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Unleashing market-based approaches to drive energy efficiency interventions in India: An analysis of the Perform, Achieve, Trade (PAT) Scheme

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ADB Working Paper Series

**UNLEASHING MARKET-BASED
APPROACHES TO DRIVE ENERGY
EFFICIENCY INTERVENTIONS IN INDIA:
AN ANALYSIS OF THE PERFORM,
ACHIEVE, TRADE (PAT) SCHEME**

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Abstract

To sustain the high economic growth trajectory of India, it is imperative that an adequate supply of energy is maintained over a long period of time. One such major initiative is the thrust laid on energy efficiency interventions as a low-hanging option for meeting the overarching energy and climate goals of the country. This paper focuses on analyzing market-based approaches for energy efficiency interventions, with a specific focus on the Perform, Achieve and Trade (PAT) scheme. Policies governing energy efficiency interventions reveal that policies have evolved over three different phases characterized by a gradual transition from a regulatory regime to a market-based arrangement. Analysis of the PAT scheme points to the fact that while the scheme is designed in a dynamic manner and has huge energy-saving potential, a lack of clarity at the policy level and operational anomalies could generate dampening effects on future energy efficiency investments. Policy streamlining becomes imperative for successful implementation of this scheme.

Keywords: energy efficiency, market-based instruments, energy-saving certificates, India

JEL Classification: L94, Q48, Q49

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1. BACKGROUND

India is one of the fastest-growing economies in the world and is increasingly assuming a pivotal role in the global energy market (Sokolowski 2019). To sustain the ongoing high economic growth of the country, it is imperative that an adequate supply of energy is maintained over a long period of time. Providing an adequate and reliable supply of energy can become a game changer in mitigating the problems of persisting poverty and widening inequality in the country (IEA 2020; Gupta, Gupta, and Sarangi 2020). Energy can play a leading role in arresting the threats posed by climate change. This builds on the intricate and quite complex nexus that exists between energy and climate change. The Indian energy sector continues to be dominated by fossil fuel-based energy and hence generates significant negative environmental externalities and adverse climate impacts. For instance, coal continues to dominate the Indian electricity sector, with its share being close to 55% of the total generation. Because of the heavy reliance on fossil fuel sources, the energy sector emerges as the single largest source of GHG emissions, contributing more than 65% of the total GHG emissions in the country. Within the energy sector, the electricity sector stands out as the major contributor with its share revolving around 75%. However, the recent transformative changes that have been instigated in the energy sector, with a specific emphasis on renewable energy and energy efficiency initiatives, can drive the energy sector on a sustainable trajectory and can become an effective mechanism for decoupling energy from negative climate repercussions. Another pertinent and quite interrelated issue is associated with the fast rise in energy demand. It is projected that there will be a dramatic surge in energy demand across all sectors in the future, primarily due to the increasing accessibility resulting from recent policy thrusts on providing access to electricity to all willing households, the growing affordability for consumers with the rise in the new middle class in the country – thereby increasing the appetite for owning electrical appliances – and the fast-increasing urbanization and population. IEA (2020) projections reveal that while the country's energy demand is projected to be doubled by 2040, the electricity demand will be tripled by the same year. These challenges highlight the importance of strategic policy actions needed to drive the sector on a sustainable development trajectory.

The Government of India has taken several proactive policy initiatives in this regard to drive the energy system towards a secure, affordable, and sustainable growth trajectory. It posited that the current energy policy thrust of the Government of India revolves around four pillars of energy development, namely the provision of modern energy access to all citizens of the country, reducing energy intensity through a host of policy- and market-led energy efficiency initiatives, achieving sustainability of the energy sector through acceleration of renewable energy generation, and enhancing energy security (Sokolowski 2019). These developments are in sync with global developments and global commitments to achieve sustainable energy. For instance, the energy policy thrusts of the country in some way reflect the pronounced goal of SDG 7. All these policy actions have led to visible progress in several dimensions of energy sector development. There has been a dramatic rise in the generating capacity, touching a new high of 366 GW in December 2019. The accomplishments in the field of renewable energy are notable. Effective policy actions combined with well-structured market reform strategies have led to wide-scale penetration of renewable energy with the deployment of 84 GW of grid interconnected renewables in December 2019. The provision of electricity access to all willing households is indeed impressive through strategic policy initiatives such as *Saubhagya*. Similar efforts in the field of cooking energy through schemes such as the Prime Minister's Ujjwala Yojana (PMUY) led to

expanding the coverage of LPG cooking systems to 96% of households in 2019 (Patnaik, Tripathi, and Jain 2019). There have been a gamut of other policy and market reforms undertaken in various subdomains of the energy sector, such as coal pricing reform, initiatives to commercialize coal mining, employing auction routes to discover renewable energy prices, discovering electricity prices through spot markets, initiatives to reform gas prices, etc. Several reform proposals are in the pipeline, including the proposal to improve the financial health of distribution companies through a variety of reform plans, such as widening the implementation of franchising schemes, etc. The recent draft amendment of the electricity act declared in April 2020 is a clear manifestation of policy efforts to drive the sector on a sustainable trajectory.

While these initiatives and policy efforts have definite implications for the Indian energy sector, the sector continues to face a host of structural conundrums largely entrenched with the intertwining of the energy and socioeconomic profile of the country and the imperative to decouple energy from climate change. In the energy access space, in terms of access to both electricity and cooking energy, the immediate issue is providing high-quality and reliable electricity. Similarly, on the cooking energy front, affordability emerges as a significant barrier for poorer strata of the society. It is reported by a survey carried out by the Government of India in 2018 that almost 50% of households get electricity for only 12 hours a day (Gol 2018). Similar observations can be found with regard to the provision of cooking energy. It has been reported recently that poor households in rural areas with LPG connections through Ujjwala schemes are not in a position to refill their cylinders primarily because of the affordability issue, and hence they continue to rely on traditional fuels for meeting primary cooking requirements (Dabadge, Sreenivas, and Josey 2018). Similarly, market-led reforms leading to low solar and wind energy prices through an auctioning process have encountered some hiccups recently. There has been a lukewarm response from investors at the auctions that resulted in the extension of deadlines and removal of price caps, eventually resulting in a slump in the growth of wind and solar energy. This has been further aggravated by the COVID-19 situation. This clearly implies that there is a need to fix some inherent structural problems. The financial health of electricity distribution companies continues to be the weakest link for the sector and poses a major threat to the Indian electricity sector. Despite several bailout action plans implemented by the Gol in the past (the most recent one was the UDAY scheme tailored to deal with the poor financial health of these electricity utilities), DISCOMs continue to be a major strain for the sector. The poor financial health of these entities pulls down the entire sector and is often the cause of several associated entrenched anomalies for the sector. The most recent effort is the proposal to infuse crore INR 90,000 to reform the electricity distribution business to revive the sector. A related problem is high AT and C loss, which continues to be around 22%, despite sustained efforts to build up the electricity infrastructure of the country. Though India is a signatory of the Paris Agreement, and per capita emission is less than half the world average and stood at 2.7 tCO₂e in 2015, considering the vibrant economic growth leading to transformation of the socioeconomic profile, its populace, and much needed growth imperatives, it is projected that emissions will rise by 90% between 2014 and 2030.

The importance of energy efficiency as a strategic solution to the majority of energy sector challenges is well documented. The primacy of energy efficiency rests on its ability to mitigate negative climate impacts as well as arresting growing energy demand by effectively reducing the energy intensity. This has been further elaborated in the next section.

Thus, the paper does the following:

- It maps the policy landscape governing the Indian energy efficiency.
- It analyzes the key market-led energy efficiency initiatives with a specific emphasis on PAT scheme.
- It offers critical assessment of financing of energy efficiency interventions.

The paper is structured as follows. The next section argues the imperative of energy efficiency and the important role it plays in addressing some of the imminent sectoral challenges. Section III highlights the current energy consumption patterns and their implications for the energy intensity of the country. The fourth section offers a nuanced understanding of the energy policy landscape of India as it has evolved in a phased manner. Section 5 analyzes the market-led focus of energy efficiency initiatives with a specific emphasis on the PAT scheme. The sixth section highlights modalities of energy efficiency financing. Section 7 presents the inherent challenges for the uptake of energy efficiency interventions in the country. The final section concludes the paper.

2. IMPERATIVES IN PROMOTING ENERGY EFFICIENCY

Given the importance of energy efficiency in driving the energy sector on a sustainable growth trajectory, it merits contextualizing the significance of energy efficiency for the Indian energy sector. Even globally, there has been a defined emphasis placed on energy efficiency as an untapped low-hanging energy option to achieve the desired energy and climate goals. For instance, Goal 3 of SDG 7 places clear emphasis on energy efficiency as the third major goal in achieving sustainable development. Target 7.3 of Goal 7 clearly points to the importance of energy efficiency by referring to “doubling the global rate of improvement in energy efficiency by 2030.” For India, it becomes even more important, given the fast economic growth and growth-led surge in energy demand and consequent adverse implications for climate change. It has been posited that the easiest way to achieve the energy goals and combat the climate change conundrum would be to capitalize on energy efficiency (Sahoo et al. 2016).

The rise in energy demand can be attributed to multiple recent developments. One such cause is connected with the changing socioeconomic profile of the Indian population, largely driven by the high-growth trends of the Indian economy. This will have significant implications for the energy demand in the country. One such indicator of the changing socioeconomic profile is manifested in terms of the emergence of the new Indian middle class by 2030. Projections indicate that there will be around 140 million middle-income households and around 21 million high-income households added to the existing numbers by 2030 (WEF 2019). Scholarly literature analyzing future electricity demand offers a nuanced understanding of such transformations and consequent impacts on electricity demand mediated through the acquisition of high-energy-consuming assets (Wolfram, Gertler, and Shelef 2012; Gertler, Wolfram, and Fuchs 2016). One projection reveals that India is expected to have 1 billion air conditioning units by 2050, which will significantly drive up the electricity demand.

This is very much associated with the rising Indian urban population. It is projected that the Indian urban population will rise to 814 million by 2050, which could further accelerate the demand for energy-using appliances. Similar projections related to growth in the infrastructure sector can have significant impacts on energy demand as well. Estimates reveal that 70% of the infrastructure in the country is yet to be built; this will be coming by 2030 and hence will further drive up the energy demand. All this

points to the fact that efforts on the energy efficiency front need to be scaled up in the face of escalating energy demand.

In addition to the above, household electrification has become a major source of the spurt in electricity demand. Electrification statistics show that half a billion people have gained electricity access since 2000. It is also argued that there is a huge latent demand, which could stimulate the energy demand in the future.

Some studies have pointed to the energy-saving potential in the country. For instance, estimates by the BEE (2019a) reveal that the energy-saving potential in both moderate and ambitious scenarios is estimated to be 87 million toe and 129 million toe, respectively, by 2031, which constitutes around 10 to 15 % of the total energy consumption in the country. Further projections by the IEA indicate that energy efficiency plans and programs could create opportunities of about \$525 billion or Eur399 billion. It is estimated that the implementation of energy efficiency programs can reduce the energy intensity in the country by 875 terawatt hours per year, which could translate roughly into savings of around \$190 billion per year in terms of energy imports by 2040 (IEA 2020). Studies also point out the energy-saving potential of specific energy-using assets in the country. For example, Parikh and Parikh (2016), by analyzing the energy-saving potential of four key energy appliances, namely air conditioners, a refrigerator, a color TV, and a ceiling fan, have shown that there exists a potential of 40% electricity savings as well as emission reduction potential by 2030, if low-cost financing is provided.

The importance of energy efficiency is also linked to strategic policy efforts to decouple climate change from energy. Though per capita emission rates are low for India, it can be seen that there has been a rise in total emissions due to the fast rise of industrialization and the rising electricity demand. Energy efficiency has become all the more paramount when it comes to India meeting global commitments. India's INDC has set the target of reducing emission by 33% to 35% from its 2005 level by 2030. This underscores the importance of strategic and definite policy actions in the domain of energy efficiency. Estimates by the International Energy Agency (IEA) indicate that the implementation of energy efficiency policies could reduce GHG emissions by about 36% by 2050 (Kumar, Kumar, and Voita 2012).

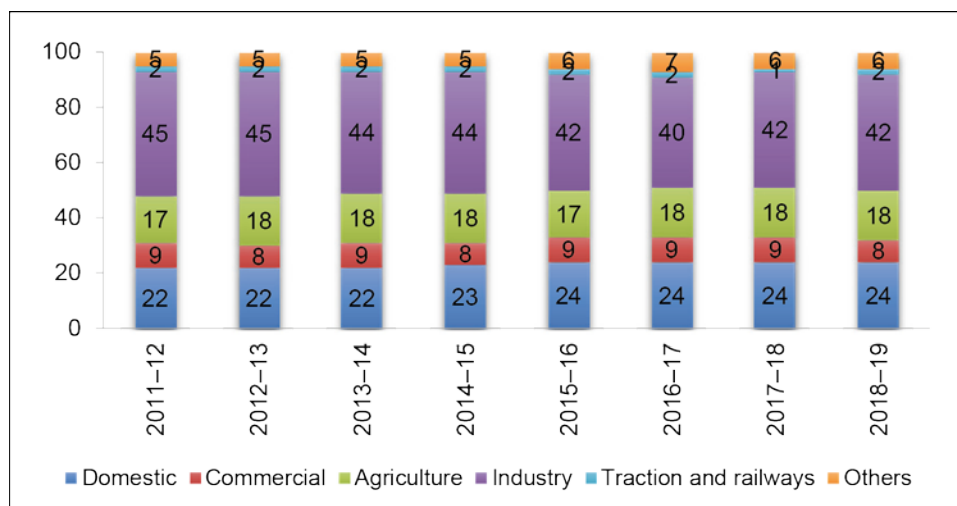
The IEA estimates also suggest that steps undertaken by India in the energy efficiency direction led to the avoidance of an additional 15% annual energy demand and saved 300 million tonnes of CO₂ emissions over the period 2000–2018. Having highlighted the significance of energy efficiency, it merits shedding light on the present energy consumption scenario and on energy intensity growth trends. This clearly reflects achievements made in the field of energy efficiency and gaps that require further acceleration of energy efficiency initiatives.

3. TRENDS AND PATTERNS OF ENERGY CONSUMPTION AND ENERGY INTENSITY IN INDIA

A nuanced understanding of the scope of energy efficiency requires mapping of energy consumption and its patterns. Such a mapping of sectoral electricity consumption in the country over the last eight years is presented below (Figure 1). It can be gleaned from the figure that industrial consumption represents a large chunk of the total electricity consumption at around 40% of the total consumption. Though there has been a marginal deceleration in industrial electricity consumption, it has been more or less consistent over the years. The next highest share is held by the domestic sector, which

showed a marginal increasing trend from 22% in 2011–2012 to 24% in 2018–2019. This could possibly be due to the large-scale household electrification undertaken recently, spurred by proactive policy initiatives like *Saubhagya*. The share of agricultural consumption in the total consumption stands at close to 18% consistently for the entire eight-year period, though doubts have been raised as to the exact consumption by the agriculture sector, as most of this consumption is unmetered and hence largely unaccounted for. Commercial electricity consumption revolves around 8–9 %, though these shares will differ when state-specific analysis is carried out.

Figure 1: Consumption of Electricity by Sector (%)



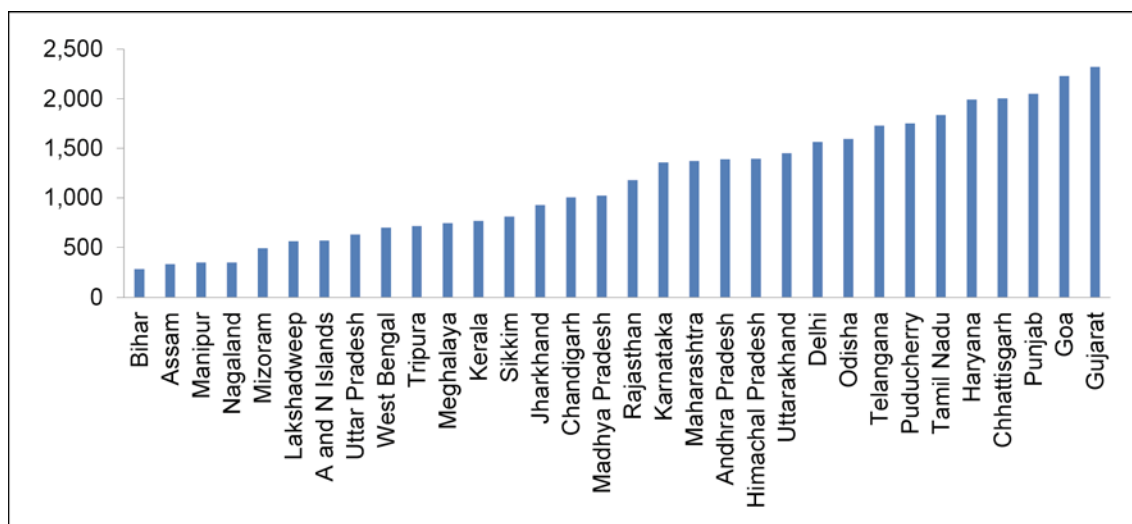
Source: Authors' compilation. Data: Different volumes of India Energy Statistics.

It is worth highlighting the key implications derived from the sectoral electricity consumption. A higher share of industrial consumption reveals that there is a need to identify energy-intensive industrial units and make appropriate action plans to minimize the energy consumption of such units. In that regard, a market-based mechanism based on the perform, achieve, and trade (PAT) scheme is a well-designed scheme to achieve industrial energy efficiency. The second important implication is very much entrenched with the political economy of tariff settings for industrial consumers. In the Indian context, some consumer categories, largely industrial and commercial consumers, pay significantly higher tariffs than the average tariffs. This acts as a deterrent for them and forces them either to have their own captive power plants or buy from the open market. Sustained efforts to improve energy efficiency could offer a win-win solution for both. The increasing share of residential consumers could be attributed to the recent uptake in household electrification and subsidized provision of electricity for the sector spurred by the *Saubhagya* scheme. It is also projected that there will be a substantial jump in household electricity consumption due to the rise of the middle class and consequent increase in the acquisition of electrical appliances. All this points to the need for structured energy efficiency incentives to be designed for the residential sector.

It is also worth noting the per capita electricity consumption in the country: It has increased over the years and stood at 1181 kWh per year in 2019. However, this is very low compared to global standards. For instance, the per capita electricity consumption in the US stood way ahead at 12,600 kWh in 2017. A cursory glance at the per capita consumption of electricity across states shows the huge presence of

heterogeneity across states, with a very low per capita electricity consumption of 280 kWh in Bihar and a very high per capita electricity consumption of 2321 units in Gujarat, which is almost double the rate of the national average (Figure 2). This highlights the need to have balanced decentralized policy actions along with centralized policies and plans that take into consideration context-specific requirements and realities.

Figure 2: Per Capita Consumption of Electricity (kWh)

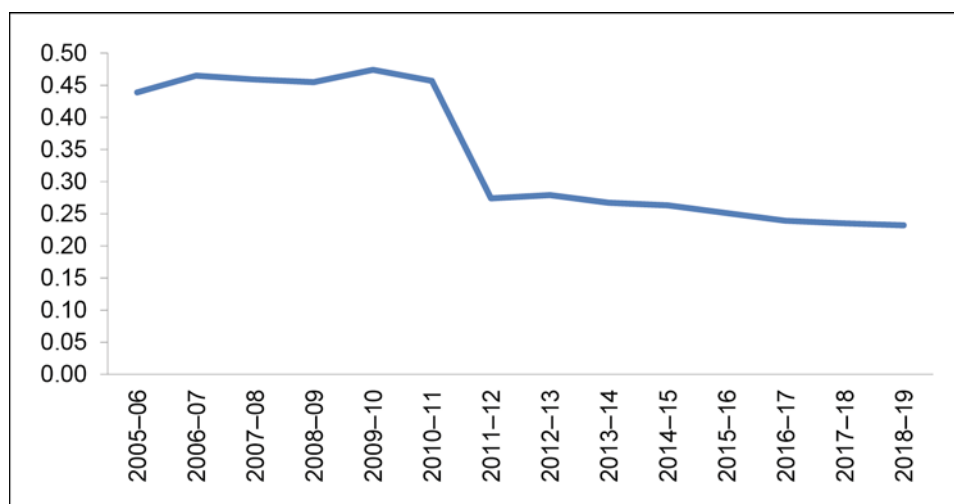


Note: In 2011, the Government of India approved the name change of the State of Orissa to Odisha. This document reflects this change. However, when reference is made to policies that predate the name change, the formal name Orissa is retained.

Source: Authors' compilation. Data: Different volumes of India Energy Statistics.

The next important consideration is to highlight the energy intensity trends for the country (Figure 3). Figure 3 below clearly reflects the trends of energy intensity (measured by dividing the total primary energy by the GDP) for the last 14 years from 2005–2006 to 2018–2019. It can be seen from the figure that there was a decline in the energy intensity over the period. This could be primarily because of the faster rate of growth in GDP compared to energy demand, the increasing share of the service sector in the economy, and energy efficiency interventions. The growth rate shows that there was a 47% decline in the energy intensity over the 14-year period. This clearly highlights the gradual decoupling of energy consumption from the growth rate. This is definitely a positive sign for the economy. Energy intensity trends also indicate that there was a significant drop in the energy intensity in 2011–2012, when it dropped from 0.457 to 0.274.

Studies point out that efficiency gains are largely confined to the industrial sector and service sector and also to some extent to residential buildings. However, it is posited that efficiency gains are offset by increased energy consumption, a rise in appliance ownership, etc., which is projected to further escalate in the future. All this indicates that there is huge scope for improving the energy efficiency performance in the country. The next section maps the policy landscape governing the energy efficiency in India.

Figure 3: Energy Intensity Trends

Source: Authors' compilation. Data: Different volumes of India Energy Statistics, MoSPI, Gol.

4. ENERGY EFFICIENCY POLICY LANDSCAPE IN THE COUNTRY

The Government of India, appears to have taken a two-pronged strategy to arrest the surge in energy demand: The first is primarily drawn from the Government of India's commitment to reduce emissions, and linked to greater infusion of renewable energy in the energy mix; and the second is its emphasis on implementing energy efficiency measures through a host of policies, guidelines, regulations, and strategies. The present section offers a critical understanding of the evolution of policies to promote energy efficiency and change the contours of energy efficiency policies through domestic compulsions and global commitments. While the domestic compulsions are largely to meet the rising energy demand, the global commitments are associated with India's declaration through its Intended Nationally Determined Contribution (INDC) to reduce the energy intensity by 33–35 % by 2030 compared to the 2005 level. These compulsions and commitments require significant policy actions both on a federal and subnational scale.

The policy landscape for energy efficiency in India offers some interesting facets of energy policy making in India. Energy efficiency policy making in India revolves around emphasis on regulation, market transformation, fiscal policies, incentive-based policy instruments, awareness creation, etc. Although, historically, energy efficiency and energy conservation initiatives can be traced back to the 1970s as a response to the global oil crisis of 1973, conservation efforts during those days were primarily intended to minimize the consumption of petroleum fuel (AEEE 2011). The real thrust on energy efficiency was heralded with the promulgation of the Energy Conservation Act 2001.

The energy efficiency policy making in India has evolved over phases, starting from the enactment of the Energy Conservation Act 2001. This can be divided into three different phases. The first phase was characterized as a period of voluntary standards and labelings and setting up of the road map for the future energy efficiency policy making in the country. The second phase can be linked to the emphasis placed on the promotion of market-based transformations to drive the energy efficiency interventions. The third phase was the phase of acceleration of market-based interventions and

transiting from voluntary mode to more of a mandatory mode of energy efficiency products and appliances. The details are presented below.

4.1 Phase one (2001–2007): Period of Voluntary Standards and Labelings

Phase one of energy efficiency policy making can be linked to the pronouncement of the Energy Conservation Act 2001, which laid down the foundation of the energy efficiency policy road map for India. This also led to the setting up of a dedicated institution called the Bureau of Energy Efficiency (BEE) in 2002 to promote energy efficiency in the country. The BEE was set up as a nodal agency to develop strategies, policies, and programs, gather and analyze relevant data, generate awareness, disseminate information, promote research and development activities, develop a testing and certification procedure, and promote innovative financing instruments for energy efficiency projects. Policy making in phase one can be characterized as largely motivational and voluntary in nature. Primacy was given to setting general standards for energy consumption, carrying out energy audits, etc.

During this phase, a standards and labeling program, as one of the flagship programs of the BEE, was initiated in 2006, as a focus area of the BEE. The approach was to set efficiency standards for products in a voluntary mode, with the premise that once it achieved a certain degree of market penetration, these standards would be made mandatory. It prescribed limits on energy consumption by setting “standards” for applicable equipment and appliances. The approach was to rate products on a scale of 1 to 5, where 5 was assigned to the most energy-efficient product and 1 to the least energy-efficient product. The scheme was aimed at offering consumers information to make informed decisions about their energy consumption in terms of electrical equipment and appliances as well as cost-saving potential. Energy efficiency standards were set for 19 items of equipment and appliances initially.

Similarly, the Energy Conservation Building Code (ECBC) was introduced in 2007 with the aim of achieving the minimum performance standards for buildings. This was designed under the premise that electricity use in buildings was rising fast. The emphasis initially was to improve the building code of commercial buildings. Star ratings for these buildings were based on a scale of 1–5, with 5 being the most energy-efficient and 1 the least energy-efficient. Initially, buildings with a connected load of 500 kW or contract demand of 6000 KVA were part of this scheme.

In addition to the above, agricultural demand-side management (AgDSM) and municipal demand-side management (MuDSM) were also introduced in 2007–2008 with the objective of reducing the energy intensity in the agriculture and municipal sectors. In the agriculture sector, it is estimated that there were around 21 million grid-connected irrigation pump sets, which consumed about 187 billion kWh of energy every year, which offered huge energy-saving potential. Similarly, in the municipality sector, improving efficiency became pivotal as it consumed 4% of the total electricity and possessed huge energy-saving potential. These were the primary energy efficiency initiatives undertaken in the first phase.

4.2 Phase two (2008–2015): Market-Led Energy Efficiency Initiatives

Phase two can be linked to the declaration of the National Mission for Enhanced Energy Efficiency (NMEEE), as part of the eight missions declared under the National Action Plan on Climate Change (NAPCC). This phase was characterized by the promotion of energy efficiency initiatives through market-led approaches. Necessary provisions were created to infuse elements of the market in achieving the energy efficiency goals through amendment of the Energy Conservation Act 2001.

In the second phase, institutional innovations occurred in the form of the setting up of Energy Efficiency Services Limited (EESL), a joint venture constituted by four government-owned companies designed to implement the market-related activities envisaged under the NMEEE. The NMEEE has four major components: a) the Perform, Achieve, and Trade (PAT) scheme; b) Market Transformation for Energy Efficiency (MTEE); c) the Energy Efficiency Financing Platform (EEFP); and d) the Framework for Energy Efficient Economic Development (FEEED). The NMEEE had set a target of achieving energy efficiency by saving 23 million toe of oil equivalent through an avoided generation capacity of 19,000 MW (Bhandari and Shrimali 2018).

Several other energy efficiency initiatives were undertaken and promoted through the MTEE. Bachat Lamp Yojana (BLY) was designed to act as a catalyst of market transformation, from CFL bulbs to the LED bulb market. BLY is an initiative undertaken to roll out energy-efficient compact fluorescent lamp (CFL) distribution at the same price as incandescent bulbs. The idea here again is to employ the economies-of-scale concept by producing on a large scale and reducing the per unit cost of production. Similar to other programs was the Super-efficient Equipment Program (SEEP) designed to usher in market transformation by offering financial stimuli. Under this program, ceiling fans were identified as a possible low-hanging fruit and highly efficient 35 W ceiling fans were deployed compared to the prevailing 75 W-rated fans.

Similarly, the ECBC provisions were also amended through the amendment of the Energy Conservation Act with emphasis on a larger set of buildings and energy consumption with a connected load of 100 kW or contract demand of 120 KVA or more (GoI 2010).

4.3 Phase three (2016 until now): Deepening of Market Transformation Initiatives and Transition from Voluntary to Mandatory Energy-Efficient Schemes

In this phase, greater emphasis was placed on the acceleration of market transformation and transiting from voluntary schemes to an increased number of mandatory energy efficiency products.

The standards and labeling program, which started with a list of 19 identified appliances in 2006, now covers 26 appliances (BEE 2019), with 10 as mandatory energy-efficient appliances and the remaining 16 as voluntary appliances. One successful implementation of the standards and labeling program is the use of super-efficient appliances at affordable prices by employing the economies-of-scale concept. The BLY and SEEP schemes introduced in the second phase were further strengthened in this phase under this program, and by the end of December 2019, about 350 million LED bulbs and 2.3 million fans had been sold in the country (Thapar 2020).

AgDSM and MuDSM. AgDSM was further boosted through pilot schemes and programs. Under the AgDSM program, 2200 old and inefficient pump sets were replaced by energy-efficient star-rated ones. Similarly, under the MuDSM program, energy audit and energy consumption optimization were made mandatory reform elements under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) scheme. The emphasis of this project was to enhance the overall energy efficiency of ULBs, resulting in a substantial saving of energy from ULBs and cost reductions. The latest statistics reveal that this project by the BEE covers 175 municipalities through the process of energy audits and preparation of detailed project reports (DPRs) (BEE 2019b). These are implemented through ESCO mode. Similarly, the EESL's Street Lights National Program (SNLP), introduced in 2015, has been a game changer by replacing 50 lakh street lights, spread across 500 cities, saving around 135 crore kWh of energy.

The ECBC program was further expanded with the second version of the ECBC announced in 2017, which is a revised and more stringent code compared to the earlier version with three levels of compliance. With this new scheme, a building can secure higher grades than with the ECBC, such as ECBC+ or super ECBC status. Emphasis was given to include the residential sector. To this end, the Eco Niwas Samhita Part I Building Envelope (Energy Conservation Building Code for the Residential Sector) was launched in 2018 with the goal of setting minimum envelope performance standards to control heat gains and losses, and to ensure adequate natural ventilation and daytime lighting for buildings. This code is applicable to residential buildings with a minimum plot size of 500 sq. m. or above. In addition, the "Energy Efficiency Label for Residential Buildings" was introduced in 2019 with the objective of comparing one house with another on the basis of energy efficiency performance.

Other efforts in this phase include building the capacity of DISCOMs in the sphere of load management, the development of DSM action plans, and the implementation of various DSM schemes. The BEE carried out the DISCOM capacity-building program in two phases. In the first phase, 34 DISCOMs were selected and provided the necessary capacity building for enhancing their energy efficiency levels. In the second phase, DSM cells were set up by 34 DISCOMs. DSM regulations were announced by these DISCOMs spread across 23 states. As part of the DSM action plan, load surveys were carried out. In the second phase, the remaining 28 DISCOMs were included in the program, and necessary actions were taken for them too.

4.4 State-Specific Action Plans

In addition to the above, a lot of effort has been made by state governments to drive energy efficiency. Under the provisions of the Energy Conservation Act 2001, states are obliged to set up state-designated agencies (SDAs) to support the implementation of energy efficiency policies and action plans. The latest statistics indicate that 36 SDAs have been set up so far, of which 16 are renewable energy development agencies, five are power departments of state governments, six are distribution companies, and two are stand-alone SDAs (BEE 2019b). The primary responsibility of SDAs is to coordinate, regulate, and enforce energy efficiency-related activities as enshrined by the Energy Conservation Act 2001. SDAs also support the setting up of State Energy Conservation Funds (SECFs). The latest statistics show that 28 states have set up SECFs, which has gone a long way to accelerating energy efficiency financing in India. States have also undertaken efforts in the sphere of demand-side management (DSM), which consists of the setting up of DSM cells, installation of consumer management systems, carrying out load research studies, deciding off-peak

and peak tariff slabs, and promoting greater use of energy-efficient appliances. For example, in many states, State electricity regulatory commissions (SERCs) have made it mandatory for utilities to carry out demand-side management exercises with the aim of improving energy efficiency through a structured plan of action. The next section primarily examines the market-based approach to energy efficiency with a specific focus on the PAT scheme.

5. MARKET-BASED APPROACH TO DRIVING ENERGY EFFICIENCY: CASE OF PAT SCHEME

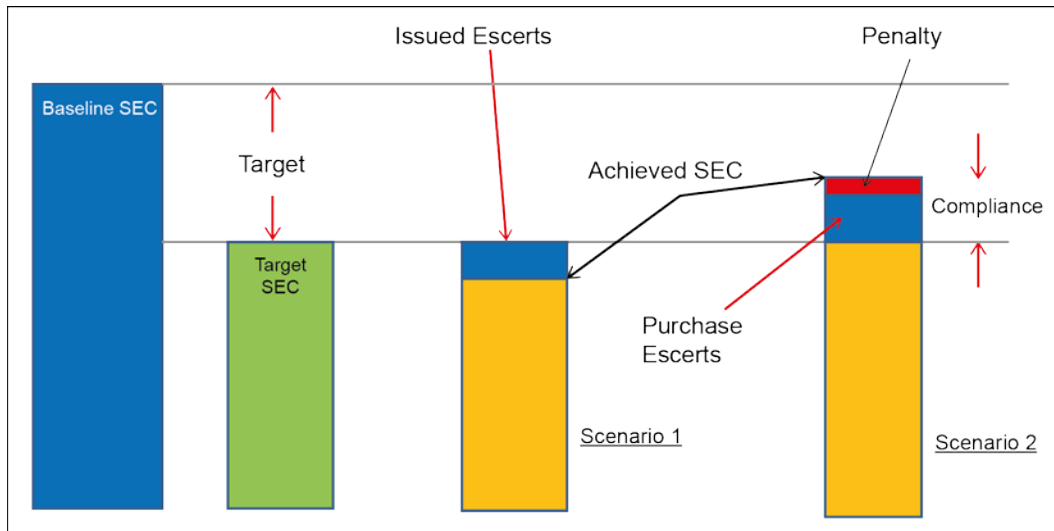
One of the policy action plans for energy efficiency is to employ market-based mechanisms to achieve the intended energy efficiency goals. These mechanisms are not new, but have rather been introduced in many other countries, such as the UK, Italy, France, and Australia. These instruments are designed to change behaviors through market signals rather than explicit directives. Ideally, a market-based instrument should be built around five key elements, namely setting the overall target, designing a framework for identifying obligated entities, distribution of targets within the obligated entities, a methodology for allocating certificates, and framing rules for market transactions. Within these five key elements, overall target setting should be given foremost importance. To this end, necessary energy efficiency policy actions were undertaken in 2012 as part of the declaration of the NMEEE. Consequent to this, necessary legal changes were introduced with the amendment of the Energy Conservation Act 2001 in 2010.

The scheme was designed with the goal of improving the energy efficiency of industrial units in a cost-effective manner. Even though the industrial sector is the largest energy consumer segment in the country, it was realized that the sector had not taken advantage of the benefits of increased energy efficiency due to problems in getting access to necessary capital to fund energy efficiency investments, and often a lack of necessary incentives towards such investments, and problems of long payback periods of such investments, coupled with inadequate information about the benefits of energy efficiency investments (Bhandari and Shrimali 2018). The PAT scheme was designed to mitigate such inherent anomalies and offer a transparent, robust, and cost-effective mechanism to attain the desired energy efficiency goals. PAT is a multi-cycle program started in 2012, which combines elements of market and is governed by the broad regulations of the BEE. The goal is to reduce the specific energy consumption in the most energy-intensive industries in the country. While the legal standing was built through the amendment of the Energy Conservation Act 2001, the operational artifacts were largely built around the principles of market-based mechanisms. It evolved over phases. This section offers a critical mapping of the PAT scheme.

The scheme is operationalized through a series of cycles, each lasting for three years. The process involves identifying sectors and designated consumers (DCs) in each sector to be part of this scheme. The assessment procedure is to carry out the assessment of specific energy consumption for each DC in the base year and project the specific energy consumption in the target year. The accounting process takes into consideration various forms of energy used in the plant and products leaving the plant in a cycle. This is called "gate-to-gate," where all the energy consumption at all stages of production is taken into consideration while estimating the current consumption. A detailed dive into the process reveals that the mode of operation is to set the target reduction based on the current energy consumption. Hence, energy-efficient designated consumers (DCs) will have lower targets than their less energy-efficient

counterparts. The process also has a system of normalization, where deviations that have occurred due to external factors beyond the control of the DCs are accommodated. The excess energy savings made by the designated consumers are converted into tradable certificates.

Figure 4: Mechanism of Trading ESCerts

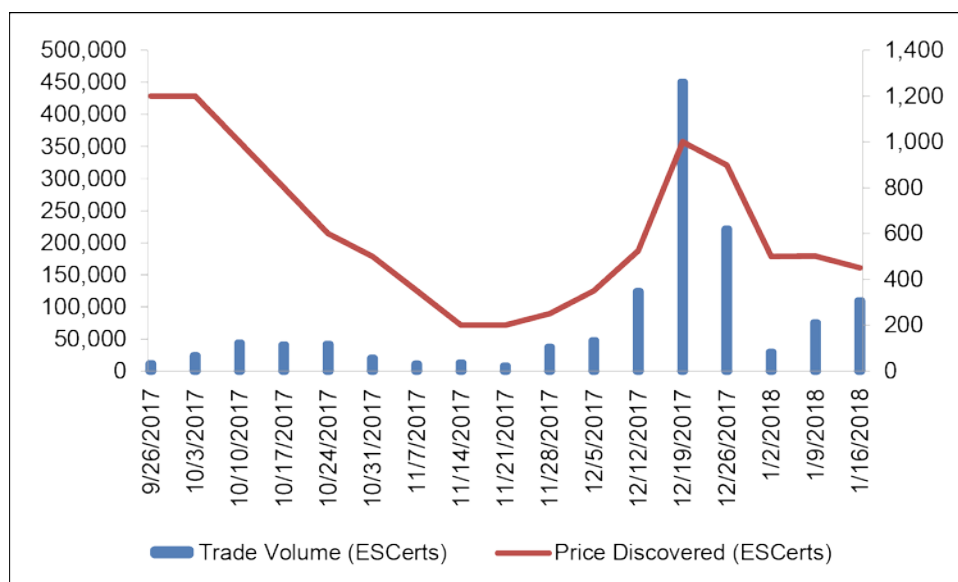


Source: BEE (2020).

The market mechanism operates through the trading of certificates known as “ESCerts,” where designated consumers who have overachieved their targets would be credited by being awarded ESCerts, whereas underachievers would be penalized (Figure 4). Each certificate possesses a value of 1 MWhs of energy saving. The BEE and the EESL are the authorized government entities for the issuance of ESCerts. Once ESCerts are issued, they are traded in power exchanges. The prices of such certificates are market determined. The regulatory constraints work in the form of setting targets. Hence, from a regulatory point of view, it is required that targets should not be set at a very low level, which would crash the market by generating surplus ESCerts. Conversely, targets should not be so stringent that it is cumbersome to attain them, which would jeopardize the goal of energy efficiency reduction.

The trading history of ESCerts reveals that energy savings accrued by the DCs during the first cycle of PAT (2012–2013 to 2014–2015) were converted into certificates and traded through the national trading platform Indian Energy Exchange (IEX) in 2017–2018. A total of 3.82 million ESCerts were issued during the first phase to 306 DCs those who had overachieved the targets. On the other hand, 110 DCs, those who could not achieve their targets, had to purchase ESCerts of about 1.42 million ESCerts. The trading occurred through the mechanism of a double-sided uniform price auction. The market price discovered through trading fluctuated widely over the trading period, ranging from a low of 200 INR per ESCert to a high of 1200 INR per ESCert (Figure 5). Unlike renewable energy certificates (RECs), ESCerts do not have forbearance and floor prices.

Figure 5: ESCert Trading Volume and Price Discoveries



Source: Authors' own construct.

The latest statistics reveal that 956 energy-intensive industries of designated consumers from 13 sectors have been identified for adoption of energy efficiency measures (BEE 2019b). Through this scheme, it is projected that there would be a saving of about 22 million tonnes of oil equivalent (mtoe) and 70 million tonnes of CO₂ by 2022 (BEE 2019b). The details of cycles are presented below and in Table 1.

5.1 PAT Cycle One: 2012–2013 to 2014–2015

The very first cycle that was implemented between 2012 and 2015 targeted 478 industrial units spread over eight sectors. This cycle led to an energy saving of 8.67 Mtoe, which is equivalent to a reduction of about 31 million tonnes of CO₂. Though the target was set low at 6.68 Mtoe, it overachieved the target. Those designated consumers were 1) aluminum, 2) cement, 3) chlor-alkali, 4) fertilizer, 5) pulp and paper, 6) power, 7) iron and steel, 8) textiles, and 9) railways. These sectors together constitute around 60% of the energy consumption in the country, which is equivalent to 231.6 Mtoe (million metric tonnes of oil equivalent) of energy. One of the major loopholes in the first phase was that certificates were issued *ex post* and hence could not provide the needed price signals to attract investment.

5.2 PAT Cycle Two (2016–2017 to 2018–2019)

Since the PAT scheme was implemented on a rolling cycle basis, every cycle identified a new set of DCs and sectors. In cycle two, 621 DCs were identified in 11 energy-intensive sectors. These sectors consist of three new sectors along with 8 existing sectors, i.e., railways, refineries, and DISCOMs. The energy-saving target set in this cycle was to the tune of 8.86 Mtoe.

5.3 PAT Cycle Three (2017–2018 to 2019–2020)

Given the overlapping nature of the duration of these cycles, the number of identified DCs in sectors has been reduced in this cycle. A total number of 116 DCs are identified across six energy-intensive sectors. The energy-savings target set in this cycle was about 1.06 Mtoe.

5.4 PAT Cycle Four (2018–2019 to 2020–2021)

Cycle four commenced on 1 April 2018. An additional 109 DCs were identified from the existing sectors and two new sectors, namely petrochemicals and commercial buildings (hotels). An energy-saving target of 0.69 Mtoe was kept as a target to be achieved in this cycle.

5.5 PAT Cycle Five (declared in 2019–2020)

Cycle five began on 1 April 2019. A total of 110 DCs from the existing sectors were identified spread across eight key sectors. It is projected to have an energy saving of 0.51 Mtoe.

Table 1: PAT Cycles, Coverage, DCs, Sectors, and Energy-Saving Targets

Cycle	Duration	Coverage of PAT		Energy-Saving Targets (Mtoe)	Sectors Covered
		Number of Sectors (Nos)	Designated Consumers (in units)		
I	2012–13 to 2014–15	8	478	6.68	aluminum, cement, chlor-alkali, fertilizer, iron and steel, pulp and paper, textile, and thermal power
II	2016–17 to 2018–19	11	621	8.86	aluminum, cement, chlor-alkali, fertilizer, iron and steel, pulp and paper, textile, thermal power, railways, refineries, and DISCOMs
III	2017–18 to 2019–20	6	116	1.06	aluminum, cement, iron and steel, pulp and paper, textile, and thermal power
IV	2018–19 to 2020–21	8	109	0.69	aluminum, cement, iron and steel, pulp and paper, textile, thermal power, petrochemicals, and commercial buildings (hotels)
V	2019–20	8	110	0.51	aluminum, cement, chlor-alkali, iron and steel, commercial buildings (hotels), pulp and paper, textile, and thermal power

Source: Authors' own construct.

Up to April 2019, there were four PAT cycles, consisting of 956 DCs spread across 13 sectors. Analysis of the PAT scheme points to the fact that the scheme is designed in a dynamic manner to tap into the energy efficiency potential of industrial units. The introduction of a trading mechanism has ushered in a new regime in the energy efficiency domain in the country. However, there are inherent challenges. The lack of clarity at the policy level could hinder future investments, and it has been argued that the targets are not set at a sufficiently stringent level, and hence could be easily achievable. This could have dampening effects on future energy efficiency investments.

6. ENERGY EFFICIENCY FINANCING

There is a critical need for financing energy efficiency projects given their importance for the sector and the development of the country. Although energy efficiency interventions are relatively inexpensive and easily scalable compared to large-scale power projects, these projects have not been taken up on the desired scale. It is argued that most of the energy efficiency benefits continue to be untapped due to inadequate and even poor investment delivery mechanisms (Kumar, Kumar, and Voita 2012). This is primarily due to poor financing of energy efficiency projects by banking and financial institutions. The problem is compounded by the fact that energy efficiency projects are largely driven by the private sector in the country and hence rely more on market financing.

However, there is huge energy-saving investment potential in the country. BEE (2019b) estimates have shown that the country has an energy-saving potential of crore INR840,852 by 2031. The energy-saving potential is found to be highest in the industrial sector. This section maps existing financial mechanisms and financing instruments in the country to support energy efficiency projects. Below is a list of the mechanisms and instruments that are in place to drive energy efficiency financing.

1. Energy Efficiency Financial Platform (EEFP)

This is an initiative undertaken as part of the NMEE to engage with financial institutions and developers to implement energy efficiency projects. MoUs have been signed by the BEE with various financial institutions as well as nonbanking financial institutions to promote energy efficiency projects through training and capacity-building programs. The most recent initiative in this area is the “Investment Bazaar for Energy Efficiency” set up regionally in four regions of the country. In addition to this, to promote and accelerate energy efficiency financing at the state level, SDAs are instructed to create committees to attract the necessary energy efficiency financing.

2. Framework for Energy Efficient Economic Development (FEEED)

Under this scheme implemented as part of the NMEE, two important financing programs were launched: the Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) and the Venture Capital Fund for Energy Efficiency (VCFEE). In the PRGFEE, support is provided to deal with debt-related challenges faced by energy efficiency projects. It is a risk guarantee instrument, with a partial coverage of risks guaranteed to financial institutions involved in extending loans to energy efficiency projects. Similarly, the VCFEE is designed to facilitate last-mile equity investment for energy efficiency projects, limited to a maximum of 15% of equity. This support is for government buildings, private buildings, and municipalities.

3. Provision of Subsidies and Grants

Subsidies and grants could be very helpful in a larger uptake of energy-efficient equipment and appliances. Often, grants are required to make the technology commercial. These are one of the most widely chosen financing mechanisms for energy efficiency financing in countries like India (Kumar, Kumar, and Voita. 2012). While subsidies are largely provided by national government and state governments, grants are provided by international agencies to support energy efficiency interventions. For instance, the ADB provided \$13 million to the EESL to support energy efficiency initiatives for efficient lighting and water pumps.

However, the subsidy-based program suffers from free-rider problems and is often characterized by high transaction costs.

4. Concessional Financing through IREDA

IREDA offer concessional financing for end user efficiency retrofit projects, DSM projects by utilities, and projects facilitated by ESCOs. This concessional funding comes in the form of concessional loans, where project developers can draw loans of up to 70% of the project costs for installing energy efficiency equipment. In addition to the above, credit lines are provided to commercial banks for financing energy efficiency projects at low interest rates.

5. State Energy Conservation Funds

The Energy Conservation Act 2001 mandates states to constitute State Energy Conservation Fund (SECFs) to facilitate financing of energy efficiency projects. The key goal of SECFs was to address the barriers faced by energy efficiency projects by supporting energy audit subsidies, facilitating interest buydown schemes, and offering partial risk guarantee. Twenty-seven out of 30 states have established SECFs. It is provisioned that SECFs will be formed in each state by the state and the BEE contributing equally to a kitty of 4 crore. However, although a majority of the states have constituted this fund, they have not been provided the necessary financial support for energy efficiency projects (World Bank 2016).

6. ESCO-Based Financing

Energy service company (ESCO)-based financing has emerged as a successful financing mechanism for financing energy efficiency projects. The modalities of this kind of funding reveal that while upfront financing is provided and/or arranged through ESCOs, companies or beneficiaries pay banks the funds through reduced energy bills (Kumar, Kumar, and Voita. 2012). In India, ESCOs play an important role by providing savings guarantees, taking risks in the implementation of energy efficiency projects, and by performing measurement and verification (M&V) activities. There are around 150 ESCOs empaneled with the BEE. ESCOs are trained by the BEE to understand and facilitate energy efficiency financing and M&V protocols, develop skill sets to estimate the baseline, and mitigate the risks associated with energy efficiency projects.

Despite several efforts undertaken to promote the financing of energy efficiency projects, there are a large number of barriers to attracting the necessary funding for these projects. One of those barriers is the indifferent attitude of the banking community toward these projects, primarily because of a lack of confidence among the commercial banks about the funding and bankability of energy efficiency projects and a lack of awareness among banking communities of the benefits of energy efficiency investments (BEE 2019b). This is further accentuated by the small size of the projects resulting in high transaction costs, and high perceived business and technical risks emanating from a poor understanding of such projects. Hindrances often found include insufficient technical expertise among the banking communities to understand and appraise the contribution of energy efficiency to the profitability of the company. Hence, this increases the credit risk of both the borrower and the bank asking for collateral, which the companies are often deprived of due to the high asset specificity of energy efficiency projects. Project-based financing by banks is often found to be suitable for large-infrastructure projects, where banks secure cash flows as collateral. However, due to inherent challenges associated with cash flow-based financing, it does not serve the purpose of funding energy efficiency projects. The nature of energy savings

resulting from energy efficiency investments often acts as a deterrent for cash-based financing of energy efficiency interventions.

Hence, there is a current need to correct the entrenched anomalies in attracting the necessary financing and driving the sector on a sustainable development trajectory. One such initiative that could act as a game changer is the need for a detailed audit and transparent reporting of energy efficiency projects to ascertain the baseline energy efficiency levels and associated energy and cost savings, because of energy efficiency interventions. Setting the baseline hence becomes the critical first step in attracting bank finance. In addition, there is a need to develop a proper M&V protocol to minimize transaction costs. The next section highlights key challenges associated with energy efficiency interventions in the country.

7. KEY CHALLENGES OBSTRUCTING UPTAKE OF ENERGY EFFICIENCY INTERVENTIONS IN INDIA

Uptake of energy efficiency initiatives is hindered by several factors, often interconnected. One such prominent factor is related to the pricing policies for electricity. In particular, low and subsidized agricultural and residential electricity prices act as a deterrent for implementing energy efficiency projects. Despite policy prescriptions to bridge the gap between Average Revenue Realized (ARR) and Average Cost of Supply (ACS), it continues to be significant and close to 40 paise per unit. It is strongly suggested that higher electricity prices would act as an incentive for consumers to opt for energy-efficient products (Parikh and Parikh 2016). However, there are political economy constraints to increasing electricity prices in the country.

Another set of challenges are very much associated with the institutional and governance framework governing energy efficiency interventions in India. As these interventions are spread across an array of sectors, it is important that necessary support systems exist to implement such projects. These challenges also emerge due to the federal political structure of the country and the positioning of energy as a concurrent item in the Indian constitution. Although institutions have been created to operate independently, often political intrusion into their functioning makes them weak. One such institutional arrangement is state electricity regulatory commissions (SERCs): for instance, DSM schemes whose success depends on the strength of electricity regulatory institutions at the state level. However, these regulatory agencies are often patronized by the state government, which leads to poor implementation of these schemes (Singh, Sant, and Chuneekar 2012).

A lack of proper monitoring and evaluation often leads to suboptimal outcomes. Periodic monitoring and evaluation of policies and plans of the BEE is not mandated by the Act, hence it often acts as a major constraint to the success of energy efficiency projects. It is important that monitoring exercises are carried out effectively to understand the effectiveness of such interventions and undertake necessary course corrections, if needed. It has been reported by studies that monitoring energy efficiency projects is often neglected, resulting in poor implementation of such projects. For instance, one study reported that the CFL program had a high failure rate, with 40% of CFL bulbs being fused within three months (Prayas 2007).

Policy-level inconsistencies and a lack of clarity hinder the successful implementation of energy efficiency projects. It has been observed that there is some sort of intertwining of energy efficiency schemes, which generates confusion in the minds of the investor. For instance, new buildings come under the ECBC, whereas energy

efficiency initiatives for old buildings are dealt with through the PAT scheme. Similarly, overlapping of PAT cycles often creates confusion among all stakeholders.

There have been several operational hurdles faced by the PAT scheme. It is argued that the targets set under the PAT scheme are lenient and hence could be easily achievable. For instance, a study analyzing the rationality of the target setting for thermal power plants under PAT showed that their targets could have been much more stringent (Sahoo et al. 2017). Similarly, policy-level hurdles are associated with the operation of ESCerts. As these certificates were issued *ex post*, i.e., after verification of a reduction in saving, they could not provide the right signal for energy efficiency investments and might have led to fluctuations in the price of ESCerts (Bhattacharya and Kapoor 2012). It is important to maintain the stability of ESCerts to attract investment in energy efficiency projects. This could be addressed by setting a floor price for ESCerts, which could reduce market uncertainties and could go a long way toward attracting the necessary capital for investment.

Finally, the standards and labeling program is one of the flagship programs of the BEE and has been connoted as a successful program, but it is argued that now it is time to design state-specific labels (Parikh and Parikh 2016). However, the challenge lies in developing the necessary ecosystem at the state level for implementing such schemes.

8. CONCLUSION

The importance of energy efficiency as a strategic solution to most energy sector challenges in the country is well-known. The importance gets reinforced in the face of a surge in energy demand combined with global commitments and domestic compulsions of combating climate change. The paper examines the policy landscape governing Indian energy efficiency, analyzes key market-led energy efficiency initiatives with a specific focus on PAT, assesses existing financial instruments shaping the sector, and critically discusses the key challenges faced by the sector. A nuanced understanding of energy consumption and its patterns reveals that industrial consumption represents a large chunk of the total electricity consumption at around 40% of total consumption, implying that there is a need to prioritize this sector as a potential sector for energy efficiency interventions. Energy intensity statistics over the last 14-year period show that there has been a continuous decline in energy intensity levels because of a faster rate of growth in GDP compared to energy demand, an increasing share of the service sector in the economy, and energy efficiency interventions.

It has been found that energy efficiency policy making in India revolves around an emphasis on regulation, market transformation, fiscal policies, incentive-based policy instruments, awareness creation, etc. Further, policy analysis also highlights that the energy efficiency policy making in India has evolved over three different phases. While the first phase is characterized as a period of voluntary standards and labelings and covers the period from 2001 to 2008, the second phase can be linked to the emphasis placed on the promotion of market-based transformations to drive the energy efficiency interventions, starting from 2008 until 2015. The third phase is the phase of acceleration of market-based interventions and transiting from a voluntary mode to more of a mandatory mode of energy efficiency products and appliances. It started in 2016 and continues today.

Analysis of the PAT scheme points to the fact that the scheme is designed in a dynamic manner to tap into the energy efficiency potential of industrial units. The introduction of a trading mechanism has ushered in a new regime in the energy efficiency domain in the country. However, there are inherent challenges. A lack of clarity at the policy level could hinder future investments. It has been argued that the targets are set at an insufficiently stringent level, and hence could be easily achievable. This could have dampening effects on future energy efficiency investments.

From the overall analysis, it can be elicited that a set of hurdles are encountered in driving towards energy efficiency goals. Key financing barriers include the lack of confidence among the banking community about the bankability of energy efficiency projects. This is further accentuated by the small size of the projects resulting in high transaction costs, and high perceived business and technical risks emanating from a poor understanding of such projects. It is suggested that proactive policy actions such as a detailed audit and transparent reporting of energy efficiency projects can mitigate these challenges substantially. In addition, there is a need to develop a proper M&V protocol to minimize the transaction costs. Other key challenges include low electricity prices, weak governance and institutional structure, a lack of proper monitoring and evaluation, policy-level inconsistencies, and a lack of clarity. It is clear from the analysis that strategic policy actions are needed at all levels to mitigate such challenges effectively.

REFERENCES

- AEEE. 2011. Energy efficiency in India: history and overview. Alliance for an Energy Efficient Economy, New Delhi, India.
- BEE. 2019a. Unlocking national energy efficiency potential (UNNATE), Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India.
- . 2019b. Annual Report 2018–19, Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India.
- BEE. 2020. Perform, Achieve and Trade (PAT) scheme, BEE website accessed on 17 April 2020.
- Bhandari, D., and G. Shrimali. 2018. The perform, achieve and trade scheme in India: an effectiveness analysis. *Renewable and Sustainable Energy Reviews*, 81, pp. 1286–1295.
- Bhattacharya, T., and R. Kapoor. 2012. Energy saving instruments – ESCerts in India. *Renewable and Sustainable Energy Reviews*, 16, pp. 1311–1316.
- Dabadge, A., A. Sreenivas, and A. Josey. 2018. What has the Pradhan Mantri Ujjwala Yojana achieved so far? *Econ. & Pol. Weekly* 5 (23), pp. 69–75.
- Gertler, P.J. O., C. Wolfram, and A. Fuchs. 2016. The demand for energy using assets among the world's rising middle classes. *American Economic Review*. 106 (6), pp.1366–1401.
- Gol, EC Act. (2010). The Energy Conservation (Amendment) Act, 2010. Retrieved June 2017, from Maharashtra Electricity Regulatory Commission: <http://www.delhisldc.org/Resources/Amended%20EC%20Act.pdf>.
- Gol. 2018. Villages with availability of electricity for domestic use, Mission Antodaya. Government of India.
- Gupta, S., E. Gupta, and G. K. Sarangi. 2020. Household energy poverty index for India: an analysis of inter-state differences. *Energy Policy* (Forthcoming).
- IEA. 2020. India 2020: energy policy review, International Energy Agency, Paris.
- Kumar, A. K. Kumar, and T. Voita. 2012. Energy efficiency financing: role of public programmes. *ECEEE 2012, Summer Study on Energy Efficiency*.
- Parikh, K. S., and J. K. Parikh. 2016. Realizing potential savings of energy and emissions from efficient household appliances in India. *Energy Policy*, 97, pp.102–111.
- Patnaik, S., S. Tripathi, and A. Jain. 2019. Roadmap for access to clean cooking energy in India, New Delhi: Council on Energy, Environment and Water.
- Prayas. 2007. Review of Nashik Pilot CFL Program of Maharashtra State Electricity Distribution Company Limited, December 2007. Prayas Energy Group.
- Sahoo, N. R., P. K. J. Mohapatra, B. K. Sahoo, and B. Mohanty. 2017. Rationality of energy efficiency improvement targets under the PAT scheme in India: a case of thermal power plants. *Energy Economics*, 66, pp. 279–289.
- Sahoo, S. K., P. Varma, K. P. Lall, and C. K. Talwar. 2016. Energy efficiency in India: achievements, challenges and legality. *Energy Policy*, 88, pp. 495–503.

- Singh, D., G. Sant, and A. Chunekar. 2012. Improving energy efficiency in India: need for a targeted and tailored strategy, *WIREs Energy Environ* 2012, 1, pp. 298–307 doi: 10.1002/wene.45.
- Sokolowski, M. M. 2019. When black meets green: a review of four pillars of India's energy policy. *Energy Policy*, 130, pp. 60–68.
- Thapar, S. 2020. Energy consumption behaviour: a data-based analysis of urban Indian households, *Energy Policy*, 143.
- WEF. 2019. Future of consumption in fast-growth consumer markets – India. World Economic Forum. Switzerland.
- Wolfram, C., P. Gertler, and O. Shelef, 2012. How will energy demand develop in the developing world. *Journal of Economic Perspectives* 26 (1), 119–138.
- World Bank (2016) India's state level energy efficiency implementation readiness, the World Bank, Washington, DC.