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Alliance for an Energy Efficient Economy

Customer Engagement

A tool for Utility driven Demand Side Management

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Introduction
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1.1 Background

The severe impacts of climate change are no longer a 'predicted future' but are already starting to manifest themselves. At the same time, energy demand—driven by growing populations, urbanisation, and development priorities—continues to escalate, portending significant environmental and grid impacts. In this context, utilities face unprecedented pressure to decarbonise.

In parallel, India's rapidly growing economy, changing demographics, and technological advancements are reshaping the market dynamics across many sectors, including the power sector. Today's customers are well informed and empowered to choose and are therefore demanding a better experience from their service providers. Many sectors that were previously served by monopolies–such as the telecom industry, airline industry, and broadband and cable television services–have transitioned to competitive markets. The ultimate beneficiaries of a competitive market paradigm are the customers, who enjoy a multitude of innovative products and services. The power sector too, which was thus far a monopolistic domain, is transitioning towards a transactive model thanks to a combination of policy reforms and enabling technologies.

The concurrence of these two developments—growing pressure to decarbonise the power sector and the transition to a transactive model—presents a tremendous opportunity, thus far unexplored, that is, to leverage customer engagement in the utility decarbonization efforts. Establishing the broader context for why customer engagement should matter to utilities today, this report makes the case for customer engagement and action as a robust pathway for influencing behavioral energy efficiency to achieve energy and/or peak demand savings.

1.2 Why utility customer engagement matters: the broader context

The government of India has been spearheading transformative efforts to bring in key operational and regulatory reforms in the power sector. For example, customers (over a certain load threshold) can purchase electricity on the open market; net metering policies in various states allow customers to generate power through solar rooftop systems and sell the excess power to electricity distribution companies (DISCOMs); and, most recently, the implementation of Electricity (Rights of Consumers) Rules, 2020 and indication of Electricity Act amendment to introduce retail competition through the segregation of 'wires and supply' business are poised to transform the distribution sector. As the distribution sector dives into the paradigm of retail competition, value-added services and customer-retention will become crucial parts of DISCOMs' business strategies.

As the electric utilities revisit their business strategies to adapt to this new paradigm of customer centricity, there is a clear need for them to step up and transform their customer engagement practices. Such a transformation will have a wide range of embedded and inter-related benefits:

Support for decarbonisation efforts: Decarbonisation of electric supply infrastructure is a capital-intensive and slow process that may take decades, whereas our window to meaningfully reduce emissions to avoid the worst effects of climate change is rapidly closing. Therefore, while work to decarbonise our power supply is in progress, it is critical to explore faster and more affordable pathways that can be deployed right away. Customer action in utility decarbonisation efforts is one such pathway, thus far largely untapped but with significant potential. Some of the biggest untapped potential lies in energy efficiency and demand flexibility—solutions that rely heavily on influencing customer action at scale. Research shows that the aggregate impact of individual utility customer actions on decarbonisation is not only profound, but also that it is one of the fastest and most cost-effective ways for utilities to make progress toward their climate change goals (Brattle, 2021)

Leveraging utility-customer touchpoints for active engagement and building trust can be a key facilitator of behavioural energy efficiency and help achieve energy and/or peak demand savings for utilities and unlock different grid benefits.

Grid benefits: The adoption of various distributed energy resources (DERs) like rooftop solar, battery storage, and electric vehicles (EVs)–which is on the rise–is poised to heavily impact distribution system operations, both technically (distribution over-voltages, multi-directional flows, etc.) and financially (upgrading network assets to accommodate the multi-directional flow of power and decrease in revenue from energy sales). The challenges associated with increasing DER integration also present an opportunity for distribution utilities to leverage customer-side assets in optimising their network operations, realising the benefits upstream towards the grid side, as well. Hence, customer engagement can serve as a reliable tool for the distribution utilities in transforming their operations and ensuring a sustainable future for the sector.

Social stewardship: The 2019 coronavirus disease (COVID-19) pandemic has also brought to the fore the need for enhanced customer-centricity for electric utilities across the globe. Proactive initiatives by utilities to ensure business continuity have led to the adoption of new, innovative ways to engage and help customers in these difficult times. The growing importance of customer-centricity in the electricity distribution sector is underscored by a recent study titled "Enhancing Customer Centricity in the Electricity Distribution Sector", undertaken by the United States (U.S.)-India bilateral programme Smart Power for Advancing Reliability and Connectivity (SPARC), which advocates leveraging the existing utility-customer touchpoints and identifying strategies and enablers for enhancing customer experience (USAID & USAID SPARC Program, 2020).

1.3 Future outlook

As India undergoes the rapid transformation of its energy sector, informed consumers will become crucial to a sustainable transformation. Historically, customer engagement practices have been largely absent among Indian utilities, with interaction generally limited to blackout events or inaccurate billing. However, the adoption of smart, digital technologies by the consumers and utility alike can bridge this gap and act as enablers for active customer engagement practices.

With the help of new information and communication technologies (ICT) and web-based applications, utilities can actively engage with customers to offer value-added services and information. Nudging the electricity end-users to plan and optimise their usage through informed data analytics could lead to a range of benefits across the entire electricity value chain. For instance, energy-aware customers are more likely to monitor their energy usage and make informed decisions on energy-saving measures. Utilities can, in turn, provide such services in exchange for revenue. Subsequently, utilities can also leverage customer-side assets through demand response (DR) and flexible demand programmes and incentivise the end user for their asset utilisation.

As the future utility strives for a symbiotic relationship with its customers to ensure viable and sustainable business operations, **active customer engagement, combined with technology, can become an essential lever for driving behavioural energy efficiency to unlock valuable benefits for the utility and its customers**.

Overview of Indian Residential Electricity Consumers

2

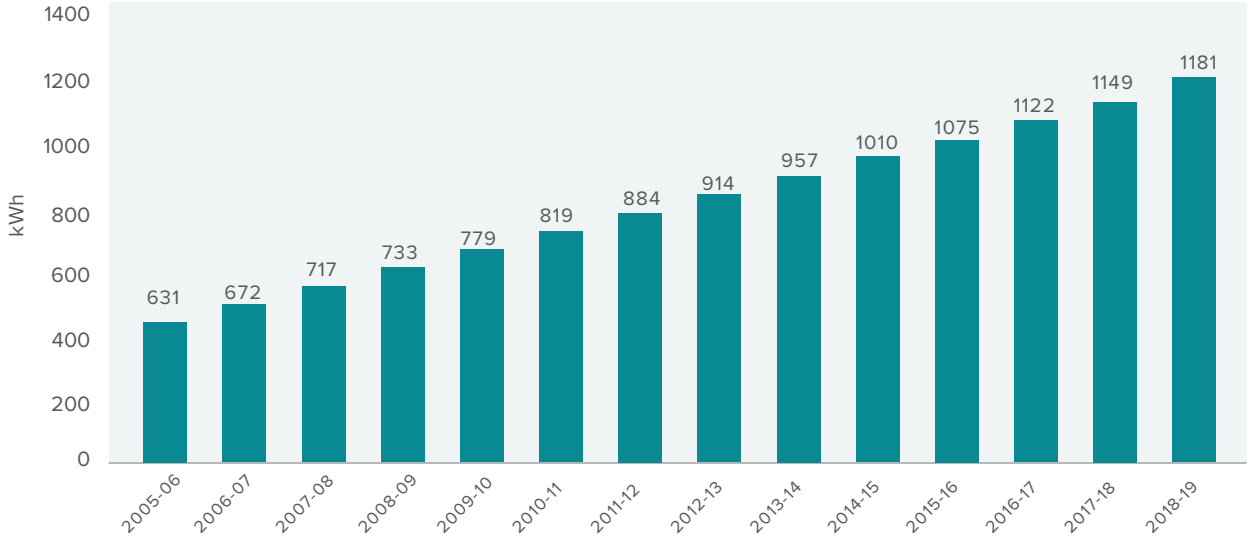
India's residential electricity consumption has grown significantly since it gained independence in 1947. Residential consumers today account for over a quarter of the total electricity consumption in the country, compared to a mere 9% in 1950 (CEA, 2020). India's domestic sector also has the highest connected load, at 308 gigawatts (GW), followed by the industrial sector at 164 GW. However, India's per capita consumption figure of 1181 kilowatt-hours (kWh) remains far below the global average of 3260 kWh (Mallapur, 2021). This difference can be largely attributed to the fact that the majority of the population resides in rural areas and is yet to acquire all the mainstream appliances prevalent in advanced economies.

Since India's economy is still developing, its residential electricity consumption is set to further increase due to its growing population, rising incomes, and urbanisation, along with increasing average temperatures, motivating Indian households to buy new appliances. Among the various household appliances that the country is yet to add, the International Energy Agency (IEA) predicts that air conditioners will experience the fastest growth, with stock levels rising to 670 million units by 2040, compared to 30 million units in 2020 (IEA, 2021). India's economic path will result in a higher increase in its electric power demand, and this increase will largely be driven by the residential sector.

Another noteworthy trend among residential customers is their increasing uptake of DER systems like solar photovoltaic (PV), EVs, battery storage, etc. This could negatively impact the distribution network if optimal management of such resources is not ensured. The rise of energy-aware consumers (or prosumers) is poised to present significant opportunities and challenges for Indian DISCOMs. It will eventually become imperative for DISCOMs to engage with consumers to provide better service delivery while also generating new revenue streams to ensure a financially sustainable and secure future for their business.

Addressing the abovementioned issues requires an understanding of various related aspects. This chapter summarises the evolving trends associated with Indian residential electricity consumers to help contextualise the consumer engagement methods employed today and discusses key topics such as tariff design, billing methods, energy consumption forecasts, and the current regulatory ecosystem.

Figure 1: **Growth of per capita energy consumption from 2005-06 to 2018-19**



Source: (CEA, 2022)

2.1 How Indian households consume energy - trends and forecast

The evolution of household appliance penetration in India reflects the rising aspirations among Indian households that have come with economic growth and increasing urbanisation. During the initial post-independence years, and even up to the late 1970s, lighting and fans (table and ceiling) accounted for over half of residential energy consumption in the average household. Afterwards (with brief overlaps in the two periods), radios, iron boxes, and heating rods started entering into the common household appliances list, with households moving towards the use of appliances for entertainment and comfort. The next generation of appliances that Indian households adopted consisted of cathode ray tube (CRT) television (TV) sets, water heaters (geysers), and refrigerators. The most recent wave of new appliances includes room air conditioners (RACs), light-emitting diode (LED) TVs, and dishwashers (post 2000).

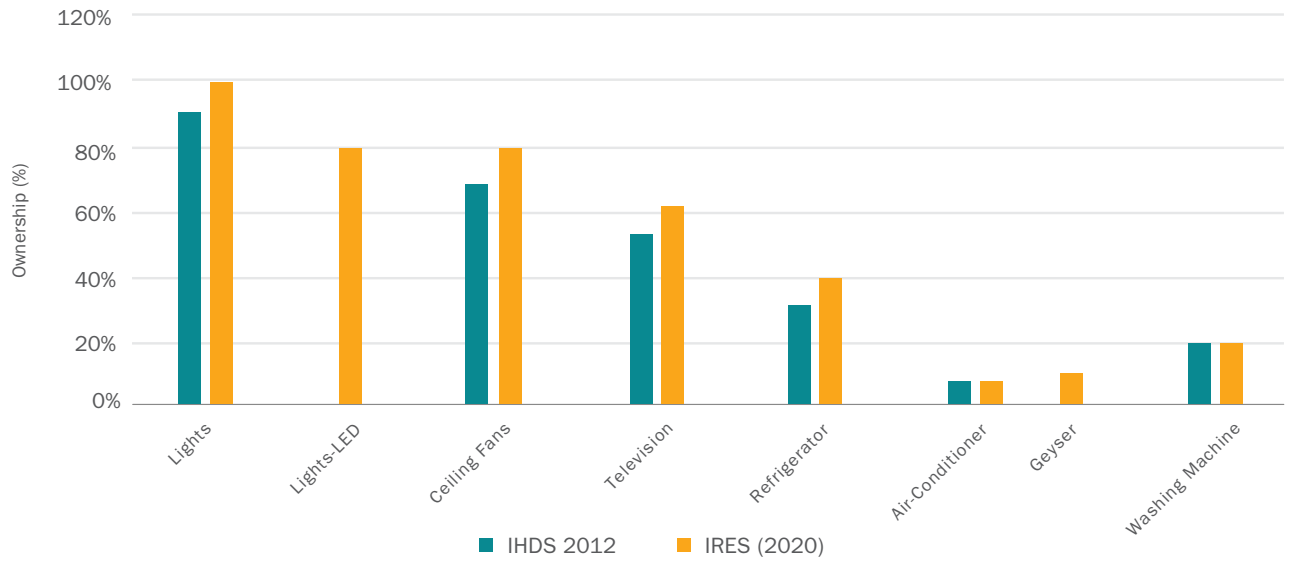
Table 1 Shows the projected increase in residential energy consumption corresponding to the rise in the number of households in India.

Table 1: Estimated growth in residential electricity consumption

Year	2017	2027
Number of households in India (in millions)	272	328
Residential electricity consumption (in TWh)	259	533

Source: (Mathew et al., 2019)

Figure 2: Change in ownership of various appliances in India



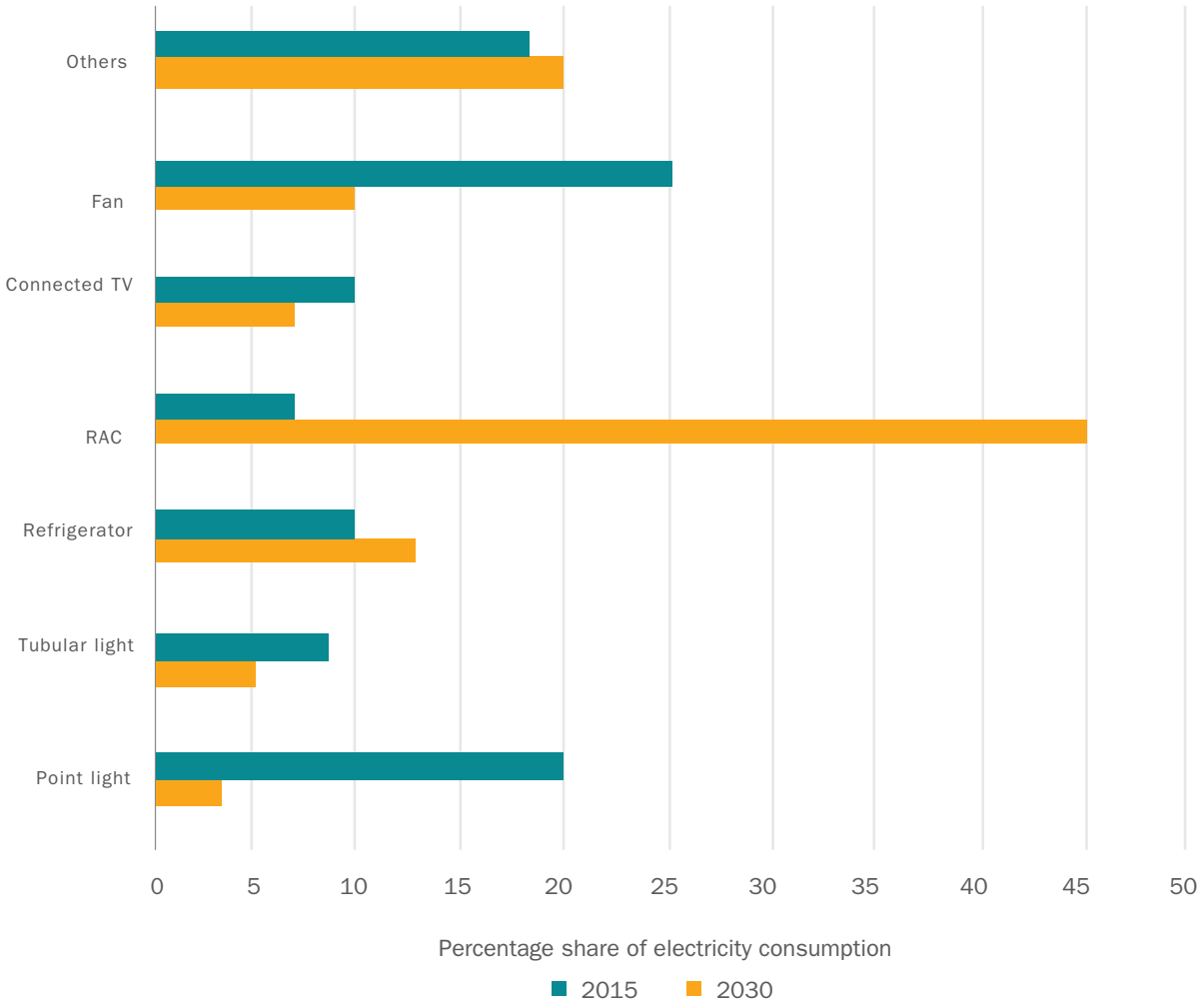
Source: IRES 2020 & IHDS-II 2012*
*(*conservative figures for AC, WM, Geyser)*

In addition to the increased penetration of consumer appliances, large-scale electrification efforts by the government have tripled residential electricity consumption since 2000. In 2015, among the connected household appliances—point lighting[1], tubular lighting, refrigerators, RACs, fans, and connected TVs (CTVs)[2]—, fans and point lights consumed the highest share of electricity. A recent study by Brookings India titled 'The Future of Electricity Demand in India' estimates that in 2030, the top four appliances in terms of electricity consumption will be RACs, refrigerators, fans, and colour TVs. Given the predicted increase in demand for space cooling in the coming years, the residential electricity

1 Point light refers to a light that gets emitted from a single point in all directions. The most common example is a lightbulb.
2 Refers to a device that connects to a television to support video content streaming.

consumption share is expected to skew heavily towards cooling appliances in general and RACs in particular (Figure 4). According to an IEA report, cooling demand will contribute significantly to India's peak electricity demand; space cooling demand, which currently accounts for 10% of peak demand, could increase to 45% by 2050 (IEA, 2018).

Figure 3: Percentage share of electricity consumption by household appliances forecasted for 2030



Share of different electrical appliances in household energy consumption by 2030

Source: (Ali, 2018)

Evolution of energy-aware consumers (or prosumers)

The increasing penetration of DERs like solar PV[3], energy storage, smart meters, EVs, etc. and the increasing electrification of flexible consumer demand are enabling end-users to play an active role in the network. Energy-aware consumers (or prosumers) have the ability to produce, store, and consume energy in an intelligent manner, enabling their proactive role in the electric value chain. Individually or through aggregators, prosumers can make operational and investment decisions, allowing them to reap financial benefits.

The rise of prosumers could lead to revenue losses for DISCOMs. Present-day Indian DISCOMs do not undertake the optimal control and operation of DER assets. Unplanned and unmanaged operation of DERs can result in adverse network conditions, jeopardising the reliability and quality of power supply. Future distribution systems need to gradually evolve into interactive systems with bidirectional energy flows based on decisions taken individually by

3 https://www.pv-magazine.com/2021/04/12/india-closing-in-on-7-gw-of-rooftop-solar/

prosumers, aggregators, and operators. In this interactive ecosystem, the decision of any one entity can directly affect grid operations.

Distribution-level activities will become more complex with increasing DER penetration, making it difficult for the DISCOMs to manage the network efficiently. In this context, it would be necessary for Indian DISCOMs to undertake enhanced consumer (prosumer)-centric activities to realise their full potential in harnessing system flexibility, reliability, and efficiency.

2.2 Regulatory ecosystem for consumers

For the majority of Indian power sector history, Indian residential consumers were perceived as a passive entity within the electricity value chain, deprived of effective regulations that would have made them a valuable stakeholder group in the supply chain. This is mainly due to the fact that India had severe deficits in both power and energy. Today, the situation has changed. The implementation of the SAUBHAGYA[4] scheme in 2017 to achieve universal household electrification has had tremendous success. As of today, India has achieved 100% village electrification and is a power and energy surplus country. Going ahead, Indian DISCOMs can actively focus on better service delivery, while also exploring innovative ways to engage with consumers to drive new business opportunities and increase revenue.

This section examines various rules and regulations implemented by the central and state governments to make electricity available to all in a fair and equitable manner, promote renewable energy sources, enhance customer choice, and safeguard the interests of the country's electricity customers.

Electricity (Rights of Consumers) Rules, 2021

Initial progress on consumer-centric regulations has been facilitated by the notification of Electricity (Rights of Consumers) Rules, 2021, which safeguards the interests of consumers, allowing them to make informed decisions regarding several aspects of electricity supply. In the words of Hon'ble Minister of Power, Shri R.K Singh, "The regulations will mark the beginning of an era of empowering power consumers in a paradigm shift bringing consumers to the centre stage and an important step towards furthering the ease of doing business across the country" (PIB Delhi, 2020). Some of the major additions/changes highlighted in the document include:

- Rights of consumers and obligations of distribution licensees
- Release of new connections and modification of existing connections
- Metering arrangements
- Billing and payment
- Disconnection and reconnection
- Reliability of supply
- Consumers as prosumers
- Standards of performance of licensee
- Compensation mechanism
- Call centre for consumer services
- Grievance redressal mechanism.

Privatisation and consumer choice:

Indian DISCOMs have long been under severe financial stress due to high Aggregate Technical & Commercial (AT&C) losses. These losses mainly occur due to the inefficient billing and collection practices used by public DISCOMs.

Now, the Government of India is planning to introduce retail competition within the electricity sector to attract private investment and make the sector financially viable in the long run. However, a general consensus has not been

4 https://powermin.gov.in/en/content/saubhagya

reached, with the public and employees protesting against the privatisation norms, fearing spiked electricity tariffs and loss of employment.

Private participation in electricity distribution has the potential to generate innovative mechanisms and new business opportunities from which the public can reap tremendous benefits, while also improving the financial health of the DISCOMs. Privatisation examples and learnings can be taken from Delhi, Mumbai, Surat, Ahmedabad, and Kolkata, where private entities have drastically reduced their losses and have improved the overall financial health of the respective licensees[5]. In 2021, Orissa became the most recent state to privatise all of the DISCOMs in its licensed area, which were bought by Tata Power[6].

Electricity (Promoting Renewable Energy through Green Energy Open Access) Rules, 2021:

The Ministry of Power implemented the draft green energy open access rules on 16 August 2021. The draft rules make an entity with a sanctioned load of over 100 kW eligible for open access. These rules will play an important role in promoting green energy, as any consumer with a sanctioned load of 100 kW or more could directly avail of electricity from renewable sources through the Open Access mechanism. In this way, the entity can procure the electricity at cheaper rates but would have to pay for the network charges in case the DISCOM network is being utilised. Earlier, the minimum requirement to participate in the Open Access scheme was 1 megawatt (MW), which barred any residential consumers from participating in the uptake of renewable energy sources. Lowering the threshold to 100 kW would make the programme applicable to most multi-dwelling apartments and societies, further enhance consumer awareness, and help enable a low-carbon future (Ministry of Power, 2021).

The government's efforts to empower electricity consumers, safeguard their rights, and enable them to make informed decisions regarding their electricity consumption choices will facilitate better consumer engagement practices by the DISCOMs. Failing to make their businesses consumer-centric could result in additional financial woes for the DISCOMs, further damaging the already stressed sector. While these rules and regulations open up new possibilities for DISCOMs to explore innovative business opportunities, there are certain issues that would need to be addressed which are discussed in the subsequent sections.

2.3 Electricity tariff design and billing system

Implementation of appropriate electricity tariffs can drive behavioural changes among end-users and provide large-scale benefits to DISCOMs and society as a whole. At present, the respective state electricity regulatory commissions (SERCs) can independently implement the tariffs for various consumer segments within the state. While the national tariff policy stresses the importance of levying tariffs that truly reflect the cost of supply, residential (and agricultural) tariffs have long been subsidised with little to no reforms in their respective structure. This is partly due to the fact that a) electricity has long been a subject of political interest and b) India's economy has a large lower-middle class.

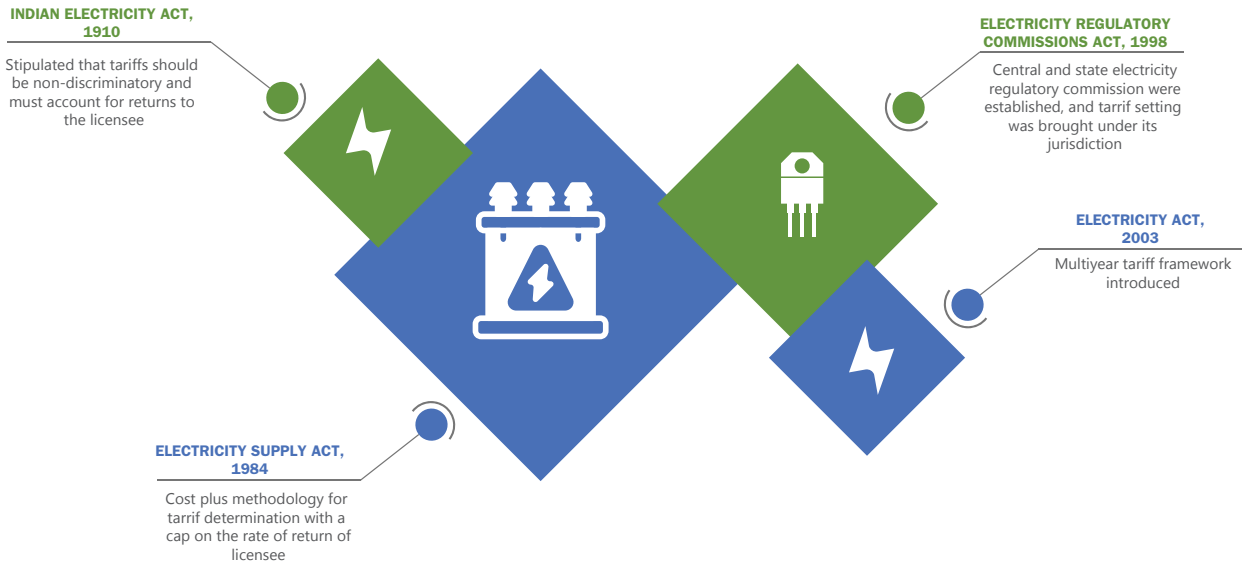
Average residential electricity tariffs in India are very low among the large economies, at 0.08 U.S. cents/kWh, compared to the global average of 13.5 U.S. cents/kWh (GlobalPetrolPrices). As such, residential consumers have little to no incentive to manage their electricity consumption in a way that could benefit the DISCOMs while also optimising their energy consumption and its associated costs.

Currently, tariff reforms are being actively discussed as one of the key components of electricity distribution sector reforms. As Figure 4 illustrates, tariff determination in India has been evolving for over a century, with a present-day focus on consumer-centric tariff reform. With the penetration of smart meters and digitisation of payment systems, consumers have witnessed an increase in transparency in their billing systems. The Smart Meter National Programme (SMNP) has replaced over 15.79 lakh conventional meters with smart meters (EESL, n.d.).

5 While DISCOM privatisation has its benefits, it still maintains the monopolistic nature of the business and will not provide customers with differentiated choices in service delivery. Segregation of the supply and wires business could provide better results from the point of view of consumer choices; however, this is debatable, as is evident from the United Kingdom (UK) experience.

6 Orissa was the first state to implement privatisation in the 1999, but due to the sustained inefficiencies and increasing losses, the Orissa regulator decided to cancel the licences of all private DISCOMs in the state in 2015 (Mohanty, 2015).

Figure 4: Evolution of tariff determination



Source: (CER, 2019)

The power sector is also set to experience a transformational shift from a unidirectional value exchange model to a multidirectional model, where consumers will become active participants in the network. In this context, tariff rationalisation (refer Table 1) is needed to maintain the balance between distributors and end-users.

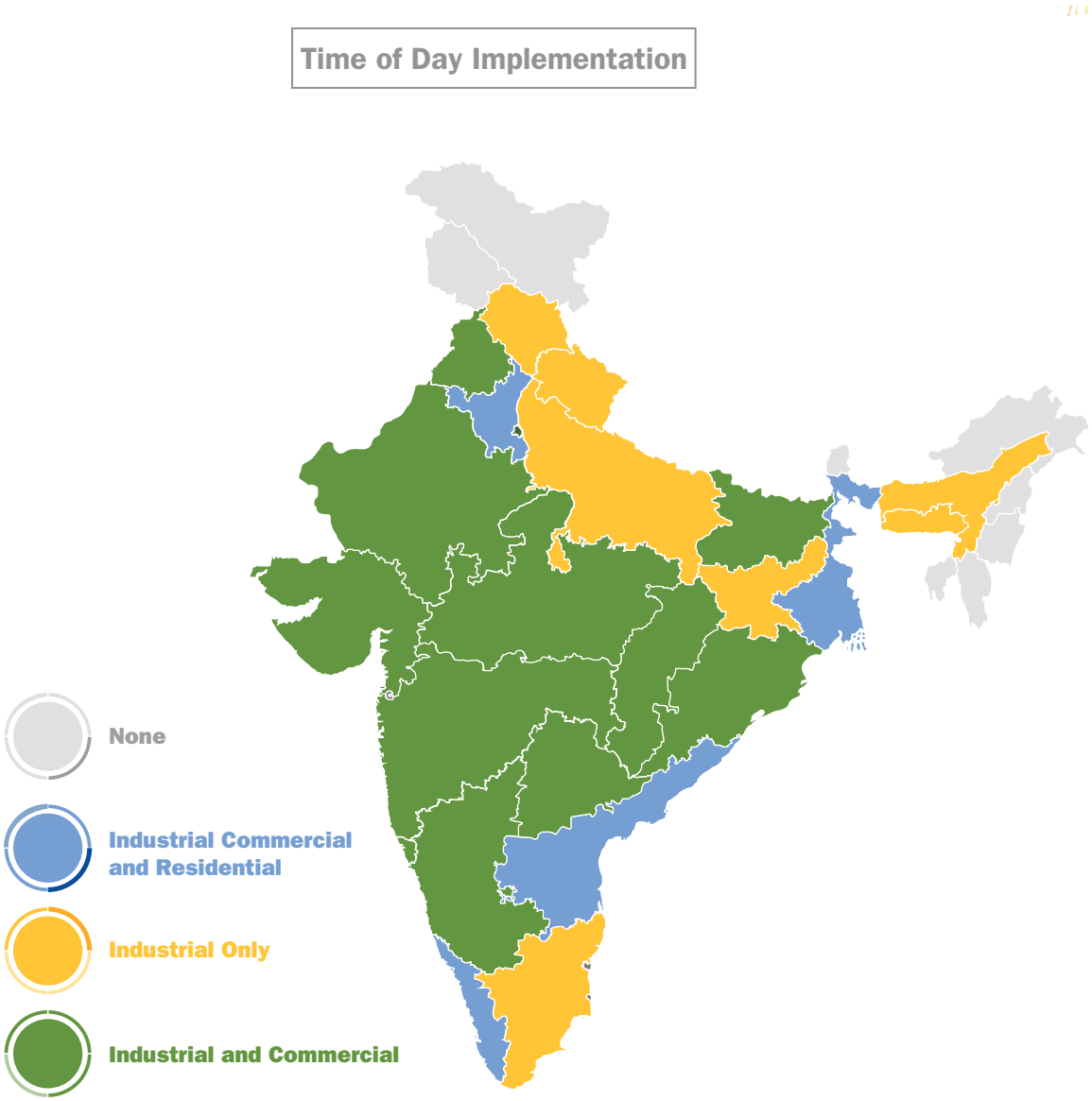
Table 2: Tariff rationalisation

Type of Tariff	Description	Advantages
kVAh based tariff	• Consumers billed based on kVAh and not kWh • Intent to motivate industrial consumers to maintain power factor	• Improvement of supply voltage • Utility cost recovery • No periodic revision of penalty
Time of Day (TOD) tariff	• Consumer charged dynamic electricity prices for peak demand and non-peak periods • Intent to reduce negative slope in load curve	• Reduction in peak demand • Incentive for customer to consume power in non-peak period
Time of Use (ToU) Tariff	• Short-term advance price signals given to the user, reflecting the utility's cost of purchasing electricity at the wholesale level • Price signals vary periodically on an hourly/half-hourly basis	• Better utility grid management • Incentives for consumer in the form of electricity cost savings
Voltage wise tariff	• Mapping of distribution losses based on distribution level	• Burden of network losses not passed on to all categories

Source: (CER, 2019)

In India, Time-of-Day (TOD) tariffs are perhaps the most popular tools used by India's regulators for peak load and demand side management. Most SERCs, apart from Sikkim and a few other Northeastern states, have implemented TOD tariffs, as evident from Fig.5. The application of a TOD mechanism is mostly limited to commercial and industrial consumers, with a few states enabling them for residential consumers, as well. Residential TOD rates are either optional or only applicable to specific segments of the population.

Figure 5: Status of TOD tariffs in India (SEEI, 2020)



Case study

Arizona Public Service [Shifting Load & Satisfying Customer with Market-driven time-of-use (ToU) tariff]

Arizona Public Service (APS), the largest electric utility in Arizona, United States, aimed to reduce peak demand and operate a cleaner, more affordable, and reliable grid while also satisfying customers by helping them understand and save money with time-of-use (TOU) rates. The company targeted its smart meter customers with a program that provided dynamic price updates reflecting the energy costs. APS sent weekly TOU Plan Coach emails throughout the summer and was able to shift over 250 MWh off-peak in the summer of 2021, reducing daily demand by 1.1 MW at the hottest time of day. As a result, customer satisfaction was 13% higher than overall satisfaction, and overall dissatisfaction was 33% lower. Additionally, customer perception of price-related metrics was 8% higher. The TOU Plan Coach program was the most successful and well-received among customers.

Green power tariffs for residential customers:

In March 2021, the Maharashtra Electricity Regulatory Commission (MERC), via its order on Case No. 134 of 2020, allowed Tata Power Company Ltd (Distribution), Mumbai to sell 100% renewable energy at a premium of 66 p/kWh on the base tariff. The order was first of its kind in India and enabled the customer to opt in for 100% renewable electricity procurement through the DISCOM. A year later, in March 2022, a similar kind of order was passed by the Orissa Electricity Regulatory Commission (OERC); it enabled any customer to procure 100% renewable electricity at a premium of 50 p/kWh.

As India moves towards decarbonising its power sector, tariff reforms will play a key role by enabling end-use customers to align their electricity demand to the requirements of the grid, thereby reducing the sector's reliance on expensive thermal power generation, especially during peak hours.

Moreover, these reforms will pave the way for more ambitious and enhanced demand-side management (DSM) programmes to be implemented by the DISCOMs. However, such structural reforms may take time to generate change, and given the urgency of climate change, there is a need for immediate solutions that move India towards a low-carbon future. In this regard, behavioural energy efficiency offers a readily available opportunity ***now*** to DISCOMs to leverage benefits like peak load management, optimal network expansion, and control, reducing peak power purchase costs and reliance on thermal power and ensuring a pathway towards a more sustainable and low-carbon future.

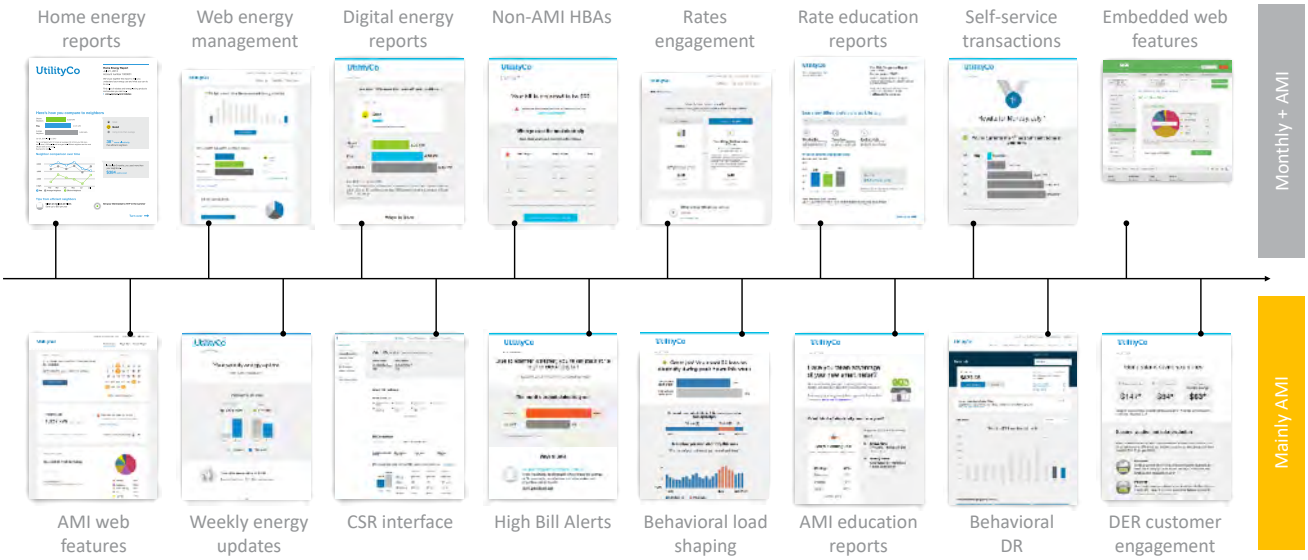
Overview of Behavioural Energy Efficiency (BEE) in India

The application of behavioural energy efficiency is broadly performed through multiple tools that produce simple, actionable messages that are relevant to customers and motivate them to save energy. BEE tools aim to change customer behaviour by providing critical information to consumers on energy use, using time-tested behavioural economics approaches such as social norms. Promoting energy-efficient behaviours among Indian households has significant potential, as residential sector electricity demand is expected to grow exponentially in the coming years. Although BEE is still at a nascent stage in India, many behavioural tools are available on the Indian market.

3.1 Understanding behavioural tools

BEE programmes around the world use a variety of tools to encourage customers to optimise, manage, and control their energy consumption. This helps consumers reduce their energy bills and DISCOMs manage demand. BEE solutions not only provide consumer education and engagement, but also alter consumption patterns. The communication materials use behavioural techniques and personalised insights to encourage customers to reduce their energy usage. This is achieved through several tools discussed below.

Figure 6: Behavioural tools



Source: Oracle, 2020

1. Home Energy Reports

One of the simple and most powerful tools in the behavioural toolkit is the home energy report (HER). These reports provide homeowners insights into their consumption, along with a comparison of their consumption with that of similar homes. HERs can help consumers track their energy consumption patterns throughout the year. This tool can also provide tips to reduce electricity demand. Typically, HERs are provided together with electricity bills.

2. Web energy management

It is a common practice nowadays for DISCOMs to use web portals for customer interface. The DISCOMs can use their existing web portals to provide focused energy consumption-related insights to customers. More specifically, interactive data visualisation can help customers understand their consumption patterns. In the portal, ToU consumers can use a Bill Comparison tool to see how their peak and off-peak time usage varied between billing cycles. The web portal can also offer advice on peak demand reduction.

3. Rate education reports and analysis tools

Consumers can learn more about their electricity tariffs using rate education reports and analysis tools. This is most commonly offered in developed economies where the consumer has the option to choose different electricity rate options, similar to what is offered by telecommunication companies in India. Rate education reports are custom reports designed to help customers determine which rate option is best for them. The rate analysis tool provides customers with more information and helps customers understand how they much they may have to pay with the different options based on their historical electricity consumption.

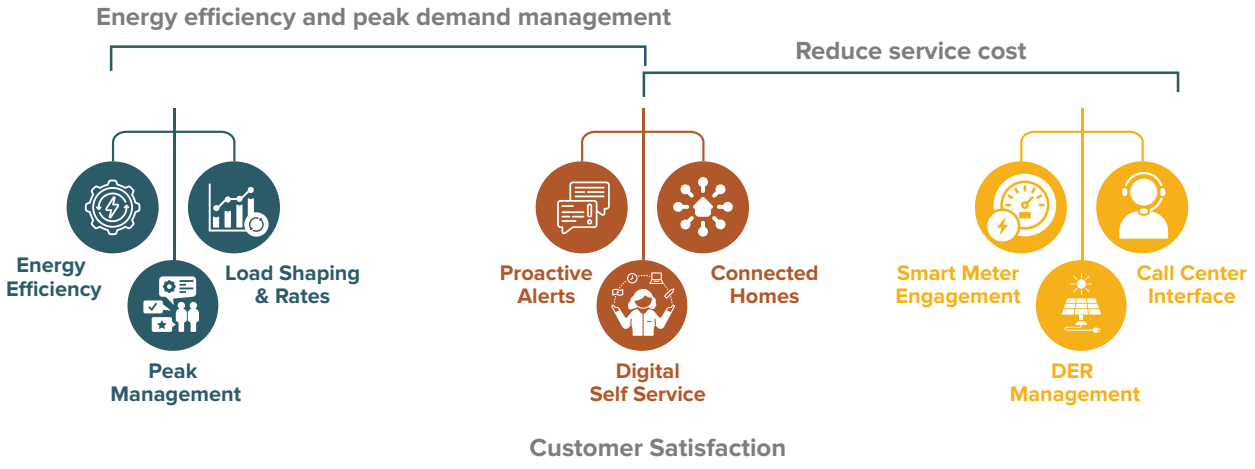
4. Behavioural load shaping

Behavioural load shaping is a tool that is useful for ToU consumers. Weekly emails are sent to the consumer regarding their time-of-use rates. The emails remind customers of the details of their current rate plan, help them track their peak usage trends over time, and provide them with peak-focused tips on how to save energy. Studies show that behavioural load shaping can help achieve a peak load shift of 1-2 percent.

5. ToU high bill alerts

A powerful behavioural strategy is to alert consumers about a potential high bill. Such alerts proactively let customers know when they are on track for a high bill and provide tips to limit electricity usage until the end of the billing cycle. Such alerts can also work with prepaid or budget billing schemes to encourage customers to lower their usage since their costs may increase.[7]

Figure 7: Customer engagement



Source: Oracle

7 Budget billing is a type of billing in which the customer pays a set amount of money each month for their bill.

3.2 Behavioural energy efficiency tools for customer engagement

DISCOMs that understand the importance of consumer satisfaction have started taking initiative to meet growing customer expectations. While DISCOMs are working hard to ensure reliable, affordable power supply, they are also using engaging with consumers through multiple mediums to provide better service. This includes providing the consumer with tools to access information and additional programmes to help them manage consumption year-round. To do this, they are turning to BEE programmes to engage with participants across their entire customer base, meet the utility's goals, and transform the customer experience.

This type of customer engagement allows DISCOMs to categorise customers according to their energy habits and use that information to generate insights and recommend relevant EE interventions. Through BEE tools, DISCOMs can dynamically segment and target customers according to demographic, behavioural, and usage characteristics. This helps the utility determine which customers have a high propensity to adopt smart devices and participate in utility-driven EE/DR programmes. As a result, DISCOMs are able to design highly specific customer segment-targeted energy efficiency campaigns. Such interventions have the greatest potential to increase customer satisfaction, reduce customer service costs, and enable the DISCOM to introduce new services.

Benefits for the DISCOM

- Customer engagement using BEE leads to measurable and consistent peak savings
- BEE increases adoption of other EE/DR programmes and clean technologies
- BEE can help DISCOMs engage more effectively with consumers

Benefits for the customers

- BEE engages, empowers, and educates customers
- BEE supports customers in changing their consumption patterns
- BEE helps consumers achieve consistent annual energy savings

3.3 Current status of behavioural energy efficiency in India

In 2006, the Bureau of Energy Efficiency, an agency under the Ministry of Power, initiated the Standards & Labelling (S&L) programme, establishing minimum energy performance standards and efficiency labelling for various consumer product categories. This programme, designed to inform consumers about the energy savings (and therefore cost savings) potential of specific products and motivate them to buy efficient products, can be viewed as India's first foray into large-scale BEE. The programme has since expanded to nearly thirty different product types in the residential, commercial, and agricultural sectors. While the S&L programme has provided a necessary and solid foundation for the promotion of energy-efficient appliances and products, to date, consumer adoption of star-labelled products remains relatively low, as consumers are dissuaded by a first-cost bias and/or lack of information. Recently, the India Residential Energy Survey (IRES) conducted by Council on Energy, Environment and Water (CEEW) found that only a quarter of electrified Indian households are aware of the star labelling scheme. The percentage is significantly lower in rural India (19%), whereas the urban population has better understanding and awareness of the programme (38%) (CEEW, 2020). Further, the Bureau of Energy Efficiency has also developed a national roadmap for the promotion of smart home concept with the aim of improving building energy efficiency and for equipping Indian homes for large scale implementation of demand response programmes. The report recommends undertaking pilot studies in India on smart home devices in order to overcome the barriers such as ambiguity about Return on Investment (RoI), inadequate

data on energy and cost saving and demand response potential at the local level and lack of understanding on consumer response to smart home devices (Bureau of Energy Efficiency, GIZ, 2021).

Bureau of Energy Efficiency's work on capacity building of DISCOMs

The Bureau of Energy Efficiency launched a programme for capacity building of DISCOMs to support and promote demand side management (DSM) measures. The Bureau of Energy Efficiency had selected 34 DISCOMs for their capacity building and providing necessary support for the implementation of DSM related activities in the financial year 2012-17. This was followed by a second phase where the remaining 28 DISCOMs were included. The phase I and II activities are as follows –

Phase I	Phase II
• DSM Cell established by 34 DISCOMs. • DSM regulation notified in 23 States for these DISCOMs. • Manpower Support provided to each DISCOM for facilitation of DSM related activities. • The Load survey had been completed and their DSM Action Plans have been finalized. • 504 officials of 34 DISCOMs had been trained as Master Trainers on Demand Side Management and Energy Efficiency under Training of Trainers activity, about 5000 officials have been trained on DSM and Energy Efficiency.	• DSM Cell has been established by 25 DISCOMs for Phase II DISCOMs. • Load Research Studies for 17 DISCOMs have been completed and Draft LR Reports have been summited to DISCOMs for approval. Preparation of DSM Action Plans are under Process. • 950 Master trainers have been trained on DSM and Energy Efficiency through 27 Training of Trainers (ToT) programs in association with respective SDAs. • Capacity building of circle level officials of DISCOMs training programs have been completed and about 1500 circle level officials have been provided training on DSM & EE. • DSM regulations have been notified for 29 States and UTs.

Source: (Bureau of Energy Efficiency , 2020)

More recently, in 2018, a utility-led BEE pilot programme was implemented by Oracle Energy & Water and BSES Rajdhani Power Limited (BRPL), with support from the United States Trade and Development Agency (USTDA). BRPL worked with Oracle Energy & Water to send personalised HERs to a representative group of two lakh customers in Southern and Western Delhi. These reports included a summary of each home's energy use, personalised energy efficiency tips, links to relevant existing utility offerings, and a normative comparison of each household's energy use to that of their neighbours. Apart from helping utility customers understand their energy usage better, HERs also empower them to undertake energy efficiency measures.

The BRPL-Oracle pilot targeted around of two lakh customers residential customers (including medium and high consumption) and achieved 3 million units in savings. After the successful completion of the pilot in March 2020, a third-party evaluation highlighted substantial improvement in customers' perception of their DISCOM (Table 3). The results also showed that 17% fewer customers had called the call centre, thanks to the proactive communication and self-service tools.

Table 3: Customers' perception of their DISCOM

+18%	BRPL wants to help me reduce my home energy use
+14%	BRPL wants to help me save money
+16%	BRPL provides useful suggestions on ways I can reduce my energy usage and lower my monthly bills
+18%	BRPL provides a variety of energy efficiency programmes
+13%	BRPL is a trustworthy source of information on energy efficiency
+13%	BRPL helps me manage my monthly energy usage

In addition to periodic feedback though HERs––generally considered the most fundamental form of BEE––, BEE programmes can make use of other channels and formats, such as real-time feedback through digital devices (e.g. using dashboards, energy management systems, or similar technologies), social interaction programmes (competition and games), and behavioural DR (Kaur & Garg, 2021).

In 2021, Tata Power Delhi Distribution Limited (TPDDL), with a consumer base of over 7 million, partnered with Autogrid to launch a behavioural DR pilot programme (TPDDL, 2021). Targeting residential customers, the pilot aims to reduce the network's capital costs and peak demand. With a mission to nudge the distribution sector towards a smarter, low-carbon, and dynamic electric grid, TPDDL and Autogrid have applied BDR to build the required flexibility on the demand side and aid the utilities in collaborating with consumers to enable efficient energy use.

While the impact of the full spectrum of BEE programmes in India has not yet been quantified, a preliminary assessment of just the HER programmes––based on international experience (which consistently shows an average of 1-3% energy savings per household) and the BRPL-Oracle pilot––indicates an energy savings potential of 3.4-10.2 terawatt-hours (TWh) per year by 2030, which translates to about 1.8-5.3 megatonnes of carbon dioxide (Mt CO_2) of avoided greenhouse gas (GHG) emissions per year. This amounts to customer cost savings of up to Indian Rupee (INR) 51 billion annually (Sachar, et al., 2019). Furthermore, the aggregate impact on customer consumption patterns is significant enough to flatten the load curve at a grid-wide scale.

International experience points to sizable energy savings potential through BEE. For example, in the U.S., the potential energy savings from behavioural interventions in the residential sector is estimated at 16-20% of home energy demand (Frankel, Heck, & Tai , 2013). BEE programmes are also highly cost-effective and come with meaningful non-energy benefits, such as increased customer satisfaction and trust, which can promote sustainable behaviours at a large scale and significantly contribute to a clean energy transition.

Data from U.S. and European programmes (Hibbard , Baker , Birjandi-Feriz , & Krovetz , 2020) demonstrates that behavioural interventions can be implemented with ease and speed, enabling countries to meet their GHG emission targets sooner and at a lower cost (IEA, 2021), thereby accelerating their energy transition and reducing their overall impact on the climate. In view of these benefits, the time is ripe for Indian DISCOMs to harness the full potential of behavioural energy efficiency. In doing so, customer engagement can be leveraged as an important tool.

Utility customer engagement measures can be effectively leveraged to drive BEE, and, in turn, BEE programmes can enhance the overall customer experience and trust, thereby improving customer engagement. This symbiotic relationship is as applicable in the evolving power distribution sector in India as in mature ones such as those in Japan and the U.S.

International experience in leveraging consumer engagement: Sacramento Municipal Utility District (SMUD)

SMUD, one of the more progressive utilities in the U.S., has recently set carbon neutrality targets. As part of its 2030 Clean Energy Vision, the utility seeks to eliminate 100% of GHG emissions from its power supply. In order to achieve this objective, SMUD worked to deliver new web-based insights and greater value to its customers by improving mobile engagement.

Mobile phones are an important channel for utilities to engage with customers, enabling them to deliver apps that can perform functions beyond bill notifications and outage alerts. The SMUD information technology (IT) team, in collaboration with a third-party energy services company (ESCO) (Opower), developed a mobile app with compelling features such as usage and cost information being presented in a visually appealing way, and the likely impact of weather changes on their bill that added value for SMUD's customers (Oracle , 2021).

Since its launch, the mobile app has seen steady growth in adoption by consumers, and SMUD has been able to motivate consumers to engage in energy conservation thanks to the app. It has generated outcomes consistent with EE interventions such as peak demand reduction and power purchase optimisation.

Source: (May et al., 2018)

4

Perspectives from Indian DISCOMs: Survey Outcomes

A key aim of this study was to understand Indian DISCOMs' perceptions of BEE programmes. In order to achieve this, the research team carried out a survey with different DISCOMs across India. The survey aims to examine whether there is a case for why BEE should be embedded in the DISCOMs' consumer engagement practices. Indian DISCOMs are set to experience a significant increase in demand in the near future, driven by increasing cooling demand and penetration of appliances and EVs. It is therefore critical for DISCOMs to develop sound consumer engagement mechanisms to catalyse and benefit from EE savings.

Selection of participating DISCOMs

Eight DISCOMs from the following states were shortlisted for the survey, based on criteria such as a high volume of energy sales to residential consumers, high peak demand, high AT&C losses, and high power purchase costs: Odisha, Bihar, Chattisgarh, Rajasthan, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, and Maharashtra. On average, the participating DISCOMs had ~80% residential customers. The survey covered specific themes such as the DISCOMs' DSM initiatives and gauged their awareness of and readiness to expand the DSM portfolio with a focus on BEE. A description of the participating DISCOMs is available in Appendix 1.

Survey framework and outcomes

The survey consisted of five sections aiming to capture data on various aspects of the DISCOM's current DSM experience, understanding of consumer engagement, operational modalities, and future plans. In order to facilitate a comparative view of the survey inputs and identify any trends, we assigned scores to the qualitative responses received (the scoring process is described in **Appendix 3).** Table 3 presents an overview of the participating DISCOMs' scores in the five sections of the survey. The following discussion summarises each of the five sections, along with a synthesis of the survey findings (complete survey responses are presented in Appendix 2).

Table 4: Overview of DISCOMs' scores

	Odisha (DISCOM-1)	Bihar (DISCOM-2)	Chhattisgarh (DISCOM-3)	Rajasthan (DISCOM-4)	Andhra Pradesh (DISCOM-5)	Uttar Pradesh (DISCOM-6)	Madhya Pradesh (DISCOM-7)	Maharashtra (DISCOM-8)
Part A: Experience with DSM initiatives	6	8	3	8	9	8	7	3
Part B: DISCOM understanding of BEE	17	18	9	15	13	11	17	19
Part C: DISCOM savings in cost of supply and additional income	12	12	20	12	20	1	0	11
Part D: Consumer engagement	11	19	15	10	20	12	8	11
Part E: Other	16	5	16	10	10	20	10	10
Final Tally	**62**	**62**	**63**	**55**	**72**	**52**	**42**	**54**

PART A: Experience with DSM initiatives

This section focused on the DISCOMs' DSM experience. The DISCOMs were scored based on the range of DSM activities they had previously undertaken and were currently implementing. Furthermore, the section also checked whether the DISCOMs had conducted energy audits to quantify the benefits from their DSM initiatives. The future plans of the DISCOM were covered as a gauge to check for alignment with BEE measures. The survey questions for this section were divided into the following categories:

1. Existing DSM activities carried out by the DISCOMs
2. Outcomes recorded from past DSM initiatives
3. DISCOM preferences regarding regulatory measures
4. Future DSM initiatives.

Appendix 2 presents the responses received from the participating DISCOMs for this section. Based on the scores assigned to the qualitative responses, DISCOM-5 scored the highest, indicating a positive experience with DSM initiatives, and stands as testament to their investment in DSM endeavors. Most of the participating DISCOMs scored well, apart from DISCOM-8 and DISCOM-3, which did not have any DSM initiatives planned. The key Part A findings are summarised in Table 5.

Table 5: Survey findings on DISCOM experience with DSM initiatives

Parameter	Survey findings
1. Existing DSM activities	DISCOMs have seen success in appliance efficiency-based projects, primarily the rollout of LED lamps and brushless direct current motor (BLDC) fans through the Energy Efficiency Services Limited (EESL) scheme. EE ACs have not achieved similar scale due to their higher price range. Agricultural initiatives such as solar pumps have also seen significant adoption.
2. Outcomes recorded from past DSM initiatives	Most of the surveyed states possess a record of energy savings achieved through DSM initiatives. DISCOMs have proof of significant energy reduction, and some states also have data that shows a significant reduction in peak demand. Demonstrated savings indicate a propensity to expand their DSM portfolio.
3. Preferred regulatory measures	Even within this small subset of respondents, the DISCOMs had widely varying preferences with respect to regulatory measures. For example, the Ministry of Power Notification to include all DISCOMs under the Energy Conservation Act was the 'most preferred' regulatory measure for some but the 'least preferred' for others.
4. Future DSM initiatives	Many DISCOMs have rooftop solar initiatives planned for their domestic consumers. Some DISCOMs have also prioritised IT adoption to capitalise on smart meter data. Consumer information app development is in progress, hinting at the consumer-centric future of DSM initiatives.

Source: AEEE Survey

PART B: DISCOM understanding of Behavioural Energy Effciency (BEE)

This section included questions centred on DISCOMs' awareness about BEE programmes and their corresponding benefits, along with knowledge of BEE initiatives implemented by their peers. Certain prevalent misconceptions concerning the limitations of BEE programmes––e.g. they are not feasible in the absence of smart meters––were also explored. The questions were divided into the following sections:

1. Benefits of BEE programmes for demand management
2. Benefits of BEE interventions for customer engagement
3. Propensity towards BEE in absence of smart meters
4. HER pilot programme awareness.

Appendix 2 presents the responses received for this section from the participating DISCOMs. Based on the content analysis and scoring exercise, DISCOM-8 scored the highest, and most of the DISCOMs displayed a good level of understanding of BEE interventions. DISCOM-3 and DISCOM-6 displayed a relatively lower level of awareness about the benefits of BEE programmes. The key Part B findings are summarised in Table 6 below.

Table 6: Survey findings on DISCOM understanding of BEE

Parameter	Survey findings
1. Benefits of BEE programmes	All participating DISCOMs consider BEE programmes to be economically scalable. The majority of the DISCOMs were also cognisant of the fact that BEE programmes are quick and easy to deploy. The potential for BEE to strengthen their existing EE programmes needs to be reinforced to the DISCOMs.
2. Benefits of BEE interventions	Peak management is a priority benefit that DISCOMs recognise and expect from BEE interventions. Another key benefit is the savings from deferral of network capacity addition. Some DISCOMs also recognise the reduction in operational cost thanks to consumer engagement, thus expressing their individual emphasis on consumer engagement.
3. Propensity towards BEE in absence of smart meters	While most participating DISCOMs understood the use case for BEE irrespective of the application of smart meters, some DISCOMs are still unable to consider BEE programmes besides smart meter-enabled interventions. This indicates a lack of awareness on the range of BEE programmes.
4. HER pilot programme awareness	Similar to the previous finding, there are DISCOMs that are unaware of the range of BEE interventions, including the HER pilot programme already implemented in India.

Source: AEEE Survey

PART C: DISCOM savings in cost of supply and additional income

This section explored the DISCOMs' approach to savings in cost of supply and views on additional non-tariff income. Given that reduction in cost of supply is a DISCOM requirement, the survey inquired about their preferred pathway to achieve the same. The questions also assessed DISCOM awareness of the financial benefits of BEE, such as additional non-tariff income streams and no additional required expenditure for deployment. DISCOMs that had undertaken efforts to estimate (or validate) the savings derived from their DSM initiatives were viewed as 'proactive' in the context of this study, i.e. more likely to undertake BEE measures to reduce their operational expenses. The questions were divided into the following sections:

1. Preferred strategy to reduce cost of supply
2. Estimating savings in reduction of cost of supply
3. Recognition of no additional expense benefit
4. Recognition of additional income benefit
5. Willingness to share data to estimate or demonstrate potential BEE savings.

Appendix 2 presents the responses received for this section from the participating DISCOMs. Based on the content analysis, DISCOM-3 and DISCOM-5 scored the highest in this section, while DISCOM-6 and DISCOM-7 showed little or no awareness of the cost savings and revenue generation potential of BEE. The key Part C findings are summarised in Table 7 below.

Table 7: Survey findings on DISCOM preferences for cost saving

Parameter	Survey findings
1. Preferred strategy to reduce cost of supply	The majority of the DISCOMs prioritise reduction in peak power procurement costs. However, the order of priorities that followed among other mentioned pathways differed. A few of the DISCOMs had set optimising operational costs by reducing consumer engagement costs as their lowest priority. This reflects the current importance attached towards consumer engagement in these DISCOMs.
2. Estimating savings in reduction of cost of supply	The DISCOMs were unable to clarify whether they had undertaken an energy audit to estimate the savings in reduction of cost of supply. Although some DISCOMs did state that a savings estimation was done, no subsequent details were divulged.
3. Recognition of no additional expense benefit	All the participating DISCOMs recognised that BEE benefits could be realised without requiring additional expenses.
4. Recognition of additional income benefit	Half of the respondents were unaware that BEE interventions could result in additional income through non-tariff streams, thus indicating an awareness gap.
5. Willingness to share data	Most of the participating DISCOMs were willing to share data under appropriate circumstances with third parties to demonstrate potential savings.

Source: AEEE Survey

PART D: Consumer engagement

In this part, the perception of the participating DISCOMs regarding the importance of consumer engagement was gauged. Scores were allotted based on the consumer engagement strategies currently employed and information on the DISCOMs' energy audits.

This section of the survey was designed to gain a better understanding of the DISCOM's views on consumer engagement through questions covering the following topics:

1. Importance of consumer engagement in DISCOM operations
2. Strategies employed for consumer engagement
3. Presence of feedback mechanisms
4. Average annual costs associated with consumer engagement
5. Details of expenditure on consumer engagement
6. Awareness of consumer engagement cost savings through BEE.

Appendix 4 presents the responses received for this section from the participating DISCOMs. Among the participating DISCOMs, DISCOM-5 scored the highest, indicating that it placed a high level of importance on consumer engagement. It was also the only DISCOM willing to share information about its annual consumer engagement expenditure. The other DISCOMs, while they indicated consumer engagement was highly important to them, could

not provide details of their expenditure, and most claimed to have not yet undertaken an audit focused on this aspect. The key Part D findings are summarised in Table 8 below.

Table 8: Survey findings on DISCOM perspective on consumer engagement

Parameter	Survey findings
1.Importance of consumer engagement in DISCOM operations	All the participating DISCOMs weighed the importance of consumer engagement in their operations as high or medium, with a majority of them opting for the former. This indicates DISCOM willingness to improve consumer engagement practices.
2. Strategies employed for consumer engagement	The majority of the participating DISCOMs have capitalised on social media as a tool for consumer engagement. Apart from the traditional method of disseminating information through electricity bills and flyers, the DISCOMs have also operationalised single-window consumer grievance cells and toll-free centralised call service centres to engage with consumers. Along with door-to-door interactions by some municipal corporations, DISCOMs have partnered with women self-help groups (SHGs) to spread awareness on energy conservation measures.
3. Presence of feedback mechanism	Consumer feedback mechanisms were largely absent among the participating DISCOMs. One respondent reported the use of a DISCOM-run mobile app for consumer engagement. Messages to increase participation in load shifting activities were sent through their system.
4. Average annual costs associated with consumer engagement	Information not available with DISCOMs, with the exception of one respondent, who said the average annual cost was INR 50 lakhs.
5. Details of expenditure on consumer engagement	Expenditure on consumer engagement has not been audited by the DISCOMs. There is scope to build a case for DISCOMs to undertake such audits to discern the benefits from effective consumer engagement practices.
6. Awareness on consumer engagement cost savings through BEE	The majority of the participating DISCOMs were aware that BEE measures could result in consumer engagement cost savings. However, there were a few DISCOMs that were unaware of this aspect, thus emphasising the gap in awareness concerning BEE measures.

Source: AEEE Survey

PART E: DISCOM operational factors related to BEE

The participating distribution companies (DISCOMs) were evaluated on various factors such as their willingness to explore energy efficiency interventions and their level of residential energy consumption. Based on these assessments, each DISCOM was given a score. DISCOM-6 had the highest score, indicating a strong inclination towards adopting energy efficiency measures. On the other hand, DISCOM-2 had the lowest score. After DISCOM-6, DISCOM-5 had scored highest and exhibited a high potential for embracing energy efficiency interventions. The other DISCOMs also displayed favorable scores, as shown in Appendix 2, indicating that they are generally open to expanding their demand-side management portfolio through cost-effective and easily implementable energy efficiency measures.

In this section, the survey tried to gather information concerning the DISCOM's operational difficulties in implementing DSM initiatives. The questions were designed to gauge the operational preparedness for BEE programmes, and the questions were covered the following topics:

1. Energy consumption patterns of residential consumers (last 5 years)
2. Focus on environmental benefits
3. Challenges in implementing BEE initiatives
4. Accounting for consumer engagement expenditure
5. Recurring challenges
6. DISCOM's smart metering plan
7. Willingness to share data.

Appendix 2 presents the responses received for this section from the participating DISCOMs. The content analysis resulted in the findings summarised in Table 9.

Table 9: Survey findings on DISCOM operational factors related to BEE

Parameter	Survey findings
1.Energy consumption patterns of residential consumers (last 5 years)	Among the DISCOMs that responded, the majority have observed a residential energy consumption increase of around 5 percent.
2. Focus on environmental benefits	The DISCOMs understand the importance of environmental savings. They correlate DSM savings to emission reductions and are willing to undertake DSM initiatives with specific outcomes related to environmental benefits.
3. Challenges in implementing Behavioral EE initiative	Insufficient funds and labour shortages are the top challenges cited by most of the participating DISCOMs. An inadequate participation rate for DSM initiatives and lack of technical expertise are implementation challenges faced by the DISCOMs.
4. Accounting for consumer engagement expenditure	The respondents had varied funding sources, ranging from their operational budget to Ministry of New & Renewable Energy (MNRE) funding, for their consumer engagement expenditure. None of the participating DISCOMs has a dedicated budget for consumer engagement expenditure.
5. Recurring challenges	The primary challenge for DISCOMs is shortage of funds. Other recurring challenges include creating programme awareness and obtaining regulatory approvals.
6. DISCOM's smart metering plan	The participating DISCOMs have ongoing smart metering initiatives. The projects are currently focused on urban areas, with future plans to extend the coverage to rural areas. DISCOMs have significant coverage of residential consumers.
7. Willingness to share data	Among the participating DISCOMs, the majority of respondents were open to data sharing but highlighted the need for regulations to enable them to share the data.

Source: AEEE Survey

Key takeaways

The following are the key takeaways based on the survey outcomes and our secondary research leading up to the survey:

- In general, the DISCOMs have a positive view of BEE and acknowledge its potential benefits, including emission reductions. However, there is an awareness gap on the full range of benefits and/or value streams of BEE, such as additional income through non-tariff streams.
- Many of the DISCOMs recognise the importance of consumer engagement and indicate a willingness to improve consumer engagement practices. However, there is a clear disparity between the private and public DISCOMs; the private DISCOMs are more conditioned towards realising the importance of consumer engagement, whereas the public DISCOMs do not fully understand its importance and tend to view it as beyond the scope of their work.
- While many of the DISCOMs are aware of the interlinkage between BEE and customer engagement, not all understand that BEE measures could result in consumer engagement cost savings, which indicates a need for greater awareness (and underscores the gap in awareness about the full range of benefits of BEE).
- In general, the DISCOMs are open to expanding their DSM portfolio through low-cost, quickly deployable BEE interventions. However, insufficient funds and lack of labour and technical expertise are commonly cited challenges hindering implementation.
- Regulations empowering the DISCOMs to share data with appropriate customer safeguards could broaden the scope of BEE interventions.

Behavioural Energy Efficiency Value Streams for DISCOMs

In this chapter, we present hypothetical use cases to illustrate the financial benefits of BEE programmes for the DISCOM. The wide-ranging benefits include facilitating efficient management of residential energy consumption, avoiding the use of expensive peaking generation through power purchase optimisation, and effective peak load reduction.

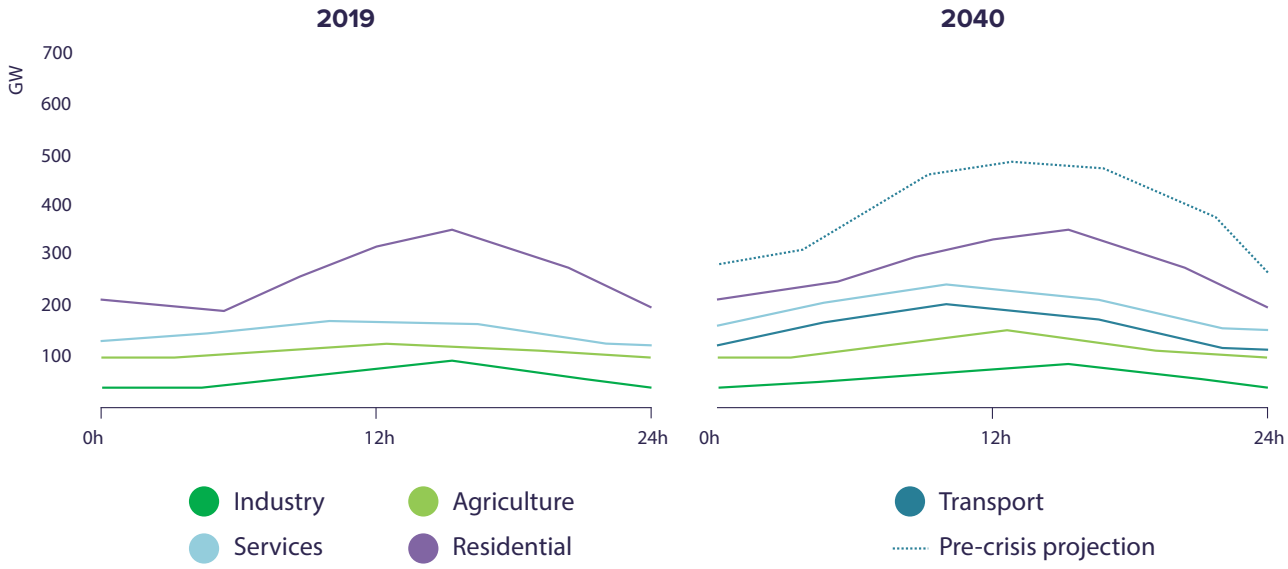
Use case 1: Peak management of urban residential load

Brief

The first use case focuses on the **management of urban residential peak demand** for the city of Hyderabad.

As per Energy Statistics 2021 (MoSPI, 2021), the estimated electricity consumption was 12,91,494 GWh in 2019-20(P). The domestic sector accounted for 24.01% of total electricity consumption in 2019-20(P). In addition, the figure depicts the daily electricity demand in India in 2019 and in 2040 (STEPS). Therefore, the management of residential demand is critical.

Figure 8: Daily electricity demand in India in 2019 and 2040 in the STEPS



Source – (IEA, 2021)

Table/Data for Hyderabad

Table 10: Overall electricity consumption

	Peak Demand (MW)		
	2019-20	2024-25	2029-30
EPS Projection	3390	4805	6458
Actual Demand	3276	4643	6241

Table 11: Residential energy consumption

	Residential Energy Consumption (GWh)		
	2019-20	2024-25	2029-30
EPS Projection	6780	9509	12726
Actual Demand	6552	9189	12298

Table 12: Compound ann ual growth rate (CAGR) of peak demand considered

CAGR of Peak Demand (%)		
FY16-19	FY19-24	FY25-30
6.95	7.00	6.00

Assumptions

- Peak reduction of 2.4% ––Thayer et al. (2016) suggests that behavioural demand response (BDR) messaging to households results in 2.4% reduction in demand (Thayer, Brummer, Smith, Aslin, & Cook, 2016). Kirchner et al. (2017) show that 3% demand savings per event can be achieved in each of the first two years. We have taken the lower of the two estimates for our analysis.
- Average power purchase cost (APPC) = INR 4.7/kWh

Results and inferences

Assuming a peak reduction potential through HERs of 2.4% on average and an APPC of INR 4.7/kWh, the corresponding peak demand reduction and monetary savings for DISCOM are as follows:

Table 13: Peak demand reduction and monetary savings for DISCOM

	2019-20	2024-25	2029-30
GWh	157	221	295
Savings (million INR)	739	1,037	1,387

Use case 2: Power purchase optimisation through peak reduction

Brief

The second use case focuses on **power purchase optimisation at the DISCOM level through reduction in peak demand** for Delhi.

According to the whitepaper titled 'The Value of the Engaged Energy Consumer' (Opower, 2014), utilities will need to do even more to shift consumers' consumption patterns, smoothen peaks, and optimise the grid to accommodate the intermittency of energy sources like solar and wind. There is a need to identify opportunities for shifting peak load to different times of day to help balance supply and demand.

The Renewables Integration in India report (IEA, 2021) highlights the fact that the power system transformation in India will be supported by the transformation of electricity demand from passive consumption to more proactive participation of demand sectors. This is already being observed in the agricultural sector, where the users play an important role in balancing power supply and demand through involuntary irrigation load shifting, and the IEA analysis foresees more active participation from the agricultural sector, buildings (including cooling), and industry by 2030. In the case of the residential sector, the report states that shifting towards advanced digital metering, automation, and smart home appliances is a prerequisite.

Table/Data

Projected peak demand and actual peak demand data is presented in the table. The peak duration is calculated using total duration and peak demand duration (1%).

Table 14: Peak demand reduction in Delhi

	2019-20	2024-25	2029-30
Peak Demand (NCR Survey)	7400	9433	11884
Peak Demand (Actual)	7409	9444	11898
Peak Demand Reduction (%)	2.4	2.4	2.4
Peak Demand Reduction (MW)	178	227	286
Total Duration	8760	8760	8760
Peak Duration	87.6	87.6	87.6

The peak demand is assumed to be met by gas plants, and the reduction in peak demand enables a shift in the demand met by gas plants to solar.

Table 15: Delhi peak power purchase (FY 2020-21)

Plant Name	Energy (GWh)	Avg. Rate (INR/unit)
NCPP Dadri	51	10.9
Aravali Power Co.	80	13.58
Anta Gas	7	12.54
Weighted average peak cost (INR/unit)	12.5	
SECI-Solar (INR/unit)	5.5	

Source: (DERC, 2020)

Assumptions

Peak demand reduction of 2.4%, based on Thayer et al. (2016) and Kirchner et al. [2017].

Results and inferences

The energy use during peak hours is calculated using peak reduction and peak duration. The savings are calculated using the energy use during peak hours and the difference between the weighted average peak cost of gas plants and the cost of solar.

Table 16: Energy usage during peak hours and savings for Delhi

	2019-20	2024-25	2029-30
Energy Usage during Peak Hours (MWh)	15577	19856	25015
Savings (Million INR)	110	140	176

Use case 3: City-wise savings potential through peak demand reduction

Brief

The third use case focuses on the calculation of **urban residential electricity savings potential through peak demand reduction**.

According to the 'Electricity in megacities' report (Nhalur & Josey, 2012), megacities have high consumer and load densities. The report notes that commercial and domestic customers consume nearly 60% of electricity and are the fastest-growing segments. The demand profile of megacities is quite different from the statewide profile, with peaks occurring in the daytime and large variations in demand with weather changes. Therefore, the third use case focuses on city-level analysis.

The city-wise savings potential through peak demand reduction is examined, as a National Renewable Energy Laboratory (NREL) study on BRPL (NREL et al., 2021) found that peak loads result in capacity and energy cost inefficiencies that are passed on to BRPL and their consumers. One percent of network and generation capacity (approximately 30 MW) is required only 0.01% (less than 1 hour) of the year, and 2% of capacity (approximately 60 MW) is required only 0.05% of the year. Thus, reducing peak demand could bring capacity savings; BRPL estimates annual savings of INR 2 crore per MW of peak load reduction. Peak demand also has a positive correlation with higher electricity prices, and, therefore, levelling the load could reduce the cost of providing energy to BRPL customers.

Table/Data

The city-wise peak demand extrapolated for 10 years was sourced from the Power Finance Corporation (PFC) report and is tabulated as follows:

Table 17: City-wise peak demand extrapolated for 10 years

	City	Peak Demand (MW)										
		2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
1	Agra	746	781	817	854	891	929	968	1006	1045	1084	1122
2	Aurangabad	333	349	366	383	402	422	440	460	480	502	524
3	Bengaluru	3067	3163	3264	3371	3482	3599	3704	3815	3930	4051	4178
4	Gangtok	39	41	42	43	45	47	48	50	52	53	55
5	Hyderabad	3390	3633	3895	4176	4479	4805	5096	5405	5735	6085	6458
6	Jammu	519	534	550	567	585	605	623	642	662	684	707
7	Jodhpur	301	318	337	357	379	402	424	448	473	500	523
8	Kanpur	732	770	811	854	900	949	990	1034	1081	1129	1180
9	Kolkata	3263	3390	3522	3659	3801	3950	4087	4228	4379	4532	4690
10	Kota	264	273	285	297	310	324	336	351	365	381	397
11	Lucknow	1450	1540	1635	1736	1842	1955	2066	2184	2309	2440	2579
12	Mumbai	3710	3809	3910	4015	4123	4234	4341	4453	4569	4689	4812
13	Nagpur	642	666	692	718	746	775	801	829	857	886	917
14	Port Blair	40	45	48	49	50	51	52	53	54	57	60
15	Pune	2011	2132	2261	2397	2543	2698	2845	3001	3166	3340	3525
16	Ranchi	307	329	352	377	405	434	462	493	526	561	598
17	Srinagar	580	608	642	678	717	757	791	826	863	901	942
18	Surat	2086	2202	2325	2456	2594	2741	2878	3022	3173	3333	3501
19	Varanasi	613	642	672	706	740	776	812	850	890	932	976
20	Vishakhapatnam	872	941	1012	1085	1159	1235	1312	1388	1465	1541	1616

Source: (CEA, MoP, 2020)

Assuming a peak load reduction of 2.4%, the potential energy savings are as follows:

Table 18: Potential energy savings (GWh)

	CITY	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
1	Agra	18	19	20	20	21	22	23	24	25	26	27
2	Aurangabad	8	8	9	9	10	10	11	11	12	12	13
3	Bengaluru	74	76	78	81	84	86	89	92	94	97	100
4	Gangtok	1	1	1	1	1	1	1	1	1	1	1
5	Hyderabad	81	87	93	100	107	115	122	130	138	146	155
6	Jammu	12	13	13	14	14	15	15	15	16	16	17
7	Jodhpur	7	8	8	9	9	10	10	11	11	12	13
8	Kanpur	18	18	19	20	22	23	24	25	26	27	28
9	Kolkata	78	81	85	88	91	95	98	101	105	109	113
10	Kota	6	7	7	7	7	8	8	8	9	9	10
11	Lucknow	35	37	39	42	44	47	50	52	55	59	62
12	Mumbai	89	91	94	96	99	102	104	107	110	113	115
13	Nagpur	15	16	17	17	18	19	19	20	21	21	22
14	Port Blair	1	1	1	1	1	1	1	1	1	1	1
15	Pune	48	51	54	58	61	65	68	72	76	80	85
16	Ranchi	7	8	8	9	10	10	11	12	13	13	14
17	Srinagar	14	15	15	16	17	18	19	20	21	22	23
18	Surat	50	53	56	59	62	66	69	73	76	80	84
19	Varanasi	15	15	16	17	18	19	19	20	21	22	23
20	Vishakhapatnam	21	23	24	26	28	30	31	33	35	37	39

Assumptions

- Peak reduction of 2.4% (based on Thayer et al. (2016) and Kirchner et al. [2017])
- Cost savings per MW of INR 2 crore (NREL et al., 2021)

Results and inferences

Based on the above assumptions, the monetary savings are estimated as follows:

Table 19: Estimated monetary savings

	City	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	Cumulative Savings (INR Cr.)
1	Agra	36	37	39	41	43	45	46	48	50	52	54	**492**
2	Aurangabad	16	17	18	18	19	20	21	22	23	24	25	**224**
3	Bengaluru	147	152	157	162	167	173	178	183	189	194	201	**1902**
4	Gangtok	2	2	2	2	2	2	2	2	2	3	3	**25**
5	Hyderabad	163	174	187	200	215	231	245	259	275	292	310	**2552**
6	Jammu	25	26	26	27	28	29	30	31	32	33	34	**321**
7	Jodhpur	14	15	16	17	18	19	20	22	23	24	25	**214**
8	Kanpur	35	37	39	41	43	46	48	50	52	54	57	**501**
9	Kolkata	157	163	169	176	182	190	196	203	210	218	225	**2088**
10	Kota	13	13	14	14	15	16	16	17	18	18	19	**172**
11	Lucknow	70	74	78	83	88	94	99	105	111	117	124	**1043**
12	Mumbai	178	183	188	193	198	203	208	214	219	225	231	**2240**
13	Nagpur	31	32	33	34	36	37	38	40	41	43	44	**409**
14	Port Blair	2	2	2	2	2	2	2	3	3	3	3	**27**
15	Pune	97	102	109	115	122	130	137	144	152	160	169	**1436**
16	Ranchi	15	16	17	18	19	21	22	24	25	27	29	**233**
17	Srinagar	28	29	31	33	34	36	38	40	41	43	45	**399**
18	Surat	100	106	112	118	125	132	138	145	152	160	168	**1455**
19	Varanasi	29	31	32	34	36	37	39	41	43	45	47	**413**
20	Vishakhapatnam	42	45	49	52	56	59	63	67	70	74	78	**654**

Endnote

These use cases are illustrative and based on simplistic assumptions, but the key point they underscore is the broad benefits to the utility. Beyond the benefits illustrated by the use cases––efficient management of residential energy consumption, avoidance of expensive peaking generation, and effective peak load reduction––, other benefits include grid management cost reduction, enhanced customer relations, and potential reduction in customer relationship management (CRM) costs. As the DISCOMs unlock non-tariff revenue, this can, in turn, reduce the tariffs for consumers. In addition, there are benefits to the customer such as reduced bills due to optimised energy use and higher-quality power thanks to grid improvement. Furthermore, there are broad societal and environmental benefits through reduced GHG emissions.

6

Way Forward: Leveraging the Synergies Between Customer Engagement and Behavioural Energy Efficiency

The Indian power sector is witnessing a remarkable revolution where active consumer engagement can facilitate the ongoing decarbonisation. The time is right for tapping into the significant potential of behavioural initiatives and operationalising residential energy demand as a resource. It is critical to facilitate pathways for electricity customers to make informed decisions and be able to modify their electricity consumption patterns. A flexible residential demand, enabled by smart meters and intelligent controllable appliances, with rooftop solar and storage is not a far reality for India. Customer engagement will be valuable to drive the adoption of GHG-reducing technologies and enable behavioural change in residential consumers to play a key role in achieving decarbonisation targets.

The winds of change are promising for the Indian power distribution sector in the way electricity is generated and getting consumed. The paradigm of DISCOM interaction with customers only through metering, billing, and collection needs to evolve. To retain consumers, and sustain retail electricity business operations in the near future, active consumer engagement would be an essential DISCOM activity. Behavioural tools are proven solutions to engage consumers while benefiting the DISCOMs by reducing the cost of operation and exploring future revenue streams. Accomplishing this requires a cohesive strategy for mainstreaming behavioural programs in DISCOMs and focused efforts to assure the necessary regulatory support for the rollout of Behavioural DSM programs. A few recommendations for creating a viable environment for leveraging behavioural energy efficiency for consumer engagement are below:

- **Capacity building of DISCOMs:** Dedicated efforts are needed to scale up capacity building of DISCOMs on advanced demand management techniques including behaviour energy efficiency and consumer engagement practices. This will be critical to bridging the gap on the full range of benefits from Behavioural EE programs, including its interlinkages with consumer engagement. In particular, this effort should focus on public sector DISCOMs and include consumers to improve their awareness. This activity can be interlinked with the current efforts undertaken by the Bureau of Energy Efficiency for the capacity building of DISCOMs.

- **Guidelines for estimating savings from Behavioural programs:** As behavioural initiatives are a niche area of demand management, the current practices under the existing DSM regulations may not be effective in qualifying the benefits across all value streams. Especially the benefits beyond the reduction in power procurement cost, such as avoided costs for network capacity expansion, environmental savings and savings in consumer engagement costs need to be evaluated. State electricity regulatory intervention is critical in developing the guidelines to help DISCOMs to create comprehensive proposals for Behavioural EE programs.

- **Best practices guide for consumer engagement:** Consumer engagement practices is an evolving landscape for Indian DISCOMs. A guidebook is essential to showcase the strong positive correlations between behavioural nudges, focus on consumer engagement practices, adoption of GHG reduction technologies and improvement

in DISCOM performance. A compendium of most applied behavioural tools and techniques to engage with consumers through digital platforms and DSM programs would be beneficial for DISCOMs.

- **Consumer right for active participation:** Ministry of Power through "Electricity (Rights of Consumers) Rules, 2020 empowered the consumers of electricity including prosumers. Consumers can now be active partners in decarbonisation using their right to set up rooftop solar systems. The rules may be further amended to establish the customer's right to alter their consumption pattern and participate in demand side management.
- **Technical assistance to DISCOMs and SDAs:** Though DISCOMs are open to expanding their DSM portfolio through BEE interventions many challenges remain including technical expertise. This is a critical gap that should be addressed in mainstreaming BEE initiatives from pilot projects to full-scale programs targeting the residential segment. A dedicated effort can be undertaken to support DISCOMs and SDAs for the inclusion of BEE in their DSM plan, develop standard program design templates, and establish a protocol for measurement and verification, and support regulatory clearance for the program.
- **Establish standard practice for consumer data sharing:** It is important to establish protocols for DISCOMs to share consumer data with appropriate safeguards. Through smart metering intervention, the granularity of electricity consumption data has improved in the Indian DISCOMs. However, guidance on smart meter data analytics and its application beyond the improvement of billing and collection efficiency is negligible. Bringing clarity to consumer data sharing and developing regulatory guidelines is essential for ensuring the scaling up of BEE interventions.

Figure 9: Benefits of behavioural energy efficiency programmes to the stakeholders and latter required actions

STAKEHOLDERS	POTENTIAL BENEFITS	ACTION REQUIRED
Domestic consumers	→ Engagement to the last milestone → Empowering and call for action → Making the Consumers a part of the	→ Customer Engagement (through digitalisation) → Empowering them with insights and → Making the Consumers Energy literate & aware
DISCOMs	→ Better Load Management → More value of the Smart Meters → Up sell and Cross Sell	→ Launching Programs around Consumers outreach and behavior change → Utilities making use of Data more to manage its operation better (like load forecasting, demand response, customer engagement, appliance level disaggregation, Electrification) → Digitisation
Policymakers and regulators	→ Ultimate reduction in Power purchase cost → Grid Stability → Customer awareness and satisfaction	→ Promoting such program → Encouraging Customer Engagement and Demand response & demand flexibility program within Utility through a separate Fund.
HER solution providers	→ To come with innovative solutions to make the Utility Digital, → Make optimum usage of the Data and Smart Meter → Developing solutions with more customisation, personalisation and encouraging Electrification	→ Customised solutions around each and every Utility → More user-friendly interface for better engagement

As awareness on behavioural initiatives is a key challenge, immediate priority should be given to engagement with DISCOMs, SDAs, and consumers to support capacity building. The whitepaper has highlighted the key findings from the behavioural pilot project in Delhi and possible savings for the DISCOMs from combining behavioural initiatives with smart meter data and consumer engagement tools. The case for behavioural energy efficiency is proven in Delhi, however, there is a need to scale up and work on awareness to build a case for behavioural energy efficiency. It makes sense to target DISCOMs with high level of residential consumer and also to examine how behavioural energy efficiency programs can be implemented with and without smart meters. In the near term or short term, emphasis should be given to set up behavioural energy efficiency pilots or programs across multiple geographical regions in India.

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Appendices

APPENDIX 1

Key statistics of participating DISCOMs (FY2021-22)

State	Total consumer base (no.)	Residential consumer base (%)	Average monthly consumption of residential consumers in urban areas (kWh)	Percentage of (residential) consumers opting for e-bill (%)
Odisha	27,92,773	91.08	242 kW	Nil
Bihar	57,89,783	87.66	-	All smart metered consumers receive e-bills.
Chhattisgarh	49,90,530	81.9	-	-
Rajasthan	50,22,789	78.3	470 MU by domestic consumers	-
Andhra Pradesh	APSPDCL – 1,02,73,687 and APEPDCL – 57,68,990	APSPDCL - 76 (FY18). APEPDCL - 85	-	-
Uttar Pradesh	2,87,11,917	89	-	-
Madhya Pradesh	55,30,536	68	706.8 MU	-
Maharashtra	2,78,52,094	74.74	300 kWh/month	79

APPENDIX 2

Survey responses

1. Existing DSM initiatives among the participating DISCOMs

State	DISCOM number	DISCOM name	1A. Existing DSM activities
Odisha	(DISCOM-1)	TPCODL	Appliance efficiency-based projects - LED lamps, BLDC fans, super EE ACs
Bihar	(DISCOM-2)	SBPDCL	Appliance efficiency-based projects - LED lamps, BLDC fans, super EE ACs; agricultural and municipal DSM programmes. In the agriculture sector, SBPDCL has installed efficient solar pumps. UJALA scheme through EESL has been implemented in the state. Bulb distribution; star labelling of power transformers and distribution transformers. Smart metering is being implemented rapidly.
Chhattisgarh	(DISCOM-3)	CSPDCL	Appliance efficiency-based projects - LED lamps, BLDC fans, super EE ACs; CSPDCL unified solar rooftop web portal; Grid-Connected Rooftop Solar Programme Phase II
Rajasthan	(DISCOM-4)	JVVNL	Appliance efficiency-based projects - LED lamps, BLDC fans, super EE ACs; agricultural and municipal DSM programmes; Kusum scheme; Grid-Connected Rooftop Solar Programme Phase II; UJALA scheme (distributed 81 lakh LEDs to residential consumers); UJALA LED scheme has picked up very well but energy efficient ACs have not picked up very well. BLDC fans are also being promoted under EESL programme. Agricultural pumpsets did not work well, hence shifting towards solar pumps and solar PV plants.

State	DISCOM number	DISCOM name	1A. Existing DSM activities
Andhra Pradesh	(DISCOM-5)	APSECM	Appliance efficiency-based projects - LED lamps, BLDC fans, super EE ACs; agricultural and municipal DSM programmes; DR pilot projects; training of trainers. APSPDCL has taken DSM measures targeting farmers with publicity through handouts, electronic media, etc. on installing EE pumpsets, the required rating of capacitors, high density polyethylene (HDPE) pipe lines at suction and delivery, and frictionless foot-valves to save energy and avail of subsidised tariffs.
Uttar Pradesh	(DISCOM-6)	UPPCL	Appliance efficiency-based projects - LED lamps, BLDC fans, super EE ACs; agricultural and municipal DSM programmes. 1. Bureau of Energy Efficiency's Municipality Demand Side Management (Mu-DSM) scheme to improve the overall energy efficiency of the urban local bodies (ULBs), which could lead to substantial savings in electricity consumption and related cost reduction for the ULBs. 2. Domestic Efficient Lighting Programme (DELP) scheme focuses on promoting energy efficiency and climate change mitigation by increasing the use of energy-efficient LED lighting at the residential level. It seeks to enhance consumer awareness about the efficacy of using efficient appliances. Aggregating demand, reducing the high initial costs, and consequently facilitating higher uptake of LED lights by residential users is the project's approach. Under the DELP scheme, each household with a connected load of 2 kW or less will be provided with up to five 7 W high-quality LED bulbs. Those with a connected load of more than 2 kW will be provided with up to ten 7 W high-quality LED bulbs. Agricultural DSM's aim is to create an appropriate framework for market-based interventions in the agricultural pumping sector, and pumpset efficiency upgradation projects have been carried out in public private partnership (PPP) mode.
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	Appliance efficiency-based projects - LED lamps, BLDC fans, super EE ACs; agricultural and municipal DSM programmes
Maharashtra	(DISCOM-8)	MSEDCL	Appliance efficiency-based projects - LED lamps, BLDC fans, super EE ACs; agricultural and municipal DSM programmes

State	DISCOM number	DISCOM name	1B. Outcomes of past DSM initiatives
Odisha	(DISCOM-1)	TPCODL	Reduction in energy usage (MU) is to be assessed. No data is available on reduction in peak demand (MW) and percentage reduction in distribution losses. Use of LED lights has increased substantially to about 1.87 crores against a consumer base of 27 Lakhs, whereas there is relatively low uptake of BLDC fans and EE ACs due to their comparatively higher price range.
Bihar	(DISCOM-2)	SBPDCL	-
Chhattisgarh	(DISCOM-3)	CSPDCL	Reduction in energy usage (MU), reduction in peak demand (MW), and percentage reduction in distribution losses have not been calculated. Reduction in energy usage observed.
Rajasthan	(DISCOM-4)	JVVNL	Reduction in energy usage (MU), reduction in peak demand (MW), and percentage reduction in distribution losses have not been calculated.
Andhra Pradesh	(DISCOM-5)	APSECM	-
Uttar Pradesh	(DISCOM-6)	UPPCL	Reduction in energy usage: 34,12,993 MWh per year; reduction in peak demand: 683 MW up to now. These outcomes are from the LED distribution programme under UPPCL.

Madhya Pradesh	(DISCOM-7)	MPPKVVCL	Reduction in energy usage: 2 MU. DSM initiatives being implemented up to 2024 are projected to result in 1 MW of load reduction and electricity savings of 244 crore units.
Maharashtra	(DISCOM-8)	MSEDCL	Reduction in energy usage: 1286.53 MU; reduction in peak demand: 49 MW

State	DISCOM number	DISCOM name	1C. DISCOM preferences regarding regulatory measures
Odisha	(DISCOM-1)	TPCODL	a. Most favoured: New central government scheme for revival of the power distribution sector in India, focused on decreasing AT&C losses and cost-revenue gap. b. Least favoured: Ministry of Power Notification to include all DISCOMs under Energy Conservation Act
Bihar	(DISCOM-2)	SBPDCL	-
Chhattisgarh	(DISCOM-3)	CSPDCL	a. Most favoured: Mandates for smart meter installation for consumers above a certain consumption limit. b. Least favoured: Draft regulations for allowing demand side participation in ancillary services
Rajasthan	(DISCOM-4)	JVVNL	a. Most favoured: Mandates for smart meter installation for consumers above a certain consumption limit. b. Least favoured: Ministry of Power Notification to include all DISCOMs under Energy Conservation Act
Andhra Pradesh	(DISCOM-5)	APSECM	a. Most favoured: Ministry of Power Notification to include all DISCOMs under Energy Conservation Act. b. Least favoured: Draft regulations for allowing demand side participation in ancillary services
Uttar Pradesh	(DISCOM-6)	UPPCL	-
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	-
Maharashtra	(DISCOM-8)	MSEDCL	a. Most favoured: Provisions to include demand-side savings under Renewable Purchase Obligation. b. Least favoured: New central government scheme for revival of the power distribution sector in India focused on decreasing AT&C losses and cost-revenue gap

State	DISCOM number	DISCOM name	1D. Future DSM initiatives
Odisha	(DISCOM-1)	TPCODL	Promoting use of EE appliances like BLDC fans, EE ACs, and EE motors, along with rooftop solar installation among domestic consumers.
Bihar	(DISCOM-2)	SBPDCL	Star labelling of power and distribution transformers. Smart metering target is 23.5 lakh units by July 2022 for urban consumers, with 3.5 lakh units already installed. LED scheme is currently operational. Suvidha app for providing information to consumers for peak load.
Chhattisgarh	(DISCOM-3)	CSPDCL	Action plan has been proposed under DISCOM capacity building programme.
Rajasthan	(DISCOM-4)	JVVNL	Grid-Connected Rooftop Solar Programme. Automated data logging of supervisory control and data acquisition (SCADA)/DSM system on distribution transformers and feeders. For rooftop solar, 295 MW is already installed under JVVNL; 25 MW is still pending.

State	DISCOM number	DISCOM name	1D. Future DSM initiatives
Andhra Pradesh	(DISCOM-5)	APSECM	After purchasing eco-friendly cars for their operations, Andhra Pradesh Eastern Power Distribution Company Ltd (APEPDCL) is now planning to energise its DSM programme, adopting smart grids and Internet of Things (IoT). The new programme will help the DISCOM save crores of rupees. The DSM programme covers major segments such as agricultural pumpsets, residential/commercial ACs, and industrial units.
Uttar Pradesh	(DISCOM-6)	UPPCL	Installation of smart meters and other equipment.
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	MPPKVVCL is waiting for ARR approval to start EE programmes focused on AC replacement, replacement of incandescent lights with LEDs, and deployment of highly efficient pump motors.
Maharashtra	(DISCOM-8)	MSEDCL	-

2. DISCOM understanding of BEE

State	DISCOM number	DISCOM name	2A. Benefits of BEE programmes	2B. Benefits of BEE interventions	2C. Propensity towards BEE in absence of smart meters	2D. HER pilot programme awareness
Odisha	(DISCOM-1)	TPCODL	Quick and easy initiative for utilities to deploy; immediately verifiable results; strengthens impact of related EE programmes; cost-effective programme scalability	Savings from peak management through load shifting; savings from deferral of network capacity addition; reduction in operational cost for consumer engagement; nudges that result in increased adoption of EE appliances	Yes	No
Bihar	(DISCOM-2)	SBPDCL	Quick and easy initiative for utilities to deploy; strengthens impact of related EE programmes; cost-effective programme scalability	Savings from peak management through load shifting; savings from deferral of network capacity addition	Yes	Yes
Chhattisgarh	(DISCOM-3)	CSPDCL	Quick and easy initiative for utilities to deploy; cost-effective programme scalability	Savings from deferral of network capacity addition; savings from power purchase portfolio optimisation	No	No

State	DISCOM number	DISCOM name	2A. Benefits of BEE programmes	2B. Benefits of BEE interventions	2C. Propensity towards BEE in absence of smart meters	2D. HER pilot programme awareness
Rajasthan	(DISCOM-4)	JVVNL	Quick and easy initiative for utilities to deploy; strengthens impact of related EE programmes; cost-effective programme scalability	Savings from peak management through load shifting; savings from deferral of network capacity addition; nudges that result in increased adoption of EE appliances	No	Yes
Andhra Pradesh	(DISCOM-5)	APSECM	Cost-effective programme scalability	Savings from peak management through load shifting; savings from deferral of network capacity addition; reduction in electricity-related emissions	Yes	No
Uttar Pradesh	(DISCOM-6)	UPPCL	Quick and easy initiative for utilities to deploy; cost-effective programme scalability	-	No	Yes
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	-	Savings from peak management through load shifting; savings from deferral of network capacity addition; reduction in operational cost for consumer engagement; nudges that result in increased adoption of EE appliances	Yes	Yes
Maharashtra	(DISCOM-8)	MSEDCL	Cost-effective programme scalability	Savings from peak management through load shifting; savings from power purchase portfolio optimisation; reduction in operational cost for consumer engagement	Yes	Yes

3. DISCOM preferences for cost-saving measures

State	DISCOM number	DISCOM name	3A. Preferred strategy to reduce cost of supply
Odisha	(DISCOM-1)	TPCODL	a. High priority: deferral of cost for upgrade of distribution network. b. Low priority: optimising operational costs by reducing consumer engagement expenditure
Bihar	(DISCOM-2)	SBPDCL	a. High priority: reduction in peak power procurement costs (both PPA and markets). b. Low priority: reduction in fixed cost of power procurement for plants used for fewer hours
Chhattisgarh	(DISCOM-3)	CSPDCL	a. High priority: reduction in peak power procurement costs (both PPA and markets). b. Low priority: optimising operational costs by reducing consumer engagement expenditure
Rajasthan	(DISCOM-4)	JVVNL	a. High priority: reduction in peak power procurement costs (both PPA and markets). b. Low priority: reduction in fixed cost of power procurement for plants used for fewer hours
Andhra Pradesh	(DISCOM-5)	APSECM	a. High priority: reduction in peak power procurement costs (both PPA and markets). b. Low priority: Optimising operational costs by reducing consumer engagement expenditure
Uttar Pradesh	(DISCOM-6)	UPPCL	-
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	
Maharashtra	(DISCOM-8)	MSEDCL	a. High priority: reduction in peak power procurement costs (both PPA and markets). b. Low priority: deferral of cost for upgrade of distribution network

State	DISCOM number	DISCOM name	3B. Estimating savings in reduction of cost of supply	3C. Recognition of no additional expense benefit	3D. Recognition of additional income benefit	3E. Willingness to share data
Odisha	(DISCOM-1)	TPCODL	No	Yes	No	Yes
Bihar	(DISCOM-2)	SBPDCL	Quantification of savings is done with EESL.	Yes	No	No
Chhattisgarh	(DISCOM-3)	CSPDCL	Yes	Yes	Yes	Yes
Rajasthan	(DISCOM-4)	JVVNL	No	Yes	No	Yes
Andhra Pradesh	(DISCOM-5)	APSECM	Yes	Yes	Yes	Yes
Uttar Pradesh	(DISCOM-6)	UPPCL	No	-	-	-
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	-	-	-	-
Maharashtra	(DISCOM-8)	MSEDCL	No	Yes	Yes	-

4. DISCOM perspective on consumer engagement

State	DISCOM number	DISCOM name	4A. Importance of consumer engagement in DISCOM operations	4B. Strategies employed for consumer engagement
Odisha	(DISCOM-1)	TPCODL	High	Social media; electricity bills/pamphlets/flyers. Customer care centres have been established at the divisional level to have direct contact with consumers.
Bihar	(DISCOM-2)	SBPDCL	High	Social media; electricity bills/pamphlets/flyers
Chhattisgarh	(DISCOM-3)	CSPDCL	Medium	Electricity bills/pamphlets/flyers
Rajasthan	(DISCOM-4)	JVVNL	High	Social media; electricity bills/pamphlets/flyers. Total revenue management (TRM) with spot billing has already been implemented in Dholpur and is being rolled out in other circles. For greater consumer satisfaction, the 'Any Where Any Time' energy bill collection project has been implemented in Jaipur. The centralised call centre has been operationalised with a Customer Management System, which shall cover fault rectification and other consumer services. Support will be provided through the toll-free number for high-risk points, burnt distribution transformers (DTs), theft, misbehaviour of employees, and other technical grievances. Automatic meter reading (AMR)-based DT metering in all Revised Accelerated Power Development and Reform Programme (RAPDRP) towns has started. For consumer satisfaction, on-demand meter testing at consumers' premises has been implemented in all circles; the consumer may request meter testing via telephone. The company has been constantly striving to eliminate any avoidable delays in providing new connections and uninterrupted power supply.
Andhra Pradesh	(DISCOM-5)	APSECM	High	Social media; school campaigns for energy education for students; door-to-door interactions; electricity bills/ pamphlets/flyers; awareness raising programmes for domestic, industrial, and commercial customers. Engaged with farming community for agricultural DSM initiatives. Consumer awareness campaigns are being conducted across municipal corporations. Partnership with (women) SHGs on energy conservation measures.
Uttar Pradesh	(DISCOM-6)	UPPCL	Medium	Social media; electricity bills/pamphlets/flyers
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	Medium	Social media; door-to-door interactions; electricity bills/pamphlets/flyers
Maharashtra	(DISCOM-8)	MSEDCL	High	Electricity bills/pamphlets/flyers

State	DISCOM number	DISCOM name	4C. Presence of feedback mechanism	4D. Average annual costs associated with consumer engagement	4E. Details of expenditure on consumer engagement	4F. Awareness on consumer engagement cost savings through BEE
Odisha	(DISCOM-1)	TPCODL	No	50 lakhs	No	No
Bihar	(DISCOM-2)	SBPDCL	Yes. Through the Suvidha app, DISCOM sends messages to consumers re: peak loads and to switch off appliances.	-	No	Yes
Chhattisgarh	(DISCOM-3)	CSPDCL	Yes	NA	No	Yes
Rajasthan	(DISCOM-4)	JVVNL	No	-	-	No
Andhra Pradesh	(DISCOM-5)	APSECM	-	-	Yes	Yes
Uttar Pradesh	(DISCOM-6)	UPPCL	No	NA	No	Yes
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	No	-	No	-
Maharashtra	(DISCOM-8)	MSEDCL	-	-	-	Yes

5. DISCOM operational factors related to BEE

State	DISCOM number	DISCOM name	5A. Energy consumption patterns of residential consumers (last 5 years)	5B. Focus on environmental benefits
Odisha	(DISCOM-1)	TPCODL	No	Yes; environmental savings is a priority area for which a dedicated team has been deployed under DSM.
Bihar	(DISCOM-2)	SBPDCL	-	-
Chhattisgarh	(DISCOM-3)	CSPDCL	No	Yes; one of the top priorities, along with consumer satisfaction, in line with company's benefit.
Rajasthan	(DISCOM-4)	JVVNL	Yes	-
Andhra Pradesh	(DISCOM-5)	APSECM	Yes, percentage increase of 4.9% (2014-2018) for APSPDCL. 14% (FY2014-18) for APEPDCL.	-
Uttar Pradesh	(DISCOM-6)	UPPCL	Yes, percentage increase of 4.57%	Yes, UPPCL is focusing on peak demand reduction through its DSM initiative in order to reduce emissions.
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	Yes	-
Maharashtra	(DISCOM-8)	MSEDCL	Yes	Uses renewable energy-based power

State	DISCOM number	DISCOM name	5C. Challenges in implementing BEE initiatives	5D. Accounting for consumer engagement expenditure	5E. Recurring challenges	5F. Willingness to share data
Odisha	(DISCOM-1)	TPCODL	Cost of conducting a BEE programme; labour shortage; technical expertise within the DISCOM	Consumer engagement costs are a part of TPCODL's operational expenditure.	Monetary implications for both the DISCOM and consumers and the lack of visibility of immediate benefits. Creating mass awareness and regulatory approvals.	Yes, in accordance with the data sharing policy of TPCODL.
Bihar	(DISCOM-2)	SBPDCL	-	-	-	No
Chhattisgarh	(DISCOM-3)	CSPDCL	Lack of scalability; labour shortage; low participation rate	No such system is in place for accounting.	Lack of investment/ funding	No
Rajasthan	(DISCOM-4)	JVVNL	Cost of conducting a BEE programme; participation rate	MNRE provides funding for promotional activities.	Shortage of funds	Yes
Andhra Pradesh	(DISCOM-5)	APSECM	Cost of conducting a BEE programme; labour shortage	Non-bill financing model	DISCOM facing financial crisis.	Yes
Uttar Pradesh	(DISCOM-6)	UPPCL	Lack of scalability; labour shortage; technical expertise within the DISCOM; participation rate	-	Inadequate workforce and skills for understanding the DSM initiatives	Yes, but only if the order comes from the senior authority.
Madhya Pradesh	(DISCOM-7)	MPPKV-VCL	Cost of conducting a BEE programme; financial crunch and approval process	Funding - for the domestic sector, the investment level is INR 3216 crore, and for agriculture, it is INR 10683 crores.	-	-
Maharashtra	(DISCOM-8)	MSEDCL	-	-	-	-

State	DISCOM number	DISCOM name	5G. DISCOM's smart metering plan
Odisha	(DISCOM-1)	TPCODL	Smart meter deployment is under implementation.
Bihar	(DISCOM-2)	SBPDCL	Target of 23 lakh smart meters by July 2022. Up to now, 3.5 lakh have already been installed. All smart meter consumers receive e-bills. Smart metering produces data that is transferred to consumers through the Suvidha app (also known as Bihar Bijli Smart App). Main aim is to manage the peak load. Integration of this data is done by Accenture. Smart metering is primarily being rolled out in urban areas.
Chhattisgarh	(DISCOM-3)	CSPDCL	CSPDCL is preparing a tender for implementation of smart meters.
Rajasthan	(DISCOM-4)	JVVNL	Total number of smart meters installed through March 2021 is 15783. Total customers are 4,30,871.
Andhra Pradesh	(DISCOM-5)	APSECM	Smart metering plan's first phase, i.e. installing them in all government offices, is complete. Smart metering planning for residential sector is planned next. The introduction of smart meters, as indicated in the submissions, will provide the utilities access to more accurate hourly or 15-minute load profiles. These can be used to more effectively analyse how load profiles are changing over time and estimate future load profiles. Equally important, aggregate load data with high spatial and temporal granularity should be published periodically. Progress is 2583, and target is 253392. Providing smart meters to the consumers with over 100 units of consumption - INR 2106 Cr. over a period of 10 years.
Uttar Pradesh	(DISCOM-6)	UPPCL	Initiative to replace the existing meters with smart ones in all the 47 towns covered under the RAPDRP, as well as in the rural areas in the district of Varanasi.; Drive to replace the existing meters with smart ones in all the 47 towns covered under the Revised Accelerated Power Development and Reform Programme (RAPDRP) as well as in the rural areas in the district of Varanasi.
Madhya Pradesh	(DISCOM-7)	MPPKVVCL	60-70% smart metering has been completed. The company implemented the first smart metering project in India over RF (865-867 Mhz) on a large scale for 1.2 lakh consumers in Indore City. Thanks to smart meter implementation, accurate and timely billing data, real-time monitoring of loading, unbalancing, hourly consumption data, and info on DTR health is available to the company, with substantial reduction in manpower and vehicle deployment, as more than 59,919 successful remote disconnections/ reconnections were done during the 2019-20 financial year. Also, the consumer can check their real-time consumption through the mobile app. In 2019-20, there was a net increase of 42.65 MUs in sold units, leading to a 14.98% improvement in the billing efficiency of the selected feeder of smart metering, from 66% at baseline to 80.98 percent.
Maharashtra	(DISCOM-8)	MSEDCL	-

APPENDIX 3

Scoring methodology applied to the survey responses

There are three main types of questions in the DISCOM questionnaire:

1. Selecting applicable options
2. Ranking high to low in terms of preference/priority
3. Closed questions (Yes/No)

The objective of the analysis was to gauge DISCOM propensity to BEE, and questions were chosen accordingly. The manual used to allot scores to the questions is summarised below:

1. Selecting applicable options: Each question had 5 options to select. Thus, for each option selected, a score of 1 was allotted, and the maximum score for this type of question was 5.

2. Ranking high to low priority: The responses to these questions were restricted to High, Medium and Low. Scores were allotted as follows:

High	5
Medium	3
Low	1

3. Closed questions: The score was allotted as shown below:

Yes	5
No	1

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