

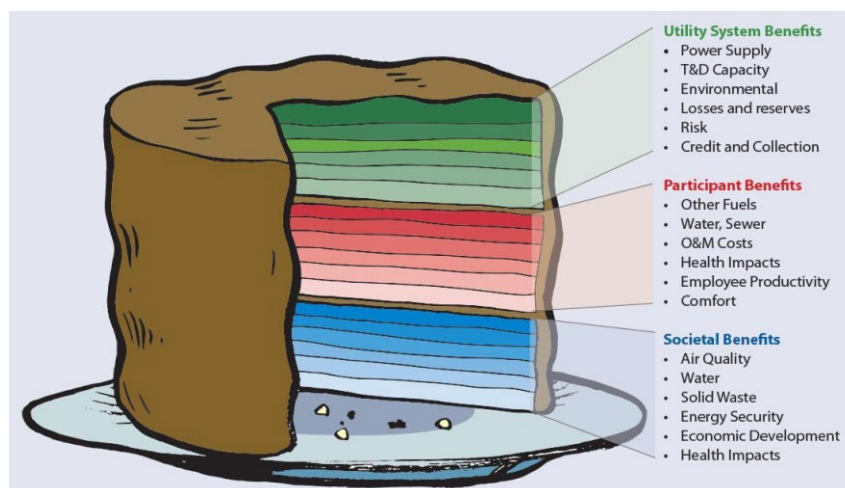
# India regulatory toolkit: Energy efficiency

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## Introduction

Energy efficiency (EE) is the use of less energy to perform the same task or produce the same result. Improving energy efficiency meets multiple objectives such as promoting sustainable development, deferring the need for investments in power sector capacity build-out and network expansion, improving economic competitiveness and generating employment. Figure 1<sup>1</sup> identifies the benefits of EE to the utility system, EE programme participants and society.

**Figure 1. Energy efficiency benefits beyond cost and energy savings**



Source: Lazar, J. & Colburn, K. (2013, 9 October). *Recognizing the full value of energy efficiency: What's under the feel-good frosting of the world's most valuable layer cake of benefits*

<sup>1</sup> Lazar, J. & Colburn, K. (2013, 9 October). *Recognizing the full value of energy efficiency: What's under the feel-good frosting of the world's most valuable layer cake of benefits* [Presentation]. Regulatory Assistance Project. <https://www.raonline.org/wp-content/uploads/2016/05/rap-lazarcolburn-layercake-webinar-iimfinal.pdf>

Energy efficiency is referred to as the “first fuel” in clean energy transitions, as it is one of the quickest and most cost-effective greenhouse gas (GHG) mitigation options, while reducing costs and strengthening energy security.<sup>2</sup> Figure 2<sup>3</sup> compares the levelised cost of energy<sup>4</sup> of energy efficiency interventions with other sources of energy in the U.S.

**Figure 2. Energy efficiency interventions are lowest-cost resource**



Source: Cohn, C. (2021). *The Cost of Saving Electricity for the Largest U.S. Utilities: Ratepayer-Funded Efficiency Programs in 2018*

Based on the data in the chart, the levelised cost of energy of EE is on average one-quarter of the cost of coal, the most commonly used resource.

In the context of the electricity distribution sector, EE programmes can be classified as follows:

- Efficiency improvements in front of the meter: efficiency improvements on the supply side, including in power generation, transmission and distribution. Examples of Indian EE programmes include the Integrated Power Development Scheme (IPDS) – (strengthening sub-transmission and distribution, metering transformers and feeders) and the Restructured Accelerated Power Development and Reforms Programme (R-APDRP)– (reducing transmission losses through network improvements).
- Efficiency improvements behind the meter: efficiency efforts at the consumer’s end, referred to as demand-side management (DSM). DSM seeks to modify consumer behaviour by means such as government policies (e.g., building codes and device standards); financial incentives (e.g., discounts on efficient appliances by distribution

<sup>2</sup> International Energy Agency. (2022, December). *Energy Efficiency 2022*. <https://www.iea.org/reports/energy-efficiency-2022>

<sup>3</sup> Cohn, C. (2021). *The Cost of Saving Electricity for the Largest U.S. Utilities: Ratepayer-Funded Efficiency Programs in 2018*. ACEEE. <https://www.aceee.org/topic-brief/2021/06/cost-saving-electricity-largest-us-utilities-ratepayer-funded-efficiency>. Emphasis by RAP.

<sup>4</sup> Levelised cost of energy is the average lifecycle cost of generating electricity, which can be used to compare the costs of alternative sources.

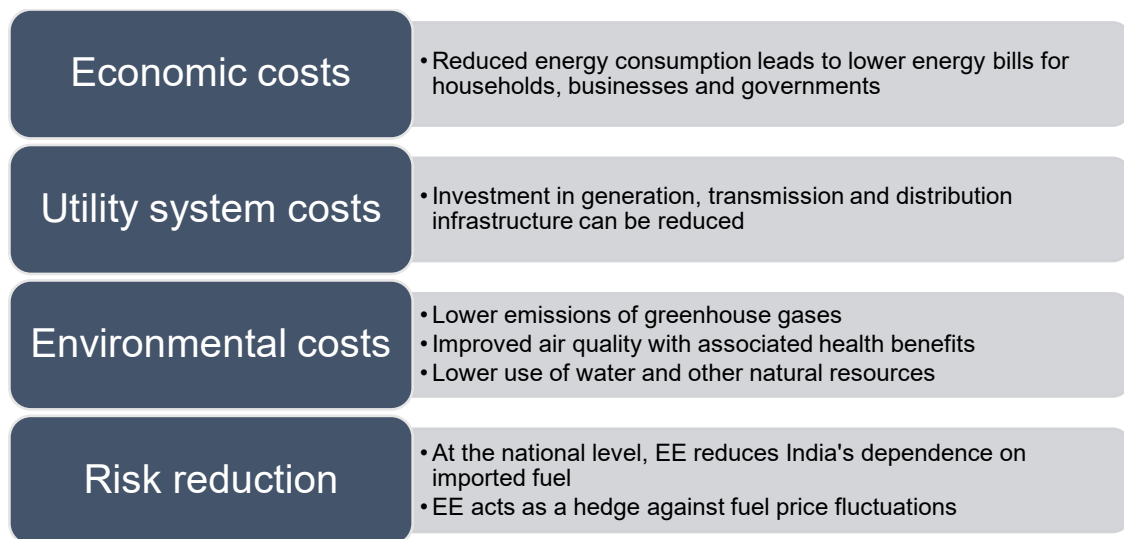
utilities (discoms)); and providing information to consumers to reduce their energy consumption (e.g., through home energy reports).

This chapter focuses on actions behind the meter, on the consumer's end. The chapter covers major EE initiatives in India, potential for EE and two case studies of EE programmes and opportunities. The chapter ends with recommendations to policymakers on integrating EE in electricity sector reforms. An annex covers the regulatory backing for EE in India.

## Major energy efficiency initiatives in India

The major benefits of energy efficiency to homes, businesses, utilities and the nation are mainly through avoided costs and risk reduction, as seen in Figure 3.<sup>5</sup>

**Figure 3. Energy efficiency lowers costs and risks**



Source: U.S. Environmental Protection Agency. (2023). *Local energy efficiency benefits and opportunities*.

Table 1 below lists the major EE initiatives and programmes in India, along with implementing agencies and benefits, in order of programmes with lowest to largest impact.

<sup>5</sup> U.S. Environmental Protection Agency. (2023). *Local energy efficiency benefits and opportunities*. <https://www.epa.gov/statelocalenergy/local-energy-efficiency-benefits-and-opportunities>

**Table 1. Major EE programmes in India**

EE initiative	Agency	Sector	Intervention	Impact
MSME programme	Bureau of Energy Efficiency (BEE)	Small industrial	EE programmes in MSMEs	The BEE GEF UNIDO project led to energy savings of 8500 tonnes of oil equivalent (TOE), with annual savings of 3802 lakh INR
DSM programmes	BEE, utilities	Agricultural, municipal, residential, commercial, small industrial	Pilot programmes on agriculture DSM; energy audits and preparation of detailed project reports (DPRs) of municipalities; some utilities have implemented small-scale EE, DSM and demand response (DR) programmes	
Energy Conservation Building Code (ECBC)	BEE	Commercial	Minimum energy performance standards set for commercial buildings with connected load above 100kW	ECBC will reduce energy use by an estimated 50% between 2017 and 2030. This will translate to energy savings of about 300 billion units through peak demand reduction of 15 GW/year
UJALA	EESL	Residential, commercial, industrial, public	Replacing inefficient lightbulbs with EE LED bulbs	Annual household bills reduced by 15%, saving consumers over 16 billion INR every year; India's annual CO <sub>2</sub> emissions cut by 3 million tonnes
Perform Achieve Trade (PAT) scheme	BEE	Industrial	Reducing specific energy consumption in energy-intensive industries such as steel, cement, aluminium etc.	Six PAT cycles conducted till 2020, with 1073 participants covering 13 sectors. Projected total energy savings are 26 MTOE, avoiding 70 million tonnes of CO <sub>2</sub> by 2023
Standards and labelling programme for EE appliances	BEE	Residential, commercial, industrial, government	EE star labels for 24 appliances including air conditioners, refrigerators, pumps etc.	Energy savings of 48.46 BU in FY17-18, leading to CO <sub>2</sub> emission reduction of 40.03 million tonnes

Source: BEE, EESL, Forum of Regulators

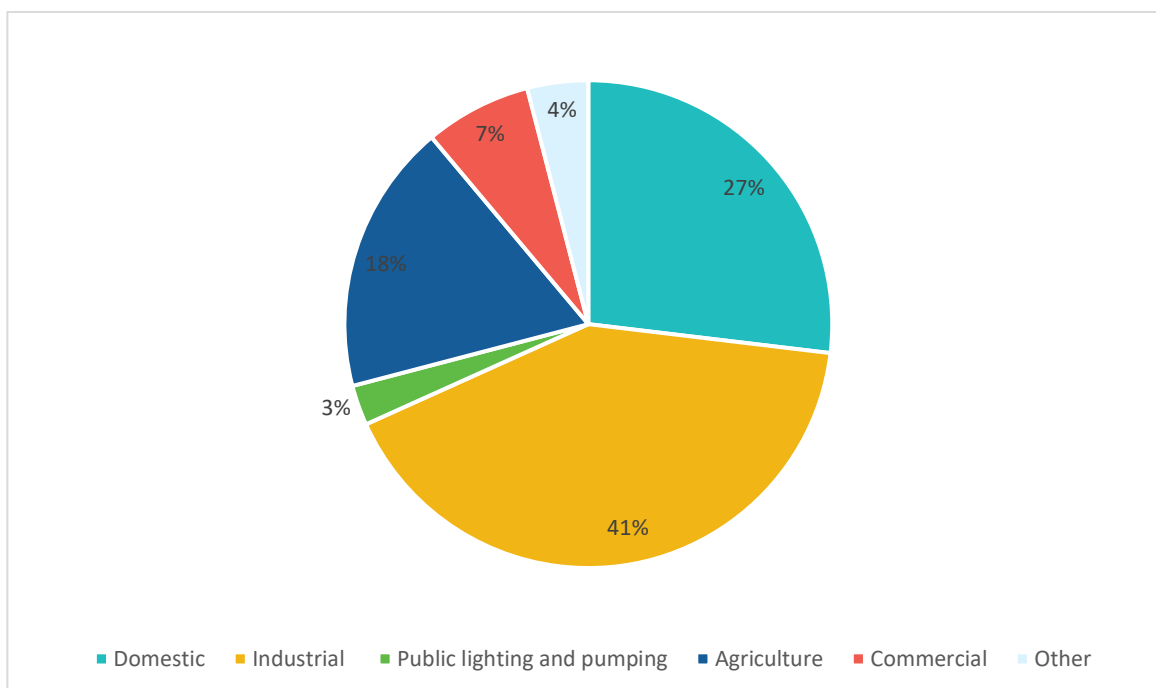
A well-reported event during the pandemic, the “9 p.m. 9 minutes” blackout, was a clarion call by the Hon’ble Prime Minister of India to switch off all lights for nine minutes as a token demonstration in response to the COVID-19 pandemic. The nation’s response and energy sector’s preparation suggests that a large-scale demand response initiative will be feasible.<sup>6</sup>

As seen in Table 1 above, energy efficiency programmes run by central agencies and targeting the industrial sector have had the largest impact so far. The impact of DSM measures in India is below the radar; there have been no specific reported load management benefits witnessed by the discoms or the load dispatchers.

## Potential for energy efficiency

Figure 4<sup>7</sup> shows the proportion of electricity sales to different consumer categories in India, out of the total sales of 1,230,208 GWh in 2021-22.

**Figure 4. Electricity sales by consumer category, 2021-22**



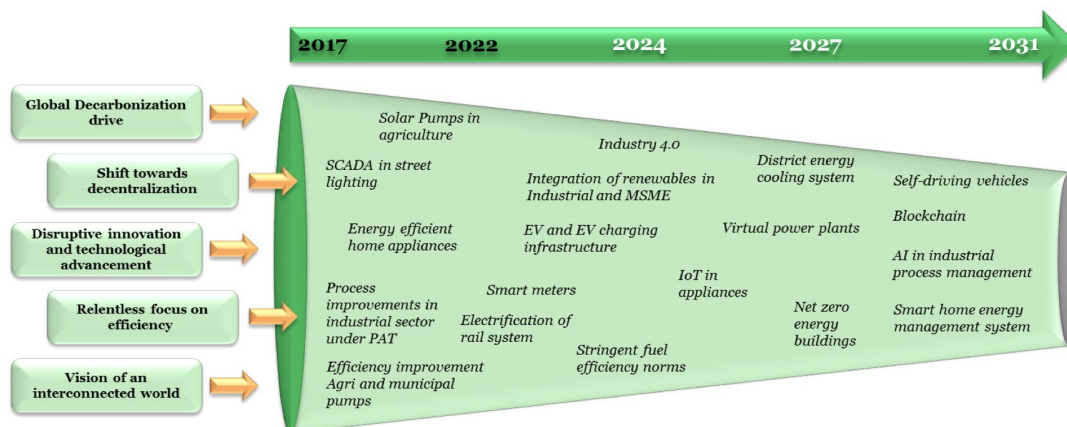
Data Source: India Central Electricity Authority. (2022). *Dashboard: Electrical energy sales to ultimate consumers (2020-21)*

Figure 5<sup>8</sup> below shows the potential EE technologies in the coming decade that have been evaluated by the Bureau of Energy Efficiency (BEE).

<sup>6</sup> Boddapati, V. & Nandikatti, A.S.R. (2020, December). Salient features of the national power grid and its management during an emergency: A case study in India, *Energy for Sustainable Development*, 59, 170-179. <https://doi.org/10.1016/j.esd.2020.10.010>

<sup>7</sup> India Central Electricity Authority. (2022). *Dashboard: Electrical energy sales to ultimate consumers (2020-21)*. <https://cea.nic.in/dashboard/?lang=en>

<sup>8</sup> Kumar, K., Soni, M., Appan, A., Satpathy, S., Yadav, R.K., Rajpal, M., & Kumar, A. (2019, February). *Unlocking National Energy Efficiency Potential (UNNATEE): Strategy plan towards developing an energy efficient nation (2017-2031)*. India Bureau of Energy Efficiency. [https://beeindia.gov.in/sites/default/files/UNNATEE\\_0.pdf](https://beeindia.gov.in/sites/default/files/UNNATEE_0.pdf)

**Figure 5. EE technologies envisaged by BEE**

Source: Kumar, K., Soni, M, Appan, A., Satpathy, S., Yadav, R.K., Rajpal, M., & Kumar, A. (2019, February). *Unlocking National Energy Efficiency Potential (UNNATEE): Strategy plan towards developing an energy efficient nation (2017-2031)*

Below, we present an evaluation of the energy savings potential of these technologies. The maximum possible savings through technological or behavioural interventions, given system constraints, is referred to as the technical potential. The economic potential is the share of technical potential that is economically viable. Market potential is the share of economic potential that can be achieved given current policies and investor outlook. Table 2 shows the market potential of EE in India by 2031 under two scenarios, moderate and ambitious.

**Table 2. Savings from EE by sector under moderate and ambitious scenarios by 2031**

Sector	Moderate savings scenario		Ambitious savings scenario	
	Mtoe	%	Mtoe	%
Agriculture	5.7	9%	9.9	15%
Transport	15.8	7%	23.8	10%
Domestic	12.1	12%	15.1	15%
Commercial	4.9	17%	6.4	22%
Municipal	0.9	12%	1.5	19%
Industries	47.5	11%	72.3	16%
<b>Total</b>	<b>86.9</b>	<b>10%</b>	<b>129</b>	<b>15%</b>

Source: Kumar, K., Soni, M, Appan, A., Satpathy, S., Yadav, R.K., Rajpal, M., & Kumar, A. (2019, February). *Unlocking National Energy Efficiency Potential (UNNATEE): Strategy plan towards developing an energy efficient nation (2017-2031)*

**Figure 6. Assumptions based on Table 2 scenarios**

Business as usual	Moderate	Ambitious
<ul style="list-style-type: none"> <li>• Current technology, policies and fuel mix</li> <li>• Electricity consumption in 2031: 2,455 TWh</li> </ul>	<ul style="list-style-type: none"> <li>• Moderate technological improvements</li> <li>• Government targets met</li> <li>• Moderate shift from fossil fuels to renewable energy</li> <li>• Electricity consumption in 2031: 2,261 TWh</li> <li>• India's nationally determined contribution (NDC) commitments for greenhouse gas emissions are met</li> </ul>	<ul style="list-style-type: none"> <li>• Ambitious technological improvements</li> <li>• Overachievement of targets, launch of new programmes</li> <li>• Ambitious shift to renewable energy</li> <li>• Electricity consumption in 2031: 2,193 TWh</li> </ul>

Based on BEE's scenarios:

- India can save 10-15% of its energy consumption depending on whether it follows a moderate or ambitious path.
- The potential investment in EE is INR 1,002,329 crore by 2031 under the moderate scenario and INR 1,320,630 crore under the ambitious scenario.
- Financing instruments proposed by BEE for Indian markets include energy-savings insurance, on-bill financing (see box on next page), cross-border technology transfer and energy efficiency financing facility, venture capital fund for energy efficiency and energy conservation bonds.

### On-bill financing

On-bill financing is a mechanism that allows customers to repay the costs of energy efficiency upgrades through their utility bills over a specific period. It enables consumers to overcome the upfront cost barrier associated with energy efficiency measures, making them more accessible and affordable.

One advantage of most on-bill finance programmes is that they can sell the idea to the customer that the cost of the financing is paid out of the energy savings: there is net positive cash flow while the loan is repaid and, after it is repaid, the customer gets all the savings.

International examples of on-bill financing include:

- *Illinois Energy Efficiency Loan Program*

This ratepayer-funded programme provides energy efficiency loans to residential customers of several utilities. As of 2022, loans range from \$500 to \$20,000 and can be repaid over the course of 1, 3, 5, 7, or 10 years.

- *Butler Rural Electric Cooperative Energy Efficiency Loan Program*

This ratepayer-funded programme serves the Cooperative's 11,000 residential customers in southwestern Ohio, supporting clean energy projects including energy efficiency, air-source heat pumps and geothermal systems. As of 2022, the programme offers loans of up to \$25,000 for up to 10 years. The programme has made 500 loans for \$7.5 million with defaults under 1%.

On-bill financing has been successfully carried out in India for programmes for low-cost efficient appliances. Under the UJALA scheme launched by Energy Efficiency Services Limited (EESL), consumers purchased energy-efficient LED lightbulbs and repaid the cost through instalments of INR 10 added to their monthly electricity bill. The programme's success can be measured by the distribution of 100 million LED bulbs across the country and the market transformation in efficient lighting.

## Case studies on energy efficiency programmes and initiatives in India

The two case studies below highlight the impact of a successful utility EE programme, as well as the potential for including EE as a part of power sector planning in India.

### Case study 1: Portfolio of DSM projects by private sector utilities in Mumbai, 2010

This case study showcases the successful implementation of DSM by utilities, with support from the regulator. Some of the programmes have been expanded and continue to generate energy savings. The programme can serve as a template for replication in other cities.

#### Regulatory backing

In 2010, the Forum of Regulators issued *Model Demand Side Management Regulations*, providing guidelines for planning, approval and evaluation of DSM in states. In the same year, Maharashtra Electricity Regulation Commission (MERC) issued the *Demand Side Management Measures and Programmes' Cost Effectiveness Assessment Regulations*, and *Demand Side Management Implementation Framework Regulations*. According to these regulations, discoms were required to incorporate DSM into their day-to-day operations and



plan and implement DSM programmes. To fund these programmes and recover costs incurred, discoms could charge tariffs through their Annual Revenue Requirement or implement programmes on consumers' premises to earn an appropriate return on investment.

## Stakeholders

Mumbai's four utilities launched DSM projects in 2010. The city's utilities at the time were public (Brihanmumbai Electricity Supply and Transport Undertaking [BEST] and Maharashtra State Electricity Distribution Company Limited [MSEDCL]) and private (Reliance Infra [R Infra] and Tata Power).

Other stakeholders responsible for implementing these DSM projects included MERC, the DSM Consultative Committee, consumer groups and private sector consultants to the utilities.

## Programme design

The DSM programmes were implemented under the MERC (Demand Side Management Implementation Framework) Regulations, 2010 and MERC DSM (Cost Effectiveness Assessment) Regulations, 2010. Under this framework, utilities were mandated to include EE and DSM as part of their operations; they proposed DSM programmes that needed to pass cost-benefit tests and they could recover the cost of the programme via the Annual Revenue Requirement (ARR) filings.

All the programmes had a common design:

### Technologies and impacts

Table 3<sup>9</sup> below shows the technologies employed by the utilities as part of the DSM programmes and their impacts.

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<sup>9</sup> Shakti Sustainable Energy Foundation. (2016). *Case studies of demand side management projects implemented in India*. [https://shaktifoundation.in/wp-content/uploads/2017/09/CaseStudies\\_DSM\\_2016.pdf](https://shaktifoundation.in/wp-content/uploads/2017/09/CaseStudies_DSM_2016.pdf)

**Table 3. Technology interventions implemented as part of Mumbai 2010 DSM programmes**

Technology intervention	Utility	Consumer category	Impact (annual energy savings (MU))	Current status
T10 and T12 fluorescent tube lights with magnetic ballasts replaced by efficient T5 tube lights with electronic ballasts	Tata Power, R-Infra, BEST	Residential, commercial and industrial	0.8	Programme amended to promote LED lights
Replacement of inefficient window air conditioners (ACs) with 5-star rated split ACs	Tata Power, R-Infra, BEST	Commercial and industrial	1.66	Programme extended to residential consumers
Replacement of old inefficient ceiling fans with BEE 5-star rated efficient ceiling fans	Tata Power, R-Infra, MSEDCL, BEST	Residential and commercial	2.22	First phase over, second phase in execution
Replacement of old inefficient refrigerators with BEE 5-star rated direct cool refrigerators	Tata Power, R-Infra	Residential	1.96	Active
Thermal energy storage, load shifting	Tata Power	Commercial and industrial	NA	Active
Demand response, peak load reduction and switching on the standby generation	Tata Power	IT & ITES companies, sewage pumping stations and industrial customers	NA	Active
Energy audit of customer's premises by firms approved by BEE	Tata Power, R-Infra	Commercial and industrial	NA	Active
Reducing the morning peak load by supporting energy efficiency initiatives	Tata Power	Commercial and industrial	NA	Active
Reduction in maximum power requirement through power factor improvement	R-Infra	Commercial and industrial	NA	R-Infra is no longer a discom in Mumbai
Replacement of inefficient HPMV lamps with efficient HPSV lamps	R-Infra	Municipal	NA	R-Infra is no longer a discom in Mumbai

Source: Shakti Sustainable Energy Foundation. (2016). *Case studies of demand side management projects implemented in India*

## Economics of the programme

The programme administration costs and incentives were recovered using the Annual Revenue Requirement mechanism. The cost per unit of energy saved can be compared to the cost of electricity generated, to determine the economic benefit of the DSM programme. Project costs were not available by programme and energy savings estimates were not always accurate, so the cost of conserved energy cannot be calculated and directly compared to the cost of supply.

## Key insights

- The unique situation in Mumbai, with multiple competing private and public sector utilities, is a factor in the success of the pilot programmes and ongoing DSM programmes.
- Participation by public sector utilities is limited. Reasons for this include more bureaucratic decision-making processes, lower power procurement costs making the programmes less attractive, and an expectation that low-income consumers would not participate in the programmes.<sup>10</sup> These utilities could achieve the economic benefits of DSM programmes by selecting programmes that cater to their consumer base and applying cost-benefit tests.
- Strong regulatory backing of DSM: MERC was the first state electricity regulatory commission (SERC) to notify DSM regulations. The appointment of a DSM consultative committee with experts and discom representatives to bridge gaps in understanding also contributed to successful implementation in 2010.
- There has been mixed experience in scaling up the DSM programmes. For example, MSEDCL has not listed any expenses on DSM or EE programmes in 2022. Tata Power continues to have EE appliance exchange offers for all consumer groups. Table 4<sup>11</sup> shows the savings achieved.

**Table 4. Savings achieved through DSM programmes**

Sr. No.	Name	Savings achieved in FY 19-20 to FY 20-21 (MU)
1	BLDC Ceiling Fan (19-20)	8.848
2	Refrigerator Program (2017-2018)	4.372
3	AC Program (18-19)	2.767
4	LED TL Program (19-20)	0.695
5	Energy Audit Program	11.835
	<b>Total</b>	<b>28.517</b>

Source: Maharashtra Electricity Regulatory Commission. (2023, 31 March). *Truing-up of Aggregate Revenue Requirement for FY 2019-20, FY 2020-21, and FY 2021-22*, p. 117

<sup>10</sup> Indian Institute of Technology Bombay. (2013, 2 December). *Demand side management in India: Status and future prospects* [Summary of workshop proceedings]. <https://www.ese.iitb.ac.in/~suryad/Workshop1.pdf>

<sup>11</sup> Maharashtra Electricity Regulatory Commission. (2023, 31 March). *Truing-up of Aggregate Revenue Requirement for FY 2019-20, FY 2020-21, and FY 2021-22*, p. 117. <https://merc.gov.in/wp-content/uploads/2023/03/Order-225-of-2022.pdf>

- More than 10 years after the initial DSM pilots, there have been attempts to broaden EE initiatives beyond appliance exchange programmes. Tata Power is conducting behavioural demand response programmes among residential consumers and automated demand response among commercial and industrial consumers. The target is to achieve 75 megawatt peak reduction within six months of launching the programme in February 2023,<sup>12</sup> accounting for approximately 8% of Tata Power's peak load.
- The outcomes of the DSM programmes need to be better documented, so that utilities can learn from them while scaling up.
- To design a robust EE and DSM strategy, an informed integrated research planning (IRP) study and options analysis should be conducted. Planners and regulators need to embed the options analysis in any new directions that are set to meet the larger objectives.

## Case study 2: Integrated resource planning in Indian utilities

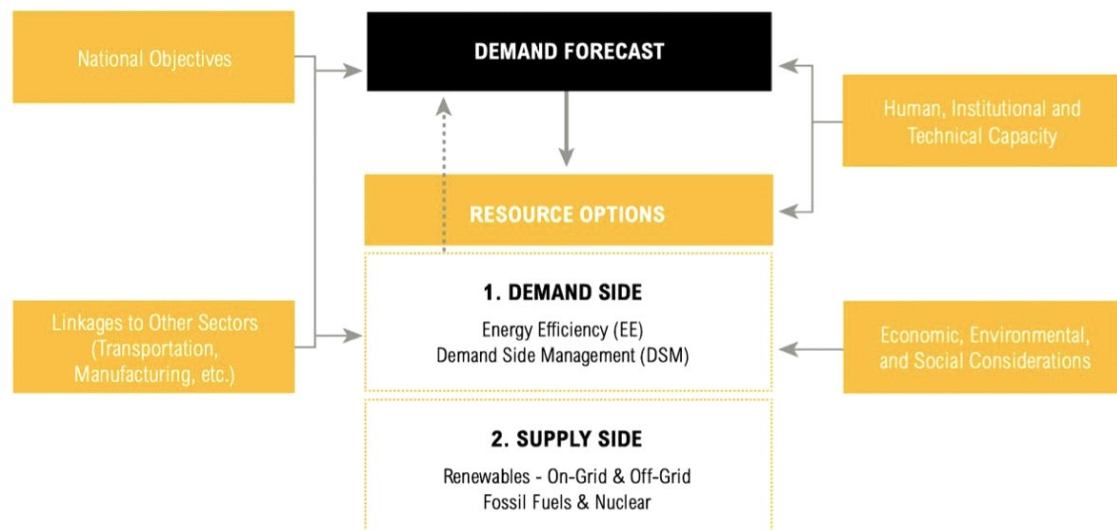
This case study describes the importance of integrated resource planning (IRP) in the power sector, its current status among Indian central electricity agencies and discoms, and recommendations to develop a robust IRP process in India.

IRP is a process used by utilities to determine the least-cost long-term means of meeting demand for energy services through combinations of both supply- and demand-side investments. It takes account of public policy objectives such as reliability, service quality, emissions reductions and equity. IRP was developed in the United States in the 1980s, and several U.S. states require utilities to follow the process. Figure 7<sup>13</sup> below shows the major components of IRP.

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<sup>12</sup> Tata Power. (2023, 1 February). *Tata Power joins hands with AutoGrid to expand AI-enabled smart energy management system in Mumbai*. <https://www.tatapower.com/media/PressReleaseDetails/2003/tata-power-joins-hands-with-autogrid-to-expand-ai-enabled-smart-energy-management-system-in-mumbai>

<sup>13</sup> Dixit, S., Chitnis, A., Jairaj, B., Martin, S., Wood, D., & Kundu, A. (2014, May). *10 questions to ask about integrated resources planning*. SADC Centre for Renewable Energy and Energy Efficiency. [https://www.sacreee.org/sites/default/files/training/files/wri\\_10questions\\_integrated\\_resources\\_planning.pdf](https://www.sacreee.org/sites/default/files/training/files/wri_10questions_integrated_resources_planning.pdf)

**Figure 7. Chart of integrated resource planning flow**

Source: Dixit, S., Chitnis, A., Jairaj, B., Martin, S., Wood, D., & Kundu, A. (2014, May). *10 questions to ask about integrated resources planning*

IRP offers a number of benefits:

- Conventional electric resource planning is based on the supply side, i.e., building generation, transmission and distribution facilities. Demand-side options to improve the efficiency of electricity use by consumers and reduce the need for electricity generation are not considered. In contrast, IRP considers a range of feasible supply-side and demand-side options and assesses them against a common set of planning objectives. By not building excess capacity, IRP leads to conservation of financial and natural resources and avoided emissions.
- IRP can add transparency and stakeholder participation to the planning process. Conventional planning is typically top-down, with public consultation occurring only as a last step, when plans are already made. IRP can make planning more open to governmental agencies and consumer groups, incorporating the aspirations of all parties with a stake in the future of the electricity system.<sup>14</sup>
- IRP allows discoms and regulators to use forecasts for power generation capacity addition, recognise demand-side assets as resources, create a low-cost merit order for available options to meet demand, and embed more renewables with key flexibility strategies. This strategy is a far cry from the conventional practice of adding generation capacity to meet the end-use demand. IRP also drives the planning process, requiring consideration of all options on demand and supply sides to meet system needs, considering all constraints and underlying assumptions.

<sup>14</sup> United States Agency for International Development, Office of Energy. (2000). *Best practices guide: Integrated resource planning for electricity*. [https://pdf.usaid.gov/pdf\\_docs/PNACQ960.pdf](https://pdf.usaid.gov/pdf_docs/PNACQ960.pdf)

## Regulatory backing for IRP

Under the **Electricity Act, 2003**, Section 73, (“Functions and duties of Central Electricity Authority”) include the “optimal utilisation of resources to subserve the interests of the national economy and to provide reliable and affordable electricity for all consumers”, although the means of determining optimal utilisation is not stated.

The **Integrated Energy Policy, 2006** recommends “...a least-cost planning approach to provide a level playing field, to Negawatts and Megawatts so that regulators permit the same return on the investment needed to save a watt as to supply an additional watt”.

The Ministry of Power has set up the national merit order dispatch to be managed by state and regional load dispatch centres (LDCs) to ensure lowest marginal cost resources are used first, instead of remaining idle while higher cost plants are run.

The **draft National Electricity Policy, 2022**, states that “Integrated Planning by distribution companies is essential to ensure optimum utilisation of assets. The inter-State transmission system, intra-State transmission system and the distribution system have to be planned in a harmonious manner so as to avoid stranded assets. The state distribution companies have, by and large, been lacking in this aspect. Discoms should prepare their distribution plan for next five years in consultation with CEA [Central Electricity Authority].”

## Status of IRP implementation in India

In India, the Central Electricity Authority has set up an IRP division. The role of this division includes preparing the National Electricity Plan (Generation) once every five years as per section 3(4) of the Electricity Act, 2003. The IRP division is also responsible for working out a feasible mix for generation expansion planning.

CEA conducts in-depth studies to forecast energy requirements and peak-load demand by estimating electricity end-use demands and modifying aggregate demands according to parameters such as GDP growth, weather, and historic electricity consumption patterns. Discoms in India produce their own estimates, typically by applying a compound annual growth rate (CAGR) to current electricity consumption, and some compare their estimates to those of the CEA. Based on the forecasts, the CEA proposes a least-cost generation mix to meet demand for the coming decade.

## Overcoming barriers to IRP

IRP is not formally practised by Indian utilities. Below are some of the barriers to IRP and ways to overcome them.<sup>15</sup>

### Structural barriers

Most states in India have vertically unbundled utilities, meaning generation, transmission and distribution companies manage their own assets and balance sheets. IRP methods for a single unbundled utility responsible for demand, transmission and supply cannot be applied.

#### *Overcoming structural barriers*

- IRP can be conducted at the national or state level. National benchmark IRPs can help in monitoring the performance of the electricity sector on cost to consumers and environmental protection.
- IRP can be applied at the utility level for making investment choices in a) transmission and distribution systems; b) end-use efficiency options; c) the mix of power available at wholesale.

### Incentive barriers

Tariff regulations allow for recovery of “actual costs to serve” if operational norms are followed. Expenses incurred (even from non-paying consumers) are recoverable in future tariff orders. This reduces the incentive for discoms to focus on cost minimisation and EE, as would happen under an IRP approach.

#### *Overcoming incentive barriers*

- Under the Electricity Act, 2003, CEA is required to coordinate planning for optimal resource utilisation. CEA can conduct demand forecasts and include IRP in its optimal generation capacity mix report.
- SERCs can delay some receivables, ensuring that costs of supply may not be recoverable in the long term. This would incentivise utilities to plan for cost-effective options. To the extent there is a capital bias at the discom (preferring costs that can be put into the rate base and on which a return can be earned) putting EE and other DERs on equal financial footing with grid assets can motivate more earnest consideration. Likewise, most traditional regulatory systems have a throughput incentive which tends to create barriers to a discom's motivation to be successful at energy efficiency (though India-specific factors relating to rate class distinctions would need to be factored into any solution to the throughput incentive).

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<sup>15</sup> D'Sa, A. (2015, July). Integrated resource planning (IRP) and power sector reform in developing countries. *Energy Policy*, 33(10), 1271-1285. <https://www.sciencedirect.com/science/article/abs/pii/S0301421503003707?via%3Dihub>

## Financial barriers

Discoms incur costs to implement EE programmes, including administrative costs and incentives to consumers.

### *Overcoming financial barriers*

Discoms can include the costs of IRP in their Annual Revenue Requirement and fund them through tariffs. The entire package can be compared to costs of power procurement.

## Technical barriers

Quantity and time of day when EE and DSM resources are available may not match load curve.

### *Overcoming technical barriers*

Accurate demand forecasting is a prerequisite to IRP. This would allow utilities to balance EE resources, renewables and new sources of demand such as electric vehicle charging along with traditional load. A portfolio of different kinds of distributed energy resources (EE programmes, demand response programmes, distributed generation, storage) can create an aggregate resource – sometimes described as a virtual power plant – that does match the load curve.

## Data barriers

Utilities may lack accurate data for IRP, given the number of unmetered connections.

### *Overcoming data barriers*

Ongoing utility efforts to improve metering and segregate agricultural feeders along with CEA's integrated management system for gathering data across the country will improve data availability and accuracy.

## Operational barriers

Discoms may be locked into older power purchase agreements (PPAs), limiting their ability to conduct IRP.

### *Overcoming operational barriers*

- Discoms can undertake IRP through managing a portfolio of demand and supply options.
- IRP for a region could be conducted by a single agency when there are multiple utilities in the state/region.
- Discoms can consider demand-side options before signing new power purchase agreements.

## Perception barriers

There is a bias towards supply, with criteria such as kilowatt hours per capita or total gigawatt hours delivered used to compare and rank discoms.

### *Overcoming perception barriers*

- Public awareness can be built around consumer energy use and highlighting the environmental benefits of EE.



- Discoms and the public can become more familiar with EE integration, as there is already public awareness of incorporating distributed renewable energy (RE) resources into the grid.

## The way ahead on IRP

In an encouraging move, the Ministry of Power's Roadmap Committee report<sup>16</sup> in 2023 has proposed determining target generation capacities using an IRP model, using inputs such as demand profiles, demand growth rates, contracted capacities and costs for new capacities. The committee suggested optimising the model for resources such as conventional sources, renewables, distributed energy resources, energy storage and demand-side management. The IRP model output gives the volume and type of resources a state or utility requires in its portfolio to meet demand optimally, in a least-cost and secure manner. It is to be hoped that this exercise is taken up by CEA and the discoms.

While IRP processes present opportunities for supporting energy efficiency options, the discoms' involvement needs careful exploration. Under the current set-up, there is a clear differentiation between consumers who pay for energy services and those whose consumption is subsidised; reduced consumption in these different categories will have significant impacts on cashflow. Specifically, the commercial and industrial consumer base contributes to the discom cashflow and its ability to meet the requirements of its power procurement agreements. Deeper engagement by the discoms to support energy efficiency should ideally include managing programmes that deliver energy efficiency services, including general awareness, technical support and financial support. In the Indian tariff design process, the regulators explicitly allow truing-up of lost revenues in the subsequent tariff exercises. Tariff design processes and the demand-side management regulations notified by almost all the state regulators in India allow for the programme costs towards the technology acquisition, running awareness campaigns and locking-in efficiency measures to be managed as tariff pass-throughs. However, due consideration is needed to quantify positive externalities and hard-to-quantify benefits as India moves towards the next level of reforms process.

## Key insights

Some of the conditions required to implement IRP in India include:

- Including environmental and social impacts in decision-making for the power supply mix, forcing utilities to include cleaner demand-side solutions.
- Modifying the CEA and discom planning process, as proposed by the Ministry of Power. This should include CEA integrating renewable energy and DSM into plans, and modifying them to meet changing requirements, including consumer demand patterns, adoption of technologies such as battery storage and phase-out of older thermal plants. Discoms should also incorporate CEA's IRP into their forecasts.<sup>17</sup>

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<sup>16</sup> India Ministry of Power. (2023, May). *Report of the Group on Development of Electricity Market in India*. EQ International. <https://www.eqmagpro.com/report-of-the-group-on-development-of-electricity-market-in-india-eq-mag/>

<sup>17</sup> Patankar, M. & Prem, I. (2023, February). *Review of Integrated Resource Planning and Load Forecasting Techniques in India*. Regulatory Assistance Project. [https://www.raonline.org/wp-content/uploads/2023/02/rap-India-IRP\\_policy\\_brief\\_FINAL-2.pdf](https://www.raonline.org/wp-content/uploads/2023/02/rap-India-IRP_policy_brief_FINAL-2.pdf)

## The way ahead on EE

As noted above, there is already strong regulatory backing for EE in India at the central and state level. Some measures to strengthen the existing structure, organised by implementing agency, are outlined below.

### Central agencies

1. **Embed energy efficiency as a part of discoms' Perform Achieve Trade (PAT) targets:** Discoms are now part of the PAT cycle, with targets for distribution loss reduction. PAT also includes well-defined mechanisms of incentives and penalties. The PAT rules can be modified to include demand-side EE targets as a part of utilities' PAT targets.
2. **Increase visibility of EE as a dominant resource:** EESL can create an EE dashboard, updated with utility EE programmes, highlighting the annual monetary and energy savings achieved.
3. **Maximise the value of smart metering infrastructure:** Smart metering is being widely promoted at all discoms in India. Smart meters have features and capabilities to monitor and account for energy efficiency. Discoms may be trained to effectively use various capabilities such as demand response and load management. Pilots, demonstration centres and discom interactions with smart meter suppliers may be organised by entities such as BEE and EESL.

### State governments and state nodal agencies

1. **Increase institutional support to energy efficiency to match support for renewable energy:** Currently, state governments allocate budgetary resources for renewable energy, green hydrogen and other sectors related to decarbonisation. These funds are allocated for projects such as installing rooftop solar plants in government college campuses. States can include EE in their budget allocations for programmes that are not already covered by EESL, discoms or the private sector, such as providing financial support for large battery storage plants or developing pumped storage and thermal storage capacities.
2. **Partner with discoms to promote compliance with building codes:** It is currently the responsibility of state designated agencies<sup>18</sup> (SDAs) and urban local bodies (ULBs) to implement and enforce the Energy Conservation Building Code (ECBC) codes. Meanwhile, discoms are the primary interface in providing electricity connections to new buildings and can also monitor consumption. State designated agencies and urban local bodies can formulate rules that mandate a role for discoms in reporting, compliance checking and monitoring and verification (M&V). While this appears at face value to be an added burden on discoms, it can also be an opportunity for discoms to promote EE at the design phase. In certain states, the state-owned discom is already the designated agency for promoting electric vehicle charging infrastructure (EVCI), and has a role in stakeholder consultation, project design, implementing measures, monitoring progress and disbursing funds.<sup>19</sup>

<sup>18</sup> Under the Energy Conservation Act, 2001 states were required to "designate any agency as designated agency to coordinate, regulate and enforce provisions of this Act within the State". There are different state designated agencies (SDAs) for renewable energy/energy efficiency and electric vehicle charging infrastructure. In certain states, SDAs are interchangeably referred to as state nodal agencies (SNAs).

<sup>19</sup> For example, the state-owned discom MSEDCL in Maharashtra.

## State regulatory commissions

1. **Modify regulations to promote EE:** State electricity regulatory commissions SERCs can issue DSM regulations in the states that have not yet done so. Under these regulations, utilities are directed to set up DSM cells and identify and implement DSM programmes. SERCs can issue regulations that require discoms to conduct procurement based on life-cycle costs. They can also determine which benefits to include in a cost–benefit assessment, from quantifiable grid benefits to hard-to-quantify benefits and benefits to society beyond the grid.
2. **Appoint agencies to implement EE programmes:** SERCs can enlist or competitively select third parties to act as implementing agencies for EE programmes, as well as or instead of discoms. SERCs can also consider setting up standard offer programmes (SOP), where utilities can purchase EE as a resource from a third party. The SERC’s role can be to select implementation and monitoring agencies and oversee the programme.<sup>20</sup>
3. **Strengthen load research, load forecasting and monitoring and verification capabilities** at discoms and SERCs through upskilling personnel and implementing automated meter reading. These training sessions can be conducted by the CEA.

## Discoms

1. **Set up virtual power plants (VPPs):** A virtual power plant is an aggregated portfolio of distributed energy resources (DERs) that can provide grid services to a discom. A virtual power plant could reveal and elevate the importance of EE programmes to complement distributed energy resources and reduce energy load at peak times. EE programmes could also complement the load shape by delivering more savings compared to a baseline at the most valuable times.
2. **Apply to the National Clean Energy Fund** to finance EE projects. The applications can be made for a loan or viability gap funding (VGF). Utilities can apply singly or as part of a consortium.
3. **Apply to state energy conservation funds (SECF):** Under section 16 (1) of the Energy Conservation Act, 2001, states are required to set up state energy conservation funds to promote energy efficiency and conservation. Under this fund, a revolving investment fund (RIF) is used to finance EE for public buildings, street lighting, pumping, etc. The funds can be accessed by public departments and agencies, so all public sector discoms can apply. While almost all states have set up energy conservation funds, only seven states were using the revolving investment fund to finance projects in 2019. We recommend that states adequately fund their energy conservation funds and encourage discoms to finance DSM activities through the revolving investment fund.
4. **Combine EE interventions with renewable energy and demand flexibility** in a portfolio of assets to access finance from green financing sources such as voluntary carbon markets.

<sup>20</sup> Gupta, D., Bhan, N., Sarda, V. (SSEF); Patankar, M., Shukla, S., Kulkarni, P., Yenumula, R., Mishra, S., Singh, H., Paliwal, I., Bhargava, P. (MP Ensystems); Maitra, A., Doolla, S., Patankar, A., Prem, I., & Rallabandi, S. (2015). *Standard offer program handbook*. Shakti Sustainable Energy Foundation. <https://shaktifoundation.in/wp-content/uploads/2021/12/SOP-Handbook.pdf>

5. **Re-focus on energy efficiency:** In the past decade, the cost of solar generation has drastically fallen, with rooftop solar generation and net metering becoming an economical option. As a result, consumer focus has shifted from end-use energy efficiency to captive or rooftop solar generation. Consumers who were aggressively investing in energy efficiency now prefer to deploy the capital for behind-the-meter renewable generation. Utilities and other agencies can educate consumers on the benefits of energy efficiency, in conjunction with renewables, to reduce costs and achieve deeper decarbonisation. State-level awareness campaigns should be run periodically in summer and during the October peak load season. Capacity building for school and college students can be conducted by utilities, as a part of their DSM activities.

# Annex I – Regulatory backing for energy efficiency

The Indian regulatory framework supports utilities to design and implement energy efficiency measures and programmes for their consumers.

The **Energy Conservation Act, 2001** was the first major policy that promoted energy efficiency and renewable energy by creating institutions including the Bureau of Energy Efficiency (chapter II) and state designated agencies (chapter VI) for energy conservation.

The **Electricity Act, 2003** which governs the electricity sector in India includes in its preamble the “promotion of efficient and environmentally benign policies” as a part of its key objectives. Within the act, the following sections directs regulators and discoms to efficiently utilise resources.

## *Section 3(1) (National Electricity Policy and Plan)*

- The Central Government shall, from time to time, prepare the national electricity policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilisation of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy

## *Section 23 (Direction to Licensees)*

- If the Appropriate Commission is of the opinion that it is necessary or expedient so to do for maintaining the efficient supply, securing the equitable distribution of electricity and promoting competition, it may, by order, provide for regulating supply, distribution, consumption or use thereof.

Empowered by this section, several State Electricity Regulatory Commissions have issued Demand Side Regulations to this effect.

## *Section 61 (c) (Tariff Regulations)*

- the factors which would encourage competition, efficiency, economical use of resources, good performance and optimum investment

## *Part X Regulatory Commission, Section 86(2) (Functions of State Commission):*

- State Commission shall advise the State Government on all or any of the following matters, namely:-(i) promotion of competition, efficiency and economy in activities of the electricity industry;

## *Part XVIII Miscellaneous, Section 166 (5) (Coordination Forum):*

- There shall be a committee in each district to be constituted by the Appropriate Government...(c) to promote energy efficiency and its conservation.

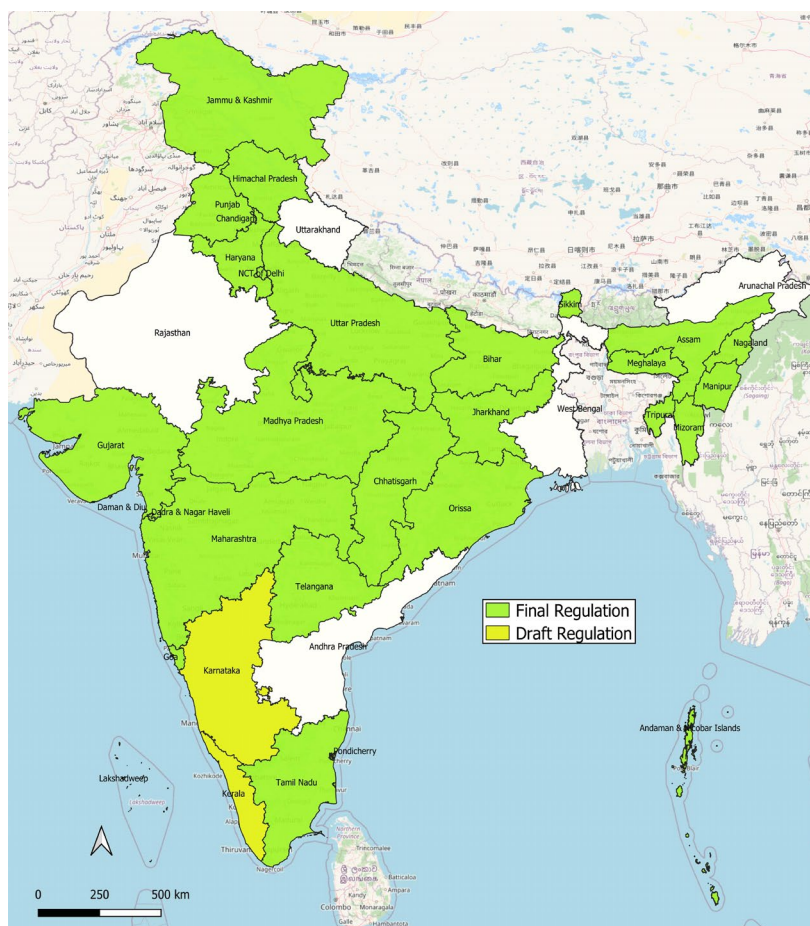
The **National Electricity Policy, 2005** mandates BEE to implement DSM and energy conservation measures. Some of the key measures are:

### 5.9 Energy Conservation

- 5.9.1 There is a significant potential of energy savings through energy efficiency and demand side management measures. In order to minimise the overall requirement, energy conservation and demand side management (DSM) is being accorded high priority.
- 5.9.6 In order to reduce the requirements for capacity additions, the difference between electrical power demand during peak periods and off-peak periods would have to be reduced. Suitable load management techniques should be adopted for this purpose. Differential tariff structure for peak and off peak supply and metering arrangements (Time of Day metering) should be conducive to load management objectives. Regulatory Commissions should ensure adherence to energy efficiency standards by utilities.

In 2010, the Forum of Regulators issued **Model Demand Side Management Regulations**, providing guidelines for planning, approval and evaluation of DSM in states. SERCs in 24 states (shown in Figure 8, below) have now notified DSM regulations or draft DSM regulations. Additionally, some SERCs directed utilities to set up DSM cells and included directives in the utility tariff orders, directing the utilities to undertake load research and identify DSM potential.

**Figure 8. Map of Indian states with notified or draft DSM regulation**



Source: MP Ensystems research, 2023

The **draft National Electricity Policy, 2022** has a section 13.0 on energy conservation and energy efficiency, which states, “The SERCs must mandate utility-driven DSM programmes and customer engagement as a means of peak load management, energy conservation and saving in cost of power”.

The **draft National Electricity Plan, 2022** has a chapter on energy efficiency and conservation. This chapter includes targets set by BEE on energy savings from 2022-2032 under moderate and ambitious scenarios and proposes measures to achieve these targets, including policies, financing, sectoral programmes, capacity building, R&D, and monitoring and verification.

In addition to the laws and regulations above, the **National Mission on Enhanced Energy Efficiency (NMEEE)** was launched in 2008, under the **National Action Plan on Climate Change**. The mission emphasised a market-based approach to meet a target of cumulative avoided capacity addition of 19,000 megawatts.

Based on these laws and policies, the Indian electricity sector appears to have adequate legal backing for implementing energy efficiency measures.

## Annex II – Glossary

- BEE – Bureau of Energy Efficiency is a government agency set up under the Energy Conservation Act, 2001 with the primary objective of reducing the energy intensity of the Indian economy. Its flagship programmes include developing the Energy Conservation Building Code, appliance EE labels and administering Perform Achieve Trade – a market-based mechanism to reduce the specific energy consumption of the most energy-intensive industries.
- CEA – Central Electricity Authority is a statutory body set up under Electricity Act, 2003 with a vision to ensure reliable 24×7 power supply of adequate quality to all consumers in the country. CEA provides technical support to all stakeholders in the power sector, supports the Ministry of Power in formulating policies in the power sector, technical standards and regulations, and disseminates power sector information across the country.
- ECBC – Energy Conservation Building Code defines norms of energy performance for various building components, taking into consideration the climatic region. ECBC is a major step towards promoting energy efficiency in the commercial building sector through setting minimum energy standards for new commercial buildings.
- EESL – Energy Efficiency Services Limited is a joint venture of four public-sector utilities, with a vision of providing universal access to sustainable energy solutions. EESL implements energy efficiency programmes across sectors including lighting, buildings, industry electric mobility, smart metering, agriculture.
- Load dispatch centres (LDCs) - Coordinating agencies set up to ensure safe and secure grid operation. Intra-state transmission of electricity is coordinated by the respective state load dispatch centres, while inter-state transmission is coordinated by regional and national load dispatch centres.
- NAPCC – National Action Plan on Climate Change was released in 2008 and outlines a national strategy for the country to adapt to climate change and enhance the ecological sustainability of India's development path. It has eight national missions on climate change, including the National Mission for Enhanced Energy Efficiency.
- NCEF – National Clean Energy Fund is a fund created by imposing a tax on coal produced/imported for the purposes of financing and promoting clean energy initiatives, and funding research in the area of clean energy. It has been used to finance schemes such as Green Energy Corridor, Green India Mission, Jawaharlal Nehru National Solar Mission (JNNSM), etc.
- NMEEE – National Mission on Enhanced Energy Efficiency is one of the eight national missions under the National Action Plan on Climate Change (NAPCC). NMEEE aims to strengthen the market for energy efficiency through initiatives such as Perform Achieve and Trade (PAT), energy efficiency financing platforms, etc.



- NEP – National Electricity Policy is a set of guidelines for the development of the power sector in India. It aims to provide electricity to all areas, protect the interests of consumers and other stakeholders, and promote the development of the power sector.
- PAT – Perform Achieve Trade scheme is a BEE initiative under the NMEEE to reduce energy consumption in energy-intensive industries, with an associated market-based mechanism for trading excess energy saving certificates.
- SERC – state electricity regulatory commissions are regulatory bodies set up at the state level tasked with functions such as determining retail tariffs and setting standards for the quality, continuity and reliability of services.
- Standards and labelling programme – a flagship initiative of the Ministry of Power to help consumers make informed choices on energy savings. It prescribes minimum energy performance levels for appliances/equipment, rated on a scale of 1 to 5 (with 5 being the most energy efficient).
- UJALA – Unnat Jyoti by Affordable LEDs for All initiative is part of the Government of India's energy efficiency efforts to promote efficient use of energy for lighting. Under this programme, discoms distribute LED bulbs at subsidised rates to every grid-connected customer with a metered connection.



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