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Scenario Analysis on Future Electricity Supply and Demand in India

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Abstract

This article delves into the factors determining the overall electricity demand in India, employing an autoregressive distributed lag model (ARDL) bounds cointegration approach from 1991 to 2021. Investigating the level relationship reveals that gross domestic product (GDP), industrial efficiency, urbanisation level, and economic structural changes could be the primary 'long-run forcing' variables that explain aggregate domestic electricity demand in India. The findings indicate a positive relationship between the explanatory variables and electricity consumption, aligning with earlier studies. The scenario analysis shows that the projected electricity demand for 2027 is in line with that of the projections of Central Electricity Authority.

Keywords

Electricity consumption, thermal power, ARDL bounds test, per capita income

JEL Classification: Q40, Q43

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Introduction

Energy, particularly electricity, is a fundamental driver of economic growth and development, serving as a crucial input in the production of goods and services

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(Asafu-Adjaye, 2000). Across the globe, energy demand has surged, with India playing a significant role in this trend. Since 2000, India has accounted for approximately 10.0% of the global increase in energy demand, and between 2000 and 2013, its share in global energy consumption nearly doubled. The International Energy Agency (IEA) projects that in the next three decades, India will experience the quickest growth in energy demand among all countries and regions. Moreover, within the next three years alone, India's electricity demand is expected to reach levels comparable to the present energy consumption of the United Kingdom.

Given this rapid rise, understanding the relationship between electricity consumption and economic growth has become vital for policymakers in developing nations. Many scholars agree that electricity is crucial in fostering industrial development, increasing productivity, and alleviating poverty (Karanfil & Li, 2015). However, alongside the challenge of meeting increasing energy demands, India must also align its electricity generation with its climate commitments. Over the years, various reforms have shaped India's electricity sector. The Electricity Act (EA) of 2003 played a transformative role by promoting competition through open access, introducing multi-year tariff frameworks, establishing distribution franchises, delicensing power generation, enforcing renewable purchase obligations, and creating independent regulatory bodies. More recently, policy measures have shifted to harmonising electricity demand with sustainability goals by encouraging renewable energy adoption.

This study examines the key economic and demographic factors influencing India's domestic electricity demand and compares these with projected demand estimates. Electricity demand is customarily determined by variables such as gross domestic product (GDP), prices, population growth, urbanisation, and weather patterns. However, India's unique economic and social dynamics impose a deeper examination of structural changes in the economy and efficiency improvements in energy consumption. To address this, the study employs the Autoregressive Distributed Lag (ARDL) model to assess and forecast electricity demand while considering the role of installed capacity in determining supply. Cointegration models, such as ARDL, are particularly useful in identifying long-term equilibrium relationships between electricity demand and its fundamental drivers.

Several studies, including the present one, have adopted a top-down approach to estimating aggregate electricity demand by establishing its relationship with macroeconomic variables through regression equations (Saxena et al., 2017). However, while this method provides valuable insights, it may overlook the convolutions of evolving economic activities, technological advancements, and policy shifts, all of which directly shape electricity consumption patterns. By addressing these gaps, this study aims to provide a more comprehensive and policy-relevant projection of India's future electricity demand.

The subsequent sections of the article are structured as follows: The second section presents an overview of the current state of the electricity sector in India. The third section offers a succinct review of existing literature. In the fourth section, we delve into the factors influencing electricity demand, followed by the fifth section, which summarises the data type, source, and the analytical method employed in this analysis. The sixth section covers the scenarios for projecting future demand and compares them with the projected electricity supply. Finally, the seventh section concludes the findings.

An Overview: India's Electricity Market and Consumption and Production

The power sector in India was predominantly government-owned and operated by state electricity boards established under the Electricity Supply Act of 1948. However, in the early 1990s, India liberalised the power sector. In 1991, amendments to the Electricity (Supply) Act allowed for the creation of private electricity generating companies (excluding hydro) to sell bulk power to the grid or other entities like industrial consumers. This shift attracted investment, injecting capital into India's electricity sector. Other significant measures in the 1990s included the establishment of independent regulatory bodies at both the central and state levels and the separation of transmission as a distinct activity. Subsequently, three pivotal milestones marked the transition of the power sector: The Electricity Act of 2003 (EA), the formation of power exchanges in 2008, and the accomplishment of One Nation, One Grid, One Frequency.

The Central Electricity Regulatory Commission (CERC), established in 1998 under the Electricity Regulatory Commissions Act of 1998 within the Ministry of Power, oversees the power sector in India. CERC's primary role is to regulate the tariffs of power-generating companies owned by the central government and oversee entities involved in interstate energy transmission and composite schemes for power generation. The Electricity Regulatory Commission Act of 1998 also empowers all states to establish their own State Electricity Regulatory Commissions (SERCs), granting them the authority to set tariffs. Historically, until the late 1990s, the electricity industry, including generation, transmission, and distribution, was controlled by state-owned Electricity Boards (SEBs). However, significant changes have occurred over the past 15 years, leading to the restructuring of these SEBs into separate public companies for each sector.

Electricity supply in India is regulated, and DISCOMs have the license to distribute power to the end-user. SERCs set electricity prices (tariffs) with two main goals: To recover DISCOMs' costs and to provide social welfare by keeping prices lower for the poor. This is achieved through a system called cross-subsidies, where some consumers pay less while others might pay more than the actual cost of service. It is important to note that this differs from any additional subsidies the state government provides. The responsibility for determining electricity prices lies solely with the SERCs, following the guidelines set out by the National Tariff Policy within the Electricity Act of 2003. The distribution is the last stage of the electricity supply chain. State Electricity Distribution Companies or State Electricity Boards (SEBs) usually oversee a large portion of the distribution segment in the electricity supply chain.

In India, thermal energy, which is predominantly sourced from coal, plays a pivotal role in the electricity production landscape of the country, making up approximately 55% of the total installed generation capacity during the year

2023–2024, followed by renewable energy sources (RES) at 32.5%, hydro at 10.6%, and nuclear at 1.9% (Central Electricity Authority). Despite maintaining the highest share, the proportion of coal has decreased in recent years, mainly due to the increasing significance of RES, as installed capacity in renewables is also increasing, indicating a transition to cleaner alternatives (Figure 1a).

In terms of electricity generation composition of the country, thermal sources (primarily coal) still hold a dominant position, constituting about 76.3% in 2023–2024 (Figure 1b). In installed capacity, the share of renewable energy is high, but in generation, its share is low (around 13% in 2023–2024) due to intermittent nature of renewable sources, grid stability issues and storage challenges.

India is currently the third-largest global energy consumer. In the Asian region, electrification has steadily risen by 6.8 percentage point (pp) since 2010, primarily driven by substantial increases in China (surging by 10 pp to over 27.0% in 2022), India (rising by 3.9 pp to 18%), and Indonesia (growing by 5.4 pp to 14%, despite a 2.6 pp decrease in 2022) (Enerdata, 2023). Figure 2 provides a breakdown of consumption by category in India.

Projections indicate a continuous upward trend in energy consumption. The overall electricity consumption rose significantly from 611.29 billion units (BU) in 2008–2009 to 1403.40 BU in 2022–2023, marking a compound annual growth rate (CAGR) of 6.1% (CERC, 2023). Despite this, India's per capita electricity consumption remains low, and is below the international average of approximately 3577 kWh for 2022 (CERC, Report on Short-Term Power Market in India, 2022–2023). A cross-country comparison reveals that India lags far behind developed nations and trails behind BRICS regarding per capita electricity consumption in 2022. However, in terms of overall consumption, it ranks third (Figures 3a and 3b).

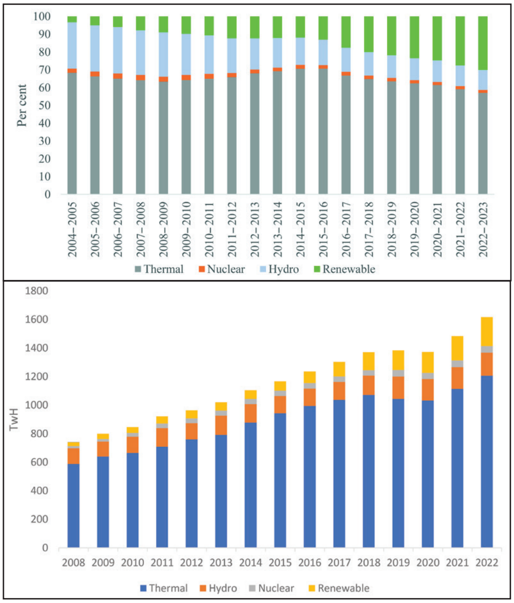

Figure 1. Electricity Installed Capacity and Generation.

Source: Central Electricity Authority.

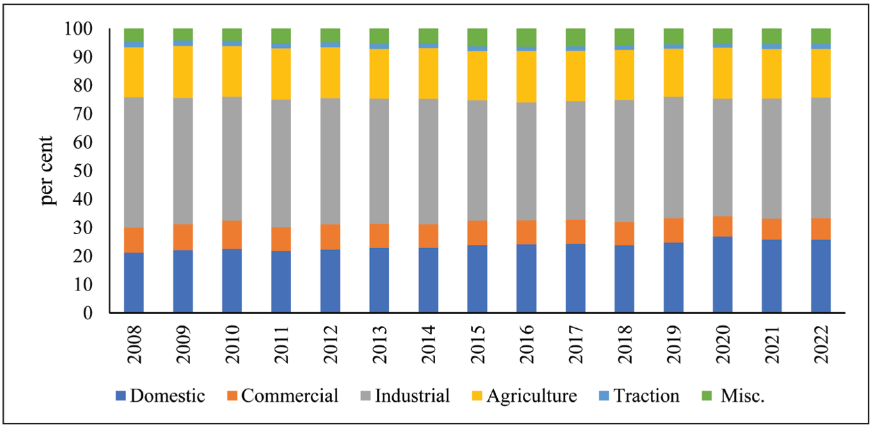

Figure 2. India's Electricity Consumption Category-wise.

Source: Central Electricity Authority.

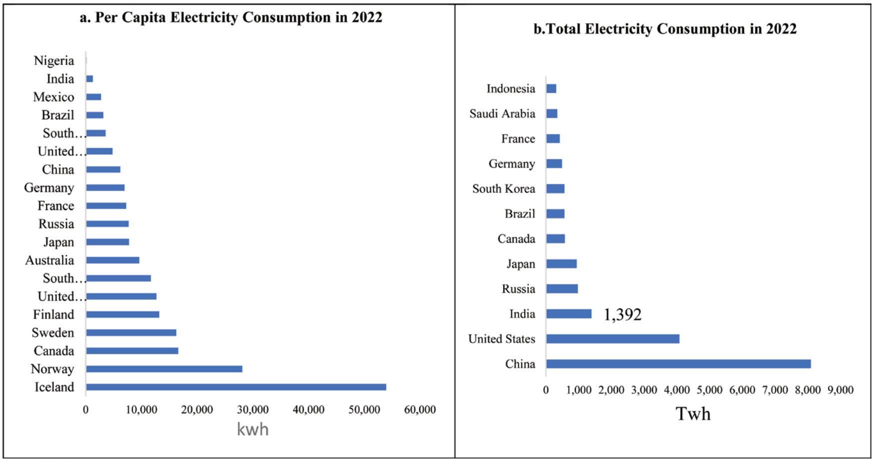

Figure 3. Electricity Consumption.

Source: Statista.

Brief Review of Literature

Energy models play a crucial role in nations' strategic energy planning. Econometric models establish functional linkages between macroeconomic variables and energy demand.

Al-Bajjali and Shamayleh (2018) studied the relationship between electricity consumption and its influencing factors in Jordan using data from 1986 to 2015. Through the application of the Vector Error Correction Model (VECM), they determined that economic structure, urbanisation, and economic growth positively impact the increase in electricity demand. Their study stressed that economic expansion and urban development drive higher energy consumption due to increased residential, commercial, and industrial activities. Additionally, the research emphasised how changes in electricity pricing and policies can influence consumption patterns over time, suggesting that effective policy measures could be implemented to manage demand growth.

Adom et al. (2012) sought to identify the determinants of historical growth patterns in overall domestic electricity demand between 1975 and 2005 in Ghana, employing the ARDL Bounds cointegration method. Their study found a long-run equilibrium relationship between electricity consumption and macroeconomic variables such as income levels, industrialisation, and energy pricing. The results indicated that the income elasticity of electricity demand was high, implying that as income levels rise, electricity demand grows significantly. Moreover, they underscored the importance of policy interventions to ensure efficient energy usage and the need for infrastructure investments to meet expanding demand sustainably.

Some studies on India underscore the connection between economic growth and electricity usage. For instance, Ghosh and Kanjilal (2020) find that cointegrating relationships exist between the utilisation of non-fossil fuel energy and GDP. Their study suggests that transitioning to RES is not only environmentally imperative but also economically viable. They contend that sustainable growth can be reached by expanding non-fossil energy sources while warranting long-term economic stability. Moreover, their research bears the notion that policy frameworks must encourage investments in renewables to leverage economic growth without aggravating carbon emissions.

Ali (2018) projects India's electricity demand in 2030 from the end-use sectors, including agriculture, commercial, municipal lighting, water pumping, and miscellaneous uses. His research gives detailed sector-wise demand forecasts, highlighting that agricultural and industrial sectors will remain the largest consumers of electricity. His findings indicate that enhancing energy efficiency in these sectors could substantially decrease the overall demand burden. Additionally, the study underscores the importance of integrating smart grid technologies and energy conservation policies to optimise electricity distribution and usage.

Thus, various studies have considered factors relevant to economies to understand the drivers of electricity consumption. These studies collectively emphasise the importance of economic structure, urbanisation, policy measures, and renewable energy integration in shaping electricity demand patterns. Their findings serve as vital inputs for policymakers aiming to develop sustainable energy strategies that align with economic growth and environmental commitments.

Factors Affecting Electricity Consumption: Theoretical Underpinnings

Electricity use is shaped by an intricate interaction of multiple factors that impact its total demand and usage trends. Electricity demand is predominantly affected by two key factors: GDP and tariff rates.[2] This represents a commonly acknowledged description of the demand function. In the framework of a contemporary economy, electricity transcends being a mere commodity; it stands as a crucial input for production processes and daily routines. It serves as an essential end-use service, with its demand influenced by a range of significant factors, sometimes conflicting, thereby altering the dynamics of electricity consumption (Gellings, 1996). Factors affecting economic activities and consumption patterns are pivotal in determining electricity consumption. In the case of India, pricing is not solely determined by market forces. Other noteworthy factors, such as weather conditions, require careful consideration when understanding electricity demand. For instance, colder days lead to increased electricity usage for heating and lighting, while longer nights in winter result in prolonged use of lights. Additionally, electricity demand vacillates during the day, with peak demands occurring during cold weather and heat waves. Incorporating weather changes into assessing electricity demand is not considered, as the seasonal changes in demand cannot be captured by the annual data used in this analysis.

Technological advancements and consumer preferences can influence electricity demand. The evolution of competitive power markets may also impact demand, potentially leading to lower electricity tariffs. On the other hand, environmental policies could increase supply costs, negatively affecting electricity demand. Furthermore, electricity demand growth rates differ across various consumer categories and regions. Short-term and long-term electricity demand forecasts can be made for specific sectors or regions, but creating an aggregate forecast would involve economic parameters like GDP as well as technological development, and there could be considerable uncertainty surrounding the evolution of these variables. This article aims to estimate future demand by analysing the relationships between electricity consumption and macroeconomic variables. An aggregate approach utilising national-level macroeconomic data is deemed suitable to achieve this.

Based on related literature, four variables are considered to estimate future electricity consumption in this study:

1. **GDP**

   GDP is often regarded as the most important factor influencing the consumption of electricity, as per the literature. Economic growth and its effect on standard of living are the foremost determinants of growth in electricity usage. Empirical studies (Ghosh, 2002) show that there is a significant and stable positive correlation between GDP and electricity consumption.

2. **Urbanisation**

   Studies have shown that urbanisation and energy consumption are closely linked. There is a difference in consumption characteristics between urban and rural areas (Wu & Lin, 2022, 2023). Towns and cities generally have more abundant and varied energy supply options than rural areas. Urban households also tend to possess a more significant number of energy-consuming appliances, including air conditioners and heating equipment. Consequently, urban residents' per capita direct energy consumption is typically higher than their rural counterparts. However, the higher population density in urban centres can lead to certain forms of energy consumption reduction, such as increased utilisation of public transport and the promotion of smaller, more compact houses. The relationship between urbanisation and energy consumption undergoes a phased progression as a country develops. Zhang et al. (2011) arrived at a 'U-shaped curve showing the association between total factor energy efficiency and per capita income in 23 developing countries and the improvement of total factor energy efficiency in China'.

Thus, the change in electricity demand would depend on the phase of economic development, a very high degree of urbanisation may reduce consumption as transmission systems and distribution improve over time, making electricity supply more efficient and cost-effective.

3. **Structural change**

Structural changes in an economy play a crucial role in shaping electricity demand, as shifts in industrial composition and economic activity influence energy consumption patterns. Several studies have attempted to quantify the elasticity of structural changes concerning electricity usage, offering important insights into how economic transformations could affect energy demand.

Lin (2003), in a study on China, estimated the elasticity of structural change before and after the 1978 economic reform. His findings indicate that before the reform, the elasticity stood at –0.469 for the long term, while post-reform, it declined further to –0.527, with a short-term value of –0.478. Lin analysed structural change by focusing on the industrial sector, specifically measuring how the ratio of heavy industry output to total industrial output influenced electricity consumption. His results suggest that the transition towards less energy-intensive industrial processes contributed to reduced electricity demand, reflecting the impact of economic modernisation and efficiency improvements. In contrast, Zuresh and Peter (2007) adopted a broader approach in their study of Kazakhstan, examining structural changes across the entire economy. They assessed the impact of industrialisation on electricity demand by analysing the share of industrial output as a percentage of GDP. Their findings indicated that as an economy moves towards more energy-intensive sectors, electricity consumption tends to increase correspondingly. This perspective highlights the fluctuating impact of structural change contingent on whether an economy is moving towards or away from energy-intensive industrial activities.

Building on these approaches, the present study examines the role of structural change in India by analysing the contribution of industry to Gross Value Added (GVA). Given India's ongoing industrialisation and economic transformation, we expect a positive relationship between industrial growth and electricity demand. As manufacturing and other energy-intensive sectors expand, electricity consumption is expected to rise, reinforcing the link between structural change and energy requirements. However, the extent of this impact will also depend on factors such as advancements in energy efficiency, government policies promoting sustainable industrial practices, and the adoption of cleaner technologies. By integrating insights from Lin (2003) and Zuresh and Peter (2007), this study aims to provide a profounder understanding of how India's structural shifts affect electricity demand and how these tendencies align with broader economic growth and energy sustainability goals.

4. **Efficiency**

   Energy plays a significant role in the quantum of CO_2 emissions, with approximately three-quarters of greenhouse gas emissions emitted globally attributed to the combustion of fossil fuels. Therefore, improving energy efficiency can be crucial in decreasing emissions. Energy intensity serves as a valuable metric for monitoring this. Energy intensity quantifies the amount of energy used per unit of GDP and effectively gauges how efficiently a country utilises energy to generate a specific level of economic output. A lower energy intensity indicates a need for less energy per unit of GDP, reflecting higher efficiency. In this study, we assess the impact of intensity by examining the ratio of industry GVA (at constant prices) to the electricity consumed by the sector. A higher value implies lower energy intensity in the economy, aligning with the approach of Lin (2003). As the value of the variable rises, electricity consumption is expected to reduce.

Data and Econometric Methodology

Model and Data

This article uses annual time series data on GDP at constant prices, industry efficiency, structural changes in the economy and degree of urbanisation to analyse the relationship with total domestic electricity consumption from 1991 to 2021. Total domestic electricity consumption data was sourced from CEIC, while the degree of urbanisation[3] was sourced from the World Bank, and industry efficiency and structural change variables were calculated using data from the Ministry of Statistics and Programme Implementation (MoSPI).

Based on the discussion in the fourth section, the long-term demand function for India is given below:

$$EC = f\,(Y, SC\ UR, EF) \tag{1}$$

where EC is total electricity consumption, Y is GDP at constant prices, UR is the degree of urbanisation, EF is efficiency measured by ratio of industry GVA (constant prices) to the electricity consumed by the sector, and SC represents structural change given by the ratio of industry GVA to total GVA (at constant prices).

Econometric Analysis and Results

We employ the ARDL approach to examine the enduring relationship and forecast future demand. The ARDL Bounds cointegration technique was first developed by Pesaran and Shin (1999) and later extended by Pesaran et al. (2001). This methodology possesses several advantages over the Johansen cointegration technique. ARDL is deemed statistically more robust in identifying cointegrating relationships with smaller sample sizes, unlike Johansen techniques that usually necessitate larger datasets for validity. Another advantage is its flexibility, accommodating both unit root or stationary outcomes or a combination of both. This eliminates the prerequisite for pre-testing, a requirement in standard cointegration methods where variables must be pre-classified as I (1) or I (0). Moreover, ARDL permits the possibility that different variables may have varying numbers of lags, flexibility absent in Johansen-type models. Therefore, the ARDL model addresses collinearity by allowing the lag of the dependent variable in conjunction with other independent variables and their lags. Finally, this method is recognised for providing long-run unbiased estimates even when some variables exhibit endogeneity. Thus, this method has been extensively applied in empirical studies for modelling because the test is not responsive to the values of irrelevant parameters in finite samples, thus giving it superior properties in small sample scenarios. We take the log form of the above variables as given in Equation 1 to proceed with further econometric analysis.

Once it is ascertained that the variables or data series do not exhibit order 2 (I (2)) integration using the Augmented Dickey fuller test (ADF) (Table 1), we subsequently explore long-term linkages between the variables and conduct the bounds test to establish the existence of a long-run relationship. We find the results supportive of a long-run relationship between the variables as given by the F test, which is significant at 1% (Table 2). We may thus say that the variables used to explain electricity consumption are the 'long-run forcing' variables.

Table 1. ADF Unit Root Test for Time Series Period, 1991–2021.

Series[#]	Level	First Difference
Log EC	–1.31	–3.70*
Log Y	0.19	–6.27*
Log SC	–2.01	–6.20*
Log UR	0.10	–10.36*
Log EF	–1.77	–3.78*

Notes: *Significant at 1%.
[#]Natural logs of variables considered.

Table 2. Bounds Test for Cointegration.

F = 14.01, Sample size 31						
	10%		5%		1%	
Sample Size	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
35	1.9	3.01	2.26	3.48	3.07	4.44

Table 3. Log-linear Long Run Relationship.#

Regressors	Coefficient	Std. Error	*t*-Statistic	Prob.
Log Y	1.0*	0.02	44.46	0.00
Log SC	1.55*	0.48	3.21	0.00
Log UR	–0.51**	0.24	–2.15	0.04
Log EF	–0.61*	0.07	–9.52	0.00

Notes: *** at 1% and 5% significance level, respectively, at lag 1 with the ARDL (1,1,1,1, 0) model.
#Estimates are heteroscedasticity consistent and free from serial correlation.

Table 4. ARDL Error Correction Regression.##

Dependent Variable: D(LOGEC)				
Selected Model: ARDL (1, 1, 1, 1, 0)				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
D(LOGY)	0.55	0.06	9.74	0.00
D(LOGSC)	0.68	0.10	6.89	0.00
D(LOGEF)	–0.36	0.04	–8.46	0.00
ECT*	–0.29	0.03	–9.07	0.00

Note: ##,*R2:0.89, DW:2.0.

After testing for the long-run relationship, we estimate the long-run relationship to find the β values as used in some studies (Dasgupta & Sarangi, 2021). Table 3 gives the log-linear long-run values from the model.

The values of the coefficients thus generated from the long-run form of the ARDL model (Table 3) are used to estimate the electricity consumption in 2027, as discussed in the next section. As per the results in Table 3, all variables have a significant impact on electricity consumption; however, depending on the development phase, urbanisation can positively or negatively affect electricity consumption, as increased urbanisation leads to more efficiency, as explained earlier.

Table 4 shows the error correction model with the error correction term having a negative sign.

As for stability, plot of parameter stability test by Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMS) clearly show that the parameters are stable for the sample under study in Figure 4.

For the robustness of the model used in the study, we estimate a shorter sample between 1991 and 2017 and find little change in the results from Table 3.

Demand and Supply Analysis

The India Energy Security Scenarios (IESS) portal,[4] by the Government of India (GOI), has projected the total supply of electricity[5] at 1934 terawatt hour (Twh) in

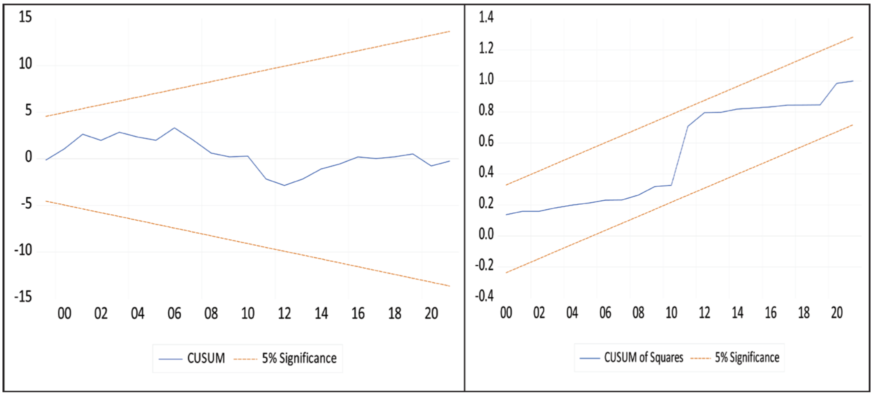

Figure 4. Plot of CUSUM and CUSUM Squares of Recursive Residuals.

2027 by aggregating electricity generation from different sources, with coal accounting for around 67.0%, while wind, hydro and solar combined contributing to around 25%.

As India's energy deficit has decreased remarkably over the years, electricity supply is roughly equivalent to electricity demand. In India, over the last ten years, there has been a decrease in the annual electricity shortfall, with a deficit of 0.3% for 2023–2024.[6]

The gap between energy requirement and energy supplied has decreased from 4.2% in 2013–2014 to 0.3% in 2023–2024. Even this gap between energy requirements and energy supplied is generally because of constraints in the state transmission/distribution network, financial constraints of DISCOMs, etc (Press Information Bureau, 2023).

As per the long-run coefficients generated in Table 3, electricity consumption as per the model could lie between 1521 Twh[7] to 1593 Twh in 2027. Electricity requirement is electricity consumption plus Aggregate Technical & Commercial losses (AT&C) losses. Given the transmission and distribution loss of around 15% (average of last three years), electricity requirement could add up to 1749–1832 Twh in 2027. As per IESS projections, the demand would be 1901 Twh for 2027. Thus, the estimate of electricity requirement in 2027 in this article is in line with the demand forecast provided by the NITI Aayog.

As economies progressively transition towards reduced carbon emissions, the Indian government has set an ambitious goal to increase non-fossil fuel energy capacity to 500 GW by 2030. Given this target (Ministry of Power, 2023), Figure 5 shows the estimates of the required growth of installed capacity to achieve this target.

Today, India has become a power-sufficient nation (Press Information Bureau, 2024) as the Government is continuously augmenting the installed capacity for both conventional and renewable energy.

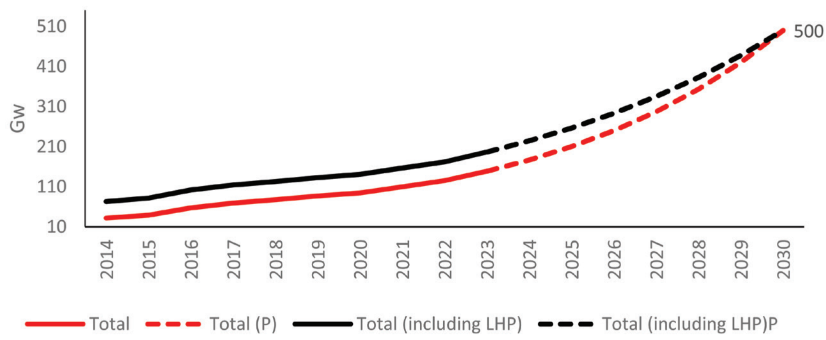

Figure 5. Installed Capacity Projections: Renewable and Non-fossil Energy.

Source: CMIE and Author's computations.
Note: P: Projection, LHP: Large hydro project.

Conclusion

This study examines the factors influencing overall domestic electricity demand over the long term, employing an ARDL Bounds cointegration approach spanning from 1991 to 2021. Notably, all variables have a significant impact on electricity consumption, in line with literature. The findings confirm that all examined variables significantly impact electricity consumption, aligning with existing literature. The study's electricity demand projections for 2027 closely match those provided by NITI Aayog. However, certain limitations regarding sector-specific demand patterns and limited consideration of technological advancements remain.

In addition to the variables covered in this study, the actual trajectory of electricity demand would depend upon a few factors, such as progress on efforts to reduce transmission and distribution losses, implementation of energy efficiency measures, expansion of electrification, and growth in electricity consumption driven by socio-economic factors. Like numerous other nations, India faces the challenge of managing its CO_2 emissions from its electricity system against the backdrop of fast-growing demand for electricity driven by the expansion of space cooling and economic progress, particularly considering the heavy reliance on coal. Enhancing energy efficiency emerges as a crucial strategy for curbing carbon emissions amidst climate change and fluctuating energy prices.

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Authors' Notes

Views solely belong to the authors and not the organisation to which they belong.

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Notes

1. CEA.
2. Tariffs are not available at an aggregate level; it varies across states.
3. It is urban population (% of total population) as defined by the World Bank. Urban population refers to people living in urban areas as defined by the National Statistical Office.
4. NITI Aayog has introduced an interactive web-based tool called India Energy Security Scenarios (IESS) 2047 Version-3.0, designed for projecting energy-related outcomes across different scenarios. It incorporates the latest advancements and policy declarations until 2047. The tool also offers adaptability to produce a range of scenarios by considering various assumptions about factors that might impact electricity demand.
5. Electricity supply consists of generation from different sources, energy received from captive power plants and imports. Electricity consumption is the difference between electricity supplied minus Technical & Commercial losses (AT&C) losses.
6. Ministry of Power.
7. Electricity consumption data of India is available in gigawatt hours, which is converted to terawatt hours. Forecasts are arrived at using CAGR method, using growth rates of last 5 years of all regressors to arrive at estimates for 2027; the long run coefficients generated from the model are used to arrive at aggregate electricity demand for 2027 using the demand function; standard error from the model is used to give the range of the estimate. COVID did not alter the production capacity of the economy as it was a one-off shock; hence, we have not excluded the COVID years in the analysis.

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