challenges and impacts, indigenous renewable energy manufacturing research and development, and investment in desert power development capability [14].

India's electricity market is expanding at a rapid rate. Peak demand is approximately 164.1 GW in the current fiscal year 2017-2018 (through 30.11.2017), while installed capacity is 330.8 GW, with a mix of thermal (66.2%), hydro (13.6%), renewable (18.2%), and nuclear generation (2.0 percent). Natural resources used to produce electricity in India are inequitably distributed and concentrated in a few pockets. Hydropower capacity exists in the North Eastern Region's Himalayan foothills (NER). The highest concentrations of coal reserves are in Jharkhand, Odisha, West Bengal, Chhattisgarh, and parts of Madhya Pradesh. The highest concentrations of lignite reserves are in Tamil Nadu and Gujarat. Additionally, the country has seen various natural gas-fired power plants and renewable energy sources such as solar, wind, and geothermal.

POWERGRID, a Central Transmission Utility (CTU), is responsible for interstate transmission system planning (ISTS). Similarly, State Transmission Utilities (STUs) are responsible for developing the Intra State Transmission System (more precisely, State Transco/SEBs).

Over the years, many transmission lines have been established to evaluate and transmit energy generated by various electricity generating stations. Acceptable voltage lines are laid in proportion to the amount of power and the distance involved. 800 kV HVDC and 765 kV, 400 kV, 230/220 kV, 110 kV, and 66 kV AC lines are the most frequently used nominal Extra High Voltage lines. All SEBs and utilities engaged in generation, transmission, and distribution, including those in the Central Sector, have installed these. In 2017-18, 13,820 circuit kilometres (Ckm) of transmission lines were commissioned (April- November 2017). This is 59.9% of the annual goal of 23,086 Ckm set for 2017–18. Similarly, during 2017-18 (April-November 2017), substations added 50,805 MVA of transformation capacity, accounting for 94.1 percent of the annual goal of 53,978 MVA set for 2017-18. As of 30 November 2017, the country's transmission grid included 3,81,671 kilometres of transmission lines and 7,91,570 megawatts of transformer power at substations. As of 30 November 2017, the total transmission power of the interregional links is 78,050 MW.

Transmission lines are governed by the regulations and standards of the Central Electricity Authority (CEA), the Central Electricity Regulatory Commission (CERC), and the State Electricity Regulatory Commission (SERC) (SERC). However, under some circumstances, transmission line loading can be regulated to preserve voltage stability, angular stability, loop flows, load flow pattern, and grid security. Except for some congestion in the southern region's power supply, power surplus states have been able to supply surplus power to utilities in power

deficient states worldwide. Power System Operation Corporation Limited (POSOCO) operates the National and Regional grids through its National Load Despatch Centre (NLDC) and five Regional Load Despatch Centres (RLDC).

Under the Ministry of Power, a Navratna company is tasked with the responsibility of engaging the power transmission industry in India for the planning, execution, operation, and maintenance of Inter-state transmission systems (ISTS), dubbed POWERGRID (power grid corporation of India limited) as the Central Transmission Utility (CTU). POWERGRID owns and operates approximately 1,42,989 kilometres of Extra High Voltage (EHV) transmission lines spanning the length and breadth of the country and 226 EHV AC & HVDC Substations with a combined transformation capacity of over 3,11,185 MVA. Its comprehensive transmission network accounts for more than 45% of the country's electricity production. Owing to the use of cutting-edge operation and maintenance methods that conform to international standards, the availability of this vast transmission network is consistently greater than 99 percent. During the fiscal year 2016-17, POWERGRID earned approximately Rs. 26,581.46 crore in revenue and Rs. 7,520.15 crore in benefit.

Additionally, as of 31.03.2017, the Company'sCompany's Gross Fixed Assets increased to Rs.1,49,730 crore. HCPTCs have been developed to meet the bulk power evacuation requirements of various Independent Power Producers (IPPs) in resource-rich and coastal states such as Chhattisgarh, Odisha, Madhya, Sikkim, Jharkhand, Tamil Nadu, and Andhra Pradesh. Construction of the corridor has been phased to conform to generation schedules.

The country's total inter-regional transmission capacity (220kV and above) was increased from 27,150 MW to 75,050 MW between the XIth and XIIth plans. POWERGRID's efforts, backed by the Ministry of Power, have decreased electricity prices and a more reliable supply of electricity in the Northern Region. During the XII Plan, POWERGRID invested approximately Rs.1,12,600 crore in the inter-State transmission system, compared to the goal of Rs.1,10,000 crore. During the XII programme, it added approximately 45,900 kilometres of transmission line and approximately 1,64,000 megawatts of transformation capacity, compared to the goal of 40,000 kilometres and 100,000 megawatts, respectively. The company has an excellent credit rating with financial institutions, which positions it well for resource mobilization.

Additionally, POWERGRID assists in the grid interconnection of renewable energy across the country by introducing a section of the Green Energy Corridors' ISTS part. Conserving right-of-way (RoW), minimizing effects on natural resources, co-developing cost-effective transmission corridors, and allowing for flexibility in upgrading lines' transfer capability to meet power transfer requirements are critical considerations country's transmission network expansion. In this direction, the CompanyCompany has been operating on higher transmission voltages of 800 kV HVDC and 1200 kV HVAC. The 800 kV, 3000 MW HVDC bi-pole line (CK-I) was commissioned between Champa, Chhattisgarh, and Kurukshetra, Haryana. Additionally, this transmission system is being upgraded to 6000 MW capacity by constructing a second HVDC Bipole (CK-2) with a 3000MW capacity and 800kV HVDC Terminals, which is scheduled to be completed by December 2018.

Similarly, the transmission of electricity has begun through the 1200 kV National Test Station (NTS) in Bina, Madhya Pradesh. POWERGRID entered the telecom sector to diversify its revenue sources and create value for its stakeholders, leveraging its vast transmission infrastructure in the country. The CompanyCompany connects all metros, major cities, towns, and remote areas of Jammu and Kashmir and the North-Eastern States through its backbone network. Overall, the network coverage is more than 41,000 kilometres, and there are 662 Points of Presence (stations) on the network. The Telecom Backbone Network covered throughout 2016-17 had a capacity of about 99.9 percent. POWERGRID has completed the prestigious project on the NKN (National Knowledge Network), which links all scientific and technical universities and research institutes across India, including the IITs (Indian Institutes of Technology) and the Sciences (IISs). Creative expression: Bharat Sanchar Bharti Public Limited (BSNL) has signed a pact with the North-eastern States, including Sikkim, to increase internet

connectivity. Optical fibres would provide broadband over existing high-tension electric transmission lines. Once the network is built, service reliability in the north-eastern area will improve significantly.

The Indian government has made the difficult task of connecting the 250,000 Gram Panchayats (GP) a part of their state initiatives by assigning one of the implementing agencies to build and maintain the state optical fibres and deploy it to Punjab Haryana, Jharkhand, and Orissa, POWERGRID. By developing Deendayalaya Gram Jyoti Yojana (DDUGY) and Integrated Power Development Scheme (IPDS) projects, the POWERGRID also helps with distribution reforms in India.

POWERGRID has a strong presence in South Asia and is actively engaged in creating a strong SAARC grid for the efficient use of shared resources. Various electrical connections exist between India and Bhutan, India and Nepal, and India and Bangladesh. Additionally, India's interconnections with Bhutan, Nepal, and Bangladesh are being improved to facilitate significant cross-border power exchange. POWERGRID offers advisory services to a diverse range of domestic and foreign clients, including various countries in South Asia, Africa, and the Middle East. The "India Smart Grid Task Force" is the name given to the government's efforts in the field of smart grid [20]. The transmission system for the entire Indian power sector is divided into five regions: northern, southern, north-eastern, western, and eastern. A regional grid is used to refer to each distinct area within an interconnected system.

F) OFF-GRID RES POWER MANAGEMENT:

In the rural areas, off-grid power management systems are offered and developed by the union and state governments to provide incentives and subsidies to the users through the local nodal agencies and state DISCOM or mini-grid which rich and poor consumers would pay the costs. This type of grid management is called mini-grid and surplus energy generation storage in batteries banks. Solar power generation costs are decreasing by the latest projects bids with a price of Rs.2.42 / kWh. The costs of gas, oil and coal will go up, and the cost of solar power generation will come down. The decentralized power supply due to decentralize the demand in India.

RES power generation capacity 175 GW targets to be achieved by India by 2022, under the roadmap of eco-friendly energy generation planning and strategy to the whole system. However, implementation and formulation for the aspired leap quantity with policy in institutional mechanisms with exploring issues and challenges in India by the Indian government for RES power generations. The financial support for eco-friendly power generation development in India for users to be available by the state and central governments. The off-grid management in India for green energy generation and significantly on requirements for the population of the rural areas to be avoided the gripping of cuts and brownouts of electricity. The electricity supply and demands to be not connected with the grid management where governments ideas should be aggressive to promote the off-grid RES power generation management such as remote areas and rural areas.

India aspires to achieve RES power generation capacity to be installed 175 GW by 2022 to establish the largest RES power generation programs aim. After the US and China, India is the biggest emitter of CO_2 and GHG emissions. Therefore, the RES power generation has significantly progressed and commitments by India. India has installed terrible with dramatical growth over the last recent years. In 2002, RES power generation installation was 3.40 GW in India with the contribution of 3.2% in the total installed capacity of power generation, which is constituted with a very small form. So, the Indian power sector has been seen exponential growth from 2002 to 2016, resulting in the installed generation of RE in 45.90 GW as an end on December 2016 in 15% sharing of the total power generation installed capacity. During the period 2002 to 2016, the RES power generation installed capacity growth rate in the compound was 20% compared to fossil fuel base capacity such as nuclear and thermal evolve at 5.6 % and 7.7%, respectively (PRAYAS,2015).

In the power sector-top research fundamentality areas to electricity access of off-grid. Electricity modernity challenge is to development of eco-friendly power systems in the objective towards to the off-grid access. And the cheaper comparison to fossil fuels electricity for affordable access. By off-grid. The government

objective and support in the valuable reduction of price and CO_2 emissions for individual premises and increase energy efficiency and performance of RES power generation systems by 2020 for remote areas communities. Funding opportunity announcement (FOA) has been accelerating the electricity of off-grid access in its ongoing efforts.

The high cost up to compound 100 kW RES power generation systems operation, reliable, the robust, climate condition and diverse geographically to demonstrate by 2020 in India is lower than the present condition.

Off-Grid FOA objective to promote accessible and affordable access to eco-friendly energy derived for off-grid electricity generation as outlined in the challenge document of MI-Innovation. Especially, the objectives are overarching for individual domestic users, is to be financial support valuable reduction in price and enlargement performance of RES power generation systems by 2020 and for remote areas community‘s objective is to demonstrate For remote areas communities, to demonstrate the objective in robust and climate conditions, reliable, autonomous operation, diverse geographically of RES power generation systems less than valuable lower cost than today by 2020.

G) CONCLUSION

At present, the coal-based TPPs energy generation in India is defined with 197 GW approximately, and it is to be needed to reach almost 500 GW by 2050. India has a current total RES power generation installed capacity of 130 GW by sharing of non-hydro RES power generation capacity of 70 GW. It will be increased more expected 155 GW by sharing solar power generation and successful wind power sellout. India could be got the first position in the world‘s countries to be used LEDs for all lighting requirements by 2019. The government of India instant target to achieve a generation of 2 trillion kWh (units) by 2019. Present power generation capacity to supply 24x7 hours for agriculture, residential, commercial and industrial etc., in the meaning of twofold power generation.

The various footsteps are holding by the Indian government, such as subsidies, incentives and initiatives of a tax rebate or exemption for promotion of RES power generation projects and CO_2 emission reduction under the IT Act.115 BBG. The country‘s ambition is to be targeted with an additional 175 GW installation of RES power generation, including sharing 100 GW solar energy generation by 2022. The Indian governments have also restarted the impeded hydro energy generation projects. The wind power generation to be enhanced goals 60 GW from present generation 20 GW by 2022.

In the energy structure scenario in India, concerning intense progress momentum in demand, short dispersion in generation corresponding transmission and distribution to be situated for economical and eco-friendly growth. The demand for a large amount of power investment and to contest in the comprehensive system. The power generation system opened to the private businessman for sharing of partnership I generation. At this moment, certain the pathway for investment utilizing market occasion.

REFERENCES

[1] EP7-Corporation-Energy, ―Energy Foresight network – International Research Projects,‖ *EP7 universitadeglistudi di padova,* February 2019.

[2] [online] http://www.eprints.asc.ernet.in

[3] Eric M. Hines, Jay A. Borkland, ChasterH.Myers, Susen E. Nilson, ―Powerful Upgrade, feature Article,‖ Civil Engineering Magazine, Archieve: vol.87, no.3, March 2017.

[4] Rahul, B., Hiremath and Bimlesh Kumar, ―Low-Cost Bioenergy Options for Rural India,‖ *journal of Management of Engineering*, vol.2, pp. 70-80, January 2018. [online] https://doi.org/10.1061/(ASCE)ME.1943-5479.0000072

[5] *Business Standard newspaper*, 18 July 2017, [online] www.business.standard.com

[6] *Daily Sunday Pioneer newspaper,* 8 July 2018. [online] www.dailypioneer.com

[7] News from CASI, –*Center for the Advanced Study of India (CASI)"*University of Pennsylvania,Philadelphia, USA, Wednesday,20 June 2018, [online]https://www.casi.sas.upenn.edu

[8] Low Costs. Huge Economic Benefits, –Sustainable energy for America‖ report 2018. [online] www.arenewableamerica.org

[9] Prof. Michael Negnevitsky, –High Renewable Energy Penetrations in Isolated and Remote Area Power Systems,‖*ENERGY 2018,Centre for Renewable Energy and Power Systems university of tasmania,*Nice,France,May 20 - 24, 2018,[online]:http://www.iaria.org/conferences2018.

[10] Power Grid Corporation in India, *Ministry of Power*, Government of India,New Delhi, Transmission Report 2016. [online] http://www.powergridindia.com

[11] Jubilee Purkayastha, –Bioprospecting of Indigenous Bioresources of North- East India,‖*Springer Science*, pp.347, 16 August 2017.

[12] India Brand Equity Foundation, Department of Commerce,*Ministry of Commerce and Industry,* Government of India, New Delhi. [online]: https://www.ibef.org

[13] Edited by Roddam Narasimha, Dilip Ahuja, –Dialogues Across Disciplines from the NIAS archives *"National Institute of Advanced Studies (NIAS).* Indian Institute of Science Campus,Bengaluru, India, 2015. [14] R.Srinivasan, P. Balachandra, –Micro-level energy planning in India-A case study of bangalore north Taluk,‖ *International Journal of Energy research*,vol.17, no.7, pp. 621-632, September 2003,

[15] Indian wind power Association, Andhra Pradesh and Telangana council and Central *Electricity Regulatory commission (CERC)*, Government of India, New Delhi, 6th Amendment,2018

[16] *Ministry of Power,* Government of India, New Delhi. Generation Report 2016.

[17] TaeHoon, Hong,A.M., ASCE, Hyun, JoongKim and TaeHyunKwak, –Energy- Saving Techniques for Reducing CO2 Emissions in Elementary Schools‖ *Technical Papers*, June 08, 2018.

[18] –CO2 emission by Indian power plants increases,‖ *IST Business Standards*, New Delhi, January 21,2017

[19] S. Jebaraja, S. Iniyanb, –A review of energy models,‖ *Elsevier, Renewable and Sustainable Energy Reviews*, Vol. 10, pp. 281–311, 2016.

[20] Shiv Pratap Raghuvanshi, Avinash Chandra, Ashok Kumar Raghav, –Carbon dioxide emissions from coal-based power generation in India,‖ *Elsevier*, *Energy Conversion and Management,* vol.47, no.4, pp.427-441,2016.

[21] Claudia, S. & Leticia, O., –Energy use and CO2 emissions for Mexico's cement industry. *Elsevier, Energy,*‖ vol. 23, pp. 725–732, 2008.