

# Power Generation in India: Present Scenario, Future Outlook and Policy Implementations

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India is one of the fastest growing nations within the global. To sustain this growth, power and power demands will increase. In this article, the present state and perspectives of using various energy sources in India for electric power generation are discussed as well as the main tools for promoting their development and utilization are highlighted. Indian power generation sector is the most expanded one in the world. Sources for power generation range from commercial ones such as coal, lignite, natural gas, oil, hydro and nuclear power to other important nonconventional sources such as wind, solar, agriculture and domestic waste. The demand for electricity in the country has been growing rapidly and is expected to grow further in the coming years. In order to meet this increasing requirement of electricity, massive addition to the installed generating capacity in the country is required. The demand of electricity has been increasing continually due to the increase in population, urbanization and usage of technology to access a comfortable life. It is also predicted that there will be a high demand of electricity by the year 2030. The Indian power sector is currently undergoing from a significant change that is redefining the outlook of the industry. The Government of India is currently focussing to attain 'Power For All' and has accelerated capacity addition in the country. In fact, the Power industry's future in India is bright, and sustained economic growth continues to drive electricity demand in India. Both energy and climate policies must be prepared for such a development in advance.

**Keywords:** India, Electricity, Energy policy, Sustainable development.

# 1 Introduction

Electricity infrastructure and production are important for a growing economy like that of India, which with a population of 1.39 billion and an area of 3.29 million square kilometre, is the 7th largest country in the world [Figure 1]. With a GDP of US\$ 2.3 trillion in 2015 and an average GDP growth of 7% per year [1] the growth of the electricity sector will be important to sustain the economic output of the country. Total electricity generation in India during 2015 was 1300TWh from both utilities and non-utilities [2]. In 2013, the electricity consumption from all sectors was 824 TWh [3], and with an average growth rate of 9%, and it was estimated to be approximately 980 TWh in 2015. The electrical network suffers from transmission losses by approximately 25-26%. In 2015, India's per capita electricity consumption was 746 kWh [2] whereas most of the countries have an electricity consumption of more than 4500 kWh per capita [7, 8]. Since per capita electricity consumption has a positive relation with GDP per capita, it can be used as a standard for judging the stage of economic development in any country [9]. There are also few exceptions in this case, depending on the structure of the economy in that particular country. It is predicted by the researchers that with the growth of the Indian economy, the GDP per capita will improve, and hence there will be need for more electricity in the future. In this regard, forecasting of the electricity demand is very important, as it can help the decision makers to be updated with the pace of the growing demands of the economy and to reduce power outages. The long-range energy alternative planning, referred to as LEAP [10], is a tool that is used to forecast energy demand and supply from various scenarios and can also be used for climate change mitigation assessment. LEAP has been used for different cases at various levels for the Indian scenario. Kale and Pohekar [11] studied the demand and supply scenarios for the state of Maharashtra, while the Indo-German Centre for Sustainability published a document that used LEAP for studying the greenhouse emissions of the country. LEAP was used in countries such as Panama where the investigators applied LEAP to promote the wind power to the Panama electricity mix [12]. Additionally, in Taiwan, LEAP was utilized in such a way so that the study on energy scenario could be done [13]. This study will basically focus on the electricity supply and demand in India. Access to the electricity, which was 84.5% in 2016, is not only a social, but also a political problem [14]. Foreseen 100% electrification (demand side) will increase the stress on the supply chain. It has been not cleared that whether the Indian government will prefer an increase of domestic energy/electricity sources, which would be the most preferred electricity mix, and how that will act in accordance with recent developments and policy initiatives for climate change mitigation. In this study, we have tried to bring attention to such crucial questions. By the set of future electricity generation models we have tried to project an outline of possible developments in the coming future.

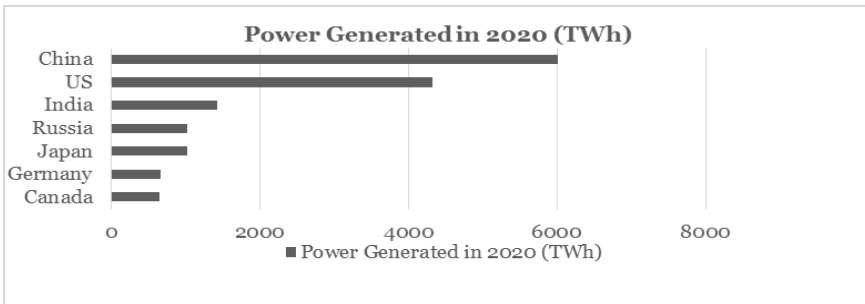


Fig. 1: Power Generated in 2020

## 2 ELECTRICITY GENERATION IN INDIA

India is the 3rd largest country from the aspect of electricity generation in the world. The national electricity grid in India has an installed capacity of 393.389 GW as of 31 December 2021. Renewable power plants such as large hydroelectric plants etc. constitute 37% of India's total installed capacity. During the fiscal year (FY) 2019-20, the gross electricity generation by the power plants in India was 1,383.5 TWh and the total generation of electricity in the country was 1,598 TWh. The gross electricity consumption in fiscal year (FY) 2019 was 1,208 kWh per capita. In FY2015, electric energy consumption in the agriculture was recorded as being the very best one (17.89%) worldwide. The per capita electricity consumption in India is low as compared to most of the major countries.

India's coal serves 70% of the total demand of electricity that is mostly used in the power sector and with India having the 5th largest coal reserves in the world, it has proven itself to produce the most economical form of energy [Figure 2]. Considering an increase in coal production of 5% each year, the coal reserves are expected to last for another 40–50 years. The World Institute of Sustainable Energy has prepared a research report for the electricity produced by coal in India and predicted that, by the end of 2032 the total coal power plant capacity would be 400 TW if coal-based power plants are preferred or 220 TW if renewable energy and gas are preferred.

India has a great power generation capacity but it only lacks in adequate transmission and distribution infrastructure. India's electricity sector is dominated by fossil fuels, especially coal, which produced about three-quarters of the country's electricity. The government is taking many initiatives to extend investment in renewable energy. It is expected that India's electricity generation is likely to be around 44.7% of the total gross electricity generation by the year 2029-30.

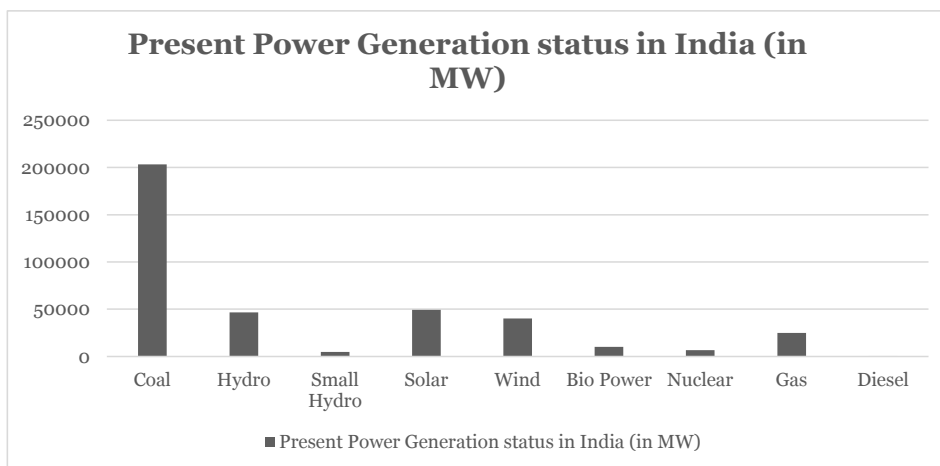


Fig. 2: Present Power Generation status in India

## 3 ELECTRICITY CONSUMPTION IN INDIA

The most important measure required for the energy balance of India is the total consumption of

1,137.00 billion kWh of electrical energy per year. Although India could serve itself completely with its self-produced energy. The total production of all electric energy producing facilities is 1,386 billion kWh, which is 122% of the countries own usage. Despite this, India is also exporting energy with the foreign countries. Along with the consumptions of electric power [Figure 3], the production, imports and exports also play a vital role in balancing the economy of the country. Electricity generated by other energy sources such as natural gas or crude oil is also utilized by India.

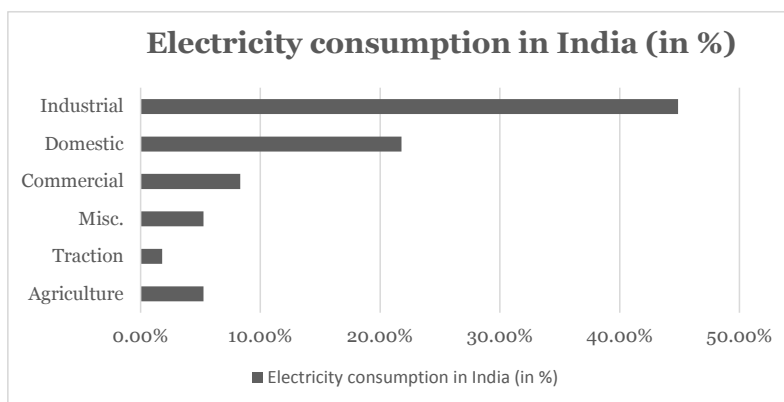


Fig. 3: Electricity consumption in India

## 4 INVESTMENT SCENARIO

Total FDI inflow in the power sector had reached US\$ 15.36 billion between April 2000 to June 2021 which is about 3% of the total FDI inflow in India.

Some major developments and investments in the Indian power sector are as follows:

- In November 2021, the NTPC announced that its 80 MW solar power-generation capacity in Jetsar (Rajasthan) has been started to be utilized for commercial operations from October 22, 2021. The total capacity of this project is around 160 MW.
- In November 2021, SJVN has started its second unit work of the 1,320 MW Buxar thermal power plant in Bihar.
- In October 2021, the NTPC was given a contract to set up a 325 MW solar power project in Madhya Pradesh.
- On September 29, 2021, NTPC Renewable Energy ltd (REL), a 100% subsidiary of NTPC ltd, signed its first green term loan agreement with Bank of India for Rs. 500 crore (US\$ 67.28 million) at a competitive rate for a period of 15 years for its 470 MW solar projects in Rajasthan and 200 MW solar projects in Gujarat.
- In September 2021, Adani Group has announced to invest US\$ 20 billion for the next 10 years in the field of renewable energy generation and component manufacturing.
- In July 2021, National Thermal Power Corporation Renewable Energy Ltd (NTPC REL), has invited a domestic tender to establish India's first green hydrogen fueling station in Leh, Ladakh.
- In July 2021, Bharat Heavy Electricals Limited (BHEL) received a large contract from Nuclear Power Corporation of India Limited (NPCIL) for the supply of 12 India's highest rated steam generators.

- In July 2021, NTPC declared that it would invest Rs. 2-2.5 crore (US\$ 0.27-0.34 million) for the upcoming 10 years to expand renewable capacity in India.
- In June 2021, NHPC signed a memorandum of understanding (MoU) with Bihar State Hydro-Electric Power Corporation Limited (BSHPCL) to begin Dagmara HE Project (130.1 MW) in the state.
- In June 2021, the NTPC has a global tender for setting up a 1,000-megawatt hour (MWh) grid-scale battery storage system.
- In April 2021, GE Renewable Energy has announced to supply 42 units of 2.7-132 onshore wind turbines.
- In March 2021, a private equity firm “Actis LLP”, planned to invest US\$ 850 million to build two green energy platforms in India.
- In January 2021, TOTAL acquired a 20% stake in Adani Green Energy. In addition, as a part of this deal, TOTAL undertook 50% in 2.35 GW portfolio of operating solar assets in Adani Energy Limited. The combined deal amount was about of worth US\$ 2.5 billion.
- In December 2020, the Asian Development Bank (ADB) and the Government of India signed a US\$ 100 million loan in order to modernize and upgrade the power distribution system for enhancing the quality and reliability of electrical supply in Bengaluru, Karnataka.
- In January 2021, Tata Power received a letter of award (LOA) from Kerala State Electricity Board Limited (KSEBL) for developing a 110 MW solar project. With this, the renewable capacity of Tata Power will increase to about 4,032 MW.
- Adani power plans to acquire Avatha group's Korba west power for an enterprise value of about Rs.4200 crore.
- JSW energy has agreed to acquire two hydro power projects from Jai Prakash power ventures for Rs.9700 crore, making it one of the largest deals in the power sector.
- Sun Edison has signed a memorandum of understanding with Government of Rajasthan to setup several solar power projects of 500 Mw capacity each totaling 5000 Mw in Rajasthan.
- Reliance power has started a 100 Mw concentrated solar power (CSP) project at Rajasthan, which is one of the biggest CSP in the world.
- REGEN power tech has unveiled the largest machine in its portfolio which is a wind turbine with an output of 2.8Mw.

## **5. CONCLUSION**

Power is the basic input for all the industry, therefore more concentration is needed to be given on it. Our mother nation needs to reduce the dependence on non-renewable resources and improve over all conservation efforts. Much of the industrial age is created using fossil fuels, there is also known technology that uses other type of renewable energies such as steam, solar, wind and bio gas. More concentration should be given to replace traditional bulbs with CFL's and LED's which will reduce power consumption. Necessary infrastructure should be designed for the transmission and distribution of power. Subsidy should be given to right person, not to all sectors. Concentration on the Tariff should be given to avoid unnecessary losses. If we concentrate in all the things, India will be the self fulfilled nation in power.

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