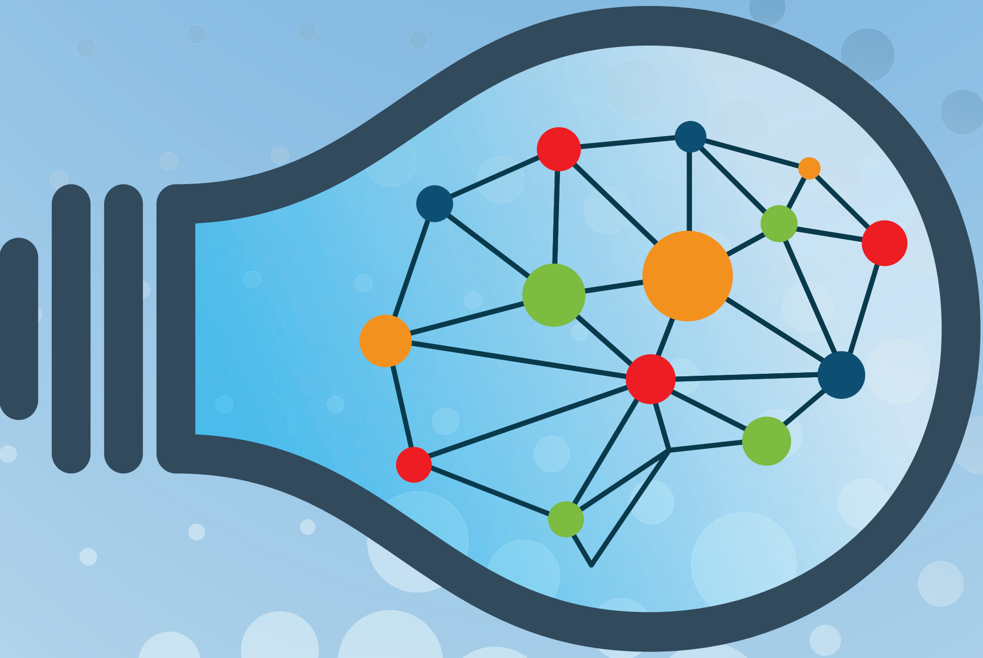

Behavioural Energy Efficiency Potential for India

WHITE PAPER / 2019

Alliance for an Energy Efficient Economy

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Behavioural Energy Efficiency Potential for India

This White Paper was co-authored by the Alliance for an Energy Efficient Economy (AEEE) and Oracle Utilities. The individuals most responsible for the development of this paper are as follows:

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Executive Summary

India's building sector energy consumption is expected to grow by an average of 2.7% per year from 2015 to 2040, more than twice the global average. About 70% of this building sector energy demand will come from the residential sector. In this light, it is important to explore innovative interventions, particularly those that would help avoid costly augmentation of generation, transmission and distribution capacities. To this end, utility-led demand-side management (DSM) programmes represent a significant and largely untapped potential for realising grid-wide energy efficiency gains in India.

India is ideally positioned to leverage the many benefits of DSM programmes:

- Firstly, India's fast-growing residential sector will be key to achieve these gains;
- Secondly, the timing for large-scale DSM programmes is ripe, as the Government of India is creating an enabling ecosystem with the launch of UDAY and similar schemes, as well as large-scale deployment of advanced metering infrastructure (AMI), such as through the Smart Meter National Programme (SMNP) of Energy Efficiency Services Limited (EESL).

Although appliance replacement/ home retrofit-based utility-DSM activities have seen progress in recent years, embracing even more innovative DSM approaches is crucial to unlocking incremental energy savings in a sustained manner. International experience demonstrates, for example, that electricity distribution utilities globally have been able to achieve on average 1% to 3% energy savings per household in a reliable and cost-effective manner simply by sending domestic/ residential consumers Home Energy Reports (HERs), which use a mix of data analytics and behavioural science to not only help utility customers understand their energy usage better, but also empower them to take steps to adopt more efficient behaviours where it makes sense for them to do so. **Behavioural energy efficiency**, as these programmes are called, not only help individual customers to save energy—and save money on their monthly energy bills—their impact on consumption patterns on an aggregate level are significant enough so as to flatten the load curve at a grid-wide scale.

This kind of intervention is largely a new concept to Indian utilities and regulators. However, BSES Rajdhani Power Limited (BRPL), with Oracle Utilities—and with the help of two lakh domestic customers chosen for this pilot programme in BRPL's Delhi-based service area—is testing a territory-wide Home Energy Report (HER) programme for the first time in India. The novelty of this programme has prompted the synthesis of this white paper. By illustrating the programme mechanics, presenting relevant case studies, and highlighting the conducive ecosystem needed to enable the scaling of such programmes at a national level, this white paper attempts to evaluate the potential aggregate impact (direct energy benefits as well as indirect non-energy benefits) if such behavioural energy efficiency programmes were delivered across all of India.

Preliminary assessment of India's behavioural energy efficiency potential, based on international experience (which consistently shows an average of 1% to 3% energy savings per household), indicates energy savings potential across India to the tune of 3400 to 10200 GWh per annum by 2030, which translates to about 1800 to 5300 ktCO_2 of yearly GHG mitigation, and customer cost savings in the range ₹ 17 to 51 billion annually. Looking across a smaller subset of 13 representative Indian states where effective behavioural energy efficiency programmes could be deployed immediately (i.e. where behavioural DSM programmes are a "low-hanging fruit" due to particularly conducive factors such as lower AT&C losses, more rapid progress in smart meter roll-outs, and/or higher average per-household energy consumption), total energy savings per annum would be in the range of 720-2140 GWh within two years, with resulting CO_2 emissions reduction to the tune of 450-1330 million tonnes of CO_2 annually.

With this quickly scalable, cost-effective, and easily-implementable savings potential from behavioural programmes in mind, this whitepaper highlights the importance of utility actions and policy and regulatory reforms to tap this huge opportunity going forward.

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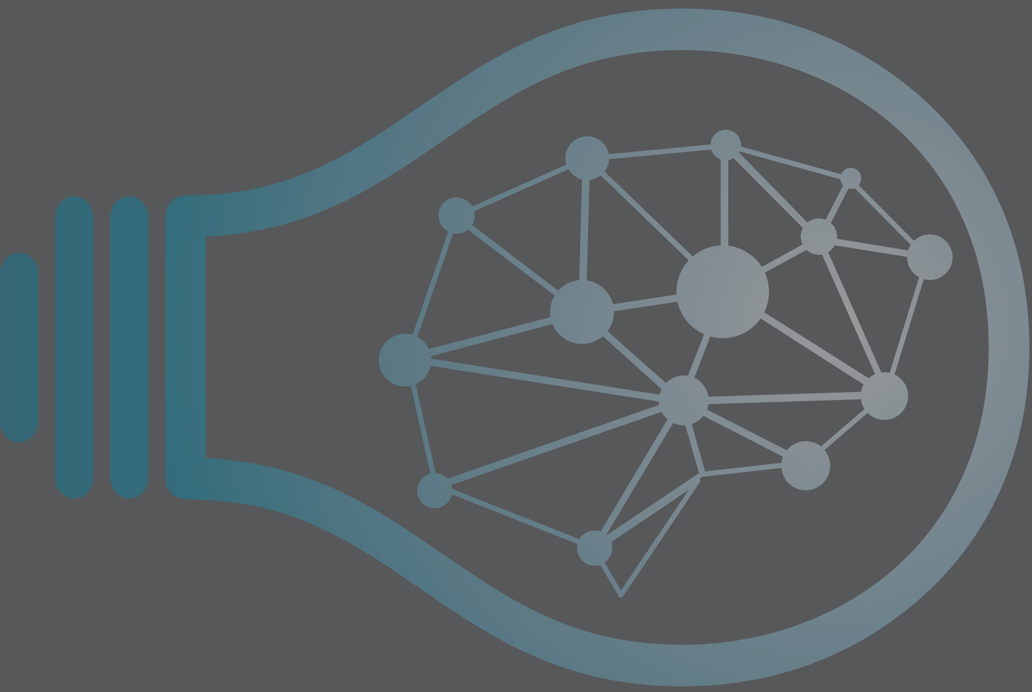

Context

India is expected to continue to be one of the fastest-growing economies in the world over the next several decades. The combined impact of rapid economic growth, rising per capita income, growing population, and accelerated urbanization in a largely tropical climate, is expected to drive up India's building sector energy consumption faster than anywhere in the world—by an average of 2.7% per year between 2015 and 2040, more than twice the global average increase (U.S. Energy Information Administration, 2017).

A majority of this growth (about 70%) in building sector energy demand in India is driven by the residential (domestic) sector. As more people have access to electricity and ownership of electric appliances (particularly air conditioners) grows, it is expected that residential electricity consumption will increase nearly twice as fast as the total residential energy use (electricity and fuels combined) from 2015 to 2040 (IEA, 2017b). Assuming no significant change under a business-as-usual scenario, India's residential electricity demand has been predicted to increase eightfold by 2050 (Rawal & Shukla, 2014).

India is experiencing the fastest growth in both floor area and energy demand globally. Under a business-as-usual scenario, India's residential electricity demand is predicted to increase eight-fold by 2050.

While this growth in electricity demand is inevitable in light of India's economic progress, and is essential for the well-being and productivity of its people, the significant increase in additional power generation capacity required, the peak load impacts, and resultant increased emissions (as fossil fuels account over 80% of electricity generation) are squarely at odds with India's global climate change commitments and pose severe environmental and societal risks. In recognition of these challenges, India's Nationally Determined Contributions (NDCs) position the building sector as a policy priority and at the centre of national energy and climate policies going forward.

International experience suggests that with the support of forward-looking legal, regulatory and policy frameworks in the electricity sector, demand-side management (DSM) programmes offer a major opportunity to reduce power demand in the building sector, save on energy costs, and avoid costly capital investment towards augmentation of capacity for electricity generation, transmission and distribution. However, DSM programmes are largely non-existent for India's residential sector today, representing significant untapped potential for achieving grid-wide energy efficiency gains.

Why Demand-Side Management

Demand-side management (DSM) refers to practices that encourage the management of demand for energy in such a way as to maximise the utilization of existing generation capacity. As a "power source" that does not need to be generated in the first place, DSM is the cheapest and cleanest option among all energy resources (Molina, 2014). DSM approaches include promoting more efficient use of year-round power, i.e. improving energy efficiency, or adjusting demand strategically during times when power supply is constrained, especially during peak demand in the winter or summer months, through demand response mechanisms. Either approach (energy efficiency and/or demand response) effectively generates utilizable energy by freeing up available supply to meet demand.

Energy savings from the introduction of dramatically scaled DSM programmes can potentially replace retiring power plants or defer or displace the need for new generation or transmission investments altogether (Billingsley et al, 2014). In India in particular, where imported fuels now account for at least two-thirds of the energy supply (per the Ministry of Power, Government of India), introduction of utility-scale DSM programmes can reduce dependence on fuel imports, reduce India's negative balance of payments, and increase economic competitiveness.

Fostering a robust market for utility led DSM not only promotes energy security and long term environmental/ climate policy goals, it also has widespread economic benefits, including job creation and investment in innovative clean energy technologies and services.

In the United States, for example, the American Council for an Energy Efficient Economy (ACEEE) forecasts that by 2030, in addition to resulting in an astounding 600 million tons of CO_2 savings, current markets for DSM will yield USD $47 billion in new investment, 610,000 new jobs, and a USD $95 billion reduction in household energy expenditures savings which can then be reinvested in other parts of the economy (Hayes et al, 2014).

As Indian policymakers deliberate how to integrate safe, reliable, and resilient energy into the nation's energy mix, discussion has generally focused on the generation side. However, just as important is how to further secure ongoing gains in high-potential demand-side management, such as cost-effective energy efficiency and demand response. And here, the fast-growing residential sector is key, representing India's greatest untapped resource for achieving these gains.

India's Upcoming Nationwide Smart Meter Rollouts Provide Ideal Timing

The timing for large-scale residential DSM programmes is ripe, especially as the Government of India is enabling advanced metering infrastructure (AMI) nationwide, such as through EESL's Smart Meter National Programme (SMNP). The SMNP, which aims to replace 250 million conventional meters with smart meters, provides an unprecedented opportunity to engage consumers with DSM programmes tailored to each household.

While justifications for this massive AMI investment have tended to focus on the obvious administrative and operational benefits of smart meters (e.g. technical losses & outage detection, reducing maintenance costs, meter-to-bill processing, etc.), it should be noted that smart metering infrastructure also unlocks an invaluable opportunity to engage the residential sector in energy efficiency and demand response programmes (Exhibit 1).

Baltimore Gas and Electric (BGE), an investor-owned utility in the U.S., and its parent company, Exelon, decided to complement their investment in smart meters with a demand response programme to achieve energy savings during high-cost peak hours (in addition to their on-going year-round energy efficiency programmes). This parallel strategy enabled BGE to reduce peak demand in a reliable way, resulting in over 300 MW of peak demand reduction each year, and alleviating the need for cost-intensive peaking power plants during the summer peak season —while increasing customer engagement and satisfaction at the same time.[1]

1 BGE is then able to sell these energy and peak demand reductions directly into the PJM wholesale market. These savings generate dollar benefits for customers through avoided costs and wholesale energy price suppression. For more, see: https://www.utilitydive.com/news/behavioral-demand-response-gives-baltimore-gas-and-electric-a-business-reas/546895/

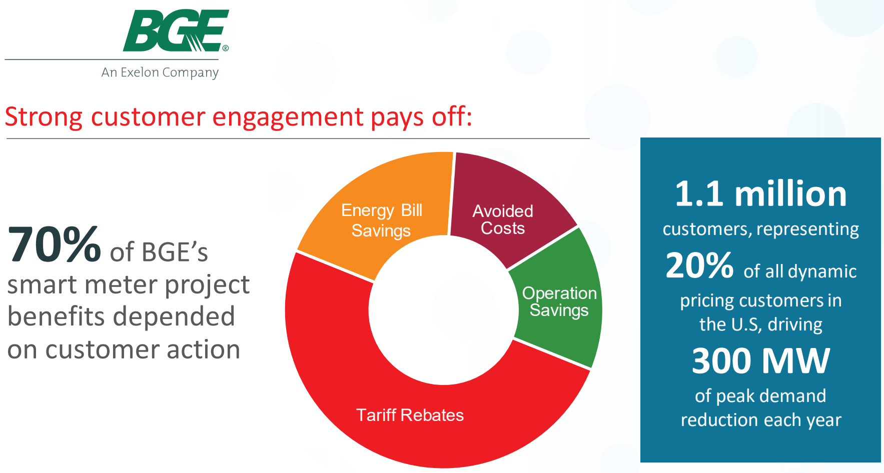

Exhibit 1: 70% of BGE's smart meter project benefits depended on customer action

Installation of smart meters, along with associated IT-enabled communications infrastructure, will pave the way for various customer-facing initiatives by DISCOMs—like management of peak demand, providing real-time energy consumption data to each and every consumer, and allowing for time-based rate options, thus helping customers to understand and manage their energy consumption while saving money.

Utilities that can find ways of unlocking the energy efficiency potential in India's residential sector in this way will not only help individual end-users become more conscientious and efficient consumers of energy, they can also help to alleviate India's growing national energy challenges.

Creating the Right Ecosystem to Advance Residential DSM Programmes

Existing DSM Policy Landscape in India

The governing legislative framework for India's electricity sector, the Electricity Act of 2003, was enacted with the primary objective to restructure and reform the ailing electricity sector. Although it empowers the State Electricity Regulatory Commissions (SERCs) to regulate tariffs for DISCOMs on the premise of competition, efficiency, economical use of resources, efficient performance and optimal investments, DSM is not explicitly promoted as a means of achieving these objectives. The work-in-progress Electricity (Amendment) Act also does not explicitly promote DSM as an alternative resource option for distribution licensees.

In January 2016, the Government of India made some important amendments to the tariff policy,[2] some of which could help to promote DSM initiatives, but only tangentially. For example:

- Encouragement to SERCs to mandate smart meter installation for consumers with monthly consumption of 500 units and more by end of 2017, and those with monthly consumption above 200 units by end of 2019 (the logic being that smart meter rollout would hasten introduction of Time of Use tariffs for domestic consumers).
- Encouragement to the state Commissions to mandate a Renewable Power Obligation (RPO). Savings from demand-side resources may be considered under RPO in the days to come, but this will require the inclusion of relevant provisions.

2 The National Tariff Policy, ratified in 2006, lays down the general approach for tariff design and stipulation by SERCs, generation capacity planning by utilities, setting renewable purchase obligations by state Commissions, procurement of power from non-conventional energy sources, implementation of Multi-Year Tariff (MYT) framework and several other important regulatory aspects in generation, transmission and distribution segments of the power sector with the aim of delivering electricity at most efficient rates to protect the interests of consumers.

Despite this progress, overall, there is lack of recognition of “DSM” as an alternative energy resource in India’s national electricity legislation and policies. In recent years, DSM initiatives have begun to attract regulatory attention at the state level—starting in 2010, for example, when the Maharashtra Electricity Regulatory Commission (MERC) introduced regulations for a ‘DSM Implementation Framework’ and ‘DSM Measures and Programme’s Cost-Effectiveness Assessment’, the first such regulatory action in India. This was followed by formulation of ‘Model DSM Regulations’ in the same year by the Forum of Regulators Working Group. As of April 2016, 19 states have since established frameworks for undertaking DSM measures by DISCOMs. However, this does not necessarily imply that the DISCOMs in these states are obligated to implement DSM measures unless directed by SERCs.

In order to accelerate and scale DSM programmes in India quickly, an enabling ecosystem is important. And to this end, the role of utilities (DISCOMS) and an effective policy framework are key in ensuring that the full savings potential and benefits of DSM programmes may be realised.

The Important Role of Utilities/DISCOMS

To consolidate and aggregate the dispersed demand of Indian residential consumers and create an environment in which DSM benefits can be realised at a grid-wide scale, it is necessary to enlist the cooperation of energy providers, who already have established brands, customer relationships, and communications channels that reach each and every end-use customer. In the more mature DSM markets around the world (such as the United States and Europe), regulators have deemed that working with energy providers to deliver these programmes through their domestic customer base is the most effective means of promoting residential DSM (Exhibit 2).[3]

Working with energy providers enables the launch of large scale DSM programmes, and consequently creates a market for various DSM innovations. This is the logic that underpins the Energy Efficiency Resource Standards (EERS) policies adopted across most U.S. states, for example.

An EERS is a performance based policy mechanism that obliges energy providers to reach a certain percentage of energy savings over a specific timeframe (usually relative to the previous year’s total energy sales), and compensates the provider for these efforts (e.g. for programme expenses, lost revenue from decreased sales, etc.), via a regulator approved tariff.[4] Though the responsibility for meeting EERS targets lies with the energy provider, achieving the intended energy savings ultimately depends on effectively engaging end use customers to implement DSM programmes.

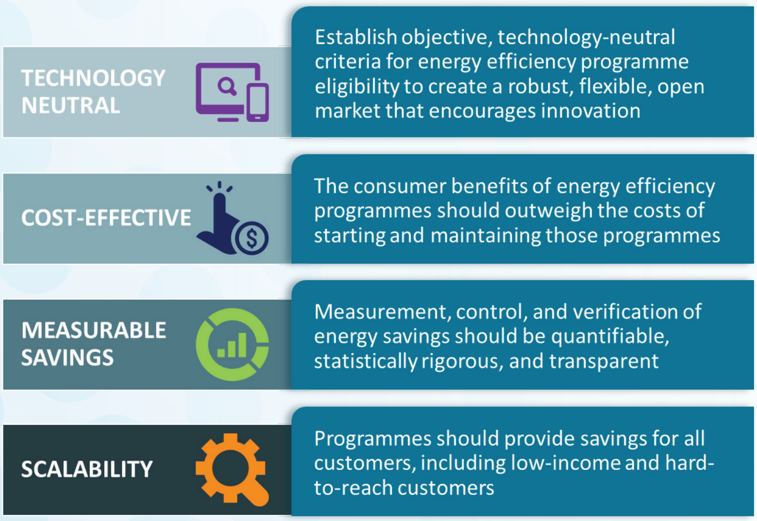

Exhibit 2: Common elements of utility-led DSM-enabling programmes and policies in mature markets

3 See, for example, U.S. Department of Energy guidance on this (https://www4.eere.energy.gov/seeaction/system/files/documents/ratepayer_efficiency_customersatisfaction.pdf), as well as U.S. EPA guidance (http://www.epa.gov/cleanenergy/documents/suca/napee_chap6.pdf) to this effect.

4. EERSs are similar conceptually to renewable portfolio standards (which require utilities to purchase a certain percentage of power from renewable energy sources, to support market development), only applied to the demand side.

Establishing Policy Frameworks that Make DSM a "Win-Win-Win" for Consumers, Energy Providers, and Society as a Whole

To enable every household to benefit from innovative approaches to energy savings and encourage energy providers to engage consumers in such efforts, India must establish a system to adequately incentivise DISCOMs to take the counterintuitive step (for utilities, anyway) of encouraging their customers to use less energy, rather than more.

Regulators around the world have come up with a variety of means of incentivizing energy providers to do so, using regulatory/policy mechanisms that have generally focused on the following steps[5]:

Rewarding utilities' DSM investments: To align the commercial interests of energy providers with policymakers' and regulators' objectives, it is important to consider financial mechanisms that eliminate negative incentives and create positive incentives for energy providers to offer DSM programmes, such as the following:

- Cost recovery of direct DSM programme implementation costs, as well as any resulting lost margin/revenues from decreased electricity sales—otherwise, energy providers cannot recover capital/asset costs and meet fixed-cost contributions. This could include, for example:
    - Decoupling: This policy breaks the link between the amount of energy a utility delivers to customers and the revenue it collects. Instead, revenues are adjusted so that utilities receive fair compensation to cover their costs, and to provide a fair return to shareholders delinked from fluctuations in sales (Migden-Ostrander et al, 2014).
    - Capitalization of operating expenses: This policy additionally allows utility operating expenses for DSM programmes to be treated as capital expenditures, which are then able to earn an authorised return on investment at par with other capital assets in the utility's rate base, amortised over a number of years (Downs & Cui, 2014).
- Ideally, cost recovery should be paired with performance-based incentives for meeting or exceeding targets, such that energy providers can continue to create shareholder value by running DSM programmes that generate greater returns than traditional sales of kWh of electricity alone, while increasing customer satisfaction at the same time (Hayes et al, 2011).

Incentivizing innovation: Innovative policy mechanisms, such as the EERS schemes adopted across the United States, have created markets for a wide variety of technologies and services by giving obligated energy providers the flexibility to select and deliver myriad verifiable energy-saving solutions to their customers—and allowing solution revisions along the way (Neme et al, 2012).

- Emphasizing technology-neutral rules and competition based on cost-effectiveness guidelines when selecting means to meet EE targets creates level playing fields for energy efficiency technologies and services and encourages innovative solutions.
- Rules that prioritise clear end goals over means enable new energy efficiency approaches to enter the market and succeed in achieving targets. By contrast, rules that limit eligibility to specific measures stifle innovation.

Ensuring transparent measurement and verification of results: Rigorous protocols for measurement and verification (M&V) are a key prerequisite for encouraging effective DSM investments and energy-saving innovation.

- Best international practice points to statistically rigorous and robust M&V using randomised control trials and post-programme baseline comparisons of energy savings (Baatz et al, 2016).

5 See, for example, IEA (2017a) for a complete picture of the range of regulatory policy mechanisms used to promote utility-led DSM around the world (report co-authored by the International Energy Agency (IEA) and the Regulatory Assistance Project (RAP)): https://www.iea.org/publications/insights/insightpublications/MarketBased_Instruments_for_Energy_Efficiency.pdf

Accounting for both energy savings impact as well as "non-energy" benefits of DSM programmes: Cost effectiveness evaluations of utility-led DSM programmes should consider the many diverse benefits produced by DSM in addition to energy and demand savings, which are generally referred to as non-energy benefits (NEBs), or "co-benefits" of DSM programmes (Freed & Felder, 2017).

NEBs may be divided into three main categories: utility, participant and societal benefits.

- Examples of utility NEBs are transmission and/or distribution savings, reduced payments arrearages, and reduced carrying costs, lower cost to serve/ lower collection costs, higher customer engagement and customer satisfaction.
- Participant NEBs are impacts that accrue to the utility customer, whereas societal NEBs are those that are realised by the public, not just the participants in utility programmes. Examples of participant NEBs are bill savings, energy literacy and empowerment better energy choices, equitability / accessibility for all, even the hardest-to-reach customers (including renters, low-income and elderly households, etc.), enhanced comfort, health and wellbeing.
- Examples of NEBs realised by society at large as externalities include public health impacts, reductions in greenhouse gas emissions, water and environmental impacts, and local economic development and employment effects, as well as resiliency and energy security benefits.

Accounting for NEBs allows for the full value of energy efficiency to be captured, and is used, for example, in cost-effectiveness testing of utility DSM programmes in many U.S. states. Including NEBs in these analyses ensures that utilities can use NEBs to better account for the value of energy efficiency as a grid resource, as well as to refine and maximise the impact of energy efficiency offerings to customers. At the same time, regulators and policymakers can use NEBs in order to assess progress towards non-energy policy goals.

Zeroing in on Behavioural Energy Efficiency

Examples of utility-led residential DSM programmes already being carried out around the world can be broadly grouped into the following types:

Accounting for energy efficiency from installed measures: This involves modifying consumer demand for energy (or using less power to perform the same tasks) by encouraging the uptake and adoption of more efficient lighting or appliances (such as water heaters, refrigerators, or washing machines), typically through the provision of financial incentives and rebates for purchase of such appliances.

Traditional demand response: Any reactive or preventative method to reduce, flatten or shift demand. Historically, demand response programmes have focused on peak reduction to avoid peak generation or peak power purchases, and/or to defer the high cost of constructing additional peak generation capacity. However, demand response programmes are increasingly being looked to assist with changing the net load shape as well (e.g. load minus solar and wind generation), and to help with the integration of distributed energy resources (DERs) more generally.

Behavioural energy efficiency: Behavioural energy efficiency programmes operate on principles pioneered by social science and proven by years of rigorous testing, such as the use of proactive, personalised feedback and social norms comparisons (Dougherty & Van de Grift, 2016). They are built on the powerful idea that providing people with more relevant, eye-catching and immediately actionable information about their energy use motivates them to use less— and/or to shift their consumption patterns so as to flatten the load curve, in the case of behavioural demand response programmes (Mazur-Stommen & Farley, 2013). By far the most common utility-run energy efficiency behaviour change programmes involve a feedback mechanism called Home Energy Reports (HERs) (Sussman & Chikumbo, 2016).

Typically, an HER is sent to customers separately from their utility bills and on a monthly, bimonthly, or quarterly schedule. HERs usually include a summary of each home's recent and historical energy use, personalised energy-efficiency tips (including links to any existing utility energy efficiency programme offerings), and a normative comparison of each household's energy use to that of their neighbours (Exhibit 3).

Home Energy Report (HER) Design: Fast Path to Insight and Action

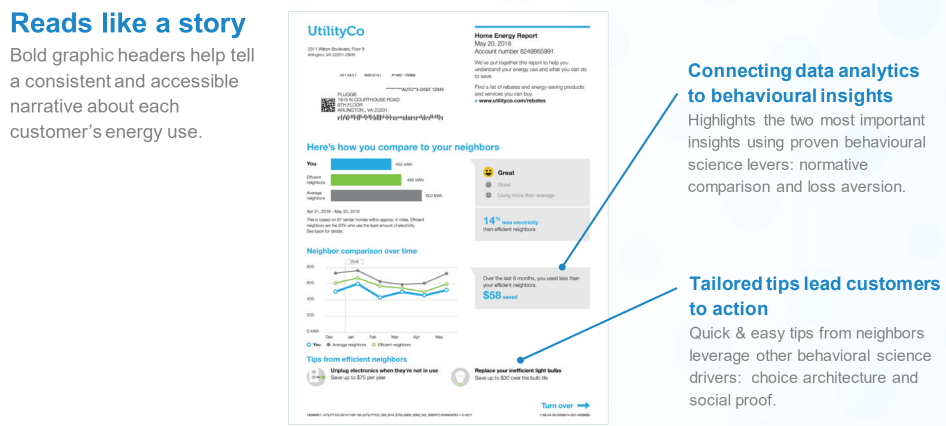

Exhibit 3: Typical design of a Home Energy Report (HER)

Studies show that it is this latter part in particular, the normative comparison of each household's energy use (e.g. electricity, gas, or both) to that of similar homes, that causes HER recipients to not only become more aware of their energy use but also to take steps to reduce their consumption in order to fall in line with that of their neighbours— to the tune of around 2% in electricity use per year by the second year of implementation (Allcott, 2011 and Allcott & Rogers, 2014).

Benefits of Behaviour Energy Efficiency Programmes

Quick and easy for utilities to deploy, requiring no additional infrastructure and yielding immediately verifiable results: Providing household energy utilization feedback does not require utilities to invest in any significant physical or administrative infrastructure (beyond the data and communication channels that they already have with each end-use customer). Therefore, HER behavioural programmes are not impeded by the need for new rates or new technologies.

Secondly, the ability to deliver HER programmes on an opt-out basis— meaning that target customers are automatically enrolled and sent communications so long as they take no action to decline—is a critical component to their ability to scale at a level that will drive grid-wide DSM impact. The opt-out basis also makes HER programmes lower in cost and far easier to scale than comparable opt-in programmes.[6] HER programmes' ability to deploy immediately, scale quickly, and start reducing demand right away is a key reason why they have fast gained traction as an effective example of utility-led behavioural DSM programmes around the world.

Cost-effective scalability: There is increasing worldwide recognition that changing behaviour may be a more cost-effective means of ensuring energy reliability and cutting carbon emissions than some of the more expensive technologies that we are currently subsidising: *e.g.* as is currently being discussed at the G20, the World Bank, the United Nations, the OECD, as well as by national behavioural insights (BI) teams around the world.[7]

6 Given that the average utility customer spends less than 10 minutes annually thinking about their energy use, the hurdles to enrolling the average residential energy consumer (who is rarely aware of how much energy they consume, let alone how much energy they could save, and in what ways) in opt-in programmes are generally high. (https://www.accenture.com/us-en/insights/utilities/creating-links-love-energy-consumers)

7 See, for example: https://ipeec.org/upload/publication_related_language/pdf/856.pdf, http://documents.worldbank.org/curated/en/744191532458732002/Mind-Behavior-and-Development-Unit-Applying-Behavioral-Science-to-End-Poverty-and-Enhance-Equity, http://www.undp.org/content/undp/en/home/librarypage/development-impact/spark-_-scale-_-sustain---2016-year-in-review.html, and http://www.oecd.org/gov/regulatory-policy/behavioural-insights.htm

In a recent US based study, researchers at MIT and Harvard found that the average cost to U.S. utilities for behavioural energy efficiency programmes is less than a fourth of the cost of acquiring or generating electricity from a new power plant (Marquis, 2016). McKinsey & Company recently estimated that if behavioural approaches were deployed to all households in the United States for which it is cost effective, these could save almost 19 TWh of energy per year which amounts to $2.3 billion annually in avoided energy spending (Heck & Tai, 2013).

Strengthening the uptake and impact of other energy efficiency programmes and policies: An additional important benefit of behavioural energy efficiency programmes is that they help sensitise customers towards their energy use and enable them to make better choices overall, strengthening the impact of other energy efficiency programmes and policies, as well as uptake of new energy efficiency technologies and services.

For example, independent evaluations of Oracle Utilities Opower Home Energy Report programmes, carried out to date with over 100 utilities around the world, show that customers receiving HERs are significantly more likely to participate in another energy efficiency programme than non-recipients.[8] This includes programmes that involve purchase of energy efficient devices: as a part of their Connected Homes REV[9] demonstration project, for example, ConEdison (New York's largest energy provider) saw a 61% increase in customers purchasing smart thermostats from the ConEd Marketplace through the use of targeted promotions delivered via their HER programme.[10]

Since HERs have high open and readership rates, they drive higher numbers of customers to take next best actions (such as adopting smart devices) than traditional mass marketing or digital advertising.[11] In this sense, behavioural DSM programmes provide an important complementary approach to increasing the adoption of high-efficiency technologies for achieving low- or net-zero energy performance. The IPCC Fifth Assessment Report estimates that globally, changes to energy-conserving behaviour by building inhabitants could deliver between 20% and 40% energy savings compared with business as usual (IPCC, 2014).

Starting with HERs or other behavioural programmes to drive engagement over time, utilities can move customers up the "engagement pyramid" by using rich analytics and personalised behavioural insights to promote those programmes from which each household is most likely to benefit deepening the customer relationship and unlocking greater energy savings at the same time (Exhibit 4).

Encourage uptake of devices that enable a more customer-centric grid

Move highly engaged consumers towards "prosumer"-enabling devices, such as by promoting adoption and use of automated peak management, smart appliances, and distributed energy resources (such as solar, EV, and batteries)..

Promote rate-based load shaping / DSM using price signals

Help educate and connect more engaged customers to the best rate for their usage profile; *e.g.* solar or EV plans for PV/EV owners, or dynamic rate plans to encourage shifting consumption to off-peak hours for those with flexibility.

100% Behavioural DSM Programmes ("No Price, No Device")

Drive energy savings and customer satisfaction with personalised communications leveraging data analytics and behavioural insights. Provide on an opt-out basis, which enables territory-wide scalability and awareness among even the hardest-to-reach / least engaged customers.

Exhibit 4: Utility-led DSM and customer engagement pyramid

8 https://www.oracle.com/industries/utilities/verification-reports/

9 Reforming the Energy Vision (REV) is a state-led comprehensive energy strategy for the state of New York. More information available at: https://rev.ny.gov/rev-demo-projects-1/

10 http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B55920BA2-ED00-4545-9519-47A4951547D5%7D

11 https://blogs.oracle.com/utilities/email-hers-create-digital-savings-and-drive-smart-device-adoption

Promoting peak load adjustments: HER programmes have shown to make additional impact on peak shaving. Worldwide data from Opower programmes show, for example, that on average, customers receiving HERs globally save about 1.5-2 times more energy during peak hours than during non-peak hours.[12]

Building on this, in countries with more mature DSM markets, some of the same behavioural approaches shown to have year-round energy-saving impact in HER programmes have been used specifically to target and encourage energy savings at peak times on peak days. To date, global instances of “no price, no device” behavioural demand response (BDR) programmes—that is, programmes in which utilities use only behavioural insights and real-time messaging to motivate peak savings, without the aid of any time-of-use price signals or installed measures—have resulted in an average of 3-5% peak savings.[13] New research shows that when HER and BDR programmes are intentionally combined, they have an even greater additive effect (Brandon et al, 2018).[14]

DSM measures to address peak load—particularly in the domestic/residential sector—are an increasingly critical need in India. Not only is Indian residential electricity consumption growing rapidly as a whole, it is especially pronounced when consumer demand spikes during the peak cooling seasons. In Delhi, for example, peak demand has more than doubled over the last decade, with more than two-thirds of the peak load on the grid coming from domestic (residential) consumers’ demand (Exhibit 5). Most of this is incurred during the summer months, when widespread use of air conditioners, chillers and fans increases dramatically.

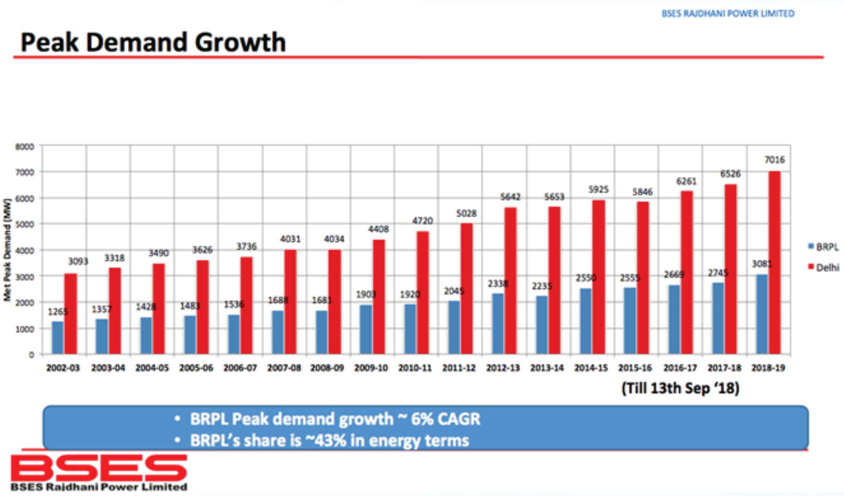

Exhibit 5: BRPL’s peak load demand as compared to that for all of Delhi over the last 15 years

The Mechanics of Behavioural Energy Efficiency Programmes

Behavioural DSM programmes are measured and verified via a randomised control trial (RCT) approach. The RCT approach is held as the gold standard for measuring the impact of behavioural energy efficiency programmes worldwide and is relied upon by policymakers and regulators in over 40 jurisdictions globally—including the U.S. Department of Energy and the U.S. Environmental Protection Agency, as well as the Japanese Ministry of the Environment, among others.

12 https://blogs.oracle.com/utilities/behavioral-demand-response-and-hers-are-better-together

13 BDR programmes may be combined with peak-time rebates (PTR) or points-and-rewards programmes with points that can be earned by saving energy during peak hours. When combined with PTR programmes (which, like pure behavioural messaging, can also be implemented on an opt-out basis, ensuring scalability), peak demand reduction can increase to an average of 14-19% (see, BGE’s recent results submission before the Maryland Public Service Commission, for example). But this paper focuses on behavioural approaches alone, i.e. those which do not require any financial incentives to encourage end-use consumers to adopt more efficient behaviours.

14 This research by noted behavioural economist John List and colleagues (recently published in the Proceedings of the National Academy of Sciences and based on more than 30 million observations of hourly household electricity consumption) shows that when HER and BDR programmes are combined, whereas the sending of HERs alone resulted in an average of 2.1% peak savings across all programmes, and BDR programmes alone generated 3.8% savings, when a treatment group within the same RCT was sent both HERs and BDR messages, treatment-group households saved an average of 6.8% (as compared to those in the control group) during peak hours. To put this impact into perspective, Prof. List and his colleagues estimate that this nearly 7% peak reduction in demand from behavioural messaging alone is roughly equivalent to increasing the price of electricity by nearly 70% during peak load events—though at only a fraction of the cost.

The RCT programme design, which is commonly used in several industries (such as by pharmaceutical companies) to test the impact of specific interventions, works as follows:

- Step 1: Select a sufficiently large representative group of customers to be included in the study population (selection of this group can, but is not required to be, a random sample).
- Step 2: Randomly assign these customers into statistically equivalent "treatment" and "control" groups.
- Step 3: Undertake a "treatment" (such as sending HERs) with the first group only.
- Step 4: Measure differences in outcomes between these treatment and control groups.

Due to the RCT programme design, which equalises the groups across all other variables, any post-treatment differences between the two groups can be attributed to the intervention.

In the case of HER programmes, personalised behaviourally-informed insights and energy efficiency advice are sent to the treatment group only, and the control group is used as a baseline against which the impact of such communications (which, again, is the only appreciable difference between the randomly-generated, statistically-equivalent treatment and control groups) can be measured (Exhibit 6).

The Randomised Control Trial (RCT) is the most stringent and trusted measurement & verification methodology

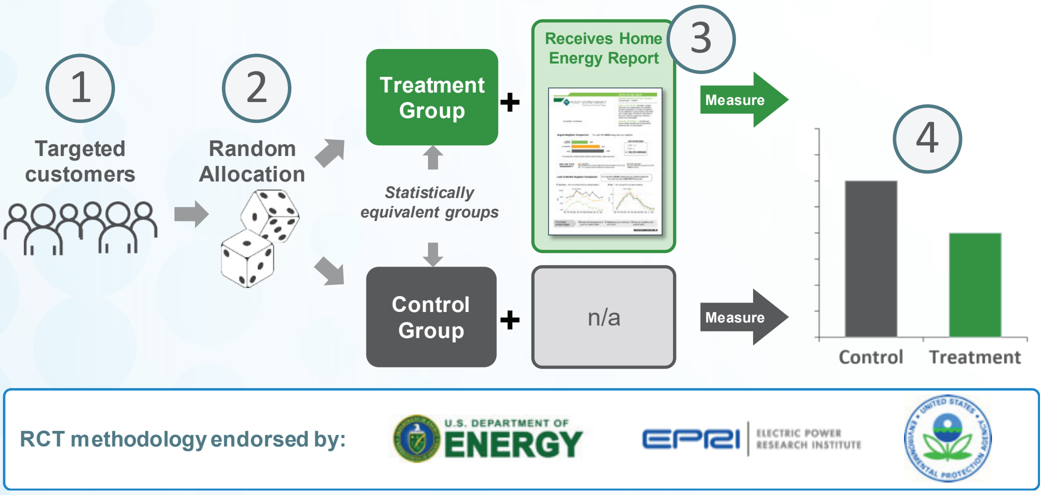

Exhibit 6: Randomised Control Trial (RCT) programme design and process of measurement & verification

HER-based Behavioural Energy Efficiency Programmes in Developing Economies

While most behavioural energy efficiency programmes around the world today have been carried out in industrialised economies, such programmes have potential to achieve energy savings and GHG emissions reductions at scale among domestic/residential electricity consumers in developing economies as well. Two recent examples are Tenaga Nasional Berhad (TNB)'s HER programme in Malaysia, and BSES Rajdhani Power Limited (BRPL)'s HER pilot programme in New Delhi.

Tenaga Nasional Berhad (TNB)'s HER programme in Malaysia

In 2015, Malaysia launched a Home Energy Report (HER) programme led by Tenaga Nasional Berhad (TNB) in collaboration with Malaysia's Ministry of Energy, Green Technology and Water (KeTTHA, now the Ministry of Energy, Science, Technology, Environment & Climate Change, or MESTECC).[15]

The Malaysian HER programme, which goes hand-in-hand with Malaysia's green development goals (contained in the 11th Malaysia Plan and the Green Technology Master Plan), has proven to be an effective means of educating and empowering citizens, and should serve as a good reference point for how similar programmes might perform in the Indian context.[16]

Now in its third year, the Malaysian programme provides TNB customers user-friendly, data-rich insights into their energy usage, alongside personalised recommendations and tips on how best to save energy in their home through the use of HERs and a complementary online portal.

On average, TNB customers receiving HERs have decreased their energy usage (relative to the control group, which receives no such information) between 1%-3%.[17] As seen in Exhibit 7 (in which each line represents average per-household savings from separate utility-led HER programmes worldwide), these results show how TNB's HER programme—the first in ASEAN and the first such programme in a non-OECD country—performs favourably compared to similar programmes around the world, even compared to regions with more mature utility-led DSM initiatives:

Long-term, steady energy savings seen across more than 100 HER programmes globally

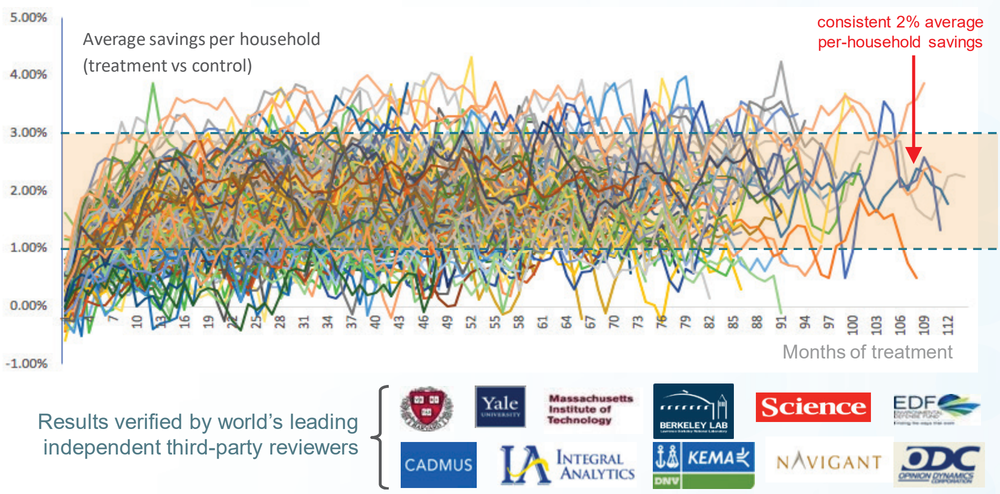

Exhibit 7: Long-term, steady energy savings seen from HER programmes with more than 100 utilities around the world

While 1-3% may sound small, the aggregate impact of these programmes has been significant: in just the last 12 months alone, the 450,000 TNB customers receiving Home Energy Reports (printed and email) saved nearly 50,000 MWh of electricity—or the equivalent of roughly 35,000 tonnes of avoided CO_2 emissions, according to the latest official grid emissions factor estimations available.[18]

Results such as these from Malaysia highlight how quickly behavioural programme impacts can scale, even in developing economies where per-household energy usage (though growing quickly) is still relatively low.

15 For more on the TNB HER Programme, see here: https://www.tnb.com.my/residential/her. TNB's HER programme began as a pilot reaching 200,000 households in 2015; Phase 2 extends outbound HERs to 450,000 households—in addition to providing personalised data-driven energy insights to all domestic customers in peninsular Malaysia via TNB's Web portal.

16 Average household energy consumption is about 250 kWh / month in Malaysia—roughly the same as in Delhi. While Malaysia ranks higher in terms of GDP per capita than India, the two countries are closer on the GINI index, so it is not unreasonable to say that they are at comparable levels of economic development.

17 https://www.energywatch.com.my/blog/2018/01/05/the-who-what-and-why-of-tnbs-home-energy-reports/

18 Based on the national grid emission factor of 0.694 tCO_2/MWh obtained from the "Study of Grid Connected Electricity Baselines in Malaysia" prepared by Green Tech Malaysia in 2014.

Collectively, the aggregate impact of Opower-run HER programmes around the world (which, again, represents the largest sample available globally) has already resulted in cumulative savings of nearly 25 TWh over the last 10 years.[19] This is enough to power 15-20 million typical room ACs for a whole year—all from simple actions taken by average domestic consumers to adopt more efficient behaviours.

India's first large-scale Behavioural Energy Efficiency Pilot Programme in New Delhi

With support from the United State Trade and Development Agency (USTDA), BSES Rajdhani Power Limited (BRPL) is already undertaking India's first large-scale behavioural energy efficiency pilot programme, working with Oracle Utilities (Opower) to send personalised Home Energy Reports (HERs) to a representative group of two lakh customers in Southern and Western Delhi.[20]

The stated objectives of this programme, which were developed with input from all of the stakeholders above in addition to the Delhi Electricity Regulatory Commission (DERC), are as follows:

- Demonstrate benefits of HERs to consumers:
    - Empower consumers to save money on their energy bills
    - Promote domestic consumer energy literacy and energy efficiency, as well as encourage participation in other DSM programmes
- Demonstrate benefits to the grid:
    - Generate verifiable energy savings at scale, using rigorous RCT programme design and measurement & verification
    - Prove potential for cost-effective and large-scale residential/domestic DSM in the form of aggregated grid load reduction, ideally in overloaded network areas
- Establish a model for on-going utility-led, consumer-focused behavioural energy efficiency programs in India:
    - Establish incentives / cost recovery mechanisms for Delhi utilities running HERs and other verified behavioural energy efficiency programmes that save customers energy and money, aligning with similar measures approved and relied upon by regulators around the world

Customer Selection: 2.6 lakh customers were selected from the 10 districts (Exhibit 8), forming a sample of the full BRPL license area. Where possible, within each district, parameters were set to select customers from areas with overloaded distribution transformers (DTs) in particular, to see what additional impact HERs could have on reducing aggregate usage on overloaded nodes.

The 2.6 lakh customers were then randomly placed into a treatment group of two lakh customers (who will receive HERs), and 0.6 lakh customers (who will receive no additional communications) to be tracked as a control group.

19 Utility Dive, October 22, 2018: https://www.utilitydive.com/news/oracle-utilities-opower-boasts-industry-leading-20-twh-of-savings-for-cons/540202/

20 https://www.bsesdelhi.com/documents/73527/2497782/Press_Release_06mar18_Eng.pdf

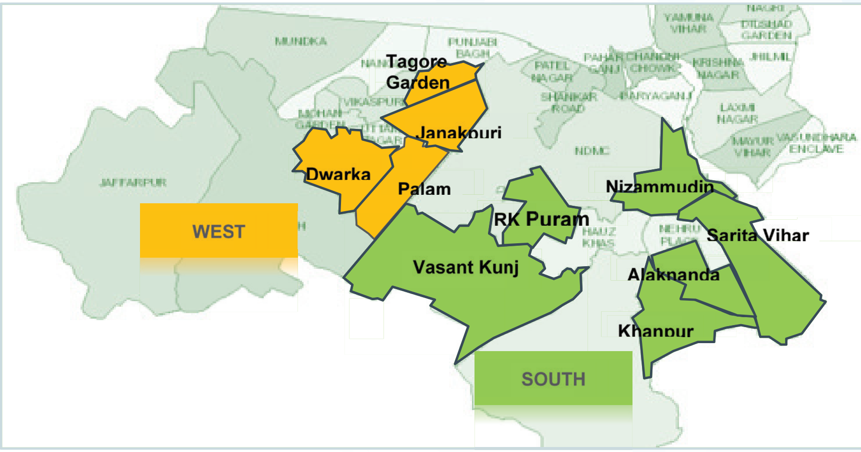

Exhibit 8: Sample of the full BRPL license area and districts chosen for the BRPL HER programme

Upon the recommendation of the DERC, the two-lakh customers receiving HERs have further been segmented into three bands that represent the spectrum of typical BRPL domestic customer usage ranges (slab-wise) under the current tariff structure (Exhibit 9).

Exhibit 9: Segmentation of the customer base for the BEE pilot programme in Delhi

BAND	TREATMENT GROUP	CONTROL GROUP
50-200 kWh/month	48,000	14,400
200-400 kWh/month	96,000	28,800
>400 kWh/month	56,000	16,800
Total	**200,000**	**60,000**

All two lakh BRPL customers in the treatment group will receive the following:

1) **Paper-based Home Energy Reports (HERs)** sent on an opt-out basis bi-monthly by post (timing-wise, just after the electricity bill has been sent) (Exhibit 10). In total, 10 paper HERs will be sent over the 18-month programme implementation period.

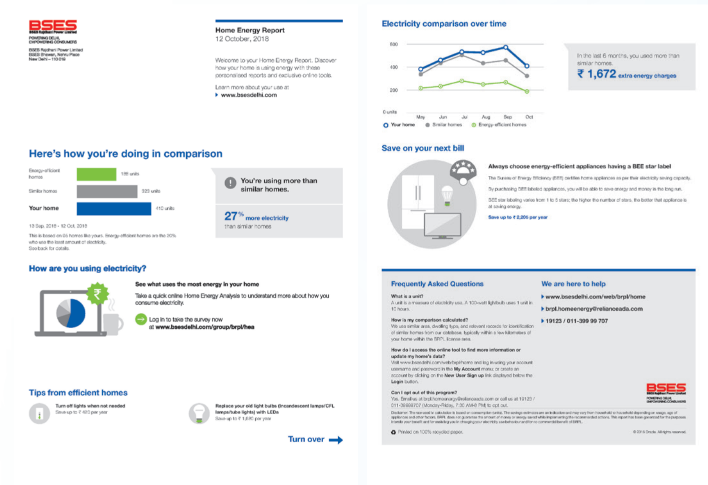

Exhibit 10: Paper-based HER design

2) **Web & mobile-based information, insights & analysis** made available 24 hours/day through widgets embedded on the BRPL Website (Exhibit 11). Those in the treatment group can access personalised data analytics and advice by logging into their account and viewing a number of online tools (which in turn are made to be interactive, enticing the customer to enter more detailed household and appliance-level information to receive further customised insights and recommendations).

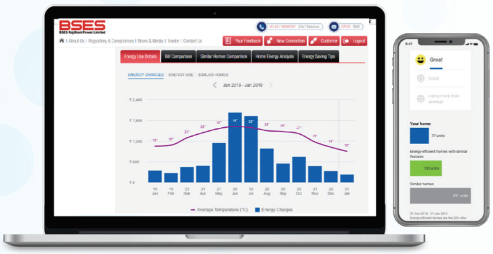

Exhibit 11: Web & mobile-based information, insights & analysis

3) **E-mail Home Energy Reports (eHERs)**, an electronic version of the paper HERs (Exhibit 12), though sent monthly (as opposed to bi-monthly in the case of the paper version) to all treatment group customers with registered, valid email addresses.

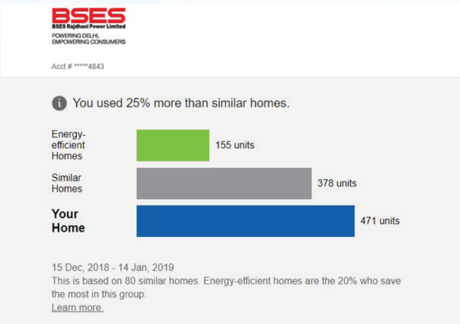

Exhibit 12: Typical e-mail HER (eHER) design

In addition to measuring the impact of HERs on year-round energy savings—for which the assumption is that Delhi-area HER recipients will save within the same 1%-3% average per-household energy savings range (treatment versus control group) seen in other parts of the world, including the Malaysian example above, where average household energy consumption is roughly the same as in Delhi—the BRPL HER pilot programme will also try to identify impact on peak load, particularly in overloaded network areas.

Why India is Ripe for Large-scale Behavioural Energy Efficiency Programmes

The HER programme currently being piloted in Delhi by BRPL described above provides a template for similar programmes that, with the right incentives in place, could effectively be rolled out across the rest of India today.

Promoting energy efficient behaviours among Indian households is an increasingly urgent need, as Indian residential electricity demand will continue to grow exponentially in the years to come. Electricity consumption in Indian homes is on the rise and has already tripled since 2000 (Exhibit 13). The percentage of households with access to electricity has increased from 43% in 2000, to more than 80% in 2016. While India's average household consumption is currently roughly a third of the current world average, this is about to change as India rapidly urbanises. On the verge of becoming the world's largest air-conditioner market, India is expected to account for about 20% of the global growth by 2050 (IEA, 2017b).

21 https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Urbanization/Urban%20awakening%20in%20India/MGI_Indias_urban_awakening_executive_summary.ashx

- McKinsey estimates that within the next decade (by 2030), 590 million people will live in Indian cities, and 91 million urban households will join the middle class.[21]

- By 2040, Indian residential air conditioners would necessitate over 1100 TWh of additional electricity consumption (from 2017 levels) under a business-as-usual scenario (Sachar et al, 2018).

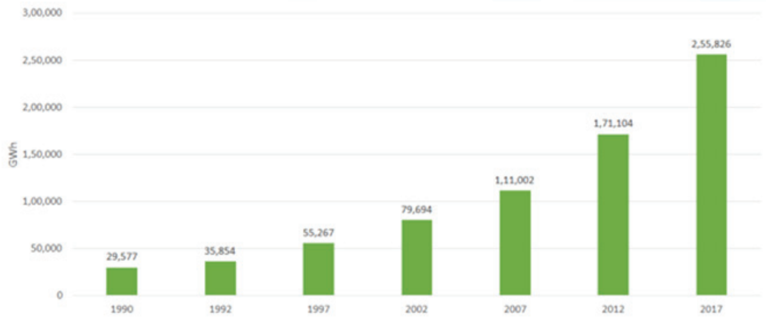

Exhibit 13: Trends in electricity consumption in India's residential sector

Indian domestic/residential electricity usage now outpaces growth in industrial, commercial and agriculture sectors. Per CEA's 19th Electric Power Survey of India, as India moves towards one of the largest urban transitions in history, the share of residential sector consumption is expected to grow from one-quarter today, to one-third within the next decade (CEA, 2017). India's residences, which increasingly avail of all modern energy services such as cooling, clean cooking, lighting, and media access, are predicted to account for 85% of the country's floor space by 2050.[22] While the projections put forth by different research groups vary (Exhibit 14), they all unanimously point to an exponential increase in Indian residential electricity consumption within the next decade.

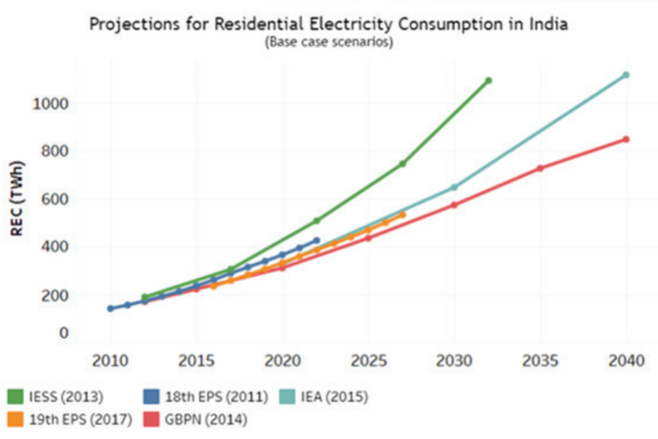

Exhibit 14: Projections for residential electricity consumption in India (base case scenarios)

If unaddressed, this demand will put constraints on already stretched national resources, posing serious social, local environmental and climate change-related burdens. A wide variety of research underscores how utility-led demand-side interventions could substantially reduce the requirements of energy supply, bypass many of the structural inefficiencies and financial losses prevalent in electricity distribution, and optimise the energy footprint of the building sector.

Although installed measures have made progress in India, primarily through demand aggregation programmes (for example, EESL's UJALA programme, which has achieved distribution of over 324 million LED bulbs and nearly 7 million LED tube lights among Indian households till date), the opportunity to change Indian consumers' behaviour through utility-led behavioural DSM programmes remains largely untapped.

22 http://cprindia.org/news/6512

In recent years, a variety of government policies and programmes calling for large-scale smart metering infrastructure investments—such as the National Tariff Policy (NTP), the Integrated Power Development Scheme (IPDS), the Ujwal Discom Assurance Yojana (UDAY, which calls for the installation of at least 35 million smart meters by 2019), and upcoming smart grid pilot projects—have injected new impetus to ensuring that the customer-facing value of these investments is made clear to end-users.

While the primary stated objective behind the mandate for all distribution companies (DISCOMs) to roll out smart meters is to reduce losses and data entry errors as well as the operational costs associated with human interface / manual meter readings, with the right incentives in place, smart meters will also enable DISCOMs to engage consumers in DSM programmes, and manage peak load effectively while also enhancing customer experience.

A breakthrough on the behavioural front, helped by new IT technology and multi-channel communications, is needed to bring about a shift in the mentality of Indian residential energy consumers and turn them into a consistent, reliable resource for DSM at scale in India's increasingly challenged energy sector.

Estimating the Savings Potential of HER-Based Programmes in India

Below, we estimate the nationwide savings potential of HERs-based behavioural energy efficiency programme deployment in India. We provide estimates of both the energy savings achievable today, as well as the cumulative impact such a programme could have on domestic/residential electricity consumption over the next decade.

Methodology

Typically, there are three ways to quantify energy savings potential:

- Technical Potential — The theoretical maximum energy savings that can be achieved through efficiency interventions, disregarding non-engineering constraints such as economics or customer adoption patterns.

- Economic Potential — The subset of technical potential that is economically feasible, based on applicable cost-effectiveness calculations.

- Achievable Potential — The subset of economic potential that is reasonable for a utility or country to achieve during a target period — assuming the most aggressive programme scenario possible —taking into account typical customer adoption patterns.

Since the aim of this study is to identify the immediate efficiency benefits that India could gain, starting now, through HER-based behavioural programmes, we focus on the economic and achievable potential. Because of the opt-out / auto-enroll design of such behavioural programmes, economic potential in this case is not limited by the pace of market transformation (as such, achievable potential equals economic potential).

To arrive at our estimate of behavioural energy efficiency potential for India, this study combines:

- Expectations of achievable savings from monthly energy savings measurements of existing Home Energy Report deployments from around the world, with

- Publicly available country-level data—for example, on India's current and future domestic electricity consumption trends, as well as the number of connected households.

We use the Central Electricity Authority's (CEA) 19th Electric Power Survey of India as our primary source of information on Indian residential electricity consumption, cross-referencing this with other sources (such as IESS, SAUBHAGYA, NSSO, and peer reports) to understand, for example, the share of urban electricity consumption in particular, and the pace of urbanization in order to factor these into our estimates.

In addition to the above, in order to calculate the economic potential, two filters are applied as further assumptions to the available data:

- Narrowing down to urban households - Recognizing that rural households may not be an immediately practical target population for HER programmes (e.g. due to lack of access to reliable electricity, or other factors), we limit the applicability of HER programmes—and our resulting savings estimates—to urban households only.

- Accounting for Aggregate Technical & Commercial (AT&C) losses - AT&C losses are used as a proxy for calculating the number of households with whom the DISCOM/local utility actually has a) legitimate and accurate monthly energy consumption data, and b) a working channel of communication / billing relationship with that customer (both essential requisites for any HER programme). In essence, the lower the AT&C losses, the higher the eligible customer base.[23]

This study presents a 10-year outlook in estimating the nationwide savings potential of HER programmes. For simplicity's sake, our analysis picks a 10-year timeframe from year 2021-2030. Since HER programmes conducted around the world typically involve a "ramping up" of savings in year one, and a "levelling-off" and more consistent (and persistent) savings in the second year of deployment (as programme participants become more acclimatised to the behavioural prompts received), we assume energy efficiency savings will start to scale and level off in a predictable way in about the second year of the programme (2021) in an Indian context as well.

A full accounting of the logic followed in arriving at the savings estimate is illustrated in Exhibit 15. Year 2017, due to granularity of data available, is used as the baseline year for calculations of future growth (with estimated savings calculated beginning in Year 2021 onwards).

Exhibit 15: Methodology followed to compute pan-India energy savings and carbon dioxide reduction potential from HER programmes

	PARAMETER	SOURCES & REMARKS	NUMBERS
STOCK & CONSUMPTION ESTIMATION			
1	Breakdown of urban versus rural household (HH) energy consumption	Latest available data NSSO (2014) as cited by Prayas (Energy Group) (2016) is utilized. This data suggests that in year 2014: ► The average rural consumption is approx. 60 kWh/HH/month ► The average urban consumption is approx. 120 kWh/HH/month	This weightage of rural versus urban average HH consumption is extrapolated for future years
2	Current (i.e. 2017) number of urban households	India Energy Security Scenarios (IESS) 2047[24]	90 million urban households
3	Current (i.e. 2017) annual total residential energy consumption	CEA (2017)	Approximately 260000 GWh
4	Current (i.e. 2017) annual urban energy consumption	Calculated based on urban versus rural weighting described above	Using #1 and #2 as the basis, the urban electricity consumption is estimated at: 162700 GWh

23 According to data provided by the Government of India (as of December 2017), the average AT&C losses in 24 of the UDAY states and union territories stands at 22.73%. Based on available information, AT&C losses for future years (by 2030) are assumed to be 15-16%.

24 http://iess2047.gov.in/pathways/2222222222222222222222222222122222222222222112222222222222222/assumptions#

	PARAMETER	SOURCES & REMARKS	NUMBERS
5	Growth rate of urban residential electricity consumption	For lack of better information, the year-on-year total residential energy consumption growth rate (from CEA (2017)) is used as a proxy for the urban residential energy consumption growth rate. The underlying assumption is that (i) expanding urbanization, and (ii) increasing energy consumption per household, is accounted for in CEA's growth projections.	Per CEA (2017)
6	2021 and 2030 (year 1 and 10 of savings) urban residential energy consumption	Year 2017 urban residential energy consumption (from #4) is used as a baseline and year-on-year growth rate per #5 is applied.	2021: 226058 GWh/year 2030: 403739 GWh/year
SAVINGS ESTIMATION			
7	Households eligible for HER-based programmes	According to data provided by GoI's UDAY dashboard, the average AT&C losses in 24 of the UDAY states and union territories stands at around 22% today; based on available information, AT&C losses for future years (2030) are assumed to be 15-16%. For the intermediate years, the AT&C losses have been interpolated.	2017: 78% 2021: 80% 2030: 84%
8	Achievable energy savings potential	Existing data from Opower HER deployments from around the world, including the recent deployment in Malaysia, consistently suggests that savings in the range of 1% to 3% of all eligible households' annual electricity consumption is achievable.	Applying 1% to 3% savings range: 2021: 1800-5400 GWh/year 2030: 3400-10200 GWh/year
9	Achievable carbon savings potential	The calculated energy savings are translated to CO_2 savings using year-on-year grid emissions factors (in terms of CO_2) projected by CEA, which align with India's NDC pathway.	2021: 1100-3400 ktCO_2/year 2030: 1800-5300 ktCO_2/year

Key Findings

Using the above methodology and data-points, our findings suggest that immediate adoption of HER programmes at scale in India could yield the following:

- By year 2021(assumed as the second-year of program implementation, and the first year of steady savings accrual) -
    - An annual reduction of 1800-5400 GWh of electricity usage nationwide. This is equivalent to eliminating 1.2 - 3.6 million residential ACs (3-star, 1.5TR) immediately.
    - The resulting reduction of carbon dioxide emissions would be in the range of 1100-3400 kilo tons of CO_2, or *approximately the equivalent of removing 80% of all passenger cars from Delhi roads for a full year.*
    - The collective impact in terms of *bill savings for Indian customers would be in the range of ₹ 9-27 billion* in year 2021 alone (assuming the current average power tariff in India at around 5 rupees per kWh), all of which could be redirected to other parts of the economy.

- Over a 10-year timeframe (by year 2030) -
    - Annual national savings in terms of reduction of electricity consumption of 3400-10200 GWh, or approximately the equivalent of taking a city half the size of Kolkata off the grid altogether for a year.
    - The cumulative 10-year electricity savings amounts to 25400-76000 GWh, enough to power a large Indian state like Rajasthan or Karnataka for 1 year.
    - The cumulative carbon dioxide emission reduction would be 14000-41900 kilo tonnes of CO_2, approximately *equivalent to removing all passenger cars from Delhi roads for a period of ten years*.
    - The collective economic impact for Indian consumers in terms of bill savings would be ₹ 17-51 billion in 2030 (at today's rate), which is enough to set up 170 – 510 MW of rooftop solar PV capacity.

Exhibit 16: Electricity savings potential through behavioural energy efficiency programmes in the residential sector, estimated based on the per-household average of 1-3% annual savings seen in other HER programmes globally

	ELECTRICITY SAVINGS (GWH)	CARBON DIOXIDE EMISSION REDUCTION (KILO TONNES CO_2)	COST SAVINGS TO CUSTOMERS (BILLION ₹)
2021 nationwide annual savings potential	1800-5400	1100-3400	9-27
2030 nationwide annual savings potential	3400-10200	1800-5300	17-51
Cumulative nationwide savings potential over the 10-year period from 2021-2030	25400-76000	14000-41900	127-380

In terms of prioritizing where HER deployments could be scaled quickly in India, prior experience suggests that the following characteristics would indicate regions with higher or more immediate potential for behavioural energy efficiency savings:

- Areas with higher average levels of per-household residential consumption
    - In global HER programmes to date, per-household energy usage is strongly correlated with—and the best predictor of—energy savings (i.e. the higher the per-household energy use, the higher the likelihood of higher energy savings) (Frades et al, 2016).
- Areas with lower levels of AT&C losses
    - Indian utilities have typically been guided by regulators and policymakers to focus on AT&C loss reductions first and foremost, above all other priorities. Thus, practically speaking, it will be more difficult to implement behavioural energy efficiency programmes in those utility districts where there is still much progress to be made on AT&C losses first.
- Areas with imminent smart meter rollouts expected and/or on the list for the Government's designated Smart City programme
    - While certainly not a prerequisite for HER programmes (which can work with just about any level of data available, as long as meter reads occur at least bi-monthly), the existence of AMI infrastructure would indicate a higher level of availability of detailed and accurate monthly energy consumption and billing data in the near future (if not already available now). Smart meters would also enable peak management on top of year-round energy-saving programmes, thus allowing greater leverage from residential DSM programmes.

While all Indian states stand to gain from the direct energy benefits as well as non-energy benefits of HER programmes, locations that have some combination of the above criteria (such as presented in Exhibit 17, in no particular order) may have higher or more immediate potential for capturing the benefits of HER deployment:

Exhibit 17: Examples of locations with high and immediate potential for HER deployment

	LOWER AT&C LOSSES	IMMINENT SMART METER INFRASTRUCTURE	HIGHER PER HOUSEHOLD ENERGY CONSUMPTION[25]
Andhra Pradesh	Y	Y	Y
Assam	Y	Y	
Delhi	Y	Y	Y
Gujarat	Y		
Haryana	Y	Y	Y
Himachal Pradesh	Y	Y	Y
Karnataka	Y	Y	
Kerala	Y		Y
Madhya Pradesh	Y	Y	
Maharashtra	Y		
Tamil Nadu	Y		Y
Telangana	Y	Y	Y
Tripura	Y	Y	

Total annual savings achieved in year 2021 from just the locations identified above would be 720-2140 GWh, which is equivalent to the energy consumed by around 1 million typical room air conditioners for a year. The resulting carbon dioxide emission savings would be 450-1330 kilo tonnes of CO_2, approximately equivalent to removing nearly a million passenger cars from Indian roads annually.

It is worth noting that the criteria listed here are meant to be indicative only; it is likely that additional criteria may play into a location's readiness for an HER programme. For example, certain urban centres in other states where distribution licensees have reported consistently good operational performance (*e.g.* low AT&C losses) and have investible surplus to put money into smart-metering infrastructure may also be considered for implementing HER-based programmes.[26]

The Way Forward

Per the Press Information Bureau of the Government of India, as India aims to achieve a 5-trillion-dollar economy by 2025—accompanied by rapid and large-scale urbanization and resulting concentration of electricity consumption in the urban centres—the country must revisit its power sector strategy today to prepare for the future. Especially in these rapidly growing urban areas, instead of focusing solely on increasing energy supply, greater attention should be given to managing electricity demand—which not only has greater environmental impact, but also results in bill savings that directly benefit consumers.

International experience clearly demonstrates that, by investing in utility-led residential-sector DSM (beginning with but not limited to behavioural programmes), electricity distribution utilities in both developed and developing countries have been able to deliver megawatt-scale energy savings and meet ambitious efficiency targets in a sustained and cost-effective manner.

India too can claim 1800-5400 GWh cost-effective, achievable energy savings annually in the near term by creating an enabling environment for HER programs through the following utility actions and policy and regulatory reforms:

25 States that have high per-household energy consumption (total domestic electricity consumption / of households in state) are assumed to have higher potential for energy savings from behavioural energy efficiency programmes, as higher energy savings are correlated with higher usage in past HER programmes globally.

26 The Kolkata distribution area served by private DISCOM Calcutta Electricity Supply Corporation (CESC) is potentially one such example.

➔ Need to make the business benefits of DSM programmes clearer to DISCOMS

As their revenues have traditionally relied on sales volume, it is only natural that DISCOMs might consider revenue erosion from DSM programmes as a threat. However, this perception overlooks the myriad ways in which DISCOMs can gain from DSM approaches.

Apart from avoiding costly power purchases to meet peak demand[27] and saving fixed costs otherwise paid towards the committed capacity for generation, transmission and distribution, HER-based behavioural programmes and other behavioural DSM-derived non-wire alternatives are more cost-effective, more customer-centric, and easier to scale. Noting that (among other impacts) behavioural programmes have helped avoid overloading of distribution transformers/systems, DISCOMs should recognise that the benefits of HER-based programmes outweigh the costs by a considerable margin.[28]

➔ Need for a clear and compelling policy impetus

To date, demand-side resources lack the kind of policy thrust given to promotion of renewable energy by the current legal and policy framework governing the Indian power sector. Policymakers should realise that unlike traditional end-use energy efficiency interventions that seeks to hasten market transformation over a period of years or decades, HER-based programmes are easy to deploy, quick to scale, and will start saving energy right away.

Apart from direct energy benefits, they should appreciate that HER-based behavioural energy efficiency programmes are a more cost-effective way to cut carbon emissions than technology-based interventions, which are often capital intensive and require considerable upfront fiscal support. Such a programme would undoubtedly be a vital lever for the government to meet its climate commitment.

Acknowledging the range of advantages of behavioural and other DSM programmes, there is a need to explicitly delineate such demand-side resources as an alternative option in the energy resource basket of DISCOMs. There are broadly two routes the policy makers can take to this end.

- Recognizing and defining ‘demand-side resources' as stand-alone independent resource apart from the conventional and renewable energy sources; this would warrant legislative action to empower the State Electricity Regulatory Commissions (SERCs) for effective enforcement.

- Recognizing and defining ‘demand-side resources’ as a qualifying resource under the definition of renewable energy sources in the existing legal and policy framework.

Thus, DSM would be able to qualify as an energy source in the merit order considered by SERCs and DISCOMs. Moreover, SERCs can either admit demand-side savings under a Renewable Purchase Obligation (RPO) or stipulate separate ‘demand-side resource purchase obligations’ where DISCOMs would be the obligated party. This would naturally create a market for demand-side resources, especially those that are easy to implement, cost-effective, and verifiable.

It is worthwhile to mention here that for the first time in India’s energy policy framework, the draft National Renewable Energy Act 2015 has advocated ‘Integrated Energy Resource Planning (IERP)’ defined as a strategic planning exercise that examines all available energy-resource options, including supply-side as well as demand-side options for securing reliable and cost-effective energy resources.

27 As aforementioned, BDR programmes implemented around the world to date have resulted in an average of 3-5% peak savings. Enabling utilities to offer peak DSM programmes as a regular part of their interactions with end-use consumers would, in the short term, allow Indian utilities to avoid having to generate and/or buy excess power from another generator today, and, in the longer term, potentially defer or avoid costly investments in additional peaking power-supply infrastructure.

28 (https://www.utilitydive.com/news/behavioral-demand-response-gives-baltimore-gas-and-electric-a-business-reas/546895/).

➔ Regulators to promote HER-based behavioural programme

SERCs have a critical role to play in a number of ways to unlock the benefits of HER-based programme. Being a “no price, no device” energy efficiency intervention offering verifiable energy savings at scale with both year-round and peak-load impacts, regulators should have no problem giving necessary approvals for implementation. Not to mention, customer engagement and education through HERs would ease enforcement of real time pricing of electricity for domestic consumers (as the amended National Tariff Policy of 2016 has advocated introduction of Time of Day tariff for domestic consumers) and help to achieve the intended load curtailment. If necessary, regulators should bring reforms in the state DSM regulations to include provision for RCT-based measurement and verification of energy savings.

However, the role of regulators should not be limited to approving project implementation by interested DISCOMs. They should allow such demand-side resource to qualify in the merit order (subject to suitable legislative backing), wherein the non-energy benefits apart from energy benefits need to be taken into account during evaluation. As a result, the DISCOMs would be able to suitably consider behavioural energy efficiency as a cost-effective energy source in their resource basket and invest.

In the event that demand-side energy savings is recognised as a resource by the country’s legislative framework, regulatory commissions should stipulate stand-alone ‘purchase obligations’ or allow energy savings through demand-side intervention admissible under RPOs.

In a nutshell, HER-based behavioural energy efficiency programmes in India can potentially offer a range of energy and non-energy benefits as well as substantial economic opportunities to the different stakeholders depending on the actions taken by them, as summarised in Exhibit 18.

Exhibit 18: Benefits of HER-based behavioural energy efficiency programmes to the stakeholders and latter's required actions

STAKEHOLDERS	POTENTIAL BENEFITS	ACTION REQUIRED
Domestic consumers	• Empowers consumers to save money on their energy bills • Educates consumers about energy use and bill savings opportunities, as well as increases participation in other DSM programmes • Improves customer engagement and trust	• Participate in the HER-based programme and take note of the insights • Act in reducing non-critical energy usage • Respond to price signals in a suitable way, in the event that dynamic pricing is introduced
DISCOMs	• Is more cost-effective and easier to scale than other DSM interventions • Helps target overloaded network areas and achieve aggregated grid load reduction	• Take cognizance of the monetary benefits of HER-based programme and evaluate mid to long-term benefits vis-à-vis costs of implementation • Partner with third-party/ solution provider to implement based on mutually agreed M&V protocol • Engage with end-use customers in a regular manner • Make the case to regulators to allow for demand-side resource to compete with supply-side sources • Invest in HER-based programmes to comply with ‘purchase obligations’ if enacted
Policymakers and regulators	• Helps achieve energy security and mitigate GHG emissions in a more cost-effective and scalable way than technology-based interventions, which are often expensive and require fiscal support. • Helps achieve verifiable energy savings at scale and load reduction without any tariff or wired intervention; cost-recovery for DISCOM is easy and ideally tariff-neutral.	• Appreciate the energy and non-energy benefits of HER-based programmes and their advantages over traditional end-use energy efficiency interventions • Recognise and define ‘demand- side resources' as stand-alone independent resource or as a qualifying resource under the definition of renewable energy sources in the existing legal and policy framework • Provide regulatory support for implementation of HER-based programmes • Admit demand-side savings under Renewable Purchase Obligation (RPO) or stipulate separate ‘demand-side resource purchase obligations’ • Bring requisite regulatory changes in the state DSM regulations to include provision for RCT-based measurement and verification of energy savings
HER solution providers	• Opportunity to provide new and innovative offerings to a greater variety of market participants	• Engage with DISCOMs and regulators to demonstrate compelling evidence of the myriad benefits of HER-based programmes • Interact closely with residential consumers and understand their desires in terms of utility-provided services and savings on energy bills

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