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POWERING INDIA'S ECONOMIC EXPANSION: A COMPREHENSIVE ANALYSIS OF THE ENERGY SECTOR'S INFLUENCE

Dr. M. Nirmal Kumar
Assistant Professor of Economics, Department of Arts, Humanities and Social Science
The Tamil Nadu Dr. Ambedkar Law University, Chennai -113
E-Mail ID: mnirmal2007@gmail.com

ABSTRACT

The world's rapidly rising energy consumption has sparked anxieties about wasteful resource use and its resulting impact on the environment. India's energy sector stands as a pivotal driver of economic expansion, having influence across multiple dimensions of the nation's growth path. India, being a developing country, has seen a faster rate of increase in power consumption. India's energy industry is more diverse than that of other countries. Traditional energy sources, like coal and water-based thermal power plants, continue to dominate the country's energy production. India is not an exception to the worrying global rate at which it is being depleted. Its growing population and ensuing rise in energy consumption are the country's biggest issues. After the US and China, it is the world's third-largest energy consumer. India's energy sector wants to increase investment in order to create a clean, sustainable and effective energy system. There has been an emphasis on increasing domestic supply, enhancing alternative energy sources and lowering India's reliance on energy imports. The Indian government made a further pledge to achieve net-zero greenhouse gas emissions by 2070 during the 2021 global climate negotiations. India also restated its goal of establishing 500 GW of renewable energy capacity by 2030. In this context, this research elaborates performance of the energy sector in India, investment prospects in the Indian energy sector, government initiatives, etc. in resilient energy ecosystem conducive to India's continued economic advancement.

Keywords: Performance of the Energy Sector in India, Investment Prospects in the Indian Energy Sector, Government Initiatives, etc.

INTRODUCTION

The worldwide COVID-19 epidemic was posing a threat to the energy sector's expansion and causing a reduction in economic activity. While government programs such as the Jawaharlal Nehru National Solar Mission, the Rooftop Scheme, the Solar Park Scheme, and others have consistently helped India's energy sector expand in terms of increased installed energy quantity and equally distributed energy to optimize reach. In December 2022, India consumed 121.19 billion units of power overall. These days, energy is the most important component for both human survival and the smooth operation of machinery. The demand has resulted in an alarming pace of energy usage.

The Indian government is developing alternatives to the main energy sources in order to combat the overuse of resources and prevent their extinction. As a result, energy resources will be used more sustainably and efficiently. Since the energy industry can guarantee long-term economic growth and development, it is one of the most important components of any economy. Growth in this sector is frequently associated with improvements in a country's well-

being and wealth. Notwithstanding all the advantages of this industry, India also prioritizes tackling the issues that crop up from time to time such as guaranteeing reliable, inexpensive, and safe energy supplies for industry and the populace together.

Key Facts on India's Energy Sector

- India is one of the top three countries in the world driving the expansion of renewable energy.
- India is ranked third in the world for the total additions to renewable power capacity.
- India ranks third globally in terms of new solar photovoltaic (PV) capacity sales.
- India has the third-largest primary energy consumption in the world, primarily from coal, oil, natural gas and biomass.
- In terms of overall energy consumption, India's industrial sector accounts for 42% (2022).
- Approximately 20–25% of industrial energy use can be attributed to the MSME sector (2022).
- According to the national strategy plan of the Bureau of Energy Efficiency (BEE), the industrial sector has the biggest potential to save energy by 2030 (60%) than any other sector.

OBJECTIVES OF THE STUDY

The present research paper has the following objectives:

- To study the performance of the Energy Sector in India.
- To analyse the Investment Prospects in the Indian Energy Sector.
- To examine the Initiatives taken by the Government of India.

RESEARCH METHODOLOGY

Every bit of the research study's underpinning is secondary data. The pertinent information was gathered from a number of sources, including the RBI Bulletin, the Centre for Monitoring Indian Economy (CMIE), the Statistical Outline of India, the Economic Survey (Government of India), the Handbook of Statistics, the Economic and Political Weekly and numerous websites, including www.cmie.org, www.rbi.org.in and www.msme.gov.

PERFORMANCE OF THE ENERGY SECTOR IN INDIA

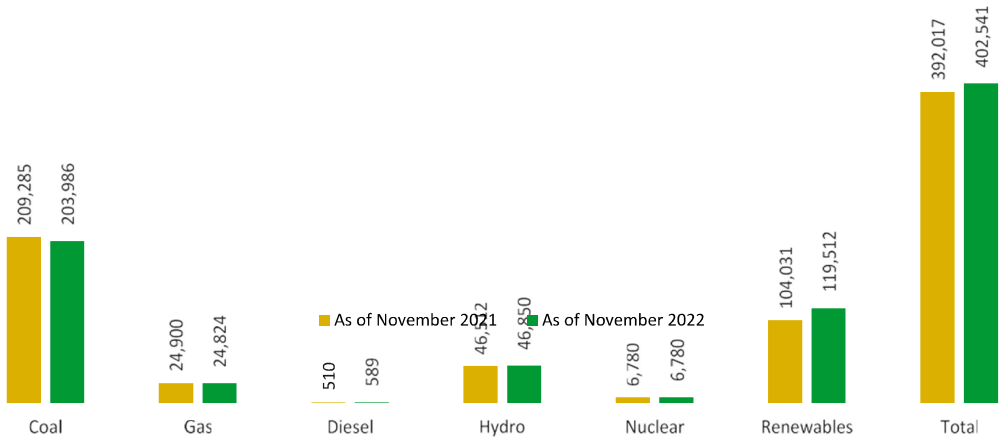
As far as installed capacity for wind, solar, and major hydropower goes India is ranked fourth in the world. By 2030, 500 GW of renewable energy would be produced in India in accordance to the nation's ambitious targets. In 2020, the COVID-19 pandemic resulted in a decrease in the usage of bioenergy and other renewable energy sources in comparison to the preceding year. Still, the market for renewable energy in India is expected to grow at a compound annual growth rate (CAGR) of 10.10% between 2022 and 2027. A number of government initiatives, growing environmental concerns, tax breaks for solar panel installations and incentives all contribute to this increase. Because there are more and more investments being made in this industry, the solar energy segment in particular will grow significantly throughout the forecast period. By 2030, the Ministry of New and Renewable Energy (MNRE) wants to have 500 GW of installed capacity for renewable energy. Future

market expansion and growth prospects are anticipated as a result of this action. The government's efforts particularly those developed by the Ministry of New and Renewable Energy (MNRE) will spur and support the expansion.

A Recent Trend in the Solar Energy Sector Indicates Considerable Expansion:

- Azure Power inaugurated a 600 MW solar power facility in Bikaner, Rajasthan, in January 2022. For a period of 25 years, Solar Energy Corporation of India Limited (SECI) would receive power generated from the project at a pricing of INR 2.53 per KWH.
- Amera Raja Batteries Ltd. (ARBL) declared in February 2021 that it would establish a 50 MW solar power plant in the Andhra Pradesh district of Chittoor with a total investment of US $26.5 million (Rs. 220 crores) over the next 18 months.
- Arcelor Mittal SA stated in August 2021 that it would invest US $ 2.2 billion (about Rs. 19,000 crores) to establish a 4.5 GW solar park in Rajasthan. It also intends to make investments in solar energy in Gujarat.
- MNRE issued an invitation to apply in December 2021 for the expression of interest to carry out the Phase II evaluation study of the grid-connected rooftop solar scheme. The program is a component of the National Solar Mission, which by 2022 intends to develop rooftop solar installation systems with a 40 GW capacity connected to the grid.

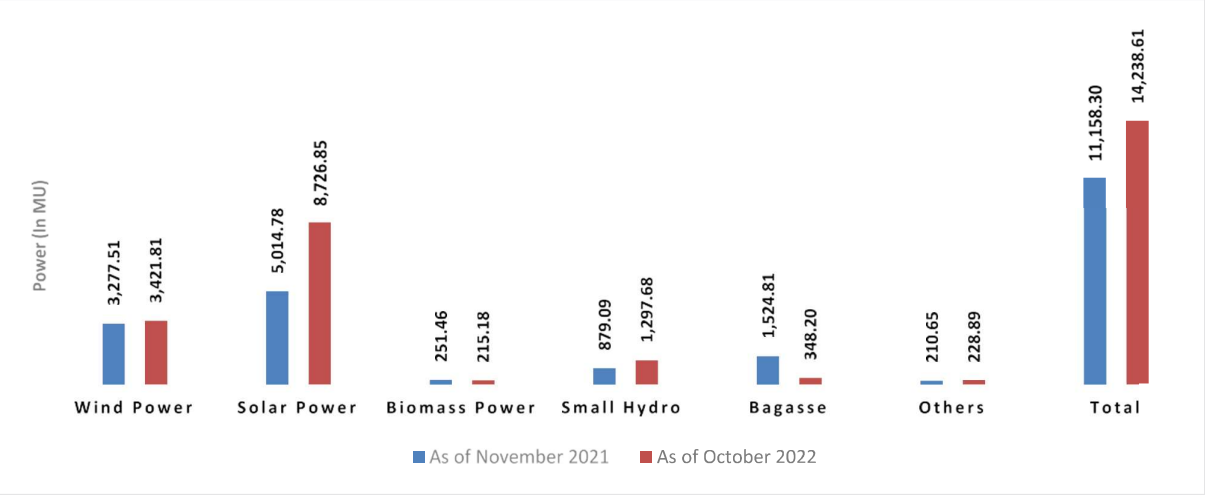
India's Total Installed Capacity by Power Source (MW)



Source: Ministry of Power & Central Electricity Authority

The above graphic shows the variation in India's total installed capacity between November 2021 and November 2022 across various power sources. Between November 2021 and November 2022, there was rise in coal, hydro, renewable energy and diesel. While nuclear capacity stayed constant, the overall installed capacity of gas decreased marginally throughout that time.

Generation of Renewable Energy



Source: Ministry of Power & Central Electricity Authority.

The aforementioned graph illustrates the shift in the renewable energy mix between November 2021 and October 2022. The installed capacity of the renewable mix, which consists of waste-to-energy, biomass, solar, wind, and small hydropower increased in November 2021 and October 2022. Wind power has the highest rate of regeneration as of October 2022 after solar energy.

The Following Bullet Points Illustrate the State of The Indian Energy Industry:

- As of March 31, 2022, India's renewable energy capacity has grown by 396% in the previous 8.5 years and it is anticipated to be more over 159.95 GW or 40% of the nation's total capacity.
- As of June 1, 2022, there will be 56.6 GW of installed solar energy capacity a 19.3-fold growth in just 8 years.
- As of August 31, 2022, the installed capacity of renewable energy sources is listed below:
  - 1.Wind Power: 41.2 GW, 2. Solar Power: 59.34 GW, 3. Biomass/Co-generation:10.2 GW, 4. Small Hydro Power: 4.888 GW, 5. Waste to Energy: 0.47 GW, 6. Large Hydro: 46.885 GW.
- Suggested reductions of 1 billion tonnes of Carbon Emissions by India by 2030 have been declared along with contributing measures.
  - Reaching net-zero carbon emissions by 2070 and installing 500 GW of renewable energy in India by 2030.
  - One solar city per state has been authorized by the government. The construction of 45 37 GW solar parks around the country has been approved. For instance, the Andhra Pradesh NP Kunta, the Madhya Pradesh Rewa Ultra Mega Solar, the Andhra Pradesh Galiveedu Solar Plant and so on.
  - Approximately 59 solar parks with a combined capacity of 40 GW have been approved in India.
  - In Gujarat, work is underway on the world's largest renewable energy park, a 30 GW solar-wind hybrid project.

PROSPECTS FOR THE INDIAN ENERGY INDUSTRY

Since 2020, India has increased the chances for US companies in its supply chain and attempted to lessen its reliance on China as a result of the energy sector's recent improvement. Several major Indian renewable energy enterprises and public sector organizations partnered with foreign technology providers as a result of the PLI scheme for solar and energy storage. Opportunities for exporting solar value chain components (e.g., U.S. Plolysilicon) to other nations are created by the expansion of manufacturing in India. Here are a few of the opportunities available in the Indian energy sector:

- ✓ **Introduction of Smart Meters**: India is planning to replace all conventional gas and electricity meters with smart meters in order to increase the revenue-generating potential and operational performance of distribution utilities. The nodal agency for overseeing the roll-out of smart meters for electricity is Energy Efficiency Services Limited the leading supplier of smart metering services in the country. In order to implement smart metering initiatives, it has established agreements with many state distribution utilities. The corporation plans to switch 250 million conventional meters for smart meters over the course of the next three years.
- ✓ **Infrastructural Development in Natural Gas:** As India builds new LNG terminals, expands its pipeline network and sets up city gas distribution infrastructure which includes compressed natural gas dispensers for transportation and piped city gas for buildings new opportunities are emerging due to the country's improved natural gas infrastructure. Hydrogen, biofuels and LNG technology will have a chance as the fuel retailing industry need new entrants to invest in new fuel dispensation.
- ✓ **Big Giants Investing in the Renewable Sector:** The major corporate companies' innovative investments have fuelled the expansion. Reliance Industries and an Indian energy company is the second-largest in the world. It has announced plans to invest US$10 billion in clean energy between 2021 and 2024. This in turn, opens up opportunities for exports for products like polysilicon, solar trackers, energy storage, and energy electrolyzers for hydrogen production. Diversifying their investments into clean energy technologies such as solar, energy storage, hydrogen, and smart grids is being done by other major corporations such as Adani, Renew Power, Avaada and public sector organizations like Coal India Ltd and NTPC Ltd.
- ✓ **Modernization of the National Power Grid:** As the Indian power grid continues to be modernized there will always be a need for both conventional transmission and distribution equipment and smart grid innovations that increase stability and dependability. Transistors, fixed capacitors, fuses for electrical equipment, lightning arrestors, voltage limiters, electric conductors, microprocessors, amplifiers, electricity meters and smart communication technologies became frequently imported as a result of this modernization.

Prospective Investments Hailing from the Energy Industry

a) A partnership agreement on strategic cooperation was signed between the Ministries of New and Renewable Generation of India and the Ministry for Energy, Utilities and Climate of the Kingdom of Denmark with a focus on offshore wind generation.

- Cooperation will be in the following areas: offshore wind forecasting and scheduling, offshore wind industry development and maintenance, offshore wind project

management technical capacity building and offshore wind industry "ensure high quality of wind turbines, components and certification requirements."

- The Indian government in accordance with the "National Offshore Wind Energy Policy," has declared the development of 30 GW of offshore wind energy projects by 2030 in an effort to draw significant investments for the growth of the offshore wind energy sector in India.

b) A fresh investment opportunity exists for the advancement of small hydro power projects with a maximum station capacity of 25 MW. This is now under the authority of the Ministry of New and Renewable Energy.

c) The second is the green strategic partnership between Denmark and India, wherein both nations have selected one another as preferred partners on the path to a green transition. Opportunities in renewable energy, water, waste management, food processing, agriculture and animal husbandry, sustainable urbanism and labour mobility are emerging from this relationship.

THE INITIATIVES TAKEN BY THE GOVERNMENT

The government's actions have tackled a number of the issues facing the energy industry today. The production, distribution and transmission of energy are some of the main issues. The following are programs that have been started to encourage energy efficiency and conservation:

A) Standards and Labelling: In 2006 the Bureau initiated the Standards and Labelling project for equipment and appliances to notify consumers about potential cost savings related with the relevant marketed product.

B) Energy Conservation Building Codes (ECBC): It was created on May 27, 2007, by the Indian government for use in newly constructed commercial buildings. For newly constructed commercial buildings with a connected load of 100 KW or a contract demand of 120 KVA and more, the ECBC has established minimum energy standards. State governments are free to alter the code to meet regional or local requirements and to notify the national government of any changes, even if the EC Act of 2001 grants the federal government certain authorities.

C) Demand Side Management (DSM) Scheme: The Agriculture Demand Side Management (DSM) initiative was launched under the DSM scheme with the goal of promoting energy efficiency in the agriculture sector by raising awareness among stakeholders and end users and developing a market-based framework for the execution of a few trial projects.

- BEE launched a program called Municipal Demand Side Management (MuDSM) to uncover the enormous energy-saving possibilities in the municipal sector. This initiative was put in place to increase overall efficiency which has the potential to significantly reduce electricity usage and as a result lower costs.
- Another initiative was launched under the name of DISCOMs' capacity building to carry out energy saving, loud management programs, DSM action plan preparation and DSM activity implementation in their respective locations.

- In order to promote energy-efficient technologies and operational techniques in SME sectors in India, the Energy Efficiency in Small and Medium Enterprises (SMEs) sector scheme was implemented.

D) Strengthening the Institutional Capacity of States: In order to remove the main obstacles to the implementation of energy-efficiency projects, the government is working to enhance state-designated agencies and contribute to the state energy conservation fund scheme.

E) School Education Program: The government instilled this concept in youngsters during their schooling in order to raise awareness among the next generation about the efficient use of resources. Through the creation of energy clubs, the promotion of energy efficiency is being encouraged. The government also mandates that lessons on limited energy sources be taught in schools. It aids pupils in comprehending the resources that are available and how best to utilize them.

F) National Mission for Enhanced Energy Efficiency (NMEE): The National Action Plan for Climate Change (NAPCC) has eight missions, the first of that being to strengthen the energy efficiency market by establishing a supportive regulatory and policy framework and encouraging creative and sustainable business models for the energy efficiency industry. The major solar-related projects that the Indian government is implementing to encourage people and businesses worldwide to switch to solar energy and 100% renewable energy.

i. **Jawaharlal Nehru National Solar Mission:** In January 2010, Dr. Manmohan Singh, former prime minister, introduced it. The goal of this project is to deploy 20,000 MW of grid-connected solar electricity via solar power generation at a lower cost.
   - Long-term policy
   - Large-scale development goals
   - Research and Development
   - Domestic production of raw materials

ii. **Rooftop Scheme:** The Solar Energy Corporation of India (SECI) carried out the initiative allocating 200 MW of projects, of which 45 MW of capacity had been put into service. Furthermore, specific initiatives have been introduced, such as the 73 MW warehouse and the 50 MW Central Public Work Department (CPWD) programs. Globally, SECI has released the largest tender providing a 30% subsidy to the residential sector, social sector, private not-for-profit education groups and health facilities. The Ministry of New and Renewable Energy (MNRE) is responsible for this tender. These are some advantages of the rooftop program.
   - It helps safeguard the environment by lowering reliance on electricity produced from fossil fuels.
   - In places that are not yet connected to the grid, such as isolated areas and places where the topography makes it challenging to install power plants and construct power lines, it helps to supply electricity.

iii. **Solar Park Scheme:** This MNRE proposal calls for the construction of many solar parks, each with a capacity of over 500 MW, spread across multiple states. The scheme's objective was to provide financial support from the Indian government to create solar parks and to assist in building the infrastructure, such as land allocation, transmission, road access, water availability, etc. needed to set up new solar projects.

The state governments will work with the developers of the solar park plan. Land will typically be sought and acquired in order to create solar power projects with a cumulative capacity close to 500 MW and above. The solar parks will assist states in attracting project developers' investment and provide job possibilities.

iv. **Viability Gap Funding (VGF) Scheme:** This is one of the plans that SECI has put into action. Over the last few years, it has allocated funds for several projects using the VGF system. Of the 750 MW allotted, 689 MW have already been installed and put into service. In order to put up grid-connected solar PV projects with a minimum capacity of 2000 MW on a build-own-operate basis, solar power producers will receive support from the VGF.

v. **Government Yojana Solar Energy Subsidy Scheme:** In accordance with the base cost of a solar energy plant, this scheme offers applicants 50%, 75%, and 90% in capital subsidies and financial support. According to this yojana, if someone has solar panels installed on their roof, they qualify for a subsidy, which is determined by the solar power plant's capacity. The plan's main objective is to encourage power looms to use solar energy. By increasing output, the effort would address the lighting problem and the facility would employ solar power to grow the textile sector. Additionally, people will be able to reduce the cost of their electricity which will boost power output and lessen the demand for thermal power plants.

vi. **UDAY Scheme:** The Government of India introduced the Ujjwal DISCOM Assurance Yojana (UDAY) in November 2015, as a rescue package for Indian energy distribution businesses. The program's goal was to identify long-term solar power solutions to the financial problems the power distribution industry was experiencing at the time. The program intends to enhance operations, create renewable energy, lower the cost of power generation and promote energy efficiency and conservation in addition to restructuring the power industry. States are free to decide whether or not to take part in the initiative. In order to pay back the lenders, the state government takes on up to 75% of the debt by issuing sovereign bonds with bonds being issued for the remaining 25%. UDAY expects to have a durable response for both potential and future power sector problems.

- The Deendayal Upadhyaya Gram Jyoti Yojana (DDUGY), Integrated Power Development Scheme (IPDS), Power Sector Development Fund (PSDF) or other state government programs that support UDAY and accomplish operational milestones will give additional/priority financing to the states.
- These states will also receive extra coal at predetermined prices, if available for free by increasing capacity utilization and obtaining low-cost power from NTPC and other Central Public Sector Companies (CPSUs).
- The Ministry of Power's Deendayal Upadhyaya Gram Jyoti Yojana (DUGY) aims to supply power to 18,500 villages over a three-year period. Off-grid or renewable energy sources would supply electricity to 3,500 of these settlements. The rural electrification component of the previous program, the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) has been incorporated into the current program. Feeder separation, sub-transmission and distribution network strengthening,

metering at all levels (input points, feeders and distribution transformers), microgrid and off-grid distribution networks and finishing rural electrification projects previously approved under the RGGVY are the primary components of the new scheme.

CONCLUSION

Energy remains one of the most important and will remain so for India's development and prosperity. The government is concentrating on creating innovative methods for utilizing renewable energy sources. Initiatives to limit the use of non-renewable energy sources include the UDAY plan, rooftop solar scheme, solar park scheme, and many more. These programs encourage the expansion of sustainable energy use. The government is increasingly concentrating on giving the people of the country a sustainable way of life that involves minimal waste and maximum use of the resources that are available. Through a number of projects, the government has also concentrated on tackling the problem of power supply in distant places by giving residents simple access to renewable energy sources to the people in those areas.

In order to meet India's energy needs, renewable energy sources will assume a central role in the upcoming years. By 2027, India intends to have installed 2,75,000 MW of renewable energy capacity. The administration must give careful thought to the plan it has chosen to advance renewable energy in India. Though success in expanding the renewable sector would require significant investment, the authorities and important stakeholders are persistently trying to address the financial issue. Compared to other renewable energy sources, solar technology is preferred and its development requires relatively affordable financing.

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