

Evolution and Evaluation of Energy Policies in India Between 2000 and 2017

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ABSTRACT

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India, as one of the world's largest energy consumers, has implemented a wide array of energy policies to meet the needs of its substantial population of 1.4 billion. This paper provides a comprehensive analysis of these policies, from the establishment of the National Electricity Board in 1950 to the introduction of the Pradhan Mantri Ujjwal Yojana in 2017. Covering a broad spectrum of energy forms, including electricity and LPG, it illuminates the evolution of India's energy policies and their effectiveness. Significant strides have been made since the 1950s when the government initiated rural and urban development programs. Landmark actions such as the establishment of nuclear power plants and the initiation of renewable energy source research and development have been critical in addressing the energy requirements of India's growing population and booming industries. Public domain data evaluation reveals a mixed performance of various schemes. While some have fallen short of their targets, others like the Saubhagya scheme have made impressive progress towards achieving universal electrification, with about 90% of households in India now having electricity access. However, concerns remain regarding the quality and reliability of this electricity provision. Furthermore, significant efforts are still required to adequately address the needs of institutional clients, small enterprises, and agricultural consumers. As the population continues to grow, it is recommended that an efficient evaluative strategy be established to monitor and address any emerging gaps in energy provision.

1. INTRODUCTION

India is on a fast track towards becoming a significant force in the global energy economy. With a rapidly developing economy and growing population, the energy demand has steadily increased. The energy sector, being one of the most resource-intensive industries in India, simultaneously holds significant importance for the nation's comprehensive growth. In the quest for sustainable development, it is imperative to decouple energy consumption from economic growth, despite the heavy reliance of the latter on energy systems.

Currently positioned as the third largest energy consumer globally, India has witnessed a doubling of energy demand over the past two decades, fueled by increasing per capita income and living standards. Presently, coal, oil, and solid biomass cater to 80% of the energy demand, thereby contributing to pollution and climate change. While the per capita energy usage in India has seen an upward trajectory parallel to population growth and GDP surge, it remains 40% below the global average [1].

Figure 1 presents a comparative analysis of India's population growth, GDP increase, and energy usage trends across the years 2000, 2010, and 2019. It is evident that alongside demographic and economic growth, the demand for coal has also doubled since 2000, marking fossil fuel as the dominant energy source. Concurrently, the demand for oil has

mirrored the same growth trajectory, primarily driven by increased vehicle ownership, road transport utilization, and improved transport connectivity.

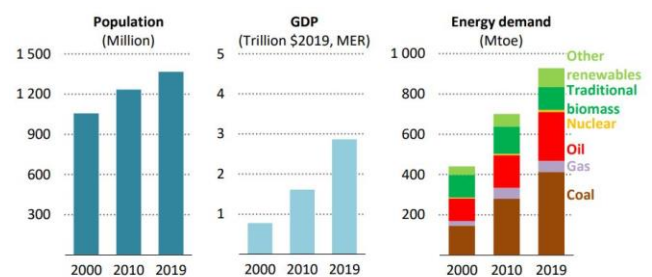


Figure 1. Indicators for India in terms of population, GDP, and use of energy (2000, 2010, and 2019)

Source: Data and graph extracted from India Energy Outlook, 2021

The total electricity production in India for the fiscal year 2020-21 (up to December 2020), inclusive of renewable energy generation, was 1017.8 billion units (BU). This represents a 3.6% decline compared to 1055.8 BU generated during the equivalent period in the preceding year. This decrement is primarily attributed to the disruptive effects of the COVID-19 [2].

2. OBJECTIVES OF THE PAPER

Informed by the preceding discourse, this paper aims to:

- (i) examine the progression of diverse energy policies implemented in India from 2000 to 2017.
- (ii) conduct an evaluation of various schemes introduced during the period 2000 to 2017, utilizing publicly accessible data.
- (iii) propose future directions that prioritize enhancing institutional efficiency and capacity for effective policy program implementation.

Methodology adopted

This investigation primarily adopts a policy research approach, scrutinizing an array of documents available in the public domain. To assess the impact and outcomes of different policies and government schemes implemented between 2000 and 2017, the study employs secondary data.

3. PRIMARY ENERGY DEMAND AND SUPPLY TRENDS IN INDIA

India's energy system has a concurrence of different parts of energy resources with both scarcity and abundance. Despite having the fifth largest coal reserves in the world, India is the largest importer of coal and a global center for oil refining. With irregular energy supply, significant technical and commercial losses have been observed at the distribution level, which is now a surplus of generation capacity over demand in aggregate [1]. Figure 2 represents the change in India's total energy demand from the years 2000 to 2020. It is evident that coal remains the most dominant resource, meeting 44% of the total demand (it was 33% in 2000).

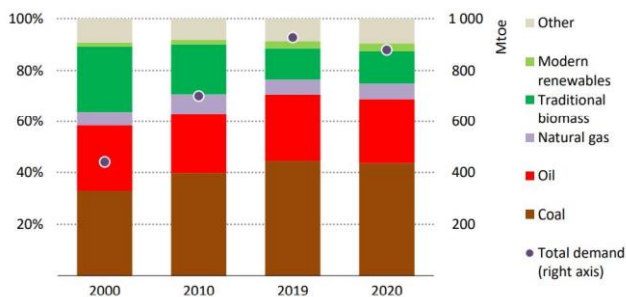


Figure 2. Total primary energy demand in India (2000-2020)
Source: India Energy Outlook, 2021

Oil is the second largest source and its use has consistently remained high. The demand for traditional biomass, primarily fuelwood, charcoal, and animal waste, has been decreasing over the years with the introduction of LPG cylinders for cooking purposes, but the overall demand for biomass fell to 12% in 2019, which was 27% in 2000. The energy and economic system of India is based on coal usage for power generation, oil used in transport and industry, and biomass for residential heating and cooking.

Figure 3, here, represents the energy demand change by fuel in specific sectors. Half of India's industrial sector demands is met by coal. They are also the primary source of energy demand. Since 2000, transportation energy consumption has increased by 3.5 times, while building/residential energy demand has climbed by 40% owing to increasing ownership of appliances and improved accessibility to contemporary cooking agents such as fuels. Due to the declining role of

economic production and with the use of traditional farming practices, the agriculture sector has witnessed a minor decrease in energy development.

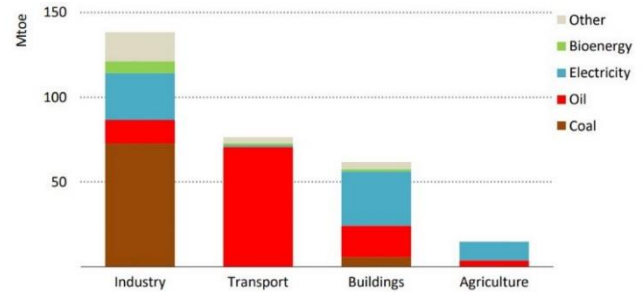


Figure 3. Change in energy demand by fuel in different sectors of the economy

Source: India Energy Outlook 2021

4. ENERGY PLANNING IN INDIA WITH RESPECT TO FIVE YEAR PLANNING

Energy Planning in India, since its inception, has been considered in relation to the more prominent developmental, industrial, or agricultural aspects. In the early plans, the energy sector was unified based on the energy source. It was only in the later years that the efforts to separate energy resource investments were made.

During the **First Five-Year Plan (1951 – 56)**, overall emphasis was laid on irrigation and energy, agriculture, and community development. This focused on setting up basic infrastructure across the nation by allocating a total of Rs. 5.58 billion to electric power development and irrigation. The target growth rate expected was 2.1%, against which 3.6% was achieved. In the **Second FYP (1956 – 61)**, the focus was laid out on developing the public sector plus industrialization by taking steps to set up electric hydropower projects. The target growth rate during this period was 4.5%, against which 4.27% was achieved.

The State Electricity Boards (SEBs) were formed during the **Third FYP (1961 – 66)**. The Energy Survey of India Committee (ESIC) was established by the GOI in 1963 to research the current and future energy demands and energy supplies, both overall and in terms of energy elements, on a regional, sectoral, as well as national basis. A total investment of Rs. 10.89 billion was planned for electric power generation and delivery. The target growth rate during this period was 5.6%, against which 2.4% was achieved following the after-effects of the Indo-Pak War and Sino-Indian War.

The economy took a severe hit during the **Fourth FYP** due to the Indo-Pak war of 1971, along with the Bangladesh Liberation War. Nevertheless, in 1975 the Electricity Supply Act was amended by allowing the Centre to invest in power generation as well as transmission. Additionally, the Irrigation and Flood Control Programme was separated from power investments. With a target growth rate of 4.4%, growth of 4.8% was achieved during this period.

The **Fifth and Sixth plans** were initiated under challenging circumstances when the rates of inflation were high, and an overall revival of the economy was needed. One of the main goals in terms of energy was to accelerate the development of indigenous energy sources while also emphasising energy conservation and efficiency. Promotion of renewable resources, oil conservation steps, and the impact of energy

usage on the green environment were given top priority.

State Electricity Boards' commercial losses increased to Rs. 4.18 billion in 1979-80, as against Rs. 1.03 billion in 1973-74. At this rate, the total loss suffered by electrical boards from 1980 to 1985 was around Rs. 30 billion. During this plan, the target of 5.2 percent was expected whereas the actual growth was recorded at 5.7 percent.

The LPG reforms of 1991 brought about a decentralized approach to resource allocation and its availability. More emphasis was placed on energy conservation through practical resource usage and efficient energy system movement. Environmental aspects of energy were given prime importance, and during this period the Ministry of New and Renewable Energy (MNRE) and the Ministry of Power (MoP) were established. As against the target of 5%, a growth of 6.01% was achieved and was highly appreciated.

Focus on Integration Energy Policy was laid out with the primary focus on end-use energy conservation. Investments were made in significant energy sectors. Price deregulation of the power industry also provided a boost to its growth. The target growth rate during this period was 8.0%, against which the growth rate of 7.7% was achieved.

Further, a National Action Plan for Climate Change was drafted and implemented. It unified India's mission for energy efficiency under the National Energy Policy (NEP), and an emphasis was laid on the promotion of alternative uses of energy, where a target of 30,000 MW was eyed at in the Twelfth Plan of renewable energy capacity. In addition, it was expected to lower GDP-related emission intensity by 20 to 25 percent in 2020, compared to the 2005 level.

By 2022, plans have been made to install 100 GW of solar energy and 60 GW of wind energy. This is around six times the existing green energy capacity of 10 GW. During the 12th Plan Five-Year Plan, the electricity sector was expected to receive roughly US\$ 250 billion in investments. The target growth rate during this period was 8.0%, the actual growth rate achieved was just 6.8%.

The government announced plans to establish an asset reconstruction business to handle strained assets in the power sector in June 2017. This was also to aid the transfer of stressed power-producing assets from stalled power projects, which were to be auctioned off later. The Indian Energy Security Scenario 2047 was developed by NITI Aayog as an energy sector planning tool for the COP21, Paris, and Intended Nationally Determined Contribution (INDC) [1].

5. EVOLUTION OF ENERGY POLICIES IN INDIA

Energy Policies in India have evolved based on the needs of the time. Energy systems through the years have been dependent on fossil fuels. It is only in the past two decades that the policymakers and the citizens have taken into consideration and adopted means of renewable energy. From generating sufficient capabilities to minimizing losses on distribution and creating an accountable and resourceful system for electricity supply, India's power sector has undergone extensive reforms. It has progressed from a welfare to a business paradigm, in which power is treated as a commodity rather than a necessity [3].

Table 1 maps out the significant policies and programs implemented in India since Independence. It shows the evolution and shift of policy decisions from generation to regulation and then adoption of non-conventional sources of

energy and eventually towards addressing and mitigating the effects of climate change through the use of clean energy.

Table 1. Indian energy scenario (significant policies/programmes)

Year	Significant Policies/Programmes
1969	Establishment of First Nuclear Power Plant
1989	Establishment of National Power Transmission Company (POWERGRID)
1992	Ministry of New and Renewable Energy supplemented energy infrastructure of the nation. It carries out research into new and renewable sources of energy
1992	Ministry of Power was established on 2nd July to oversee electricity production and infrastructure development
2003	The Electricity Act, 2003
2015	India Energy Security Scenario (IESS) 2047
2015	Ujwal DISCOM Assurance Yojana for revival and financial turnaround DISCOMs
2016	Pradhan Mantri Ujjwala Yojana: Provision of LPG Cylinders to households living Below the Poverty Line

The energy policies in India post-independence (during 1947-1970) focused primarily on electricity supply. During this period, a new era of infrastructure development became known, which also led to the growth of the gas and oil sector. As our nation was shaping its path towards human and economic development, the energy sector also evolved based on need and demand. Recently in 2019, the Central Electricity Authority and the Energy Survey of India Committee were formed in the early years of post-independence planning to focus on four primary goals for India's energy policy: affordable access, increased independence and security, economic growth, and greater sustainability. Seven areas of action were identified to meet these four objectives, and they are as follows:

- (i) Energy Consumption by businesses, households, transportation, and agriculture
- (ii) Energy Efficiency/de-carbonization measures on the demand side
- (iii) Production and distribution of coal
- (iv) Electricity generation, transmission, and distribution
- (v) Augmenting supply of oil and gas, both by domestic E&P and through the acquisition of overseas acreages
- (vi) Refining and distribution of oil and gas.

The **Energy Supply Act 1948** focused on the rationalization of the production and supply of electricity along with taking concrete measures towards the development of electricity across the nation. Under the act, a central body, the Central Electricity Authority, was formulated for planning for power and energy-related policy formulation and for monitoring the progress. The act also constituted State Electricity Boards (SEBs) for looking into matters concerning the distribution, generation, and utilization of electricity within the state.

Central Electricity Authority (CEA), an organization constituted initially under Section 3(1) of the repealed Electricity (Supply) Act, 1948. It was later made into a full-time body in 1975 with the prime goal of ensuring a reliable twenty-four by seven power supply of adequate quality to all consumers in the country. A national plan (every five years) for optimum utilization of available resources for power generation was formulated along with other monitoring and technical duties. CEA also promotes research and development in the power sector.

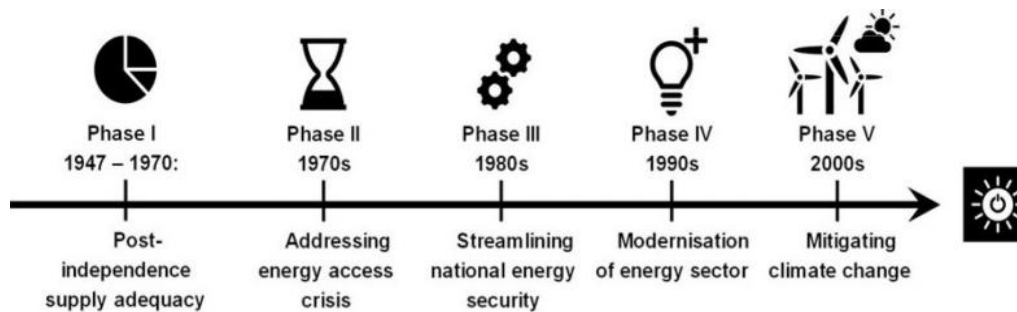


Figure 4. Evolution of energy policies in India since independence (chronologically)

Source: Evolution of sustainable energy policies in India since 1947: A review. Wiley Interdisciplinary Reviews: Energy and Environment, 340: 1-16. 10.1002/wene.340 [4]

As a result of the increased demand for oil and gas, more attention and resources were devoted to oil and gas exploration and production. For the refining and marketing of oil and oil products, the Oil and Natural Gas Corporation (ONGC) and the Indian Oil Corporation (IOC) were formed later. During this time, the demand for coal remained high, prompting the establishment of laws and conservation requirements [2] (Figure 4).

Since electricity was made into a concurrent subject, the responsibility of developing the electricity sector fell on both the state and the Union. State Electricity Boards were supposed to expand electrification (which had previously been limited to cities) across the country by developing underdeveloped transmission lines, adding generation capacity, and expanding electrification (which had previously been limited to cities) [3].

The **Fuel Policy Committee of 1974** initiated a holistic approach towards the creation of a national energy policy. The report presented the trends in energy consumption along with fuel resources in India. It also provided a perspective on long-term energy problems. The general recommendations of the Committee were the broad outline of national energy policy [5]. This led to the creation of the Ministry of Energy with two separate departments, i.e., Coal and Power.

A significant attempt in energy policy formulation was the creation of the **Working Group on Energy Policy** that was established in 1977 under the Planning Commission to develop a long-term perspective development plan for the energy sector and to make policy recommendations for more efficient use of available resources, including non-conventional energy sources. They devised a methodology that also took into consideration the non-commercial energy sources. It was dependent on the social, economic, and political factors for creating a holistic picture. The decisions and approach towards energy taken during the Seventh Five-Year Plan were based on the recommendations given by this working group.

Following that, a year later, the Ministry of Power established a **Committee on Power** to examine all aspects of the functioning of State Electricity Boards and Central organisations engaged in electricity generation, transmission, and distribution, including organisational structure, management practices, planning systems, operational efficiency, financial performance, tariff structure, and legislative framework [6]. It further emphasized the need to decentralize the planning and implementing process in the power sector. However, the SEBs have not been able to perform well and have been incurring heavy losses.

The recommendations from the Fuel Policy Committee, Committee on Power, and Working Group on Energy Policy

have been instrumental for policymakers and the government in formulating the programs related to energy and in the drafting of energy policy.

The **National Biogas Program** was started in 1981-82 as part of the National Project on Biogas Development (NPBD) by the Ministry of Non-Conventional Energy Resources (MNES). The core objective of this program was to promote family-level biogas plants as an alternative to the use of fuelwood in rural areas, and the program failed to achieve its objectives at that time and has evolved into the National Biogas and Manure Management Programme. The lack of community ownership, faulty biogas plant design – mismatch between the plant design and its environment, difficulty establishing a price for input and output, and a lack of coordination between organizations involved in the program with inefficient monitoring and review were the main reasons for the program's failure [7]. These measures have been taken into consideration for further policy development and the biogas produced is also now used as a source of lighting in rural and semi-urban areas, along with it being an essential source of clean cooking fuel. As of March 2020, the number of Biogas Plants in India touched 5 million [3].

6. POWER REFORMS (THE 1990S- AS A RESULT OF LPG)

In the early 1990s, the government took initiatives to bring in reforms in the power sector to control fiscal deficits and energy shortages. The electricity sector was opened for private independent power producers. Investments were allowed in the electricity generation sector for private participation. The government, however, retained the authority to set tariffs. To isolate the SEBs' developing problems in the mid-1990s, the government decided to divide them into three parts: generation, transmission, and distribution. However, by the late 1990s, SEBs were still running in losses, and there was growing unrest between the private entities and the government. The need for an independent regulator for the power sector became evident during this period.

7. REMOTE VILLAGE ELECTRIFICATION PROGRAMME 2001

The remote village electrification initiative aimed to provide basic electricity to rural (very distant) locations by offering free connections to low-income residents. The capital cost was subsidized by 90% in the form of grants by the Indian Government. This was an instrumental step in moving towards

universal electrification of all households. This program was then modified into the *Rajiv Gandhi Grameen Vidyutikaran Yojana* in 2005.

India's National Action Plan on Climate Change, published in 2008, was an essential step towards addressing climate change effects and reducing GHG emissions. The strategy called for a 20-25 percent reduction in the economy's emissions intensity (CO₂ per unit of GDP) by 2020 [8].

However, in the process of focusing on the economy and despite this commitment to reduce emissions, India's development trajectory continues to move towards the creation of an infrastructure that is highly dependent on fossil fuels.

There are eight missions under the broader context of NAPCC.

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Ecosystem
- National Mission for a Green India
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change.

8. DEEN DAYAL UPADHYAYA GRAM JYOTI YOJANA (DDUGJY) 2015

The Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) for village electrification and developing energy distribution infrastructure in rural regions was merged into the DDUGJY scheme in December 2014.

Through the following project components, DDUGJY promotes the realization of "24×7 Power For All" in India's rural areas [2]:

- a) Separation of agriculture and non-agriculture feeders facilitating continuous quality power supply to non-agricultural consumers and adequate power supply to agricultural consumers;
- b) Strengthening and augmentation of sub-transmission & distribution infrastructure;
- c) Micro-grid and Off-grid distribution network;
- d) Metering of Distribution Transformers/Feeders/Consumers; and
- e) Rural Electrification component (including the erstwhile RE projects).

As per the Annual Report by the Ministry of Power (2020-2021), all the census villages in India are fully electrified.

9. NATIONAL TARIFF POLICY, 2016

The Nation Tariff Policy of 2003 was amended in 2016 under Section 3(3) of the Electricity Act, 2003. The primary goal of the policy was to provide all citizens access to affordable electricity. The power generation plants have been given the allowance to increase their capacities by 100%, which is subject to conditions. Power in rural areas is to be provided through microgrids with provision for the purchase of power into the grid as and when the grid reaches there [9].

Another exciting aspect of the NTP is the Renewable Purchase Obligation (RPO) which promotes the order that 8% of the total consumption of electricity shall be from Solar

Energy by March 2022. The other amendments include provisions for cross-subsidy, Structuring of competitive bids, Renewable Generation Obligation (RGO), Procurement of power from waste to energy, and such.

10. SAUBHAGYA PRADHAN MANTRI SAHAJ BIJLI HAR GHAR YOJANA 2017

The Ministry of Power launched a flagship scheme named **Pradhan Mantri Sahaj Bijli Har Ghar Yojna** to provide last-mile electric connections and connectivity in all urban and rural areas. It aims to achieve universal household electrification.

According to the Annual Report for 2020-2021, the scheme's total outlay is Rs. 16320 crores, including budgetary support of Rs. 12320 crore from the Indian government. Grants of up to 75 percent (90 percent for individual category states) are available to states, with an extra award of 15 percent (5 percent for particular category states) available if 100 percent household electrification is achieved by December 2018.

11. THE WAY AHEAD

The outbreak of the COVID-19 Pandemic followed by the national lockdown has added stress on the liquidity problems of the power sector. As part of the Atma Nirbhar Scheme, the government announced a liquidity infusion package for the power sector. The DISCOMs can discharge their dues to the CPSU Gencos and Transcos, IPPs, and RE Gencos by availing of concessional loans from PFC and REC against State guarantees. Against the liquidity infusion package, Rs.1185.08 billion worth of loans have been sanctioned, and Rs.45,083 Cr has already been disbursed/ released by December 31, 2020 [1].

India's progress in moving forward with the goal of universal electrification through schemes such as Saubhagya has been commendable. As per the government data, 90% of the households in the nation are electrified. However, in reality, there have been numerous concerns about its quality and reliability. In terms of non-household customers, only about 80% of institutional clients, 65% of small enterprises, and 50% of agricultural consumers have been connected to the grid [10].

The policy objective should also focus on the institutions' efficiency and capacity to implement the policy program. There is a need for an efficient evaluative strategy to be kept in a place that monitors and troubleshoots any gaps if they arise.

The COVID-19 pandemic and its economic consequences have the potential to reverse previous successes and put some connected homes back into energy poverty, as seen in India, where 40 million individuals with electrical connections may lose their ability to pay for an extended package of services [11]. Some low-income households are forced to choose between their energy needs and other demands, which may lead them to revert to old, inefficient fuels.

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