Towards an Energy-Efficient Economy: Policy Measures by Government of India

Sangeeta Bansal and M. Rahul

1 Introduction

India, one of the largest and the fastest-growing economies of the world, is also the world’s third-largest consumer of primary energy after China and the USA (BP, 2019). Between 2012–13 and 2019–20, India’s GDP has grown at an average rate of 6.6% (Fig. 1). India’s share in global energy consumption has reached 5.8% in 2018. With economic growth, the energy consumption is expected to increase manifold in future. The increase in energy consumption led to a 7% increase in carbon emissions in 2018, and India accounted for around 7% of global CO₂ emissions (BP, 2019). Energy plays a pivotal role in the social and economic development of the country and is necessary to meet the Sustainable Development Goals ranging from poverty alleviation to bridging the gender gap. Its increased consumption, however, has a deteriorating effect on the environment. Energy consumption leads to emissions such as nitrogen dioxide and sulphur dioxide causing air pollution and contributing to greenhouse gas emissions. Six out of the ten most polluted cities in the world are in India (IQ-Air, 2019). Saraswat and Bansal (2020) find that around 10 or 7 years of life expectancy would be gained if PM2.5 levels reached WHO standards or national standards, respectively.

Views are personal and do not represent those of the organisation that the author belongs to.

S. Bansal (✉)
Centre for International Trade and Development, School of International Studies, Jawaharlal Nehru University, New Delhi, India
e-mail: sangeeta.bansal7@gmail.com

M. Rahul
Indian Economic Service, Department of Economic Affairs, Ministry of Finance, New Delhi, India
e-mail: rahulmeco@gmail.com

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India’s commitments at the United Nations on climate change require the country to reduce its emission intensity of GDP by 33–35% of its level in 2005 levels by 2030 (Government of India, 2015). One avenue that is likely to deliver significant gains in achieving the conflicting objectives of economic prosperity and protecting the environment is using energy more efficiently. Greater energy efficiency can lead to lower emissions resulting from energy production and use, deliver cost benefits and ensure energy security with minimum effect on the competitiveness of industries and the economy. Energy efficiency has been called “the first fuel” (IEA, 2020)—each unit of energy saved through its efficient usage is akin to a unit generated without the externalities that energy production entails.

Per capita primary energy consumption has been increasing in India over the years, as is expected for a fast developing economy, but its level remains far below that of the USA and China (Fig. 2). In 2018, USA’s per capita primary energy consumption was around 12 times that of India. China’s was around 4 times that of India’s.

India’s energy intensity has been continually falling (Fig. 3). Changing sectoral composition of the economy towards a larger share of the services sector and technological development has contributed to this decline. Energy efficiency in India, however, remains far below the potential and has substantial opportunities for improvement. Evaluating 25 of the top energy-consuming countries in the world across 36 different policy and performance metrics spread over four categories: buildings, industry, transportation, and overall national energy efficiency progress, International Energy Efficiency Scorecard find India’s rank to be 15 (American Council for an Energy-Efficient Economy, 2018). Germany and Italy are tied for the first place. To realise this potential, the Government of India has adopted various policy measures that aim at greater energy efficiency in its industries and final products. In terms of the sectoral composition of India’s final energy consumption, Industry
accounts for around 56%, transport accounts for around 10%, and residential sector accounts for around 9% (Fig. 4). These three sectors continue to be the dominant users of energy and therefore hold the potential for major energy efficiency improvements. This chapter aims at studying the Government of India’s energy efficiency policies and assesses their performance in terms of leading the economy towards a more energy-efficient India.

The rest of the chapter is organised as follows. The next section discusses the economics of energy efficiency and various policy instruments that can be used to enhance it. While Sect. 3 describes various policy instruments adopted by India, Sect. 4 evaluates their performance. Finally, Sect. 5 contains concluding remarks.
Economics of Energy Efficiency

At the outset, it may be useful to understand the difference between the concepts of energy efficiency and energy conservation. Energy efficiency refers to the amount of energy used in deriving a particular outcome. An increase in energy efficiency therefore would refer to a greater level of that outcome from the same level of energy input. The literature quantifies it with energy intensity. However, energy conservation, on the other hand, refers to a reduction in the total use of energy. Thus, energy conservation may result from energy efficiency but not necessarily so; overall energy use may increase along with an increase in energy efficiency (Gillingham et al., 2009).

All energy efficiency interventions are based on a premise that there is a socially optimal level of energy efficiency that is yet to be realised. This “energy efficiency gap” (Jaffe et al., 2004) could arise from a variety of reasons that prevent the market outcome to achieve a socially efficient outcome. There are two crucial steps in the path towards improving energy efficiency: energy-efficient technologies are developed, and the available technologies are widely adopted. Technological innovation is the linchpin of energy efficiency. The basic requirement for the adoption of energy-efficient technologies is that they are available. The private sector is not always forthcoming to invest in the development of new technologies owing to the large sunk costs in research and development (R&D), the uncertainty inherent in research and technology development, and relatively long gestation periods as well as the fact that the new products may not be competitive compared to the existing products. This calls for policy intervention in the form of incentivising investments in developing energy-efficient technologies. Provision of financial and technical support to firms and start-ups wishing to develop new energy-efficient technologies is a good starting point. Effective translation of research and development into a marketable product that can
be commercialised is also important. Support for the marketing of innovative energy-efficient products would help its commercialisation. However, an important aspect for incentivising innovation is also the availability of an innovation-friendly intellectual property rights regime. Adequate protection needs to be accorded to innovators so that the costs incurred in the R&D process are rewarded through a temporary grant of the sole right to gain from the innovations. This would provide incentives for embarking upon a risky innovation process. An ideal intellectual property rights regime also has to strike a balance between protecting innovators for a reasonable amount of time while at the same time making the technical knowledge available to the public domain after considerable gains have been reaped by the innovators to foster competition.

Once these technologies are available, the next step is increasing their adoption. The diffusion of innovation is usually viewed as an S-shaped curve (Fig. 5). The objective of policy interventions is to shift the diffusion curve upwards so that the adoption of energy-efficient innovation takes place at a faster rate. Economists have a range of policy instruments in their arsenal for achieving this. It would be useful to categorise the potential economic instruments that can aid in achieving energy efficiency objectives into three:

(1) **Market mechanisms**

Coase theorem tells us that, with clearly assigned property rights and no transaction costs, an efficient solution can be achieved through a bargaining process between the economic agents. When there are a large number of agents and likely asymmetry of information, such a bargaining process may not be feasible. This is usually the case

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**Fig. 5** Diffusion of energy-efficient innovation
in real life. In such a case, the optimal outcome is achieved through the creation of a market for the externality under question. One such market is the market for energy-saving certificates. An upper limit on the energy intensity for a group of economic agents is decided. This is allocated among economic agents, in the form of energy intensity permits. The agents who are able to achieve an energy intensity less than the allotted permits are allowed to trade them with the agents who are unable to achieve their target energy intensity. Trading between the agents ensures that the optimal level of emissions is achieved at the lowest cost. The advantage of such a mechanism is that it is technology agnostic and allows the economic agents involved to choose the best way to meet the targets.

(2) Fiscal instruments

Taxes

A key fiscal measure to promote energy efficiency is the imposition of taxes according to the polluter pays principle. A tax can be imposed on either the producer or the consumer and works by increasing the cost of doing a certain activity, thereby dissuading entities from doing more of that activity. In the context of energy use, an energy tax incentivises firms to save energy. The revenue generated from the tax can be channelled into activities that require explicit government support for promoting energy efficiency, for instance, for introducing technology advancement at the industry level.

Financing

A second fiscal instrument that can be deployed for energy efficiency is providing financial support. Governments can provide concessional loans or grants to fully or partially finance steps required to improve energy efficiency to industries. Financing can be provided for improvement of existing inefficient facilities, as well as new or existing facilities, where new technologies are being implemented which impose risks great enough to deter investors to undertake improvements. A key financial instrument in this regard is viability gap funding, which can help businesses meet the initial cost of introducing a new technology that will improve energy use. Financing as an instrument should be used ultimately to create an enabling economic environment capable of providing long-term financing and to establish a financing structure overtime where the necessary funding will come from private sources.

Green Public Procurement

Green public procurement is defined as the acquisition of goods or services by the public sector taking environmental aspects into account. As one of the largest purchasers, the public sector has substantial power to exert influence over the market. Public sector procurement can create a much-needed demand for products and services that foster energy efficiency. The practice of green public procurement can help encourage the market to produce and sell more energy-efficient products and services. This, in turn, can help the market to mature and foster innovation across the board.
(3) **Other regulatory measures**

Energy efficiency can be improved through the use of other regulatory measures such as setting norms and standards. Norms and standards are rules and targets set by public authorities specifying minimum levels that need to be met. These are supposed to encourage the use of energy-efficient technologies and are subsequently enforced by compliance procedures.

However, using standards to enhance energy efficiency can yield the desired results only if they are effectively implemented. If enforcement is poor, as is in many developing countries, such measures would end up increasing the cost of operation for businesses without energy efficiency gains. Another regulatory decision is how frequently these should be revised in the light of new technologies or information. On the one hand, it seems intuitive to tighten the standards as technologies improve; on the other hand, such a policy may create strategic incentives to delay innovations in anticipation of tighter standards (Bansal & Gangopadhyay, 2005). Committing to a standard, before the improvement actually takes place, provides the right incentive for a strategic firm to invest in R&D.

(4) **Nudge/Behavioural instruments**

The insights provided by behavioural economics and psychology are being increasingly used in various policy scenarios, and environmental policy can also borrow from them. Behavioural economics suggests that economic agents could be guided in their actions by perceptions of fairness, social norms and social status, and even by other idiosyncratic factors rather than pure rational decision-making as modelled in conventional economic theory. One instrument could be moral suasion. Repeated appeals could be made to economic agents to behave in a particular way. This has been conventionally used by Central Banks to affect desired behaviour among the commercial banks. Transparency could also be used as a potential instrument to affect behaviour of economic agents. Richard Thaler and Cass Sunstein have suggested disclosures as an environmental policy instrument. While there may not be any regulation requiring attaining of a particular physical target, mandatorily requiring economic agents to disclose the impact of their activities on the environment can have a positive impact on the activities of these agents. The success of such a scheme was due to the worst offenders being targeted by the media and environmental groups, providing a social nudge.

The policy interventions in the context of energy efficiency should be guided by efforts at removing barriers to the adoption of energy-efficient products and technologies. The literature has suggested a range of reasons that could result in the suboptimal adoption of energy-efficient innovation. This could be a result of, among others, environmental externalities, lack of adequate information or behavioural biases (Jaffe et al., 2004; Patrik et al., 2010; Howarth & Andersson, 1993; Gillingham et al., 2009). It is important to understand the sources of market inefficiency as the policy intervention that addresses a particular issue effectively could vary. Informational issues are one of the most prominent barriers to the adoption of energy-efficient technologies. First, uncertainty about the performance of energy-efficient products inhibits
the adoption of more energy-efficient technologies (Patrik et al., 2010; Howarth & Andersson, 1993). The adoption of an energy-efficient technology by an agent also provides an opportunity for other agents to learn from the experience of early adopters. Thus, there involve positive externalities in the adoption of new technologies, and therefore, there would be under-provision of the same in the market due to non-internalisation of the same (Jaffe et al., 2004). The policy intervention could be in the form of subsidising new technologies so that more people experience it, and through positive externalities, this could result in a wider diffusion.

Another informational issue is that of asymmetry of information between different agents. It is likely to be the case that producers of products are more informed about the energy efficiency characteristics than the consumers of these products. This may lead to adverse selection resulting in the suboptimal choice of energy efficiency investment. Another form of principal–agent problem arises when the owner of a building or premises that has been provided on rent has to invest in energy efficiency equipment but the utility bills have to be paid by the tenants (Jaffe and Stavins, 1994; Jaffe et al., 2004; Sanstad & Howarth, 1994). This leads to underinvestment in energy efficiency measures. To address this barrier, energy efficiency standards for products could be specified, and labels that convey information on their energy efficiency could be provided.

Behavioural economics suggests that consumers are not rational in making their decisions and have cognitive biases. These include norms and values of energy efficiency, inertia and bounded rationality (Gillingham et al., 2009; Sanstad & Howarth, 1994; Patrik et al., 2010).

Another barrier to energy efficiency could be that households and small firms may be credit constrained and therefore unable to opt for the more energy-efficient options that have higher upfront costs (Hirst & Brown, 1990). Further, studies have found relatively high discount rates in the case of energy efficiency investments compared to interest rates in the rest of the economy (Hirst & Brown, 1990; Jaffe & Stavins, 1994).

All these barriers to energy efficiency are usually from the perspective of users of products that consume energy in their operation. However, a major concern is regarding the production of energy, especially, from fossil fuels. It is a process that involves considerable environmental externalities. Since the environmental costs from the production of energy are not internalised without regulatory intervention, the producer has no incentive to produce energy in a socially optimal manner. The result is that as long as the private gains from energy efficiency are not sufficient to induce the producer of energy to reach the socially optimal level, it would not do so. Taxes or emission trading mechanisms have the potential to nudge the producers of energy towards more energy-efficient means.

Thus, we have seen that, where the barrier to energy efficiency results from gaps in information, the policy interventions that are most likely to help are those that increase the level of information available with the consumer such as conducting information campaigns, labelling programmes and rating programmes (Hirst & Brown, 1990). Labelling and rating schemes are also likely to help in cases where bounded rationality makes it difficult to make informed decision-making. In the case of asymmetric
information-induced inefficiencies, in addition to information enhancing policies, enforcement of standards and norms is useful in inducing optimal behaviour. Limited access to capital can be addressed through financial incentives for energy efficiency investments or tax credits. As we shall see in the following section, energy efficiency policy in India has leveraged almost all the above-mentioned policy options in encouraging energy efficiency in the country.

3 Energy Efficiency Policy in India

The institutional framework for energy efficiency in India is based on the Energy Conservation Act, 2001. Section 3 of the said Act paved the way for the creation of the Bureau of Energy Efficiency (BEE). The Act has fixed a gamut of functions for BEE ranging from recommending the norms for processes and energy consumption standards, norms for appliances, guidelines for energy conservation building codes, to the training of personnel and dissemination of information. The Act was amended in 2010.

A number of programmes have been initiated to address energy conservation by BEE. These schemes cover a wide range of sectors, namely households, buildings, electrical appliances, demand-side management in agriculture and municipalities, as well as micro, small and medium enterprises (MSMEs) and large industries (Fig. 6). In terms of the policy instruments discussed in the previous section, India

![Diagram](image)
has attempted to use almost all major policy instruments including subsidies, standards and labelling, cap and trade scheme as well as information dissemination programmes. Below we give a brief description of the various schemes according to the different sectors they are implemented in:

3.1 Industry Sector

In the industrial sector, the major energy efficiency interventions are the Perform, Achieve and Trade (PAT) Scheme for large industry and the BEE SME (small and medium-scale enterprises) Programme, the Global Environment Facility-United Nations Industrial Development Organisation-BEE (GEF-UNIDO-BEE) Programme, GEF-World Bank-BEE Programmes for the Micro, Small and Medium Enterprises (MSME) sector (BEE, 2020).

PAT is essentially a cap and trade scheme in energy efficiency launched from 2012 onwards under National Mission for Enhanced Energy Efficiency (NMEEE). PAT imposes energy consumption targets on firms (designated consumers) in energy-intensive industries. Designated consumers which are able to achieve energy savings greater than that mandated receive energy-saving certificates (ESJets). Designated consumers who are unable to meet their targets are allowed to meet the shortfall through the purchase of ESCerts from those with a surplus. PAT cycle-I ended in 2015 with a saving of 8.67 million tonne of oil equivalent (MTOE). The second PAT cycle was launched with effect from April 2016 for the period 2016–17 to 2018–19. Under this, 89 new DCs were identified from existing sectors and 84 DCs from three new sectors, railways, refineries and electricity DISCOMs were included. Overall, a reduction of 8.869 million tonnes of oil equivalent from a total of 621 DCs was targeted in this cycle. PAT cycle-III was notified with effect from April 2017, PAT cycle-IV from 1 April 2018 and PAT cycle-V from April 2019. PAT scheme is now being implemented on a rolling cycle basis with the inclusion of new sectors/DCs every year (GoI, 2019; MoEFCC, 2018).

In the MSME sector, BEE SME programme was initiated to bridge the gap in the technological know-how of the SMEs by conducting technology demonstrations and imparting training programmes. Four industrial clusters are part of the BEE SME programme. These cover forging (Ludhiana), textile (Pali), food (Indore) and brick kilns (Varanasi) (BEE, 2020). In order to ensure finance for energy efficiency in MSME industrial clusters, BEE-WB-GEF programme was introduced with a grant agreement being signed in 2010. A revolving fund has also been created under this to provide concessional finance for energy efficiency projects in the sector. Another national project is being executed by BEE in collaboration with the UNIDO under GEF funding. Under this, a range of activities includes assessment of the current operational efficiency, technology identification, etc., to MSMEs for implementation of energy efficiency interventions in 12 MSME clusters covering brass, ceramics, dairy, foundry and hand tools.
With regard to financing instruments for energy efficiency, the **Energy Efficiency Financing Platform (EEFP)** aims at the creation of mechanisms that would help finance demand-side management programmes. Major activities under this have been related to outreach and training at financial and banking institutions (MoEFCC, 2018). **Framework for Energy-Efficient Economic Development (FEEED)** was intended to develop fiscal instruments for energy efficiency. Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) provides partial risk coverage to financial institutions for lending to energy efficiency enhancing investments (BEE, 2019; MoEFCC, 2018).

### 3.2 Domestic Appliances and Building Sectors

Market Transformation for Energy Efficiency (MTEE) Scheme aims at “accelerating the shift to energy-efficient appliances in designated sectors through innovative measures to make the products more affordable” (MoEFCC, 2018). Refrigerators, ceiling fans, air conditioners, water heaters and motors were identified as the priority products for initial standards and labelling development. One of the programmes under this scheme was the Bajat Lamp Yojana, later rechristened as the **Unnat Jyoti by Affordable LEDs for All (UJALA)** was launched in 2015 with the aim to provide LED bulbs to domestic consumers with a target to replace 770 million incandescent bulbs with LED bulbs by March 2019. As on 2 April 2020, 36,22,65,188 LEDs have been distributed under the scheme resulting in estimated savings of over ₹18 crore each year and energy savings of 47,046 million kWh per year (National UJALA Dashboard, 2020). Energy Efficiency Services Ltd. (EESL) is the implementing agency for the programme. LED bulbs are distributed at subsidised rates. Domestic consumers can procure LED lights at a low price, with the balance through easy instalments through their electricity bills. Another programme under MTEE is the **Super-Efficient Equipment Programme (SEEP)**. SEEP was launched with the aim to subsidise the production of super-efficient fans to reduce energy consumption in Indian households.

**Energy Conservation and Building Code (ECBC)** was launched in 2007, and a new ECBC was launched in 2017 that goes beyond to encourage building energy consumption. ECBC 2017 is applicable to commercial buildings that have a connected load of 100 kW or greater or a contract demand of 120 kV A or greater (BEE, 2020). In order to measure energy efficiency, an index called energy performance index which is the ratio of annual energy consumption to the total built-up area excluding unconditioned basements is considered. Along with minimum energy efficiency requirements, the code also requires buildings to have a mandatory installation of renewable energy generation as well as passive design strategies such as daylight and shading. Buildings under the code have been classified into hospitality, educational, businesses, assembly, health care and shopping facilities (BEE, 2020).

In the area of residential buildings, **EcoNiwas Samhita 2018** was launched which prescribes minimum energy efficiency norms for residential buildings. An energy
efficiency labelling scheme for residential buildings has also been proposed. Voluntary labelling of buildings in the form of Star Labels for commercial buildings was launched in 2009. Buildings are rated from 1 to 5 based on their actual energy performance, 5 being the best. A total of 261 buildings have been star rated. A star rating is valid for 5 years (BEE, 2020).

**Standards and labelling** for energy efficiency has been used in the area of electrical appliances since 2006 initially as voluntary labels for refrigerators and tube lights. Mandatory labels were introduced in 2009. Today, 24 appliances are covered under standards and labelling scheme, with 10 of these appliances requiring mandatory labelling. While standards prescribe minimum energy efficiency requirements for appliances, labelling involves attaching labels that provide information on the energy efficiency characteristics of the appliances. BEE has issued two types of labels. One is a comparative label that allows consumers to compare the energy efficiency of particular products in terms of star ratings. The other labelling is an endorsement labelling which indicates that the particular appliance is highly energy efficient in its category.

### 3.3 Municipal and Agricultural Sectors

**Demand-side management programmes** have been introduced with respect to Agriculture, Municipal/Urban Local Bodies, and Distribution Companies (DISCOMs). Irrigation constitutes a major share of electricity use in the agricultural sector, and therefore attempts have been made under DSM to generate awareness about energy-efficient pump sets (GoI, 2019; MoEFCC, 2018). BEE nationwide awareness programmes have been undertaken to address energy efficiency in water pumping, sewage pumping, street lighting and public buildings across urban local bodies (ULBs).

**Municipal Energy Efficiency Programme (MEEP)** aims to retrofit energy-efficient pumps in 500 Atal Mission for Rejuvenation and Urban Transformation (AMRUT) cities. Energy audit has been completed in more than 250 ULBs, and EESL will be conducting the upgradation of pumping systems in these cities. Conventional street lights are being replaced under the Street Light National Programme (SLNP) (BEE, 2020).

### 4 Impact of Energy Efficiency Programmes

As per Government of India estimates, the implementation of energy efficiency schemes in India has resulted in a total cost savings of around ₹53,000 crore in 2017–18 and reduced CO₂ emission by 108.28 million tonnes, mainly contributed by the schemes PAT, UJALA and standards and labelling (GoI, 2019). In 2018–19,
the savings have been estimated at ₹89,122 crore, emission reductions of 151.74 MTCO₂. In the first cycle of PAT, from 2012 to 2015, 478 industrial units from aluminium, cement, chlor-alkali, fertiliser, iron and steel, paper and pulp, thermal power and textile sectors were included. Under the first cycle, 309 designated consumers exceeded their targets (BEE, 2020). The actual achievement in terms of total energy saved in each sector was above target in all sectors except thermal power plants where it was marginally less (Fig. 7) (MoEFCC, 2018).

Energy efficiency market-based instruments have been used in many other countries. European Union (EU) had issued energy efficiency directives¹ for member states to set national energy efficiency targets based on either primary or final energy consumption, primary or final energy savings, or energy intensity. It also directed the member states to establish an energy efficiency obligation scheme in order to achieve energy efficiency targets by 31 December 2020. The target was to be “at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1.5% of the annual energy sales to final customers of all energy distributors or all retail energy sales companies by volume, averaged over the most recent three-year period prior to 1 January 2013”. Around 15 EU member states have active

¹EU Directive 2012/27/EU.
energy efficiency obligation schemes: Austria, Bulgaria, Croatia, Denmark, France, Greece, Ireland, Italy, Latvia, Luxembourg, Malta, Slovenia, Spain, Poland and the UK (Fawcett et al., 2019). In the UK, the Carbon Reduction Commitment Energy Efficiency Scheme (CRC) was introduced in 2010 to incentivize energy efficiency for large energy users. Participants in this scheme were required to buy allowances for their carbon emissions (UK Govt., 2017). The scheme was run in two phases: from April 2010 till March 2014 and from 1 April 2014 till 31 March 2019. The scheme was decided to be closed after the 2018–19 compliance year. Energy-saving targets and trading in it in Italy were introduced in 2005 for electricity and gas distributors with at least 50,000 consumers (Stede, 2017). Only additional energy savings are rewarded with energy-saving certificates. South Korea introduced Energy Efficiency Obligations in 1995 with the objective of incremental energy savings of 0.20% per year in comparison with total fuel consumption (IEA, 2017).

Oak and Bansal (2019) use a difference-in-differences estimation to show that the PAT scheme led to a fall in energy intensity of DCs in cement and fertiliser industries. A sector where energy efficiency schemes seem to have had a negligible impact is the paper and pulp industry (Oak & Bansal, 2019). A major criticism of the PAT scheme has been that the targets under the scheme have not been stringent enough, leading to the easy achievement of these targets and actually over-achievement by most sectors (Singh & Sharma, 2018; Haider et al., 2019; Sahoo et al., 2017). Sahoo et al. (2017), based on data envelopment analysis (DEA), and find that PAT targets for thermal power plants were less than the sector’s potential. At full potential, they estimate that the sector could produce 4.7 million additional ESCerts. Based on stakeholder interviews, Bhandari and Shrimali (2018) find that PAT is not additional and major improvements in energy efficiency were on account of rising energy prices during the period. Haider et al. (2019), using DEA-based analysis, found that the Indian paper and pulp industry has the potential to reduce energy input along with all proportionately by 18%. Dasgupta and Roy (2017) find that while sectors like aluminium, cement and fertiliser are operating efficiently as per global standards, paper and pulp and iron and steel sectors are lagging behind. The unit-specific targets in the scheme take a lenient view of highly inefficient firms due to the unit-specific targets. Further, while setting the target, BEE does not take into account factors such as raw material composition and quality, internal consumption of products by the plant itself and in-house energy conversion (Singh & Sharma, 2018). Another criticism is that since the issuance of the ESCerts is after the verification of the energy savings, it does not allow trading during the cycle and therefore the generation of price signals for energy-efficient investments (Bhattacharya & Kapoor, 2012).

An important sector that has great potential for energy savings is the building sector. The adoption of ECBC 2017 is estimated to reduce energy use by 50% by 2030 and a savings of ₹ 35,000 crore and 250 million tonnes of CO₂ (BEE, 2020). Thirteen states have made ECBC mandatory for commercial buildings. As of 2018–19, 117 buildings, both constructed and under various stages of construction, were

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2Additionality implies that only measures that would have not taken place in the absence of the policy are rewarded.
under the ECBC mandate (BEE, 2020). Twenty-two buildings out of these 117 have completed their constructions and have resulted in energy savings of 44.55 MU. In terms of star-rated buildings, between 2015–16 and 2018–19, 49 buildings have been star rated and have resulted in a total savings of 82.5 MU between 2015–16 and 2018–19 (BEE, 2020).

Based on an impact assessment of 13 appliances conducted by BEE that were covered under standards and labelling scheme, it was found that the total savings for appliances sold between 2015–16 and 2018–19 amounted to 55.7 MU in 2018–19. This led to an estimated reduction of 45.7 million tonnes of CO₂ during 2018–19. Under the UJALA scheme, a total of 347.4 million LED bulbs, 7.35 million LED tube lights and 2.22 million energy-efficient fans have been sold between 2015–16 and 2018–19. The programme is estimated to have led to energy savings of around 44,852 MU of energy (BEE, 2020). In the ULBs, more than 84 lakh LED street lights have been replaced between 2015–16 and 2018–19 under the SLNP. This has resulted in an estimated energy savings of 5647 MU and emission reductions of 4.6 million tonnes of CO₂ in 2018–19 (BEE, 2020).

With regard to labelling, Jain et al. (2018) using a discrete choice experiment showed that prior knowledge of label increased consumers’ willingness to pay for energy-efficient air conditioners and refrigerators in India. The willingness to pay for five-star rating as compared to three-star rating air conditioners and refrigerators is Rs. 9060 and Rs. 6633, respectively. Chunekar (2014) compared the standard and labelling programme for refrigerators in India, with the USA, China and the European Union energy star programmes. The article found that the range of consumption levels in a particular star label is much wider in India as compared to other countries. In addition, India lags behind other countries on its consumption levels corresponding to the highest energy efficiency rating. Parikh and Parikh (2016) estimated savings between 52 and 145 billion kWh in 2030 from four household appliances—ACs, refrigerators, televisions and ceiling fans (10–27% reduction). The carbon emission reduction is estimated in the range of 42 megatons to 116 megatons in 2030 (30% reduction).

Grover et al. (2019) conduct a discrete choice experiment in New Delhi to assess consumers’ willingness to pay for fuel-efficient cars. They use a novel approach to evaluate the effect of combining the labelling policy with a regulatory incentive. For the purpose, they incorporate the odd–even scheme that was recently implemented in Delhi in their experiment. According to the scheme, cars with an odd-numbered licence plate were allowed to run on odd dates and those with even numbers on even dates. They find that consumers in New Delhi are willing to pay more for fuel-efficient cars. Further, driving restrictions tied to a labelling system seem a promising policy to increase the uptake of fuel-efficient cars in New Delhi. They find an increase in respondents’ stated willingness to pay (WTP) for the best efficiency label from 4.93 thousand US dollars to 7.48 thousand US dollars. They interpret the difference as regulatory costs—i.e. the extra 2.55 thousand US dollars represent the amount that respondents are willing to pay for an energy label that would exempt them from the driving restrictions.
5 Recommendations and Conclusions

Over the years, the Government of India has taken several policy measures to enhance energy efficiency of the economy; however, India still ranks low in terms of energy efficiency and there is potential for further gains. Some suggestions on energy efficiency policy are as follows:

- Consumer awareness is an important aspect in the success of government efforts. Lack of awareness about energy efficiency, products and instruments is a major impediment in the adoption of energy-efficient technologies. Consumer awareness campaigns and making information about the energy efficiency part of the school curriculum could go a long way. Sengupta (2017) using a survey of 250 households in Delhi showed that people are reluctant to shift to LEDs due to high prices and being habituated to incandescent lamps. The paper suggested that an effective campaign could bring social acceptance of energy-efficient lighting. Not taking into account consumers’ responses can yield less than desirable results. A drawback of the SEEP scheme is that it does not take into account the consumers’ behaviour and their purchasing propensity for super-efficient fans (Troja, 2016).

- Financial incentives are likely to have a positive impact on the adoption of energy-efficient appliances by households. These financial incentives could be in the form of low-interest loans or bringing down the cost of appliances through large-scale procurement by the government as was in the case of procurement of LED bulbs by BEE (Parikh & Parikh, 2016).

- It is important that the schemes are reviewed and evolved as per the changing landscape. Though BEE claims that the PAT scheme is highly effective, rigorous studies that quantify the additional gains in energy efficiency due to the scheme need to be conducted, and the results are used for the implementation of future phases of the scheme. Further targets should be set that yield the economically optimal energy efficiency improvements. Where standards are used as instruments, implementation and enforcement would yield desired results. There is a need for constant monitoring and updation of standards.

- With reference to energy efficiency trading, it is important to have a clear long-term target so that there is minimal policy uncertainty for stakeholders involved. This would encourage them to make concrete investments in energy efficiency improvements.

- Buildings hold great potential for future energy efficiency gains as India is on the path of urbanisation and economic growth (Mathur, 2019). It is important that energy efficiency standards are implemented for this sector in a comprehensive manner for both domestic and commercial constructions.

- Digital technologies can be leveraged to improve energy efficiency. The use of equipments such as smart metres can lead to better energy management and therefore reduce avoidable energy losses.

- Public procurement can have energy efficiency guidelines so that only goods and services that meet the minimum energy efficiency standards are procured by public authorities. This could give a fillip to energy-efficient products in the country.
Energy efficiency is a crucial component of India’s overall climate strategy. It is an area that is perceived to deliver a win-win situation for all the stakeholders involved. Given the uncertainties governing the current global economy in the aftermath of COVID-19 and the resulting slowdown, it is yet to be seen how renewable energy investments would be impacted in the coming days. In such a scenario, energy efficiency measures could provide the much-needed impetus for climate mitigation actions in the coming times.

References

Adam B. Jaffe, Richard G. Newell, & Robert N. Stavins. (2004). Economics of energy efficiency. *Encyclopedia of Energy*, 2.

Adam B. Jaffe, & Robert N. Stavins. (1994). The energy efficiency gap: What does it mean? *Energy Policy*, 22(10), 804–810.

American Council for an Energy-Efficient Economy (2018). *The 2018 international energy efficiency scorecard*. [https://www.aceee.org/sites/default/files/publications/researchreports/i1801.pdf](https://www.aceee.org/sites/default/files/publications/researchreports/i1801.pdf).

Bansal, S., & Shubhashis, G. (2005). Incentives for technological development: BAT is BAD. *Environmental & Resource Economics*, 30(3), 345–367.

BEE. (2019). *Unlocking national energy efficiency potential (UNNATEE) strategy plan towards developing an energy efficient nation (2017–2031)*. Bureau of Energy Efficiency, Ministry of Power, Govt. of India.

BEE. (2020). *A report on impact of energy efficiency measures for the year 2018–19*. Bureau of Energy Efficiency, Ministry of Power, Government of India.

Bhandari, D., & Shrimali, G. (2018). The perform, achieve and trade scheme in India: An effectiveness analysis. *Renewable and Sustainable Energy Reviews*, 81, 1286–1295.

Bhattacharya, T., & Kapoor, R. (2012). Energy saving instrument–ESCerts in India. *Renewable and Sustainable Energy Reviews*, 16(2), 1311–1316.

BP (2019). *BP Statistical Review of World Energy*. BP: London, UK.

Chunekar, A. (2014). Standards and labeling program for refrigerators: Comparing India with others. *Energy Policy*, 65, 626–630.

Dasgupta, S., & Roy, J. (2017). Analysing energy intensity trends and decoupling of growth from energy use in Indian manufacturing industries during 1973–1974 to 2011–2012. *Energy Efficiency*, 10(4), 925–943.

Fawcett, T., Rosenow, J., & Bertoldi, P. (2019). Energy efficiency obligation schemes: Their future in the EU. *Energy Efficiency*, 12, 57–71.

Gillingham, K., Newell, R. G., & Palmer, K. (2009). Energy efficiency economics and policy. *Annual Review of Resources and Economics*, 1(1), 597–620.

GoI. (2019). *Enabling inclusive growth through affordable, reliable and sustainable energy in economic survey 2018–19*, vol. I. Government of India.

GoI. (2015). *India’s intended nationally determined contribution*. Government of India.

Grover, C., & Bansal, S., Martinez-Cruz, A. L. (2019). May a regulatory incentive increase WTP for cars with a fuel efficiency label? Estimating Regulatory Costs Through a Split-Sample DCE in New Delhi, India (June 24, 2019). Available at SSRN: [https://ssrn.com/abstract=3408942 or http://dx.doi.org/10.2139/ssrn.3408942](https://ssrn.com/abstract=3408942).

Haider, S., Danish, M. S., & Sharma, R. (2019). Assessing energy efficiency of Indian paper industry and influencing factors: A slack-based firm-level analysis. *Energy Economics*, 81, 454–464.

Hirst, E., & Brown, M. (1990). Closing the efficiency gap: Barriers to the efficient use of energy. *Resources, Conservation and Recycling*, 3(4), 267–281.
Howarth, R. B., & Andersson, B. (1993). Market barriers to energy efficiency. *Energy Economics, 15*(4), 262–272.

IEA. (2017). Energy efficiency obligation. International energy agency. Retrieved from [https://www.iea.org/policies/792-energy-efficiency-obligation?country=Korea&jurisdiction=National&sector=Industry&status=In%20Force&topic=Energy%20Efficiency&type=Market-based%20instruments](https://www.iea.org/policies/792-energy-efficiency-obligation?country=Korea&jurisdiction=National&sector=Industry&status=In%20Force&topic=Energy%20Efficiency&type=Market-based%20instruments). Last accessed 26 May, 2020.

IEA. (2020). Energy efficiency indicators 2020. Paris: International Energy Agency. Retrieved from [https://www.iea.org/report/energy-efficiency-indicators-2020](https://www.iea.org/report/energy-efficiency-indicators-2020).

IQ-Air. (2019). *World air quality report*. URL [https://www.iqair.com/world-most-polluted-cities/world-air-quality-report-2019-en.pdf](https://www.iqair.com/world-most-polluted-cities/world-air-quality-report-2019-en.pdf). Accessed May 30, 2020.

Jain, M., Rao, A. B., & Patwardhan, A. (2018). Appliance labeling and consumer heterogeneity: A discrete choice experiment in India. *Applied Energy, 226,* 213–224. [https://doi.org/10.1016/j.apenergy.2018.05.089](https://doi.org/10.1016/j.apenergy.2018.05.089).

Mathur, A. (2019). Public costs and private benefits: The governance of energy efficiency in India. *Building Research and Information, 47*(1), 123–126.

MoEFCC. (2018). *India: Second biennial update report to the united nations framework convention on climate change*. Ministry of Environment, Forest and Climate Change, Government of India.

MOSPI. (2020). *Energy statistics 2020*. Government of India: Ministry of Statistics and Programme Implementation.

National UJALA Dashboard. (2020). [http://www.ujala.gov.in/](http://www.ujala.gov.in/). Accessed on April 2, 2020.

Oak, H., & Bansal, S. (2019). Effect of Perform-Achieve-Trade Policy on Energy Efficiency of Indian Industries. *Available at SSRN 3412317*.

Parikh, K., & Parikh, J. (2016). Realizing potential savings of energy and emissions from efficient household appliances in India. *Energy Policy, 97,* 102–111.

Patrik, T., Jenny, P., & Patrik, R. (2010). Categorizing Barriers to energy efficiency: An interdisciplinary perspective. *Energy Efficiency, 49–62*.

Sahoo, N. R., Mohapatra, P. K., Sahoo, B. K., & Mahanty, B. (2017). Rationality of energy efficiency improvement targets under the PAT scheme in India—A case of thermal power plants. *Energy Economics, 66,* 279–289.

Sanstad, A. & Howarth, R. (1994). ‘Normal’ markets, market imperfections and energy efficiency. *Energy Policy, 22*(10), 811–818.

Saraswat, Y., & Bansal, S. (2020). *Health effects of sustained exposure to fine particulate matter: Evidence from India* (February 21, 2020). Available at SSRN: [https://ssrn.com/abstract=3542183 or http://dx.doi.org/10.2139/ssrn.3542183](https://ssrn.com/abstract=3542183 or http://dx.doi.org/10.2139/ssrn.3542183).

Sengupta, S. (2017). Social acceptability of energy-efficient lighting. In *Sustainable Smart Cities in India* (pp. 275–294). Springer.

Singh, A., & Sharma, B. (2018). DEA based approach to set energy efficiency target under PAT framework: A case of Indian cement industry. *Central European Review of Economics and Management, 2543–9472*.

Stede, J. (2017). Bridging the industrial energy efficiency gap—Assessing the evidence from the Italian white certificate scheme. *Energy Policy, 104,* 112–123.

Troja, B. (2016). A quantitative and qualitative analysis of the super-efficient equipment program subsidy in India. *Energy Efficiency, 9*(6), 1385–1404.

UK Govt. (2017). *CRC Energy efficiency scheme*. United Kingdom Government. Retrieved from [https://www.gov.uk/government/collections/crc-energy-efficiency-scheme](https://www.gov.uk/government/collections/crc-energy-efficiency-scheme). Last accessed 26 May, 2020.