Utility Scale DSM Opportunities and Business Models in India

Prepared for the World Bank
Energy and Extractives Global Practice,
South Asia Region

Prepared by :
Ashok Sarkar and Neha Mukhi of the World Bank,Padu S. Padmanaban,
Senior Advisor, and team from PwC comprising of Amit Kumar, Kulbhushan Kumar, Manoj Bansal and Shuboday Ganta

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ENERGY EFFICIENCY SERVICES LIMITED

ESMAP
Energy Sector Management Assistance Program

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For further information about this Report, please contact: Ashok Sarkar at the World Bank (asarkar@worldbank.org).

Executive Summary

The promise of Utility driven Demand Side Management (DSM) in India includes effective management of electricity deficit, rising power supply costs, energy subsidies, climate change, environmental degradation and energy security concerns, all of which are indispensable problems faced by electricity distribution utilities (also referred as 'DISCOMs' in this report), governments and society as whole in the foreseeable future.

The emergence of Energy Efficiency Services Limited as public sector energy services company (ESCO) to design, finance and implement utility scale DSM solutions and further lead investment related actions has proved to be a silver bullet towards breaking the institutional and financial logjam to scale up utility DSM resources in India. By adopting unique market driven approaches, derived from globally successful and innovative DSM delivery models, EESL has achieved unprecedented scale of success in advancing Utility DSM solutions in the recent past. The EESL's UJALA initiative[1] has become the quintessential DSM program for Indian utilities driven entirely by market based mechanisms. The program has sold over 100 million 7 watt and 9 watt LED lamps to replace less efficient incandescent and CFL lamps among households and institutional consumers. The program is currently delivering over 35 million kWh of energy savings per day that translates to more than INR 14 crore in energy cost savings per day, and 2667 MW of avoided generation capacity.

The success of UJALA has reinforced stakeholder confidence in the promise of DSM and reestablished the Utility DSM market potential from INR 44000 crores, estimated in 2010, to INR 1.6 lakh crores by considering the end use energy efficiency opportunities alone. Residential end use appliances, agriculture/irrigation pumping and municipal infrastructure are the top three DSM markets contributing to this potential. The renewed DSM market potential is envisaged to deliver 178 billion units of electrical energy savings per annum that roughly translates to 18-20% of the current levels of all India annual electricity consumption and 150 Million tons of annual CO_2 emissions reduction potential. Apart from this, demand response, solar photovoltaic (SPV) rooftop systems along with emerging smart grid technologies offer tremendous potential for Utility DSM in India. The market potential for rooftop SPV systems is 124 GWp and the realistic national demand response potential is yet to be evaluated in a comprehensive manner.

Given that the market driven mechanisms have gained significant momentum, India is at the cross roads for adopting the right policy approach that can effectively complement the market mechanisms in ensuring the promise of DSM is delivered to Indian stakeholders. Demand side resources lack the kind of impetus laid for promotion of renewable energy sources in the legal and policy framework (Electricity Act 2003, Electricity Amendment Bill, National Tariff Policy Amendments etc.) governing the power sector.

Therefore, on the policy front, there is a need to explicitly recognize 'demand side resources' as alternative resource option in the energy resource basket of electric Utilities. The perception about DSM and its treatment by Utilities must be clearly emphasized in the policy framework by allowing it to directly compete with supply side options within the principles of equity, reliability and cost effectiveness. India's Power Minister recently stated that 'one unit of energy saved is 1.3 units of energy generated[2]' while advocating a flagship DSM program. This must be considered in spirit /principle and reflected accordingly in the electricity governance and policy framework. There are broadly two options available for the policy makers to achieve this.

- The 'demand side resources' can be explicitly defined and emphasized as stand-alone independent resource apart from the conventional and renewable energy sources. This however requires legislative action to empower the state regulatory commissions for effective enforcement and consideration of DSM by the Utilities and central /state governments.
- The 'demand side resources' can be recognized as a qualifying resource under the definition of renewable energy sources in the existing legal and policy framework.

[1] Abbreviation for 'Unnat Jyoti by Affordable LEDs for All' or formerly known as Domestic Efficient Lighting Program (DELP) http://www.delp.in/

[2] As per media reports; http://timesofindia.indiatimes.com/india/Piyush-Goyal-pushes-for-energy-saving-bulbs-even-as-streetlights-remain-on-during-the-day/articleshow/50498644.cms

Additionally, there is a need for consideration of demand side resources at the planning stage to enable integrated resource planning by Indian Utilities and central /state governments. The importance of IRP cannot be over stated, especially in the India's power market conditions, because it not only creates a market for demand side resources but also saves on the enormous fixed costs otherwise paid by utilities towards the committed capacity for generation, transmission and distribution. This ensures that the enhanced penetration of demand side resources in the overall energy resource mix of Utilities effectively optimizes power resource costs and results in the reduced cost of power for consumers. This is also one of the important promises of demand side management.

Furthermore, on the reforms front, there is a need to mainstream the role of DSM in the ongoing electricity and climate change reforms. There is a need to set clear DSM performance milestones under the operational efficiency improvement component of the Ujwal DISCOM Assurance Yojana (UDAY) so that the participating DISCOMs adopt DSM as an important strategy in achieving the operational efficiency goals envisaged under the scheme. The DSM performance milestones should be set in the form of quantum of energy savings and/or peak demand reduction with a robust mechanism for monitoring and verification. Additionally, there is a need to review the incentive mechanism proposed under UDAY to adequately compensate the DISCOMs for scaling up DSM activities.

On the regulatory front, despite the existence of DSM regulations in about 17 states and 7 Union Territories, enforcement of those regulations continues to be limited in many states. There is a need to strengthen the DSM regulatory framework with regard to capacity and authority of DSM cells, establishment of DSM targets, cost effectiveness evaluation of DSM programs, EM&V of DSM programs, cost recovery mechanisms and incentive framework for Utilities.

On the delivery front, DSM delivery models such as demand aggregation, bulk procurement, on-bill financing, standard offer and standard rebate have gained tremendous stakeholder confidence in the wake of EESL's UJALA success. There is no single best delivery model for designing a successful DSM program for Indian utilities, who must evaluate various program designs in the context of Utility / state priorities, DSM goals, DSM technology / solution, customer participation, cost effectiveness, and the ability to overcome important local obstacles.

On the market development front, agriculture pump set efficiency up-gradation is one of the important DSM markets in India with transcending benefits for the power sector stakeholders and society as whole. However, several attempts to capture this market by both central and state level institutions have still remained at pilot scales primarily due to persisting market realities and implementation challenges. The EESL's new Ag DSM solution and program design offers hope and promise in overcoming many of these challenges. Moreover, integrated DSM solutions must be scaled up by considering both water and energy side interventions with appropriate delivery models to maximize resource savings in the agriculture intensive states.

Lastly, on the environmental front, DSM is a key strategy to meet India's low carbon development commitments (viz. to reduce the emissions intensity of GDP by 33% to 35% by 2030 and to achieve about 40% cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030) in the newly emerging global framework for combating climate change (UN Paris Agreement signed by 175 countries). The role and significance of DSM in achieving these commitments must be clearly formulated and integrated with other sustainability actions, plans and policies.

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List of Acronyms and Abbreviations

Abbreviation	Definition
AC	Alternating Current
ACS	Average Cost of Supply
ADR	Automated Demand Response
AEC	Ahmedabad Electric Company
Ag DSM	Agricultural Demand Side Management
AMI	Advanced Metering Infrastructure
APEPDCL	Eastern Power Distribution Company Limited of Andhra Pradesh, India
APERC	Andhra Pradesh Electricity Regulatory Commission
APSPDCL	Southern Power Distribution Company Limited of Andhra Pradesh, India
ARR	Annual Revenue Requirement
AT&C	Aggregate Technical & Commercial
BEE	Bureau of Energy Efficiency, Government of India
BELP	Bangalore Efficient Lighting Program
BESCOM	Bangalore Electricity Supply Company Limited
BLY	Bachat Lamp Yojana
CAD	Canadian Dollar
CAGR	Compound Annual Growth Rate
CCMS	Centralized Control and Monitoring System
CDM	Clean Development Mechanism
CERO	Carbon Emissions Reduction Obligation
CESC	Chamundeshwari Electricity Supply Corporation Limited
CFL	Compact Fluorescent Lamp
CSCO	Carbon Saving Community Obligation
DC	Direct Current
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
DELP	Domestic Efficient Lighting Program
DISCOM	Distribution Company
DR	Demand Response
DSM	Demand Side Management
DSRPO	Demand Side Resource Purchase Obligations
EA	Electricity Act 2003, India
EC	Energy Conservation
EM&V	Evaluation, measurement and verification
EPC	Energy Performance Contract
ESCO	Energy Services Company
EU	European Union
FOR	Forum of Regulators
FRP	Fiber Reinforced Plastic
FY	Financial Year
GDP	Gross Domestic Product
GOI	Government of India
GRIDCO	Grid Corporation of Orissa Limited
HESCOM	Hubli Electricity Supply Company Limited

HP	Horse Power
HVAC	Heating, Ventillation & Air Conditioning
HVDS	High Voltage Distribution System
IEA	International Energy Agency
IERP	Integrated Energy Resource Planning
INDC	Intended Nationally Determined Contribution
INR	Indian Rupee
IPDS	Integrated Power Development Scheme
IPMVP	International Performance Measurement and Verification Protocol
JERC	Joint Electricity Regulatory Commission for the state of Goa and Union Territories
JVVNL	Jaipur Vidyut Vitran Nigam Limited
LED	Light Emitting Diode
MERC	Maharashtra Electricity Regulatory Commission
MNRE	Ministry of New and Renewable Energy, India
MoP	Ministry of Power, India
MOSPI	Ministry of Statistics and Programme Implementation, India
MSEDCL	Maharashtra State Electricity Distribution Co. Limited
MW	Mega Watt
NITI	National Institution for Transforming India
NMEEE	National Mission for Enhanced Energy Efficiency
NTP	National Tariff Policy
NTPC	National Thermal Power Corporation
PAT	Perform Achieve and Trade Scheme
PGVCL	Paschim Gujarat Vij Company Limited
PSDF	Power System Development Fund
PV	Photo Voltaic
RE	Renewable Energy
REC	Rural Electrification Corporation
RFID	Radio Frequency Identification
RGO	Renewable Generation Obligation
RPO	Renewable Purchase Obligation
SERC	State Electricity Regulatory Commission
SPV	Solar Photo Voltaic
TOD	Time of Day
UDAY	Ujwal DISCOM Assurance Yojana
UJALA	Unnat Jyoti by Affordable LEDs for All
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
WENEXA	Water-Energy Nexus

1. Introduction

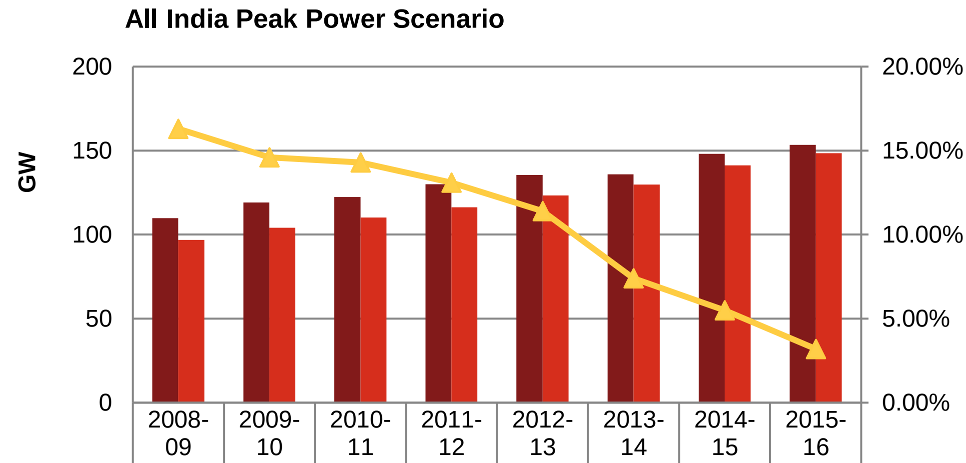
The Ministry of Power, Government of India, defines Demand Side Management (DSM) as 'actions of a Distribution Licensee (Utility), beyond the customer's meter, with the objective of altering the end-use of electricity - whether it is to increase demand, decrease it, shift it between high and low peak periods, or manage it when there are intermittent load demands - in the overall interest of reducing the costs of electricity supply'. Another definition of DSM, widely accepted by Indian industry, is that 'DSM refers to cooperative activities between the utility and its customers (sometimes with the assistance of third parties such as energy services companies and various trade allies) to implement options for increasing the efficiency of energy utilization, with resulting benefits to the customer, utility, and society as whole'.

Often the terms energy efficiency and DSM are used interchangeably. It is important to understand that DSM (in this report) explicitly refers to all those activities that involve deliberate intervention by the Electric Utility in the marketplace so as to alter the consumer's load shape. Because end use energy efficiency solutions can also alter consumers' load shape, all references to DSM in this report includes potential energy efficiency solutions that can be effectively delivered with some form of utility intervention. In fact, the later sections of the report that discuss Utility DSM potential in India categorize DSM opportunities into three principal groups, one of which is energy efficiency.

1.1. The Promise of DSM

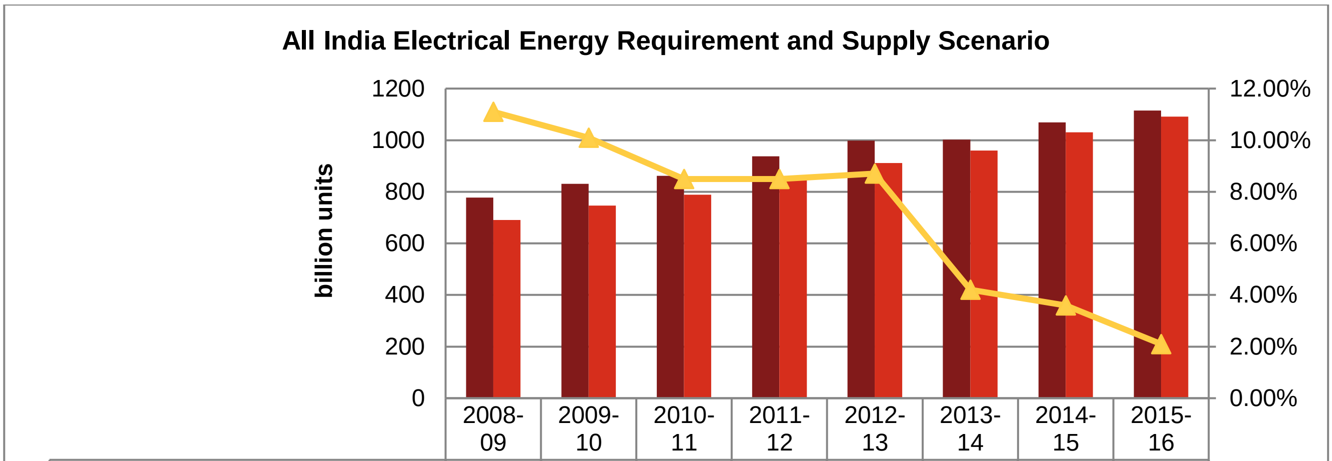
Managing electricity shortfall

The all India peak power requirement and the annual electrical energy requirement have been growing at 4.9% and 5.3% (CAGR) respectively in the last eight years. Despite this enormous growth in the demand, India's power supply scenario has improved significantly in the recent times. The peak power deficit has improved from 16.3% in 2008-09 to 3.2% in 2015-16, whereas, the deficit in annual electrical energy requirement has improved from 11.1% to 2.1% during the same period.



	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Maximum peak demand requirement (GW)	110	119	122	130	135	136	148	153
Maximum peak demand met (GW)	97	104	110	116	123	130	141	148
Maximum deficit in any month (%)	16.30%	14.60%	14.30%	13.10%	11.40%	7.40%	5.50%	3.20%

Source: Central Electricity Authority



	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Total energy requirement (BU)	777	831	862	937	998	1002	1069	1114
Total energy availability (BU)	691	747	788	858	911	960	1031	1091
Total energy deficit (%)	11.10%	10.10%	8.50%	8.50%	8.70%	4.20%	3.60%	2.10%

Source: Central Electricity Authority

Nevertheless, most households experience some level of "load-shedding" (deliberate enforcement of feeder-level outages due to shortfalls), sometimes as high as 15+ hours per day, especially in rural areas. The imbalances in supply and demand have been traditionally managed by load shedding or depleting grid voltage and frequency at the risk of total loss of bulk power supply system. This causes enormous problems for both supply and the demand side actors, while also creating social unrest due to reduced economic activity. The challenge of managing electricity supply shortfall is indispensable for Indian electric Utilities in the foreseeable future. There is tremendous pressure on Indian Electric Utilities to provide '24*7 power for all', which is an important power sector development vision/goal for sustaining the renewed economic growth.

International experience indicates that successfully managing electricity shortfall entails optimum mix of both demand and supply side actions. DSM actions can alter load shape and effectively complement supply side options to deal with electricity crises. Moreover, DSM resources[3] can be acquired within short gestation periods unlike conventional supply options. This makes DSM all the more relevant for bridging the power demand supply gaps in the Indian scenario.

Optimized power resource costs

India has witnessed more than 50% increase in wholesale electricity prices in the last 10 years[4]. The rising electricity tariffs is an important concern for Indian households and small/medium scale enterprises. Easing the burden of rising electricity tariffs is a crucial political promise in many Indian states. The direct and cross subsidy mechanism adopted by the state governments and Utilities to achieve this is not sustainable.

DSM has been globally recognized as the alternative least cost energy resource and is proven to be cheaper than building new energy supply infrastructure. Acquisition of cost effective DSM resources has the potential to put brakes on the rising power tariffs by optimizing the power resource costs of electric Utilities. Power purchase

[3] DSM resources could mean a saving in consumption (kWh) and/or demand (kW/KVA) available as a result of implementation of energy efficiency improvements or price induced load management, to be expressed in the following three important dimensions: Quantum – as to how much is available (kWh and/or kW); Time – as to when is it available (at what time of day, on what days, in what season); Cost – as at what would be the cost

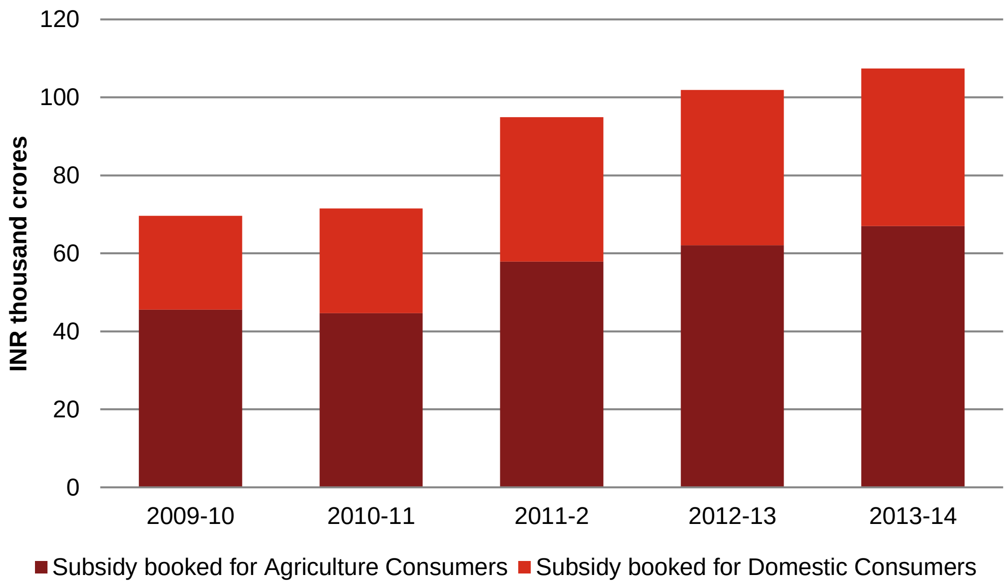
[4] MOSPI

expenses contribute for more than 75% of consumer tariffs in India. Utilities can avoid/delay the costly power purchase expenses through DSM resource acquisition and thereby reduce the impending tariff rise[5].

Reduced energy subsidy burden on state governments and improved fiscal health

Power tariff subsidies have been adopted as powerful fiscal policy tools to meet the socio economic development objectives of state governments. Yet, subsidies are a huge burden on the government finances in various states. The situation cannot be more precarious because in many instances, load shedding is adopted to bring down the subsidies to a manageable level even when there is enough generation capacity available in the market to meet the unrestricted demand[6]. Electricity subsidies are delivered in the form of direct subsidies from state fiscal budgets to select classes of consumers (viz. agriculture, residential etc.). Apart from this, cross subsidies also exist where commercial and industrial consumers subsidize residential consumers. The cumulative electricity subsidies booked and received by Indian electric Utilities, in the period 2003 - 11, was INR 1.75 trillion (US$38 billion) and INR1.3 trillion (US$28 billion) respectively[7]. A more recent data compiled by the Planning Commission (presently known as NITI Ayog) shows that the cumulative electricity subsidies booked and received by Indian Electric Utilities, in the period FY 10 – FY 14, was INR 2.78 lakh crores and INR 1.68 lakh crores respectively.

All India estimates of electricity tariff subsidy burden on state governments



Source: Planning Commission, 2014

Also, in FY 13, the state subsidy as share of the gross fiscal deficit was as high as 57% in some states.

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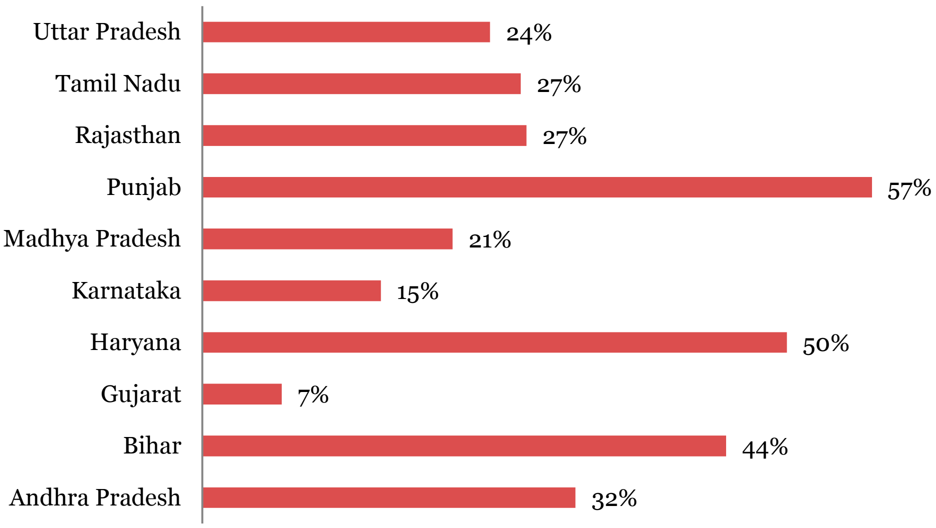
[5] There is some misconception among stakeholders that DSM investment by Utilities should always be tariff neutral or reduce existing tariffs. This may not always be true even for cost effective DSM measures. DSM resources (energy savings and demand reduction) acquired by implementing large scale DSM programs involve certain costs (Eg: technology, incentives for uptake, outreach, awareness, monitoring, verification etc.) like any conventional power generation sources. These costs may lead to tariff rise when passed onto consumers. However, the tariff rise resulting from cost effective DSM resource acquisition will always be less than the impending rise expected from conventional power generators.

[6] SE4ALL report titled “Direct Delivery of Power Subsidy to Agriculture in India”

[7] The World Bank, 2014

State support to power sector (direct subsidy intervention) as share of gross fiscal deficit (for 2012-13)



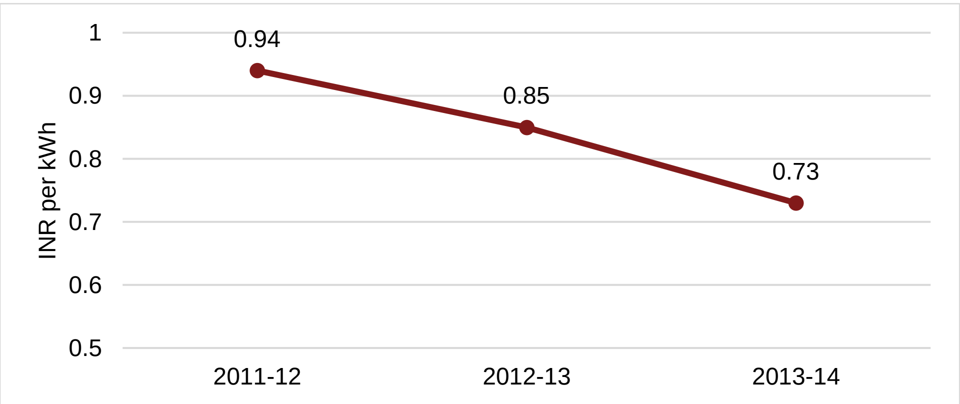
Source: PwC analysis based on data compiled from RBI's latest budget estimates and performance of state utilities published by Power Finance Corporation

DSM measures targeted at subsidized consumers has the potential to reduce the subsidy burden of state governments in the same proportion of energy savings achieved. This will help improve the fiscal health of state governments substantially. For illustration, even a moderate 10% reduction in the subsidized energy consumption due to DSM actions can reduce 5% of the current levels of gross fiscal deficit in states like Punjab and Haryana.

Improved financial health of electricity distribution Utilities

The gap between average cost of supply and average revenue realization (post subsidies received) has been the major driver of losses and poor financial health of the Indian electricity distribution utilities, which are perceived as the weakest link in the overall power sector value chain.

Gap between average cost of supply and average revenue realization for Indian electric Utilities



Source: The Performance of State Power Utilities for the years 2011-12 to 2013-14; Power Finance Corporation

As of March 2015, the accumulated losses for all electricity distribution Utilities in India was INR 3.8 lakh crores[8].

DSM resources (energy savings) directly contribute to the reduction in revenue gap for Indian Utilities, especially when the actions are targeted at subsidized consumers. For illustration purposes, even a moderate 10% energy savings through DSM actions can reduce the revenue gap by INR 7300 crores per year[9] for all the Utilities in the country.

Combating climate change

India depends on fossil fuels for 70%[10] of its installed power generation capacity. Much of the contribution to India's greenhouse gas emissions is a direct result of burning fossil fuels for power generation.

In the recently concluded COP21[11] held in Paris, India communicated its climate ambition [known as 'Intended Nationally Determined Contribution' (INDC) and agreed upon a new global framework to combat the challenges posed by climate change. More than 175 countries across the globe, including India, have signed the United Nations Paris Agreement, which is envisaged as the new global framework that drives collective action towards low-carbon and climate-resilient future. After decoding India's INDC[12], some of the important commitments that rests critically on the power sector transformation are as below:

1. To reduce the emissions intensity of GDP by 33% to 35% by 2030 from 2005 level.
2. To achieve about 40% cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030.

DSM is regarded as alternative clean energy resource worldwide and therefore is an important strategy for India to achieve its climate goals as per the UN Paris agreement. Scaling up DSM would create a virtual clean energy capacity for Indian Electric Utilities to bridge demand supply gap and add more clean energy resources in the overall energy resource basket of these Utilities. Enhanced DSM actions by Utilities would also avoid/delay adding capacity for power generation that is tied up with conventional fossil fuels and result in improved air quality and controlled environmental degradation, both of which are the emerging environmental challenges for India in the context of rising urbanization.

1.2. History and Evolution of Utility DSM in India

The onset of Utility driven DSM first began in 1982, with the formation of an Energy Conservation Cell by the Gujarat Electricity Board (erstwhile Gujarat Urja Vikas Nigam Ltd). The cell supported preliminary walk-through audits in over 150 industrial units (Lele and Raval, 1990; Lele, 1991). Following this, many State Electricity Boards with funding from the Department of Power and the Rural Electrification Corporation promoted Rectification of electric pump sets in the late 1980s (Bhatnagar, 1991). The Rural Electrification Corporation (REC) provided financing to State Electricity Boards for rectification of electric pump sets in REC project areas under its Energy Conservation Program. During 1989/90, about 22,000 pump sets were rectified under this program (Nadel, Gopinath and Kothari, 1991). The Department of Power also funded REC to provide training and guidance regarding energy conservation in agricultural pump sets to officers and field level

[8] Towards Ujwal Bharat UDAY: The Story of Reforms; Ministry of Power, Government of India
[9] All India annual electricity sales assumed as 1000 billion Units to estimate this value
[10] Central Electricity Authority, November 2015
[11] 21st U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) held in Paris in December 2015
[12] INDIA'S INTENDED NATIONALLY DETERMINED CONTRIBUTION: WORKING TOWARDS CLIMATE JUSTICE; UNFCCC

functionaries of State Electricity Boards, Agricultural Departments of State Governments, and banks (Nadel, Gopinath and Kothari, 1991).

In the 1990s, there were few attempts at scaling up Utility DSM measures in Gujarat, Haryana, and Orissa. The first and largest of these programs was delivered by the Ahmadabad Electric Company (AEC) in Gujarat. This was also the first Utility sponsored DSM program conceived and executed in a systematic phased approach that comprised of—(1) feasibility research, (2) initial testing and program design, (3) pilot programs and (4) full-scale program roll-out (Glen Weisbrod, Mark Tribble and Vijay Deshpande, 1998). In Orissa, a DSM cell was established within GRIDCO in 1997 to plan, evaluate and implement DSM measures.

Subsequently, during the Tenth Five year plan (2002-07), several pilot DSM programs were undertaken by state owned and private sector Utilities with the assistance of international development institutions. The Bangalore Electricity Supply Company (BESCOM) in Karnataka introduced the Bangalore Efficient Lighting Program (BELP) to promote purchase and use of CFLs by domestic consumers on a monthly instalment basis paid through electricity bills[13]. An estimated 1.81 Lakhs CFLs were purchased by consumers under the scheme and as a consequence CFL sales sky rocketed in the city. The program delivered 10.46 MW of peak load reduction for BESCOM. BELP was the first utility driven DSM lighting program involving alliance between CFL suppliers/energy service companies and the utility to test and demonstrate large scale replacement of incandescent lamps with CFLs among households. Similar programs were piloted by a private Utility in Mumbai distribution circle, and MSEDCL (a state owned utility of Maharashtra). These pilot programs mainly focused on efficient lighting, smart metering, awareness, and agriculture pumping. During this period, several Utilities under the directions of state regulatory commissions introduced Time of day (TOD) tariffs, power factor improvement incentives and load factor incentives in their tariff structures. Many of these incentives are active even today.

During the Eleventh Five year plan (2007-12), the Bureau of Energy Efficiency (BEE), learning from the success of pilot CFL programs, launched the Bachat lamp Yojana (a national CFL promotion scheme) aimed at transforming the lighting market in India. BEE developed a programmatic framework to mobilize private sector funding and resources to distribute CFLs at discounted prices to the end users and recover costs under the Clean Development Mechanism (CDM) framework. Utilities played the crucial role of marketing, distribution, program administration, monitoring and evaluation. CFL promotion and distribution under the BLY scheme became the flagship DSM initiative for many Utilities during the XI plan period. Over 29 million incandescent bulbs have been replaced by CFLs under this program. Apart from the CFL promotion scheme, the BEE also launched national Agriculture DSM and Municipal DSM programs to enhance energy efficiency in irrigation pumping, municipal street lighting and water pumping infrastructure in the country. These programs aimed to create conducive market conditions to replace existing pumping and lighting systems with energy efficient technologies by fostering internationally successful energy performance contracting structures between public Utilities and private energy service companies. The Agriculture DSM program was successful with MSEDCL implementing a pilot program in Solapur, Maharashtra. The pilot replaced 2209 pump sets with BEE 5 star rated ones and realized 6.1 MU of annual energy savings. Many states (Eg: Punjab, Haryana etc.) also mandated the use of BEE star rated pump sets new agricultural connections under the scheme. PGVCL (a state owned utility in Gujarat) also implemented a wider scale DSM program replacing thousands of agriculture pump sets with energy efficient ones and gaining significant energy savings. Apart from the BEE driven national Ag DSM, the USAID's WENEXA (Water-Energy Nexus) also promoted pilot projects that involved upgradation of inefficient agriculture pump sets through public private partnership models. The XI plan period also witnessed significant milestones on the regulatory and institutional fronts of Utility DSM. The Forum of Regulators (FOR), entrusted with the responsibility of harmonising regulations, constituted a working group (with BEE as key member) in June 2008, to deal with issues related to the implementation of DSM measures in the electricity distribution sector. In April 2010, Maharashtra pioneered the first regulations for '*DSM*

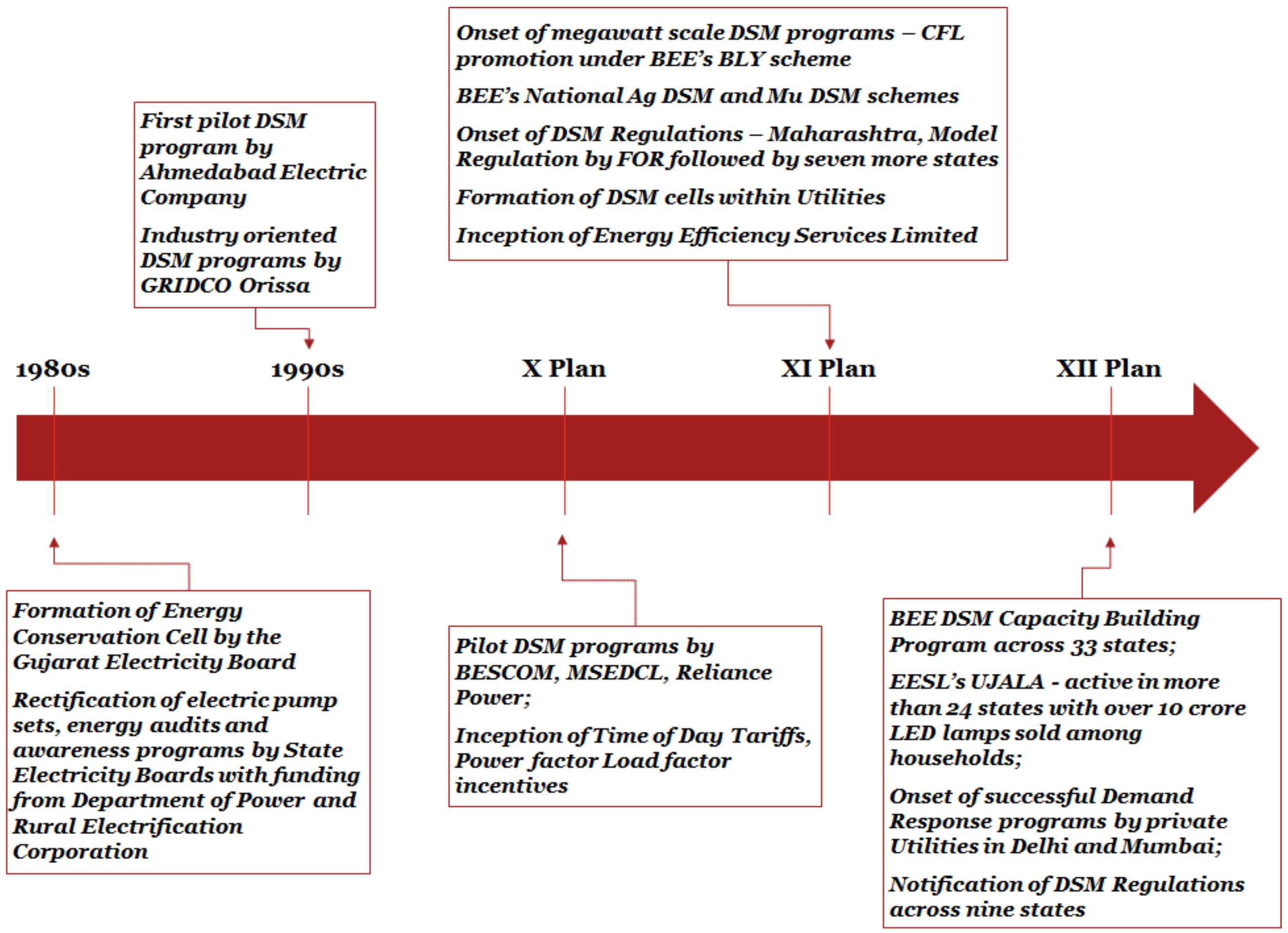
[13] This mechanism is called On bill financing and is discussed in detail in the later chapters

Implementation Framework' as well as '*DSM Measures and Program's Cost-Effectiveness Assessment'*. Despite the lack of an explicit mandate for DSM in the Electricity Act (EA) 2003, the Maharashtra Electricity Regulatory Commission (MERC) successfully interpreted the EA 203 provisions to allow for the promotion of utility driven DSM programs and cost recovery of such activities through consumer tariffs. The FOR working group later adopted many provisions in the MERC DSM Regulations and published the 'Model DSM Regulations' in May, 2010. Following this, in the remainder of XI plan period seven more states notified DSM Regulations by adopting the FOR's model regulations. Many of these regulations led to the establishment of DSM cells with significant authority and dedicated resources within the Electric Utilities of those states to plan and implement DSM programs in continuous cycles. One of the most significant achievements on the institutional front came on the heels of boosting the energy efficiency services infrastructure in India. BEE along with the Ministry of Power facilitated the establishment of 'Energy Efficiency Services Limited' (EESL), as public sector energy services company to lead investment related DSM actions and create self-sustaining energy efficiency and DSM markets in the country. EESL is promoted by 4 leading central public sector undertakings (CPSUs) in the Indian power sector.

Since the beginning of XII plan period, EESL has significantly scaled up DSM investments by suitably adapting the globally successful innovative DSM program designs to Indian market conditions. In the last 2-3 years, EESL's 'UJALA' scheme[14], the flagship LED lighting initiative, has sold over 100 million self-ballasted LED lamps to domestic and institutional consumers in about 24 states and union territories across the country. Apart from leading the investment related efforts, EESL has been engaging the private sector energy service companies (ESCOs) and energy efficient technology/equipment manufacturers to invest and support in the development of energy efficiency and DSM services infrastructure. The EESL led DSM investments so far have unlocked enormous potential for scaling up Utility DSM by way of energy efficiency improvements in various other end use applications such as ceiling fans, tubular lamps and air conditioners. Apart from EESL's initiatives, several private and public utilities have also initiated independent demand response and energy efficiency improvement programs in Delhi, Maharashtra and other states. Private sector Utilities have achieved 10 - 15 MW peak load curtailment in major metropolitan cities like Delhi and Mumbai by rolling out meticulously planned demand response initiatives. On the regulatory front, nine more states notified DSM regulations putting the total tally to 17 states with established regulatory framework for DSM. Also, in the current five year plan period (XII plan), BEE in partnership with EESL has initiated a nation-wide capacity building program to mainstream DSM into utility operations. As part of the capacity building initiatives, EESL is currently supporting *33* selected Utilities across the country to conduct load research studies, develop concrete DSM action plans and strengthen the capacity of DSM cells for effective DSM program implementation and coordination.

[14] Abbreviation for 'Unnat Jyoti by Affordable LEDs for All' or formerly known as Domestic Efficient Lighting Program (DELP) http://www.delp.in/

Snapshot of Utility DSM Evolution in India



1.3. Utility DSM opportunities and resource potential

The Utility DSM opportunities in India can be broadly categorized into three principal groups or sub components - demand response, end use energy efficiency and distributed generation close to the point of consumption. Apart from this, the DSM potential of smart grid applications is also discussed separately to highlight the role of smart grid in all the above principal groups.

Demand response (DR)

Demand response is the ability to change electricity usage by end use customers from their normal consumption patterns in response to incentive payments designed to induce lower electricity use at times of high wholesale prices or when system reliability is jeopardized.

Typically, there are two types demand response programs adopted by Indian Utilities.

Rate induced demand response: Utilities mitigate their exposure to costly power purchase and system imbalance by financially exposing end use customers to retail tariffs that change over time. Customer exposure to high retail tariffs financially incentivizes load curtailment or shifting during peak hours and thereby helps Utilities mitigate commercial risk stemming from wholesale power markets. Rate induced designs are mostly voluntary in nature and customers can choose whether or not to curtail demand.

Most of the Indian Utilities have adopted Time of Day (TOD) tariff structures for High Tension (HT) category consumers, mostly large industrial and commercial consumers. There is tremendous potential for peak load curtailment by introducing TOD tariff structures in the residential category by way of smart meters.

Indian Utilities can also adopt more dynamic tariff structures such as 'Real Time Pricing' - a rate in which the price for electricity typically fluctuates hourly reflecting changes in the wholesale price of electricity and customers are notified of real time prices in a day ahead or hour ahead basis.

Incentive based demand response: An innovative combination of technology and business relationships with large commercial and industrial consumers that enables Utility to get committed load curtailment when needed by offering attractive incentives.

Indian Utilities have administered different types of incentive based demand response programs in the last three years mostly through third party service providers (commonly known as 'Demand Response Aggregators').

The Maharashtra Electricity Regulatory Commission in its April 2010 regulation under Section 4(c) has recognized 'Demand Response' as an integral part of the DSM implementation framework, which itself is a testament to the usefulness of such programs to the Indian utilities.

In Mumbai, Tata Power has adopted the most basic form of demand response in which the Utility notifies the aggregator who will in turn alert the enrolled customers to provide committed load curtailment for specified period (known as DR event). The participating consumers curtail load during the DR event according to pre-established curtailment plans. Utility calculates curtailment supplied based on meter data and mutually agreed standard methodology. The key feature that makes this type of program basic is the use of simple yet innovative communication systems to alert the aggregators and/or customers about the DR events who will then undertake manual implementation of load curtailment options. Tata Power has conducted more than 25 such DR events and achieved 15 MW of load curtailment in Mumbai service area. Reliance owned Utilities have also adopted similar DR programs at pilot scale in Mumbai and Delhi.

In Delhi, Tata Power has recently unveiled the country's first large scale implementation of an automated demand response (ADR) program. Over the past year, Tata Power along with Honeywell, a key implementation partner, has hooked up more than 160 commercial and industrial customers with internet and cellular connected load controls capable of shedding about 11.5 MW of load at a moment's notice[15].

In Rajasthan, the Jaipur Vidyut Vitran Nigam Limited (JVVNL) succeeded in carrying out four Demand Response events of 1 hour duration each. Each of these events delivered 22 MW of load curtailment from 10 large industrial consumers.

There is tremendous potential to scale up incentive based demand response programs especially among Utilities in Urban areas and those that predominantly serve large industrial/commercial loads. Indian Utilities can also adopt the innovative Demand Bidding/ Buyback mechanism in which customers offer bids to curtail load based on wholesale electricity market prices or an equivalent.

[15] Proceedings of the meetings held by 'Utility CEO Forum on Demand Side Management'; Shakti Sustainable Energy Foundation

End use energy efficiency

Energy efficiency improvement typically involve incentives to customers to buy down the cost of high-efficiency equipment, and incentives to upstream manufacturers and retailers to stock and distribute high-efficiency products. Many Indian Utilities have adopted DSM programs that focus on large scale replacement or retrofitting of conventional end use appliances with energy efficient technologies. Such energy efficiency measures typically allow customers to use less energy while receiving the same level of end service.

The EESL's UJALA initiative is the quintessential example for this type of DSM opportunity. The program has sold over 100 million 7 watt and 9 watt LED lamps to replace less efficient incandescent and CFL lamps among households. The program is currently delivering over 35 million kWh of energy savings per day that translates to more than INR 14 crore in energy cost savings per day, and 2667 MW of avoided generation capacity[16].

There is enormous potential for UJALA like Utility scale energy efficiency programs for other major end use applications such as ceiling fans, air conditioners, tubular lamps, refrigerators, electric geysers, agriculture pump sets, industrial motors, and many other end use equipment that can deliver unprecedented energy savings and load curtailment for Indian electric Utilities.

Distributed generation close to the point of consumption

Roof mounted solar photovoltaic (SPV) system is emerging as the most effective clean technological options for DSM by way of distributed generation close to the point of consumption. As per the recent estimates of MNRE (Ministry of Renewable Energy, Govt. of India), the total realistic market potential for rooftop SPV in urban settlements of India is found to be around 124 GWp. The payback period for small scale SPV systems for domestic and commercial purposes range from 6 - 10 years and any grant/subsidy sponsored by central / state policies will help in further reducing this payback period.

Currently, the majority of rooftop SPV projects implemented in India are driven by national and state specific policies driven by net and gross metering concepts coupled with capital subsidy for rooftop SPV systems. The government of India has committed to achieve 100 GW of solar capacity in the country by 2020, of which 40 GW is expected to be achieved through decentralized and rooftop scale solar projects. Electricity Regulatory Commissions, in more than 15 different states, have notified the regulations for grid connected rooftop SPV projects. The state policies mostly encourage self-consumption and sale of surplus power to Utility at predefined rates. Some states (*e.g.* Kerala) have also initiated mandatory rooftop SPV installations for domestic and commercial buildings falling under specified conditions pertaining to connected load and/or built up/plot area.

There are many challenges on the policy, technology, and consumer awareness fronts for large scale deployment of rooftop SPV systems in the country.

On the policy front, net-metering allows customers who generate their own electricity from solar to feed unused electricity back into the grid and be compensated for that. Most of the states have fixed this compensation as the tariff at which the consumer is buying electricity from the grid. Only few states have allowed special feed-in tariffs that permit consumers to sell unused electricity into the grid at higher rates than the tariffs. Residential tariffs are subsidized either through cross subsidies or direct subsidies from state governments. In this scenario, the economics for residential rooftop SPV systems is not attractive for residential consumers to make the investment. This is despite the fact that Utilities benefit more by promoting rooftop SPV systems in this segment of consumers, because they help in bridging the revenue gap resulting from subsidies. For commercial consumers, where the rooftop SPV system makes a clear economic case for investment because of high tariffs,

[16] http://www.delp.in/

the Utilities perceive substantial loss of revenue. Therefore, there is a need to demystify this perception by establishing the relevant cost effectiveness indicators for rooftop SPV investments from the vantage point of Utility, consumer, state government and society as whole.

On the technology front, one of the key requirements for any energy source to connect to the grid is the availability of 'anti-islanding protection'. Anti-islanding protection is a way for the inverter to shut itself off and stop feeding power into the grid, when it senses a problem with the power grid, such as a power outage. This requirement is crucial to ensure safety of Utility engineers working to fix outages and other grid related problems. Most of the states in India suffer from frequent power outages, mostly due to load shedding rather than problems in the grid's infrastructure. Thus when the grid shuts off, the solar PV inverter will also turn off completely, preventing the owner from using the generated energy for themselves. With high unreliability of the grid, a lot of the electricity generated by the solar PV system will be wasted. The anti-islanding protection is an essential safety feature that cannot be removed. Inverter manufacturers will have to make their inverters capable of cutting off the connection to the grid in case of grid failure, while still being able to operate (acquire reference voltage) and provide solar energy for self-consumption. If such a provision is available then net-metering customers can still use their grid-connected PV systems even during power outages.

Furthermore, empirical evidence suggests that customers installing SPV systems may become more energy efficient because they begin to measure energy thereby driving a behavioral change. This if true, is bound to enhance the DSM potential of SPV systems than what is generally perceived.

DSM Measures and Technologies for Indian Utilities[17]

	State of Play	Opportunity
Rate induced demand response	TOD tariffs for Large Industrial and Commercial (HT) consumers only	TOD tariffs for residential customers Real Time Pricing for HT consumers enabled by advanced metering infrastructure (smart grid)
Incentive based demand response	Pilot scale programs adopted by very few private and public Utilities	Manual DR programs with aggregator Auto DR programs with direct load control Demand bidding /buy back

Energy efficiency improvement opportunities in end use applications with efficient technologies

Sector	***HVAC***	***Lighting***	***Water Heating***	***Pumping***	***Others***
Residential and Commercial	BEE 5 star rated Air conditioners and ceiling fans; Inverter technology based Air conditioners; Ceiling fans driven by brushless DC motors	Electronic ballasts Self-ballasted LED lamps Smart lighting controls	Solar water heaters BEE 5 star rated electric geysers Heat pump based water heaters Automatic timers for electric geysers	BEE 5 star rated pumping systems	BEE 5 star rated refrigerators Inverter technology based refrigerators

[17] This table is only illustrative with high potential measures and does not comprehensively identify all possible measures and technologies.

Industry	Energy efficient chillers	Self-ballasted LED lamps Smart lighting controls	Solar water heaters	BEE 5 star rated pumping systems	BEE 5 Star rated industrial motors Variable frequency drives for air compressors Fiber Reinforced Plastic (FRP) blade fans for cooling towers
Agriculture				BEE 5 star rated pumps Solar pumps	
Municipal Street Lights and Water Pumping		LED fixtures with centralized control and monitoring system (CCMS)			
		Distributed generation close to the point of consumption			
Residential, commercial and industry			Rooftop solar photovoltaic systems		

Unlocking the potential for smart grid enabled DSM programs in India

Intelligently planned smart grid technologies that integrate Utility DSM as central goals have enormous potential to acquire reliable demand side resources (energy and peak demand savings) and provide a more comprehensive solution to the critical problems faced by Indian Electricity Distribution Licensees. DSM provides the scale and scalability to make smart grid solutions cost effective and easy to implement.

Data provided by smart grid technologies enable consumers to make informed decisions about how much, when and at what cost they use energy at various end use applications. This means the consumers gain enhanced information over end use energy in order to respond to price signals or other Utility incentives thereby increasing the overall capacity for demand side management. Integrated analytical solutions (Eg: bills comparing energy usage over past time or peer consumers in similar group) enable Utilities and consumers to monitor, measure, and evaluate demand side resource acquisition in a transparent and reliable manner.

It is not just electricity use information, but control is also an important function to make use of information and act on demand side. Smart appliances/equipment that simply allow consumers remotely turn off/on (through a programmable device) in advance of their need is one such control feature that is the key to better management of energy demand. Smart appliances that can effectively communicate with meters and respond to utility signals are critical components of auto DR solution discussed earlier. Smart appliances could include typical appliances (refrigerators, air conditioners, water heaters, etc.), electric and smart building components like lighting and window shading. For example about half of refrigerator's energy use is for defrosting and ice-making cycles that can be run at any time of day. Dishwashers and clothes washers can often have delayed start times. Air conditioners and water heaters can be turned off briefly, or even run in advance of their need. Many Indian Utilities experience early morning peak loads driven by water heating or late morning / afternoon peak load driven by air conditioning. Therefore, smart appliances present a massive potential to manage such peak loads when deployed at sufficient scale.

The heart of any smart grid application is AMI (Advanced Metering Infrastructure), which is the collective term to describe the entire infrastructure including smart meters, two way-communication between Utility and consumers, control equipment and all applications that enable the gathering and transfer of energy usage / pricing information in real-time. AMI is a combination of hardware and software components that enable measurement of energy consumption and communicating/ controlling usage by Utilities and customers. AMI is the core component of incentive based automated demand response (auto DR) solution discussed earlier in this section.

'The initiation and expansion of smart and dynamic energy efficiency programs' is one of the key milestones and activities highlighted in the 'Smart Grid Vision and Roadmap' published by the Ministry of Power, Government of India (GOI) in August 2013. Despite this, the impact and outcomes related to energy efficiency are often neglected in the evaluation of potential benefits offered by smart grid systems in many states. Similarly, Utility DSM plans implemented so far have neglected integration with smart grid solutions because of the cost implications and the perceived complexity of such programs.

Despite the widespread benefits of smart grid enabled DSM solutions, deploying them involves four major challenges that include high upfront investment, justifying the cost effectiveness of such investment, integration with DSM solutions and other grid infrastructure, standardization, and lack of awareness.

Justifying the business case for smart grid systems is one of the most important barriers for Indian Utilities in scaling up smart grid enabled DSM programs and investments. Such investments must establish substantial incremental benefits for consumers, Utilities and society as whole in order to pass the basic regulatory screening process. Encouraging consumers to purchase smart appliances may be difficult unless those consumers recognize benefits to themselves. Thus it is critical to identify clear consumer benefits from smart appliances, and ways to convince consumers of the benefits, or to find ways to convince the manufacturers to include smart capability as a standard feature. Also, consumers are unlikely to justify the replacement of still-useful appliances based solely on smart grid capabilities even if they see the benefits. Thus add-on devices that provide some level of smart capability for conventional appliances could act as a stopgap or shortcut in the early years (or decades) of smart grid roll-out.

Other important concerns that could be expected from the Indian consumers' perspective are as follows:

- Difficulty in adapting to DSM programs enabled by smart grid (Eg: Time of Day tariffs in domestic sector), or the perceived complexity of such programs
- Claimed health effects from electromagnetic radiation emitted from smart meters
- Privacy concerns
- Suspicion of utility motives, and that the meters are over reporting energy use

Merely, making energy use information available to consumers does not automatically result in energy savings. The means and knowledge to turn information into meaningful action to curtail/shift energy use will also be necessary. Thus systems that can analyze the data and give consumers specific and actionable information on energy use and what they can do about it, or can automate responses to the data, may be most useful. Such systems would also likely prove most useful by providing a rationale for financing large integrated DSM programs.

Also, the financial resource requirement for smart grid enabled DSM programs is enormous and the poor financial health of Indian Utilities further complicates this problem. In addition, the technical capacity of Utility personnel is limited to enable integration of smart grid applications into DSM solutions and other technical protocols. 'Smart Grid as a Service' concept can be very useful to overcome the financing and capacity barriers in scaling up smart grid enabled DSM solutions. This concept is similar to energy performance contracting, which monetizes the future benefits of smart grid enabled DSM solutions to compensate for the cost recovery of the service provider. However, such business models require robust, transparent and cost effective systems to monitor and evaluate the benefits resulting from smart grid enabled DSM programs.

Utility DSM Resource Potential in India

The National Mission for Enhanced Energy Efficiency (NMEEE) (2010), which is one of the eight national missions under the National Action Plan for Climate Change, is the most significant planning milestone for DSM in India. The NMEEE indicated ₹ 44,000 crores of DSM investment potential and 74.40 Billion Units of annual energy saving potential from demand side measures across various demand side sectors of the Indian economy. The breakdown of DSM potential across various demand side sectors indicated by NMEEE is shown in the table below.

DSM potential established under NMEEE

Sector	Investment potential (INR crores)	Energy savings potential (Billion kWh/annum)	Cost of saved capacity (crores / MW)
Industrial	12,100	49.00	1.73
• Generic energy efficiency	4,200	23.70	1.24
• Process energy efficiency	7,900	25.30	2.19
Buildings	1,139	3.52	2.27
• Commercial buildings	570	1.71	2.34
• Government-owned offices	340	0.76	3.14
• Government-owned hospitals	85	0.87	0.68
• Privately owned hotels	144	0.18	5.61
Municipal	1300	3.7	2.46
Agriculture	30,000	30	5.46
Total	**44,000**	**74.40**	**2.92**

Source: NMEEE, Government of India, 2010

Agriculture and Industry emerge as the biggest markets for DSM investments as per the NMEEE estimates. However, recent trends in the market driven DSM investments to improve energy efficiency in the street lighting and domestic lighting sectors has unlocked a massive potential for scaling up DSM investments (see table below). In the residential sector, energy efficiency improvements by way of appliance replacement /retrofits has unearthed enormous potential for DSM.

DSM potential unlocked from the residential appliance efficiency improvement opportunities

End use	Investment potential (INR crores)	Energy savings potential (Billion kWh/annum)	Avoided Generation Capacity (MW)	Cost of saved capacity (crores / MW)
Residential appliances	***91,937***	***89***	***41002***	***2.24***
Lighting - Self ballasted LED bulbs and tubular lamps	22,777	26.64	20361	1.12
Energy efficient ceilings fans	48,160	40	11218	4.29
Energy efficient room air conditioners	21,000	21.98	9423	2.23
Municipal street lights	***25,200***	***8.43***	***3365***	***7.49***

Source: PwC analysis

Considering both NMEEE and PwC determined DSM market potential estimates, the table below gives a consolidated assessment of the DSM market potential in the major demand side sectors of India. Residential end use appliances, agriculture/irrigation pumping and municipal infrastructure are the top three DSM markets contributing to this potential.

DSM market potential in India (re-evaluated)

Sector	DSM Investment potential (INR crores)	Energy savings potential (Billion kWh/annum)	Avoided Generation Capacity (MW)
Industry	12,100	49	8964
Residential	91,937	89	41002
Commercial Buildings	1,139	2	313
Municipal Infrastructure	25,200	8	3365
Agriculture	30,000	30	5488
Total	***160,376***	***178***	***59132***

Source: PwC analysis and NMEEE, Government of India, 2010

One can observe that the DSM market potential has re-established from INR 44,000 crores to INR 1.6 lakh crores in a span of six years. The renewed DSM potential is envisaged to deliver 178 billion units of electrical energy savings per annum that roughly translates to 18-20% of the current levels of all India annual electricity consumption and 150 Million tons of annual CO_2 emissions reduction potential @0.85 tCO_2/MWh grid emissions factor.

2. Review of Utility DSM policy framework for in India

In India, Utility DSM progress so far is primarily driven by institutional development[18], donor funded studies and pilots[19], market based investments facilitated by national institutions in the broader context of energy efficiency & conservation[20], economic efficiency of retail tariffs[21], market recognition for DSM based Utility services, enhanced customer satisfaction and other ad hoc competitive advantages for Utilities, especially in the competitive electricity distribution markets (*e.g.* Delhi and Mumbai). By virtue of these market driven approaches, the DSM market has significantly evolved in India.

On the policy front, DSM Regulations have been active in about ***17 states and 7 Union Territories*** till date. These regulations provide a systematic approach for the entire DSM implementation cycle by clearly defining the roles and responsibilities for the key stakeholders. However, the enforcement of DSM regulations continues to be limited in many states.

Given that the market driven DSM mechanisms have gained significant momentum in the recent times, India is at the cross roads for adopting the right policy approach that can effectively complement the market mechanisms in capturing the DSM potential and also delivering the promise of DSM.

International experience suggests that strong legal, policy and regulatory frameworks with clear and unambiguous mandates that prioritize energy efficiency over other resources have had significant impact in driving electric Utility DSM investments and programs. In US, compliance with statewide legislative mandates or regulatory savings or spending targets is poised be the primary driver for the increase in Utility DSM program spending through 2025[22]. Policies that drive Utility DSM investment in US include: energy efficiency resource standards[23]; renewable portfolio standards[24] under which energy efficiency is a qualifying resource; statutory requirements that utilities obtain "all cost-effective energy efficiency" resources[25]; and long-term integrated resource planning[26] requirements. In the European Union (EU), article 7(6) of the Energy Efficiency Directive requires EU member countries to achieve energy saving targets by end of 2020. As a consequence of this, many EU member countries have adopted a combination of legislative actions and regulatory mechanisms to enforce energy efficiency obligations on energy Utilities.

'Energy efficiency obligations' is a regulatory mechanism that requires obligated parties to meet quantitative energy efficiency improvement targets in a predefined time frame. Typically, the obligation is placed on energy

[18] Establishment of the Bureau of Energy Efficiency, Energy Efficiency Services Limited, DSM cells within electric Utilities, and designation of state nodal agencies.
[19] USAID's WENEXA and On-bill CFL pilots in Karnataka, Shakti Sustainable Energy Foundation's Demand Response pilot in Rajasthan etc.
[20] National Mission for Enhanced Energy Efficiency (NMEEE) introduced in 2007-08, Bachat Lamp Yojana, Agriculture DSM pilot projects, EESL's UJALA, National LED Street Lighting program, National Energy Conservation Awards for Electric Utilities etc.
[21] Time of Day (TOD) tariffs for high tension industrial and commercial consumers.
[22] The Future of Utility Customer Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025; Ernest Orlando Lawrence Berkeley National Laboratory; 2013
[23] A regulatory mechanism that requires electric Utilities to meet quantitative energy efficiency improvement targets in a predefined time frame. It is also called as energy efficiency obligations in various other jurisdictions across the world. The targets could be stipulated in terms of % of electricity sales, kWh of energy savings, MW of load reduction etc.
[24] Same as renewable purchase obligations in India
[25] For example, the California Public Utilities Code, which is the California state law for operation of utilities, was amended in 2003, that required all Utilities in California to first meet their "unmet resource needs through all available energy efficiency and demand reduction resources that are cost effective, reliable, and feasible".
[26] IRP is a long term utility plan for meeting forecasted annual peak and energy demand, plus some established reserve margin, through a combination of supply-side and demand-side resources over a specified future period. IRP has been practiced in US for more than 25 years through state legislations and regulatory oversight.

utilities, who are in the business of distribution and retail sales of energy commodities. Energy efficiency obligations for utilities require them to reduce the demand for energy by promotion of demand side measures. A survey by IEA in 2012 has found dozens of jurisdictions around the world with some form of energy efficiency obligations for energy Utilities.

Typically Utility energy efficiency obligations implemented across the globe share the following features:

- A quantitative binding target for energy efficiency improvement
- Target enforced by laws and regulations with the threat of financial penalties
- Clear definition of obligated parties that must meet the target
- A systematic process for compliance verification

Snapshot of Utility DSM obligations in select countries across the globe

Country	Target	Obligated parties	Enforcement mechanism	Compliance mechanism	Performance incentives for obligated parties
Australia - New South Wales	0.4% of total electricity sales in 2009 Increasing to 4.0% in 2014	Electricity retailers and customers who purchase power directly from wholesale market	Combination of legislation and regulation Financial penalty for non-compliance	Self-achievement of savings Or Purchase of energy efficiency certificates	Trading of energy efficiency certificates among obligated parties
Canada – Ontario	1330 MW reduction in peak demand by 2014 6,000 GWh of energy savings by 2014	Electricity distribution licensees	Combination of legislation and regulation	Self-achievement of savings verified by third party and approved by regulator	CAD 0.3 to 1.8 per unit allowed for goal achievement ranging from 80% to 140%
China	0.3% of electricity sales and maximum load in the previous year	Government-owned grid companies	Regulation issued by central government agency	Self-achievement of savings verified by third party	Not documented
Italy	6 Mtoe cumulative in 2012	Distributors of electricity and natural gas	Combination of legislation and ministerial decrees Financial penalty for non-compliance	Self-achievement of savings Or Purchase of energy efficiency certificates	Trading of energy efficiency certificates among obligated parties
Poland	53,452 GWh by 2016	Electricity, natural gas, and district heating companies and brokers	Combination of law and regulation Financial penalty for non-compliance	Self-achievement of savings Or Purchase of energy efficiency certificates	Trading of energy efficiency certificates among obligated parties
United States – California	6,965 GWh, 1537 MW, and 150 million therms in 2010-2012 for investor-owned utilities;	Investor-owned and publicly owned electricity and natural gas utilities	Combination of legislation and regulation Financial penalty for non-compliance	Self-achievement of savings rigorously verified by third party contractors	Capped at 450 million USD for investor owned utilities

	700,000 MWh for publicly owned utilities				
United Kingdom	12.4 MtCO2 under the Carbon Emissions Reduction Obligation (CERO), 6 MtCO2 under the Carbon Saving Community Obligation (CSCO) and £3.7 billion under the Home Heating Cost Reduction Obligation	Large energy suppliers	Combination of legislation and regulation	Self-achievement of savings	Not documented

The lessons for India from the aforementioned international experience is invaluable. The emphasis on demand side resources as 'alternative resource in the energy resource basket of electric Utilities' can allow it to compete directly with supply side options within the principles of equity, reliability and cost effectiveness. Demand side resource purchase obligations (DSRPO)[27] and IRP are the quintessential policy tools to achieve policy driven growth of Utility DSM investments going forward. A strong legal framework enacted through legislative actions can be the pillar of effective enforcement of such policy tools.

2.1. Examination of legal framework, national policies and programs in the context of Utility DSM

Energy Conservation Act 2001 and related regulations

The Energy Conservation Act 2001 (EC Act) was enacted to set up the Bureau of Energy Efficiency (BEE) as nodal agency with specific powers and functions to facilitate, regulate and promote energy efficiency in all sectors of the economy. The EC Act also provided with multiple functions and statutory powers to the central and state governments to facilitate and enforce efficient use of energy and its conservation. The EC Act is the governing framework for promoting energy efficiency and conservation in India. The Act has provided statutory basis to regulate energy consumption and enforce energy efficiency standards on buildings, end use energy consuming equipment and any energy user notified as 'designated consumer'.

Perform, Achieve and Trade (PAT) scheme is most significant outcome of the EC Act. It is a regulatory instrument to reduce specific energy consumption in energy intensive industries (notified as designated consumers), through a market based mechanism that facilitates certification and trading of excess energy savings to enhance the cost effectiveness of energy efficiency investments. In 2012, Indian government through the Bureau of Energy Efficiency notified specific energy consumption improvement targets over a three year cycle (2012-15) for 478 designated consumers (individual obligated entities) in eight energy intensive sectors, namely thermal power plants, aluminum, cement, chlor-alkali, fertilizer, iron and steel, pulp and paper, and textiles. These sectors represent 65% of India's total industrial energy consumption. In the next cycle, PAT

[27] A term coined for promoting DSM related targets for Indian Utilities and serves the same purpose as energy efficiency obligations or energy efficiency resource standards enforced across the globe

envisages to deepen and widen the regime of targets by including more no. of consumers from existing and new sectors.

The EC Act does not provide explicit provisions for the promotion and implementation of demand side management by electric Utilities. Also, the government is currently contemplating to notify DISCOMs as 'designated consumers' under the EC Act 2001 and subsequently notify targets under the PAT scheme. There is a perception that this would provide a major policy thrust for Utility driven DSM. The mandate of a designated consumer under the EC Act and PAT scheme is to reduce one's own energy consumption or intensity within its operating boundary or facility. For distribution Utilities this means the electricity losses within the distribution network and not the electricity demand beyond the customer's meter. Moreover, the electricity regulatory commissions are already regulating the AT&C losses and distribution losses under the governance framework provided by the Electricity Act 2003.

Electricity Act 2003

The Electricity Act 2003 has repealed three previously enacted laws to restructure and reform the ailing power sector in India. The Act created a consolidated policy framework for generation, transmission, distribution, trading and consumption of electricity adhering to market-based mechanisms. The Act also aimed to promote efficient and environmentally benign policies across the value chain of electricity in India.

While there are several provisions[28] in the Act that call for efficiency and economical use of resources, DSM can only be an implicit alternative for utilities under such provisions as several other options exist for the utilities to bring about efficiency and economical use of resources. It is also worth while noting that the state electricity regulatory commissions have interpreted these implicit provisions to notify DSM Regulations in their states.

There are no provisions in the Electricity Act 2003 that explicitly clarifies DSM as alternative resource for electricity distribution licensees while they plan for meeting the forecasted peak power and energy demand both in short and long term scenarios.

Suggested Amendments in the Electricity Act 2003 to strengthen the legal framework for Utility DSM

Section of Electricity Act 2003 / existing provisions	Suggested amendment
Section 2: Definitions	**Add:**

[28] *Section 42 (1) of the EA 2003 states that "it shall be the duty of a distribution licensee to develop and maintain an efficient, coordinated and economical distribution system in his area of supply and to supply electricity in accordance with the provisions contained in this Act", section 62 (D) has empowered the State Electricity Regulatory Commission (SERC) to determine tariffs for retail sale of electricity, section 61 (C) allowed the SERC to regulate tariffs by considering "the factors which would encourage competition, efficiency, economical use of resources, good performance and optimum investments", section 61(D) allowed the commissions to 'reward utilities based on the principles of efficiency in performance', section 86 (2.1) allowed the regulatory commission to advise the state governments on matters of 'promotion of competition, efficiency and economy in activities of the electricity industry', and section 86 (4) of EA 2003 provided that 'in discharging its functions, the SERCs shall be guided by the National Electricity Policy and the National Electricity Plan'.*

	▪ "Demand Side Management" means the actions of a Distribution Licensee, beyond the customer's meter, with the objective of altering the end-use of electricity - whether it is to increase demand, decrease it, shift it between high and low peak periods, or manage it when there are intermittent load demands - in the overall interest of reducing the costs of electricity supply "DSM" short for Demand Side Management ▪ "Demand Side Resource" means a saving in consumption (kWh) and/or demand (kW/KVA) available as a result of implementation of DSM program, to be expressed in the following three important dimensions: o Quantum – as to how much is available (kWh and/or kW) o Time – as to when is it available (at what time of day, on what days, in what season) o Cost – as at what would be the cost.
Section 3: **NATIONAL ELECTRICITY POLICY AND PLAN** The Central Government shall, from time to time, prepare the national electricity policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy.	The Central Government shall, from time to time, prepare the national electricity policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, ***demand side resources***, hydro and renewable sources of energy.
Section 61 (h): **TARIFF REGULATIONS** The promotion of co-generation and generation of electricity from renewable sources of energy	The promotion of ***demand side resources***, co-generation and generation of electricity from renewable sources of energy
Section 86: **FUNCTIONS OF STATE COMMISSION**	**Add**: *Promote demand side resources resulting from implementation of DSM related programs, and also specify demand side resources as percentage of the total procurement of electricity in the area of electricity distribution licensee*

Electricity Amendment Bill 2014

The Electricity (Amendment) Bill 2014 was introduced in the Indian parliament in December 2014 seeking to amend the principal Electricity Act 2003. Amongst various changes that the amendment proposes, following seem to be the major thrust areas:

- Separation of carriage and content, i.e. segregation of wires and the supply business
- Enabling open access, competition and markets
- Greater impetus for renewable energy by including the definitions of renewable energy sources, renewable energy service company, notification of national renewable energy policy, creation of national renewable energy fund, renewable generation obligations and other provisions
- Greater accountability of the regulatory institutions

Amending the Electricity Act 2003, which is the principal central act governing the power sector structure and policy, is a crucial exercise with far reaching and long term implications. It is also an opportunity to change the course of the policy direction to address the critical issues currently faced by the sector. Therefore, it becomes extremely important to assess the immediate as well as long term challenges before the sector at this cross road. Lack of clear / explicit impetus for Utility DSM is both an immediate and long term obstacle to achieve policy driven growth of DSM resource acquisition by electric Utilities. In this regard, the following table describes the amendments necessary in the Electricity (Amendment) Bill 2014 to strengthen the legal and policy framework for DSM. Broadly the proposed amendments seek to establish DSM as a resource that qualifies under the renewable energy sources or provide equal impetus to DSM as a stand-alone alternative resource for consideration by electric Utilities, central /state governments and state commissions.

Suggested Amendments in the Electricity (Amendment) Bill 2014 to strengthen the policy framework for Utility DSM

Section of Electricity Act 2003 / existing provisions	Suggested amendment
Section 2: Definitions	**Add:** ▪ "Demand Side Management" means the actions of a Distribution Licensee, beyond the customer's meter, with the objective of altering the end-use of electricity - whether it is to increase demand, decrease it, shift it between high and low peak periods, or manage it when there are intermittent load demands - in the overall interest of reducing the costs of electricity supply "DSM" short for Demand Side Management ▪ "Demand Side Resource" means a saving in consumption (kWh) and/or demand (kW/KVA) available as a result of implementation of DSM program, to be expressed in the following three important dimensions: ○ Quantum – as to how much is available (kWh and/or kW) ○ Time – as to when is it available (at what time of day, on what days, in what season) ○ Cost – as at what would be the cost.
Section 2: Definitions '(57A) " renewable energy sources" for the purposes of this Act, means the small hydro, wind, solar, bio-mass, bio-fuel, bio-gas, co-generation from these sources, waste including municipal and solid waste, geothermal, tidal, forms of oceanic energy and such other sources as may be notified by the Central Government from time to time	'(57A) " renewable energy sources" for the purposes of this Act, means the small hydro, wind, solar, bio-mass, bio-fuel, bio-gas, co-generation from these sources, waste including municipal and solid waste, geothermal, tidal, forms of oceanic energy, ***demand side resource*** and such other sources as may be notified by the Central Government from time to time
Section 2: Definitions '(57B) "Renewable Energy Service Company" means an energy service company which provides renewable energy to the consumers in the form of electricity for the purposes of this Act;'	**Add:** Energy Services Company means a company which provides energy efficiency and DSM services to the Distribution Utility or consumers for the purposes of this Act

Section 2: Definitions '(61A) "Smart Grid" means an electricity network that uses information and communication technology to gather information and act intelligently in automated fashion to improve the efficiency, reliability, economics, and sustainability of generation, transmission and distribution of electricity and such other information as may be specified by the Authority	'(61A) "Smart Grid" means an electricity network that uses information and communication technology to gather information and act intelligently in automated fashion ***to facilitate DSM*** and also to improve the efficiency, reliability, economics, and sustainability of generation, transmission and distribution of electricity and such other information as may be specified by the Authority
Section 2: Definitions '(46A) "obligated entity" means the distribution licensee or the consumer owning the captive power plant or the open access consumer, as the case may be, which is mandated under section 86 of the Act in order to procure electricity from or any market instrument representing the renewable energy sources;'	'(46A) "obligated entity" means the distribution licensee or the consumer owning the captive power plant or the open access consumer, as the case may be, which is mandated under section 86 of the Act in order to procure electricity from or any market instrument representing the renewable energy sources ***and demand side resource***;'
Section 3: **NATIONAL ELECTRICITY POLICY AND PLAN** 3.(1) The Central Government shall, from time to time, prepare, review and notify the National Electricity Policy, Tariff Policy and ***National Renewable Energy Policy***, in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy and for separation of distribution and supply functions and measures to promote Smart Grid, ancillary services and decentralized distributed generation, etc.	3.(1) The Central Government shall, from time to time, prepare, review and notify the National Electricity Policy, Tariff Policy, National Renewable Energy Policy, and ***National DSM Policy*** in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro, renewable sources of energy, ***demand side resources*** and for separation of distribution and supply functions and measures to promote Smart Grid, ancillary services and decentralized distributed generation, etc.
Section 3: **NATIONAL ELECTRICITY POLICY AND PLAN** (4) The Central Government may, after such consultation with the State Governments as may be considered necessary, notify policies and adopt measures for promotion of ***Renewable Energy Generation*** including through tax rebates, generation linked incentive, creation of national renewable energy fund, development of renewable industry and for effective implementation and enforcement of such measures.	(4) The Central Government may, after such consultation with the State Governments as may be considered necessary, notify policies and adopt measures for promotion of Renewable Energy Generation and ***DSM resource acquisition*** including through tax rebates, generation linked incentive, creation of national renewable energy fund, ***creation of national DSM fund***, development of renewable industry and for effective implementation and enforcement of such measures.
Section 61 (h): **TARIFF REGULATIONS** The promotion of co-generation and generation of electricity from renewable sources of energy	The promotion of ***demand side resources***, co-generation and generation of electricity from renewable sources of energy
Section 86: **FUNCTIONS OF STATE COMMISSION**	**Add**: *Promote demand side resources resulting from implementation of DSM related programs, and also specify demand side resources as a percentage of the total procurement of electricity in the area of electricity distribution licensee*

National Renewable Energy Act (Draft)

The draft 'National Renewable Energy Act (RE Act)', published by MNRE (Ministry of New and Renewable Energy) in early 2015, seeks to promote the production of energy through the use of renewable energy sources in accordance with climate, environment and macroeconomic considerations that reduce dependence on fossil fuels, ensure security of energy supply, reduce CO2 and other greenhouse gas emissions.

For the first time in India's energy policy framework, the draft RE Act emphasizes the need to move towards 'Integrated Energy Resource Planning (IERP)' and provides the following definition for the same in Section 13 of the Act.

'IERP' is a strategic plan for securing reliable and cost-effective energy resources. Such a planning exercise:

- *Examines all available energy-resource options, including supply side as well as demand side options*
- *Makes a thorough, objective assessment of the benefits, co-benefits, direct and indirect costs, cost of externalities, and risks associated with each energy option*
- *Evaluates all resources to maximize energy, environmental, and economic security*

Section 14 of the draft RE Act provides for the development of long-term vision for IERP as one of the key functions of the 'National Renewable Energy Advisory Group', which is envisaged to advise the Central Government on effective implementation of this Act.

Section 15 of the draft RE Act provides for the development of National Renewable Energy Policy based on the principles of IERP to create a supportive eco-system for RE deployment in the country.

While the explicit reference to IERP in the draft RE Act signifies the importance of demand side resources in India's energy mix, there is still no clear mandate for IERP compliance by the energy Utilities involved in energy production/ generation, transmission and distribution at both central and state level in the draft RE Act. More importantly, at the state level, there is a need to provide clear mandate for IERP enforcement by the electricity regulatory commissions while performing their regulatory duties towards energy resource planning undertaken by the state's electric Utilities. In order to accomplish this in a simple yet effective manner, there is a need to clarify what constitutes demand side resources and further consider such resources as qualifying resource under the definition of renewable energy sources in section 3 of the draft RE Act.

Ujwal DISCOM Assurance Yojana (UDAY)

UDAY, launched in November 2015, aims to provide for the financial turnaround and revival of electricity distribution companies (DISCOMs), which are perceived as the weakest link in achieving the power sector developmental goals such as 24*7 Power for All. UDAY is the most comprehensive upgrade of the Financial Restructuring Plan formulated by the government of India to provide a permanent resolution of the past as well as potential future issues of the power sector under four broad initiatives:

i. ***Improving operational efficiencies of DISCOMs***
ii. Reduction of cost of power purchase
iii. Reduction in interest cost of DISCOMs
iv. Enforcing financial discipline on DISCOMs through alignment with State finances

What makes UDAY unique from the earlier versions of the financial restricting programs is that there is an enhanced focus on the improving operational efficiencies of DISCOMs and reduction of cost of power purchase both of which are important to sustain the benefits of financial restructuring.

UDAY is operationalized through a tri-partite agreement amongst the Ministry of Power, Govt. of India, State Government and the DISCOM. Adopting UDAY is optional for States.

DSM is as an important strategy envisaged to improve the operational efficiencies of DISCOMs under UDAY.

Efficiency improvement benefits envisaged from DSM activities under UDAY

DSM activity	Benefit
LED bulbs: 77 crore bulbs & 3.5 crore streetlights	45000
Agricultural pumps –1 crore	12000
Fans & Air-conditioners –16 cr. Fans & 18 lakh A/Cs	1500
Total	***58500***

Source: Ministry of Power, 2015

Scaling up DSM measures is expected to provide INR 58,500 crore benefit to DISCOMs by way of operational efficiency improvement under UDAY.

Overall benefits envisaged from UDAY

Activity	Performance Milestone	Envisaged Benefit (INR crores)
Interest Rate Reduction	3% on 25% DISCOM debt 4% on 75% DISCOM debt	17,000
Debt takeover by State	8% on 75% DISCOM debt	27,000
AT&C loss reduction	Reduce to 15%	33,000
Supply of domestic coal and coal swapping		36,000
DSM		*58,500*
PAT		7,600
Transmission Loss Reduction	1% of Intra State	1,600
	Total	**1,80,700**

Source: Ministry of Power, 2015

DSM contributes the largest component of benefits to DISCOMs among all the initiatives formulated under UDAY.

Key performance milestones and conditions under UDAY

- AT&C loss reduction by FY 2018-19 – 15% for States with AT&C loss > 20% in the current scenario; 10% for ~~remaining~~ States
- Elimination of ACS- ARR gap by FY 2018-19
- DISCOMs to comply with the Renewable Purchase Obligation (RPO) outstanding since 1st April, 2012, within a period to be decided in consultation with MoP
- Working capital will only be allowed up to 25% of the DISCOM's previous year's annual revenue

Incentives for DISCOMs and state governments operationalizing UDAY and meeting the agreed performance milestones

- Additional / priority funding through DDUGJY, IPDS, Power System Development Fund (PSDF) or other such schemes of MoP and MNRE
- Additional coal at notified prices and in case of availability through higher capacity utilization, low cost power from NTPC and other Central Public Sector Undertakings (CPSUs)
- States not meeting operational milestones will be liable to forfeit their claim on IPDS and DDUGJY grants.

Given that DSM is expected to serve the largest pie of benefits under UDAY, there is a need to set clear DSM performance milestones so that the participating DISCOMs adopt DSM as an important strategy in achieving the operational efficiency goals envisaged under UDAY. The DSM performance milestones should be set in the form of quantum of energy savings and/or peak demand reduction with a robust mechanism for monitoring and verification. Furthermore, there is a need to review the incentive mechanism proposed under UDAY to adequately compensate the DISCOMs for scaling up DSM activities.

National Tariff Policy (NTP)

In January 2016, the govt. of India made significant amendments to the principal NTP ratified in 2006. A holistic view of the power sector has been taken and comprehensive amendments made to achieve the objectives of major electricity reforms (viz. UDAY, Electricity Amendment Bill 2014). The following table highlights the key amendments ratified under the four broad objectives of NTP amendments 2016 and further underscores how DSM can help in achieving specific objectives.

Objective	Highlights of key amendments in NTP ratified in January 2016	How DSM can help achieve specific objectives under NTP
Electricity for all	• 24*7 power for all • Remote village electrification through micro grids • Affordable power from coal washery reject based plants	• Energy savings and peak load management resulting from DSM are important resources for achieving '24*7 power for all' goal • Approx. 18% of the end use energy requirement in the country can be supplied through DSM (current energy deficit – 4%)
Efficiency to ensure affordable tariffs	• Smart meters to enable time of day tariffs, reduce theft and allow net-metering • Reduce cost of power through expansion of existing power plants, transmission capacity and sale of un-requisitioned power	• DSM through time of day tariffs provide the largest opportunity to improve end use efficiency • DSM enables optimization of power resource costs for Utilities - energy savings are generally cheaper as compared to energy supply costs

Environment for a sustainable future	• Renewable Power Obligation (RPO) - 8% of electricity consumption from solar energy by March 2022 • Renewable Generation Obligation (RGO) • Affordable renewable power through bundling of power • No inter-State transmission charges for solar and wind power • Procurement of 100% power produced from Waste-to-Energy plants • Promotion of Hydro projects • Ancillary services to manage grid operation	• DSM results in avoided / delayed generation, transmission, and distribution capacity addition and therefore is a clean and sustainable energy resource • DSM actions directly contribute to India's commitments under the United Nations Paris agreement for mitigating climate change

Promotion of renewable generation sources is clearly one of the main focus of the NTP amendments. There is no similar explicit advocacy for demand side resources. 'Faster deployment of smart meters to enable TOD tariff' provides a significant policy thrust to capture and scale up innovative demand response markets. The electricity regulatory commissions must leverage this to strengthen the DSM regulations, enforce smart meter installations and promote demand response initiatives.

EESL's UJALA has proven that the demand side resources can be purchased / delivered at cost effective rates, which are substantially lower than the average costs of power supply incurred by many Utilities across the country. In this regard, there is a need to review the NTP for recognizing demand side management as an important strategy for reducing the cost of power.

On the sustainability front, there is a need to review NTP for promoting 'demand side resource purchase obligations' just as 'renewable purchase or generation obligations' within the principles of equity, reliability and cost effectiveness. This will also lay the groundwork for 'Integrated Resource Planning' by the Utilities.

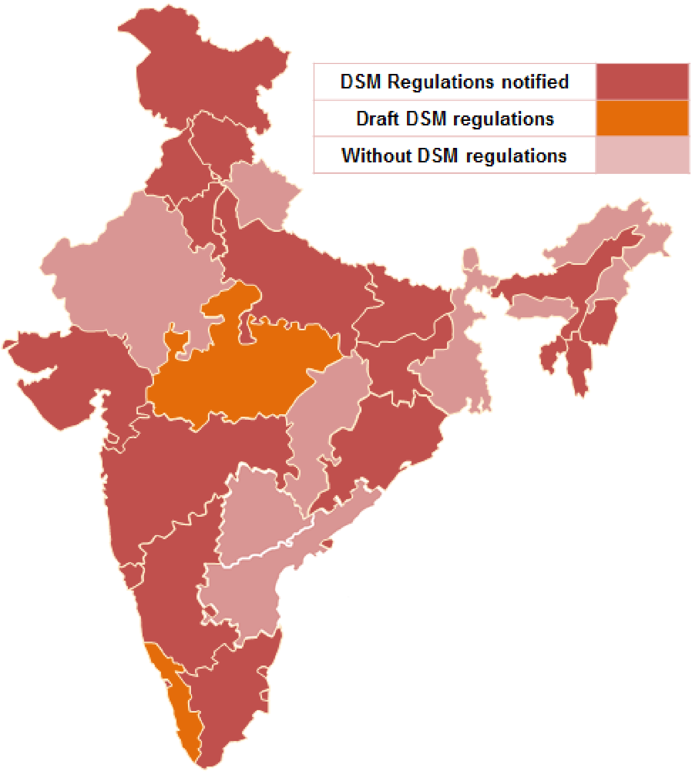
2.2. Review of Utility DSM Regulatory Framework

In a regulated industry, such as the electricity supply and distribution, 'DSM Regulations' provide the mandate as well as an objective framework to plan, finance and acquire DSM resources. As on date, Demand Side Management Regulations are active in 17 states and 7 union territories across the country. Broadly, the DSM Regulations cover objectives, implementation framework, and cost recovery mechanism while outlining the roles envisaged for the Utility and the state commission at various stages of the DSM implementation cycle.

Illustrative scope of Indian DSM Regulations

- DSM objectives
- Assessment of technical potential for DSM
- DSM targets
- Constitution of DSM cell - roles and responsibilities
- DSM process guidelines
    - Load research, market research and assessment of baseline

- Formulation of DSM plan
    - Review and approval of DSM plan by the commission
    - Preparation of DSM program document
    - Implementation of DSM programs
    - Monitoring and reporting of DSM programs
    - Evaluation, measurement and verification (EMV) of DSM programs
- Mechanism for cost recovery
- Incentives

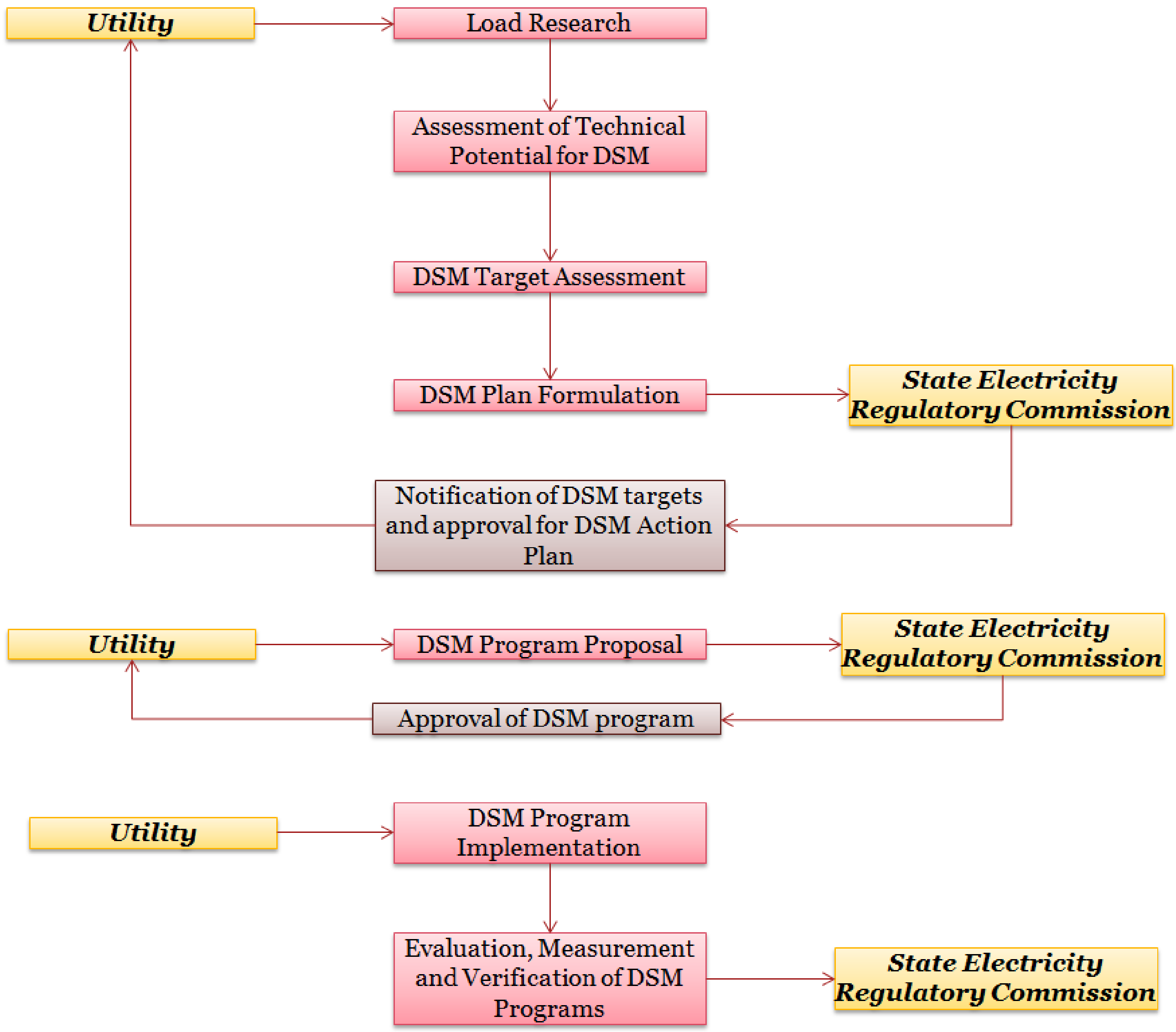


Map of Indian states with active DSM regulations

Some of the important DSM regulations that has fostered a conducive policy environment for growth of Utility DSM investments in India are:

- The mandate to establish DSM cell within the Utilities has been the driver of institutional development to plan, implement and evaluate Utility DSM programs in a sustainable manner
- The mandate to conduct load research and assess technical potential for DSM has established a systematic approach to identify DSM opportunities, set baseline and targets for implementation and evaluation of utility DSM programs
- The provision of including the DSM related costs in the ARR (annual revenue requirement) petitions has established a definite mechanism for financing and cost recovery of Utility DSM investments

Illustrative DSM program planning and implementation cycle specified in Indian DSM Regulations



Examination of the critical gaps to strengthen the DSM Regulatory Framework in India

Load research

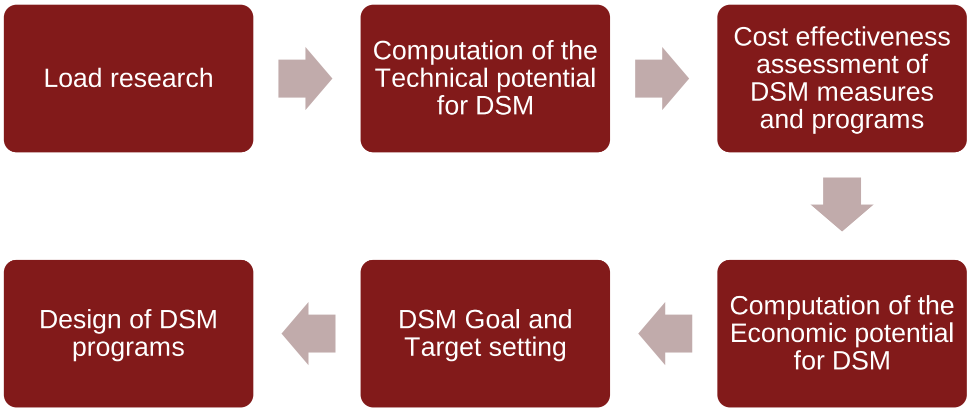
'Load Research' is an activity that allows Utilities to study the ways their customers use electricity, either in total or by individual end uses. In the context of DSM, load research is conducted with the following key objectives.

- Identify strategic demand side measures for Utilities

- Quantify the technical potential[29] for acquiring demand side resources[30] and
- Support informed assessment of the DSM action plan for Utilities

The Indian DSM regulations have given clear mandate to the Utilities to conduct load research while planning/evaluating for DSM investments. Load research is mandated as the starting point in the DSM planning cycle of Utilities.

Illustrative steps in DSM Planning process as per Indian DSM Regulations



The government of India through BEE and EESL has been supporting 33 slected Utilities across the country to undertake load research, technical potential assessment and make informed assessment of the DSM action plan.

International experience suggests that load research function supports a number of Utility operations besides DSM. For example, load research can help Utilities undertake better load forecasting, transmission and distribution network/capacity planning, manage intermittence from renewables, and improve allocation of costs among different rate classes and many. In this regard, the Indian Regulatory Commissions should aim to institutionalize load research functions with dedicated resources and authority. This will allow the outputs of load research functions to support various functional divisions within the Utility (Eg: DSM Cell, T&D Planning cell, Tariff filing division, GRID management cell etc.) objectively. Also, the regulations pertaining to load research must strive to separate data collection and analytics functions in order to strengthen the objectivity of such assessment.

Enforcement of DSM cell constitution

The enforcement of DSM Regulations continues to be limited in many states. For example, most of the DSM Regulations mandate the constitution of DSM Cell (within the Utility) to strengthen the institutional capacity of Utilities to plan and implement large scale DSM interventions in a systematic and coordinated manner. Regardless of this, many Utilities in the states with active DSM regulations are yet to constitute the DSM cell with stipulated resources and authority.

[29] Technical potential is a theoretical construct of the technical upper bound of energy efficiency and DSM potential with complete market penetration of energy-efficiency and demand side practices, deemed technically feasible from an engineering perspective.
[30] Demand side resources constitute energy savings (kWh) and peak demand reduction (kW or KVA), which are further characterized as to when is it available (at what time of day and what season) and at what incremental cost.

Enforcement of DSM targets

The DSM Regulations also stipulate that the commission shall establish DSM targets for Utility/ies after reviewing the technical potential for DSM in the licensee area. However, none of the states with active DSM Regulations have ratified DSM related targets so far. Also, the information on technical potential alone may be insufficient to stipulate realistic DSM targets by state commissions. The economic potential, which is a subset of technical potential of only those DSM measures that are cost-effective should be considered as pragmatic benchmark by commissions while stipulating DSM targets for Utilities. The derivation of economic potential estimate requires that the DSM Regulations define the cost-effectiveness indicators for screening DSM programs and also outline the methodology to derive the proposed cost-effectiveness indicators.

Cost effectiveness of DSM investments

Most of the DSM Regulations accord high priority to 'Cost Effectiveness', while evaluating the DSM programs during the planning process. In spite of this, only Maharashtra[31] has issued comprehensive guidelines and regulations for establishing the cost-effectiveness indicators of DSM programs and screening. The unconventional nature of DSM programs makes it very difficult for Utilities to establish cost-effectiveness in the traditional manner. The definition of appropriate cost-effectiveness indicators and their representation of interests of various stakeholders is the fundamental challenge. The critical questions for state commissions while developing the cost-effectiveness guidelines and regulations are as follows:

- What are the indicators for representing the cost-effectiveness of DSM measures and programs?
- What are the avoided costs of power (both energy and capacity) that can be expected from large scale implementation of DSM programs under different power supply scenarios in the states?
- Which indicators should be considered for screening DSM programs based on cost-effectiveness?

The 'MERC Regulations on DSM Measures' and Program's Cost-Effectiveness Assessment', the 'MERC Cost-Effectiveness Assessment Guide' and the 'California Standard Practice Manual' are some examples that can be adopted by state commissions while developing the 'DSM cost effectiveness regulations and guidelines'.

EM&V of DSM investments

The absence of clear guidelines for EM&V (evaluation, measurement and verification) of resources (savings) acquired from DSM is another important bottleneck for driving Utility DSM investments in a regulated environment. The EM&V guidelines should be specific to different program designs, DSM measures and technologies adopted by the Utilities. The International Performance Measurement and Verification Protocol (IPMVP) can be adopted for developing broad M&V principles for the Indian Utility DSM markets. The 'California Energy Efficiency Evaluation Protocols' and the 'Eskom M&V Guidelines' can be considered as best practices and suitably adopted to formulate Indian EM&V guidelines and protocols. The international EM&V guidelines represent a library of collective experience that has evolved over the past 25 years to suit a diverse range of contexts, circumstances and situations.

Cost recovery mechanism and incentives

Indian DSM Regulations allow Utilities to consider the net incremental costs associated with planning, design and implementation of DSM programs in the annual revenue requirement (ARR) petitions and recover such costs from consumer tariff. Alternatively, DSM Regulations in certain states (viz. Maharashtra, Tamil Nadu,

[31] Punjab has also issued guidelines on cost-effectiveness by describing three different cost-effectiveness indicators and their limits. However, there are no clear regulations on the screening of DSM programs based on these indicators.

Mizoram, Manipur and Delhi) also allow the Utility to create a pool of fund for sourcing upfront DSM investment by imposing public benefit charge (cess) on select consumer classes.

Moreover, there is no clear incentive framework in the Indian DSM Regulations for Utilities to achieve or exceed DSM targets as set by the regulator. Utilities perceive loss of revenue from sales and loss of return on equity (RoE) investments towards distribution infrastructure capacity addition, which would otherwise be necessary to accommodate the rising power demand in the absence of Utility DSM measures. This is one of the major pitfall for advancing Utility DSM. Electric utilities are fundamentally in the business to sell electricity, not save. Therefore many utilities may perceive that DSM, especially focusing on energy efficiency measures that results in substantial energy savings (reduced sales from the utility's vantage point), is inherently against the bottom line business objective of electric utilities that creates value for the company. This is even more critical in the states with private distribution licensees and franchisees.

There is a need to demystify this perception. The Indian government has done this effectively by advocating DSM as an important strategy to improve operational efficiency of Utilities in the ongoing electricity reforms, especially under UDAY. The operational efficiency improvement benefits envisaged from DSM is in itself a significant incentive for the Indian Utilities. Apart from this, mandatory DSM related targets or obligations (similar to renewable purchase obligations) as discussed earlier in this chapter, can also be effective to ensure that utilities pursue DSM options.

Furthermore, the DSM regulatory framework in India has to evolve to overcome the challenge of perceived DSM disincentive to Indian utilities in the foreseeable future. International experience, especially in US, show a wide variety of regulatory incentives accorded to electric utilities in order to compensate for the perceived losses or disincentives.

1. Lost revenue recovery incentives

Lost revenue recovery incentives allow utilities to recover from ratepayers (consumers) all of the fixed costs that do not vary directly with sales and that they would have recovered had they not promoted sales reductions through energy efficiency.

Because DSM decreases the amount of energy needed to satisfy a given level of energy service or comfort, it reduces the volumes of energy sold by the utility. Some portion of the resulting lost revenue is offset by a reduction in variable costs that are avoided - for example, the cost of fuel for thermal power plants. The remaining portion of lost revenue, that which is not offset by variable cost reductions, represents pure earning losses to the utility. The most common type of lost revenue adjustment mechanism is based on the calculation of the amount of the reduction in a utility's sales of energy that is due to its own DSM initiatives. This must be calculated net of any efficiency trends that are occurring independently of DSM, since sales losses due to other factors would have been experienced anyway. Lost revenue recovery is usually effected through the same procedure as is used for program cost recovery.

A few jurisdictions in US have put into place mechanisms that fully ***decouple revenues from sales***. In California, this was done through a mechanism enabling distribution utilities to recover the levels of non-fuel revenue requirements that were authorized in the base rate case (tariff) - not more, and not less. Annual proceedings (similar to truing up petition hearings in India), incorporating mechanical adjustments, have been made to modify tariffs so as to collect the authorized levels of revenues until the next general rate case. Decoupling mechanisms remove the short-term utility incentive to increase sales, and prevent the loss of revenues due to sales reductions from DSM.

2. Shareholder Incentives

By its nature, DSM cannot be a force for increased total revenues for the utility. What shareholder incentives can do, however, is compensate for DSM's inability to contribute to total revenue growth, by providing an opportunity to retain the utility's earnings. The basic purpose of shareholder incentives is to provide utilities with a positive incentive to continue to build and pursue DSM. Sometimes penalties for underperformance are part of shareholder incentive mechanism. If penalty provisions are present they are usually structured to be less likely than positive rewards. Shareholder incentives are intended to counter the business disincentives to DSM by making it a source of earnings.

The most common type of shareholder incentive adopted internationally is ***rate basing***. This mechanism allows utilities to amortize DSM expenditure with regulated rate of earnings and include the amortized DSM expense in the determination of rate base (tariff). It essentially treats DSM expense as any other physical utility infrastructure investment that inherently provides earnings for utility shareholders. The most

Another common type of shareholder incentive adopted internationally is the ***shared savings*** mechanism. This approach provides the utility with a share of the net benefits, that is, benefits after all costs of DSM measures including utility program costs have been deducted, thus sending the signal to maximise resource savings per utility currency spent. They usually provide for a small share of life cycle benefits as a potential reward to shareholders. The approach requires that both energy savings and the resource benefits flowing from those savings be quantified. The benefits are calculated over the lifetimes of the DSM measures put into place. The utility receives a share of the total net present value of these life-cycle benefits.

The above discussed DSM regulatory incentives have been structured and adopted for markets comprising of investor owned (private sector) vertically integrated utilities. The Indian regulators must evaluate the DSM regulatory incentives adopted across the globe in the context of India's power market structure, which is dominated by unbundled or vertically disintegrated state owned (public sector) utilities, within the basic principles of the country's electricity governance policy.

Review of regulatory orders appraising Utility scale DSM programs in India

There is no correlation between the existence of DSM regulations and growth of Utility DSM investments among Indian states. For example, Puducherry and Andhra Pradesh were among the first set of states to implement the EESL's UJALA initiative. The Joint Electricity Regulatory Commission, which has the regulatory jurisdiction for Puducherry passed the first landmark order for EESL's UJALA initiative in February 2014. This project was structured such that the Electricity Department of Puducherry (Utility) would purchase energy savings resulting from UJALA project at a predetermined rate (feed-in tariff) in INR per kWh. The order allowed Puducherry Utility to compensate EESL's investments at INR 1.23 to 0.67 per unit of verified energy savings. Similarly, the Andhra Pradesh Electricity Regulatory Commission, in October 2014, allowed the state owned Utilities (APSPDCL and APEPDCL) to compensate EESL's investments toward DELP projects in Guntur, Anantapur, Srikakulam, and West Godavari at INR 1.411 to 0.888 per unit and 1.0481 to 0.6593 per unit of verified energy savings.

These orders provided a paradigm shift towards regulatory appraisal of DSM programs by adopting the traditional cost plus approach to evaluate DSM resource costs and allowing such resources to compete directly with the conventional sources of power.

In all other states, where the UJALA scheme is active, the state electricity regulatory commissions have notified regulatory orders allowing On-bill financing for implementation of the scheme. These orders have broadly stipulated the following:

- Terms of On-bill transaction between Utility and customer - number of lamps to be offered, period of recovery etc.
- Determination of on-bill charges
- Reflection of on-bill charges in the Utility bills
- Treatment of on-bill repayment defaults by consumer
- Mechanism for replacement for defective bulbs
- Eligibility for participation (underwriting criteria)
- Impact on ARR

There is a need to standardize the evaluation of several aspects of the above mentioned DSM regulatory orders and streamline the regulatory appraisal of DSM programs in the country.

Significance of load shedding restrictions in the promotion of Utility DSM

Load shedding is the bane of India's power supply system. It is predominantly adopted by Indian Utilities as the most cost effective supply side solution to manage electricity shortfall and this is one of the principal barriers for scaling up Utility DSM in the country.

The electricity supply code and standards of performance regulations allow Utilities to undertake planned/scheduled load shedding to bridge the gap between demand and supply. These regulations also make a clear distinction between load shedding and outage. The former signifies Utility actions for managing demand supply mismatch in a planned way and the latter signifies actions to manage generation or transmission network failure and other force majeure events.

Despite such regulations, load shedding standards are often violated. Ad-hoc unscheduled load shedding is often reported in many rural parts of the country. Most states do not report per feeder load shedding, breaking it down to hourly or half hourly data. Load shedding actions are taken manually at the substation level and there is limited data aggregation at the Utility level.

Load shedding is an outcome of the Utility's power restriction policy. DSM on the other hand is customer driven to curtail or shift demand as response to utility incentives. While load shedding has significant economic impact among consumers (*e.g.* loss of industrial production, high operating costs with alternate energy sources, disruption of commercial services etc.), DSM is a localized market driven solution and does not entail any adverse economic impact.

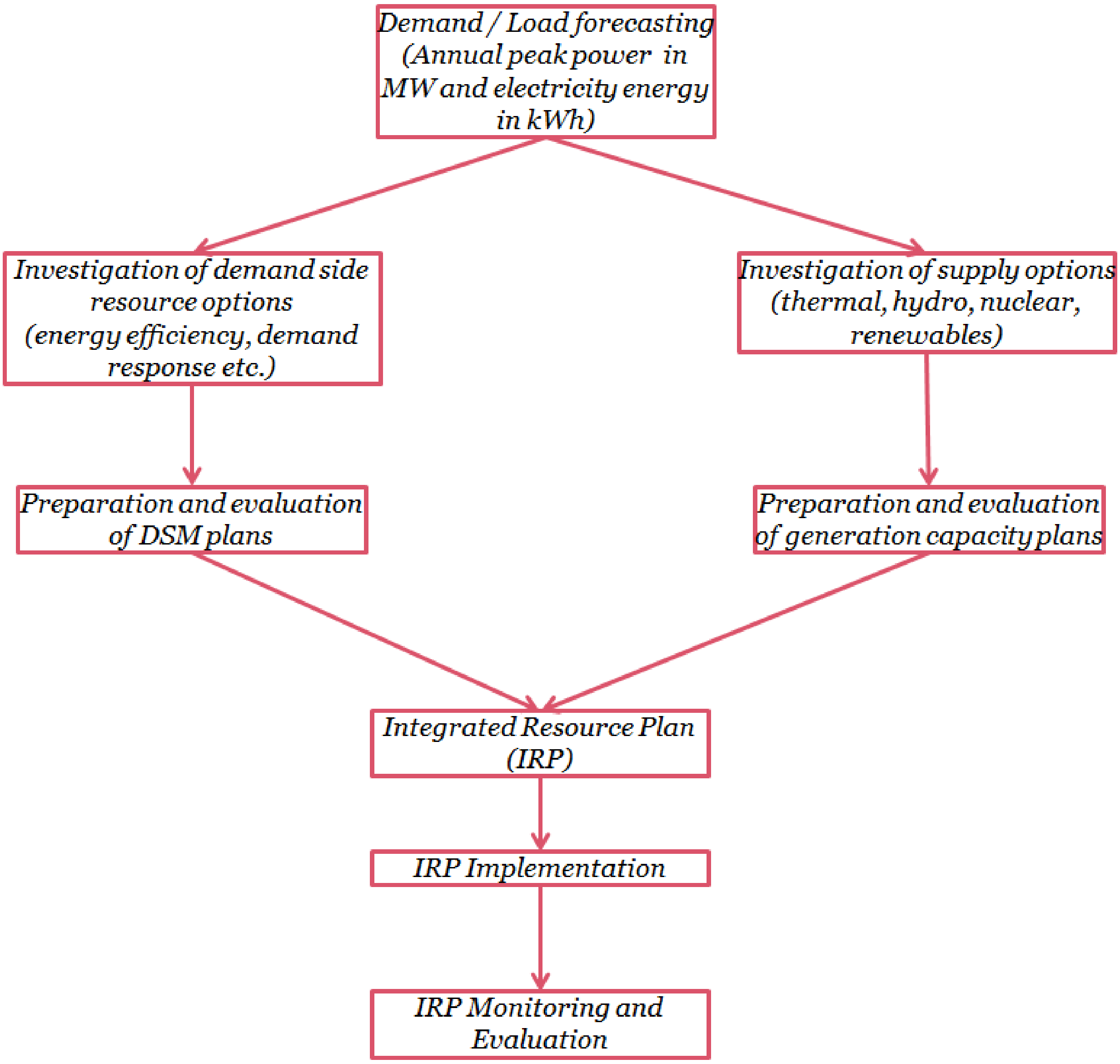
There is need to review electricity supply code and standards of performance regulations to adopt an integrated approach by promoting DSM as complementary measure to load shedding. A standardized and reliable data collection mechanism drawn from the feeder level meters or any other granular data must be established and enforced to capture and evaluate the actual load shedding conducted by electric Utilities. In the longer run, possible amendments to the Electricity Act may be required for imposing stringent penalties for relying on load shedding alone for managing electricity shortfall.

2.3. Significance and benefits of IRP in the promotion of Utility DSM

Integrated Resource Planning (IRP) is a planning approach that helps Utilities meet long-term energy requirements, by considering all cost-effective options of supply and demand side measures, while incorporating principles of equity, environmental sustainability, reliability, flexibility and other country-or state-specific goals. While IRP does not present a silver bullet solution to all energy problems in India, it does address many shortcomings of conventional power planning: frequent underestimation or overestimation of demand requirements; lack of consideration for all supply and demand side options, including energy efficiency measures.

International experience has indicated that the principles of IRP has been practiced successfully in various jurisdictions to mainstream DSM into Utility operations. About 28 U.S. States have legally mandated IRP processes, and countries such as South Africa and Thailand have adopted approaches that incorporate key elements of a good IRP. A significant share of the Utility DSM spending through 2025 in US is expected to be driven by integrated resource planning.

IRP process snapshot for Indian Electric Utilities



In India, IRP is yet to be adopted to its full potential. Compliance with 'Renewable Purchase Obligations' by electric Utilities has kick started IRP in a nascent form by considering other resources apart from the conventional ones (*e.g.* coal, gas, hydel etc.).

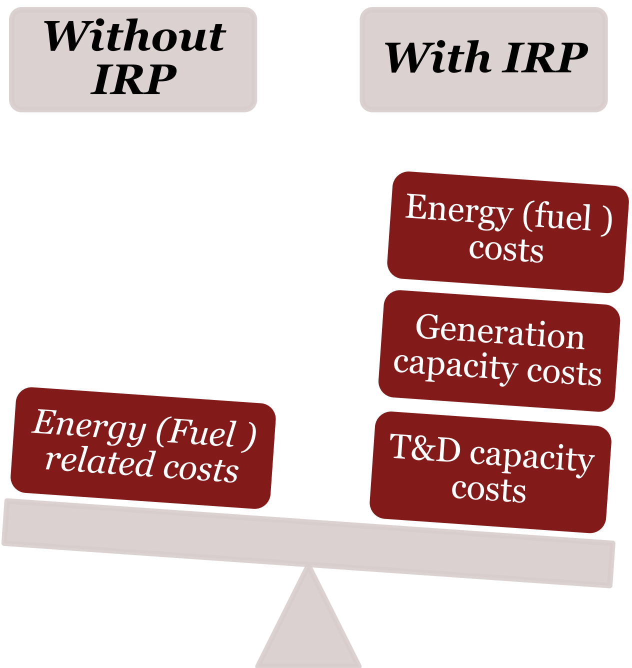
Shortcomings of conventional power resource planning by electric Utilities

Utility resource planning in India is often being carried out in the absence of robust data on the actual demand for electricity. This is mainly because of the fact that a significant portion of electricity consumed is not metered. Without clear data of what the actual demand for electricity is, it is difficult to determine how much of supply is required, leading to under or over estimation of demand and investments in new generation capacities. Under estimation of electricity demand leads to massive load shedding and black outs, whereas over estimation leads to tariff hikes and more importantly, has down side effect on demand side resources. This down side effect results from the payment of fixed costs of boxed down generators and/or inability to recover the complete costs from interstate short term electricity trade. The Indian power market structure requires that long term power purchase agreements entered between electricity distribution Utilities and power generation companies are based on two part tariffs, that represent fixed and variable costs associated with electricity generation from conventional sources. This puts a binding obligation on electricity distribution Utilities to pay fixed costs even when the generating capacities are not dispatched.

Significance of IRP as driver of cost effective demand side resources

The significance of IRP can hardly be overstated for Indian electric Utilities because not only it allows demand side resources to directly compete with conventional supply but also saves on the enormous fixed costs otherwise paid by Utilities towards the committed capacity for generation, transmission and distribution. Currently, in the absence of IRP, when Indian Utilities pursue for demand side resources and avoid purchase of power from the committed generators, they still have to pay the fixed costs of the boxed down generators. This substantially reduces the cost effectiveness of demand side resources for the Utilities. IRP requires that Utilities consider both demand and supply side resources for meeting the forecasted annual peak power and energy demand in the long term. Simply put, IRP ensures that the demand side resources effectively complement supply options rather than just supplement them in the overall resource mix of electric Utilities. More importantly, this enhances the cost effectiveness of demand side resources by avoiding the fixed capacity cost burden and enables greater optimization of power resource costs. This significance of IRP is more relevant to Indian states that are surplus in power (Eg: Gujarat). IRP provides a sustainable solution to one of the most critical questions posed by Utilities in India –***Is DSM a cost effective resource option for Utilities in power surplus states?*** For power deficit states, which is the case in most Indian states, demand side resources directly contribute to bridging the gap in demand and supply.

DSM related avoided costs from a Utility's vantage point



3. Emerging Utility DSM business and delivery models in India

This chapter seeks to introduce the emerging Utility DSM business and delivery models that are poised to transform the landscape of how Indian Utilities acquire megawatt scale demand side resources using market driven approaches.

The Utility DSM business and delivery model (also refereed as 'program design' in this study) is an integral part of the DSM program to reach out to the target customers and motivate them with incentives and information campaigns. The design constitutes evaluation and selection of appropriate delivery mechanisms to roll out the identified measures at scale. The design process should address many considerations, including target market, program goals, program budget, type and quantum of incentives, incentive delivery channels, monitoring and verification methods. The design should also define the eligibility criteria for customer participation in the program and further detail the steps involved from customer application and utility appraisal to realization of incentives by explaining the roles and responsibilities of program administrators and other stakeholders.

As discussed in section 1.2, a diverse range of Utility DSM business and delivery models have been tested at pilot scales before the XII plan period. However, a majority of these projects did not take off Utility scale mainly due to the lack of appropriate regulatory framework and institutional capacity to implement the programs that required substantial human and financial resources to undertake marketing, outreach, and program monitoring activities.

With the inception of EESL, Utility scale DSM programs got a major boost. Drawing from the lessons of wide range of pilot scale DSM projects and their delivery models, EESL has significantly scaled up DSM investments across the country, in the last 2-3 years, by supporting Utilities with design, finance and implementation of large scale programmatic interventions. EESL's flagship initiative – UJALA has received a major thumbs up both by central and state stakeholders. EESL has designed UJALA such that it uniquely fits Indian Utility market conditions. The tremendous success of EESL's UJALA projects has significantly enhanced stakeholder confidence in the promise of Utility DSM.

3.1. Demand aggregation and bulk procurement

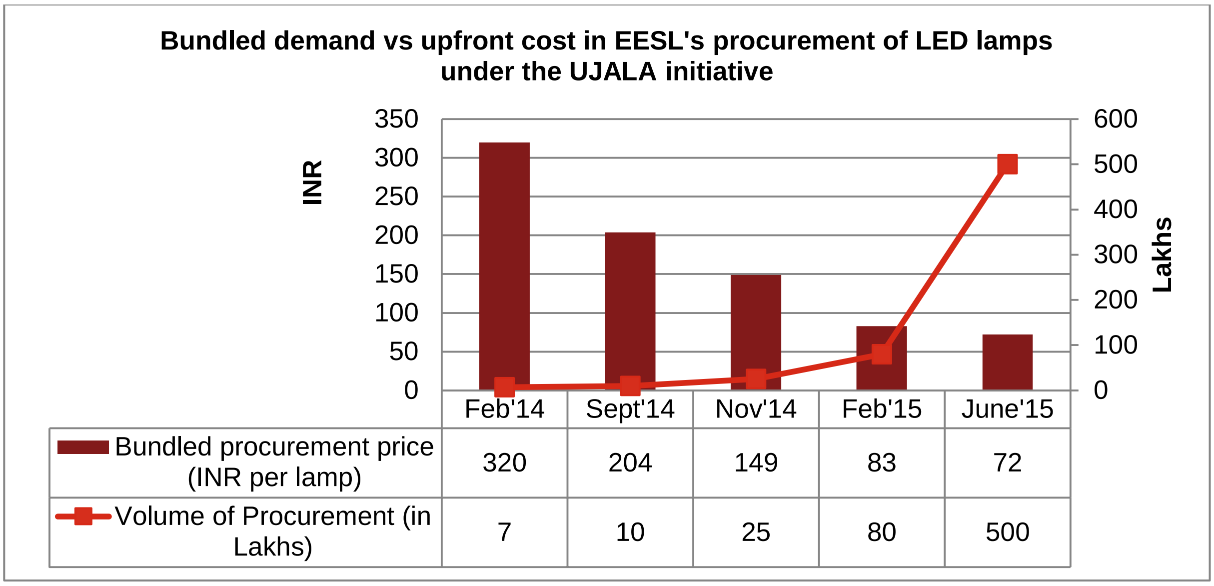
One of the most critical success factors in EESL's DSM delivery model was demand aggregation and bulk procurement of DSM solutions. Indian consumer's sensitivity to high upfront cost of energy efficient end use technologies was an important barrier to design successful DSM delivery models. This coupled with high discount rate expectation further had weakened the case for investment towards energy efficient end use technologies. EESL broke this barrier by aggregating demand for DSM solutions at Utility, state and country level to significantly enhance volumes, improve economies of scale and reduce the upfront cost in the process. Bundling demand allowed EESL to undertake bulk procurement for DSM solutions in high potential markets such as domestic lighting thereby reducing the upfront costs substantially to the end user.

The idea of demand aggregation was actually first conceived by a central core committee led by the Ministry of Power in 2009[32]. This committee recommended several demand aggregation strategies to enhance market volumes and reduce the high upfront cost of LED self-ballasted lamps, which emerged as the most energy

[32] The economic case to stimulate LED lighting in India, 2010, Ministry of Power, Govt. of India

efficient solution for general lighting illumination markets. The committee suggested a centralized institutional mechanism to implement the proposed demand aggregation strategies and vested the responsibility to EESL.

In 2013-14, EESL successfully bundled the demand for 7 watt self-ballasted LED lamps in its flagship DELP scheme (former UJALA). In a span of one and half years, EESL bundled demand for more than 6 crore LED lamps in progressive phases of procurement to reduce the upfront cost of LED lamps from INR 320 per lamp to INR 72 per lamp thereby achieving more than 75% reduction compared to retail market prices.



Source: EESL

EESL has sold over 100 million self-ballasted LED lamps through bundled procurement to domestic and institutional consumers in about 24 states and union territories across the country.

EESL's bundled procurement was carefully orchestrated with robust technical standards, quality control mechanisms, and testing infrastructure to have sustained benefits for the end user. In many cases, the manufacturers hesitated to participate in bundled procurement tenders because of the inherent wholesaler retailer conflicts. Indian Utilities must tactfully overcome these barriers through a continuous dialogue with potential suppliers.

There is tremendous potential to adopt demand aggregation and bundled procurement for other potential DSM solutions (viz. LED tubular lamps, BEE 5 star rated ceiling fans, air conditioners etc.). Demand aggregation can also be adopted to scale up DSM solutions in the public institutional markets (*e.g.* municipal infrastructure). The common ownership and homogeneous nature of many of the facilities, particularly those with common functions (schools, hospitals), offer unique opportunities for bundling many projects together, allowing procurement at a large scale and attracting new suppliers into the energy efficiency business.

The following sections will discuss the important features of emerging DSM delivery models with examples and further evaluate their application potential to the various Utility DSM markets in India.

3.2. On-bill financing

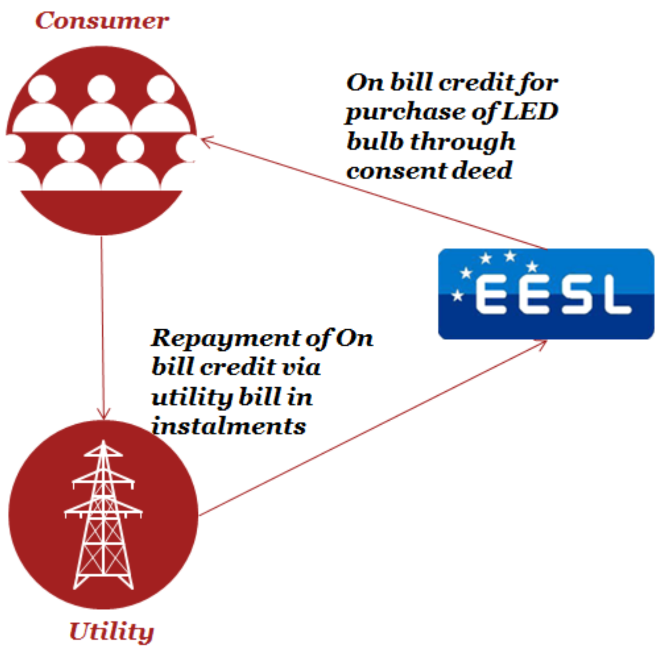
Broadly, on-bill DSM programs involve financing for energy efficiency improvements on the consumer's utility bill. The fundamental objective is to overcome the barrier of high upfront costs, which has been the major impeding factor in the uptake of energy efficient end use technologies. On-bill financing can be perceived as loan/credit extended to the Utility customers in order to purchase energy efficient retrofits that benefit them in terms of decreased energy costs. Electric Utilities are uniquely positioned to recover on-bill loans from its customers by leveraging the electricity service connection as a key collateral. On-bill programs also take out the complexity of general asset financing for end users by providing a more convenient means of repayment through the utility bill.

In India, on-bill DSM programs have been in existence (at pilot scales) since the last decade. Electric Utilities in Bangalore and Mumbai reported lakhs of CFL purchases by domestic consumers on a monthly instalment basis paid through electricity bills during tenth and eleventh plan periods.

In the present scenario, on bill financing is emerging as one of the key design options for Utility scale DSM programs that typically offer incentives to buy down the cost of high-efficiency appliances. EESL's UJALA initiative has adopted on bill financing as key design component for projects in about fifteen states, where EESL has sold more than 20 million LED lamps by extending on-bill loans. In these states, EESL extends on-bill loans directly to the consumer through a formal consent deed and the electric Utilities simply play the role of recovering on-bill charges via utility bill collection. The UJALA project design in these states also allow Utility customers to make full upfront payment for purchasing LED lamps[33]. There is tremendous potential to scale up on bill design based DSM programs for other end use applications (viz. tubular lamps, ceiling fans, air conditioners etc.). In this regard, on-bill financing will continue to gather traction in the coming years.

Globally, on-bill DSM programs have been predominantly operating in the U.S., primarily focused on residential consumers and availed on a wider range of demand side technologies. Until last year, on-bill programs have been operating or preparing to launch in at least 25 states and delivered over 2 billion US$ of financing to consumers for energy efficiency improvements[34]. In the recent times, Canada and U.K have also been reporting on-bill DSM programs and achievements. The U.K Green Deal program offered a wide range of energy efficiency upgrades (viz. solid wall, cavity wall or loft insulation, draught proofing, double glazing, solar PV panels, heat pumps etc.) to consumers at no upfront cost through a charge on the energy bill[35].

On-bill program design for DELP



Despite the three long decades of on-bill evolution in U.S., the market penetration rates have been low with less than 1% in most of the programs and max. 12-15% for select programs that ran for more than 10 years. At the same time, consumer payment default rates also remained low ranging from 0 to 3% percent for most on-bill programs. The on-bill program experience in the U.S. reveals a wide range of design features adopted to balance the objectives of consumer uptake (market penetration), cost effectiveness, ease of implementation for program administrators, regulatory compliance and default risk mitigation.

[33] The total no. of LED lamps sold in the 15 states where on bill financing design is adopted is over 80 million. However, over 75% of these sales have taken place on the basis of upfront payment.
[34] U.S. Department of Energy and U.S. Environmental Protection Agency; 2014

[35] https://www.gov.uk/green-deal-energy-saving-measures/overview

There is no 'one size fits all' design for on-bill programs and the design must be suitably adapted to fit local market conditions and priorities.

Lessons from global experience of on-bill DSM programs

The current regulatory framework in India does not provide a harmonized approach on the above mentioned aspects of on-bill DSM programs. There is a need to address these gaps and enhance transparency in the evaluation of on-bill DSM programs by stakeholders. Some of the important actions in this regard could be as follows:

- Develop a harmonized approach to determine on-bill program costs by breaking it down into critical sub components[36]
- Develop guidelines and standards for effective replacement of defective products in on-bill DSM programs. This will help build confidence among customers on various on-bill products promoted by Utilities. Enhanced confidence can also lead to greater participation and uptake of on-bill programs.
- Establish whether the on-bill program administrators have to comply with state money lending laws and any national financial laws/regulations.
- Develop a criteria to establish who gets paid first in the event that a consumer makes partial payment of Utility bill. This is important for investors who seek to evaluate the risk of consumer default of on-bill loans.
- Develop risk mitigation mechanisms and protocols to manage on-bill payment defaults when building occupants/tenants change.
- Establish norms / benchmarks for marginal software costs required for billing system modifications to track the recovery of on-bill charges.
- Develop a comprehensive cost effectiveness evaluation criteria from the vantage of point of different stakeholders to evaluate on-bill DSM programs. Also, establish whether 'bill neutrality' should be considered as a primary screening criteria for on-bill DSM programs.

3.3. Standard rebate and standard offer

Standard rebate design offers capital rebates to offset the differential cost involved in the purchase of high efficiency electric appliances. The rebate is usually paid directly to the purchaser, who submits a proof-of-purchase receipt. In this case, the customer may self-install the unit, provided that they supply the paid sales invoice along with the rebate application form. Wholesalers and distribution centers, can also be reimbursed, typically requiring a proof-of-sale to a retail customer. In this case also, the customer can claim the rebate at the time of purchase. Utility can make customers aware of the product through a variety of sources including bill inserts, direct mail pieces, utility website, appliance contractors, builders, and retailers.

Standard offer is a mechanism under which utilities purchase energy savings and/or demand reductions at a predetermined rate per kWh or per kW (termed as Standard Offer rates) without offering any upfront

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- [36] These sub components could include but not limited to the following :
- Basic cost of equipment with standard manufacturer warranty (inclusive of taxes, duties an any levies)
- Transportation, transit insurance, loading, unloading, storage, and handling costs (F.O.R. project site costs)
- Distribution cost
- Marketing and awareness cost
- Dismantling, installation and erection cost
- Cost of capital
- Annual maintenance cost
- Service tax

rebates/discounts. Any energy user (utility customer) or energy service company (ESCO) that can deliver energy and/or demand savings is paid fixed amounts per kWh or kW by the utility upon realization/verification of energy savings. The fundamental idea of the Standard Offer approach is that it treats DSM investments in a manner analogous to generation of electricity, and considers the energy savings and demand reductions as resources (virtual power supply) that the utility will pay for. This essentially means that the Standard Offer rates are considered as feed-in tariffs for DSM resources thus creating favorable market conditions to compete directly with supply side resources (viz. thermal, hydro, nuclear, and renewables).

Standard Offer program designs have been successfully adopted in US and South Africa to deliver DSM programs. In South Africa, Eskom, the national electric utility reported that its standard offer program yielded a demand savings of 106.4 MW and energy savings of 726.6 GWh[37] from its inception in October, 2011 through December 2012. The program offered payments for delivered savings from energy efficiency projects at a fixed rate for the Eskom peak period (16 hours per day from 6:00 am to 10:00 pm on weekdays) for 3 years. The typical technologies implemented under this program included efficient lighting and fixtures, LEDs, hot water systems, solar systems, and industrial process optimization. A standard amount was paid per kWh saved. This amount was based on the technology and was up to 85% of the NERSA benchmark for avoided costs. The eligible projects were within a size range of 50 kW to 5 MW. Payments were made to the project developers in installments, with 70% of the payment upon project completion and 10% at the end of each of the three years. Measurement and Verification (M&V) was required for each of the 3 years, and payments were adjusted based on the M&V results.

Published standard offer rates in South Africa[38]

Target technologies	c/kWh
Energy efficient lighting systems	42
LED lighting technologies	55
Building management systems	42
Hot water systems	42
Process optimization	42
Industrial and commercial solar water systems	70
Renewable energy	120

Source: http://www.eskomidm.co.za/

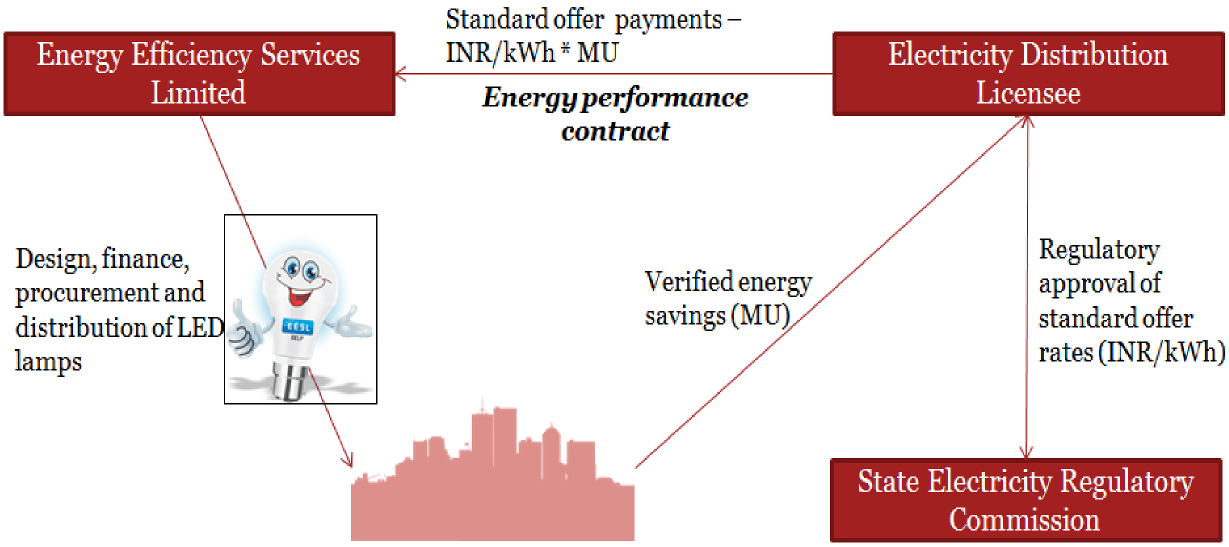
The EESL's UJALA projects in Puducherry and Andhra Pradesh offered LED self-ballasted lamps to domestic households at discounted prices by adopting the principles of both standard rebate and standard offer designs. For Indian market conditions, mitigating the high upfront cost for consumers is crucial to the success of DSM programs. In this regard, UJALA projects in these states distributed LED lamps at INR 10 per lamp and the remaining upfront cost of procurement was offered as capital rebate financed by EESL. Further, these projects have been structured as standard offer contracts with the EESL and respective Utilities as counterparties. The Puducherry Utility has committed to compensate EESL's investments at INR 1.417 to 2.440 per unit of verified energy savings. The Andhra Pradesh Utilities (APSPDCL and APEPDCL) have committed to compensate EESL's investments at INR 1.411 to 0.888 per unit and 1.0481 – 0.6593 per unit of verified energy savings.

[37] Shakti Sustainable Energy Foundation 2013
[38] The rates correspond to the period 2011-12 when the program was active

EESL's DELP Program Location	Utility	Program Scale (approx. no. of retrofits)	Annual energy savings purchased in Million kWh	Approved Standard offer rates (feed in tariff) in INR / kWh
Puducherry	Electricity Department of Puducherry	6 Lakhs	40.9	1.417 – 2.440 (JERC)
Andhra Pradesh – Guntur and Anathapur	APSPDCL	30.82 lakhs	191.63	1.4118 – 0.8881 (APERC)
Andhra Pradesh – West Godavari and Srikakulam	APEPDCL	25.86 lakhs	158.2	1.0481 – 0.6593 (APERC)

The key features of EESL's UJALA projects designed by adopting standard rebate and standard offer designs are as follows:

- LED retrofits are offered at discounted prices to eligible households in exchange for incandescent bulbs
- EESL will undertake design, procurement, finance, and distribution of LED lamps along with warranty management under a contractual framework (energy performance contract) with the utility
- Utility will purchase verified energy savings from EESL at standard offer rates established by the regulator
- Standard Offer rates are established based on the deemed savings and 'Cost plus Return' approach adopted by regulators for establishing feed-in-tariffs of conventional power resources
- Web based monitoring system[39] will capture energy savings in real time– rated wattage and hours of usage



EESL adapted the internationally successful standard offer program design and blended it with standard rebate design and energy performance contracting models to offer energy savings as a resource, which electric utilities purchased at a pre-determined rate stipulated by the regulator. The standard offer rates for energy savings was determined by adopting the cost plus approach methods used by the regulators for determining the tariffs of

[39] RFID tags are fixed on sample LEDs at random that in turn uses a computer chip and antennas to record and transmit critical operating parameters to a web enabled system that is remotely accessible

conventional power generators. This facilitated the regulators to appraise UJALA projects in the same way they do for other conventional power supply options. The standard offer rates for energy savings from UJALA projects were much lower than the average power purchase cost of the utilities. This established energy efficiency as the new cost effective resource option to meet the short the term energy demand. The critical success factor for achieving such low standard offer rates was utility scale demand aggregation and bundled procurement by EESL.

EESL's Standard offer based UJALA projects have tremendous potential for replication across various other end use applications such as ceiling fans, tubular lamps, ACs, agriculture pumps sets, and refrigerators.

However, the Utility DSM regulatory framework must be strengthened by outlining the standard methodology to evaluate standard rebate and standard offer programs. This will guide the Utilities to develop and evaluate such programs in systematic manner considering all the key elements of a successful DSM program delivery model. Some of the key questions to be answered in this regard are as follows:

- How to establish standard offer rates (feed in tariffs) for energy savings resulting from different technologies?
- What should be the process, methodology and protocols for monitoring and verification of energy savings?
- How to evaluate the cost effectiveness of standard offer programs?
- What quality control mechanisms must be in place at the stages of procurement, distribution and after sales services?

The following table provides the key advantages and limitations of various emerging DSM program designs for Indian Utilities.

Program design	Advantages	Limitations
Standard rebate	▪ Mitigates the high upfront cost barrier faced in many low income consumer classes ▪ Highly cost effective for consumers ▪ Rapid market transformation can be achieved with high participation in short periods	▪ Realization of energy savings is critical for utility 's cost effectiveness ▪ Greater due diligence is essential in sanctioning rebates ▪ Higher transaction costs for exercising greater due diligence
Standard offer (without upfront rebate)	▪ Treats energy savings resulting from DSM programs as alternative resources (virtual power supply) ▪ Fosters competition between conventional resource options and DSM ▪ Utility Compensation /payments accrue only after savings realization	▪ Lack of upfront rebate may limit participation ▪ Long term incentive pay out for Utility as energy savings spread over the useful life of equipment ▪ Realization of energy savings is critical for utility 's cost effectiveness ▪ Greater due diligence required for verification of energy savings ▪ Higher transaction costs for exercising greater due diligence
Standard offer plus rebate (EESL's DELP)	▪ All of the above	▪ Realization of energy savings is critical for utility 's cost effectiveness ▪ Long term incentive pay out for Utility ▪ High transaction costs

On-bill financing	▪ Mitigates the high upfront cost barrier faced in many low income consumer classes ▪ Highly cost effective for Utility as it involves complete cost recovery through consumer bills ▪ Provides greater assurance of energy savings for Utilities	▪ Stringent regulations and enforcement is required for securing the on bill loans ▪ Higher administration costs for billing system modifications ▪ Programs targeting high investment appliances may limit consumer participation
Above designs with third party equity funding (Eg: EESL driven projects)	▪ Third party resources can effectively overcome the lack of capacity within Utilities ▪ Reduced project monitoring and administrative burden for the Utility	▪ DSM resources tend to be costlier to compensate of the cost of capital and services of third party ▪ Certain DSM programs may not prove to be cost effective with third party funding

There is no single best delivery model for designing a successful DSM program. Indian Utilities should evaluate each of the above mentioned program designs in the context of Utility priorities, DSM goals, customer participation, cost effectiveness, and the ability to overcome important local obstacles.

4. Agriculture DSM - Challenges and solutions for sustainable delivery model

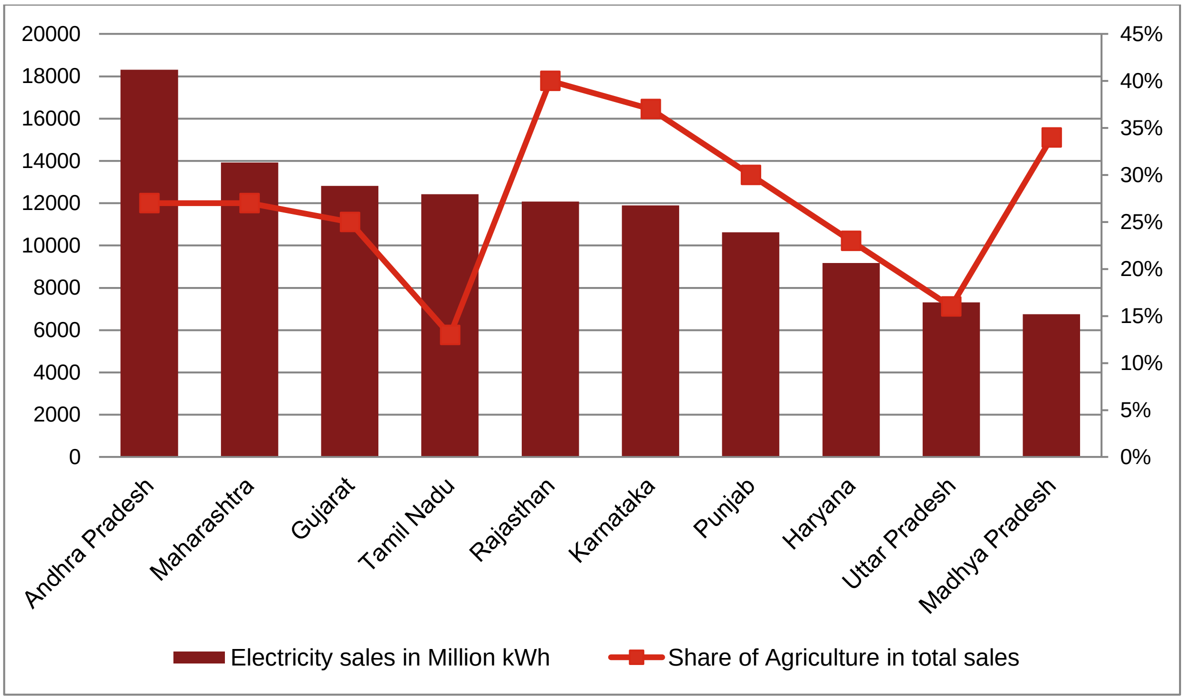
Managing agricultural load has been the bane of many electricity distribution licensees in agriculture intensive states of India. Farmers perceive zero marginal cost for electricity use because of subsidized tariffs and, hence, disregard efficiency in energy consumption. The annual subsidy burden as a result of this to all the state governments is a whopping INR 67,000 crores[40] in 2013-14. Continuous under recovery of agriculture subsidies (gap between subsidy booked and received by utilities) has been the major driver of losses for many Indian Utilities.

20 Million agriculture pump sets connected with the grid

Agriculture sector contributes 22% of national electricity consumption

54% growth in agriculture electricity consumption envisaged by 2022

Top ten agriculture intensive states in India



Source: Planning Commission, 2014

Agriculture pump set efficiency up-gradation presents an unprecedented scale of DSM potential (30 billion units of energy savings/annum) that can reduce the agriculture subsidy burden of state governments by up to 25%. A minimum of 2.5 HP reduction can be expected in the connected load of every pump set connection through efficiency up-gradation. Replacing the pumping system components such as foot valves, suction and

[40] Planning commission 2014

delivery pipes, pump and motor assemblies, and optimum sizing of pumps and pipes are proven measures for pump set efficiency up-gradation.

Pump set type	Existing efficiency range	Improved efficiency range
Monoblock	20% - 30%	40% - 45%
Submersible	25% - 35%	45% - 55%

Potential benefits to stakeholders from agriculture pump set efficiency upgradation

Government

- Reduced subsidy burden and improved fiscal deficit
- Meeting environmental commitments
- Meeting social objectives among rural farmer communities by providing pumpsets at subsidised cost

Utilitites

- Energy savings and better peak load management
- Reduced gap between subisdy booked and received
- Improved financial health
- Reduction of reactive energy losses in rural feeders
- Enhanced service quality: reliability and voltage of power

Farmers

- Subsidised pumpsets for irrigation
- Reduced expenditure on electricity bills
- Free repair and maintenance of pumpset during project duration
- Lower pump failure rate
- Enhanced social security

Review of agriculture DSM projects so far

In 2009, the Bangalore Electricity Supply Company (BESCOM), under the WENEXA initiative[41] supported by USAID, developed an innovative public private partnership for replacing inefficient agriculture pumps sets with efficient technology ones in Doddaballapur, Karnataka. The private energy service company took up the roles of financing, procurement, dismantling, installation, and maintenance of efficient pump sets along with overall project management. The company entered into an energy performance contract (EPC) with BESCOM by linking the compensation / remuneration / cost recovery to energy savings performance stipulated according to a pre-determined methodology. The project reported 35%[42] energy savings and also reported rise in ground water levels due to integrated water side interventions. Extensive capacity building and awareness campaigns also played a crucial role in reinforcing the benefits of Ag DSM among the farmer community.

In 2010-11, under the national program for Ag DSM, the BEE and the Maharashtra State Electricity Distribution Company (MSEDCL) jointly developed a pilot project aimed at agriculture pump set efficiency

[41] A bilateral program between the Ministry of Power, Govt. of India and USAID
[42] USAID 2013

upgradation in Solapur, Maharashtra by adopting the WENEXA model. The project was structured as public private partnership between MSEDCL and a private pump set manufacturer. The project reported 25% energy savings[43] by replacing 2209 pump sets by 2012-13.

In the last 2-3 years, EESL also initiated a few pilot projects with the Utilities in the states of Karnataka and Andhra Pradesh. These projects have targeted a relatively small scale of pump sets as compared to the enormous potential in the states.

Ag DSM pilot projects implemented by EESL

State	Utility	Number of Pumps	Guaranteed Energy Saving in %	Estimated Annual Energy Savings (MUs)
Karnataka	HESCOM	590	37%	2.92
	CESC	1337	37%	5.67
Andhra Pradesh	APEPDCL (on going)	2496	28%	21.3
Total		***4423***	***32%***	***29.89***

Source: EESL

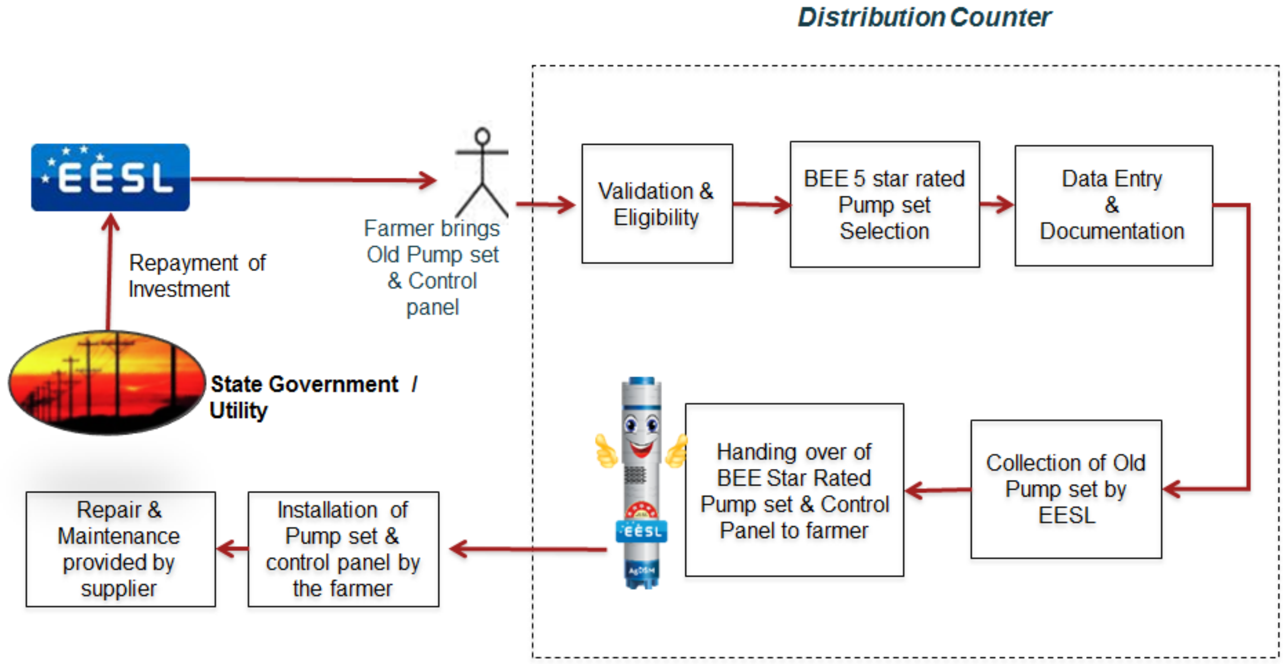
EESL's Ag DSM solution and program design

Drawing lessons from the above mentioned pilot projects, EESL has initiated a new program design for scaling up the Ag DSM pilot projects into Utility scale programs. The key features of EESL's Ag DSM solution and program design is summarized below.

- EESL will distribute BEE 5 Star rated pump sets (along with control panels) at designated distribution centers and collect the old pump sets for recycling
- Total upfront cost of the BEE 5 star rated pump set is borne by EESL
- The dismantling and installation cost of pump sets shall be borne by the farmer
- EESL, Utility and state government will enter into a tripartite agreement that will set the terms of EESL's cost recovery linked to energy savings performance
- Free repair and maintenance of BEE 5 star rated pump sets for the entire term of project
- Independent Monitoring & Verification mechanism will stipulate energy savings performance based on deemed savings approach

[43] BEE 2013

EESL's Ag DSM program Design



Market realities and challenges in scaling up EESL's Agriculture DSM solution

How to ensure participation / uptake by farmers given the voluntary nature of scheme?

Today, almost all agriculture intensive states subsidize electricity to agriculture customers either fully or partially. Farmers perceive zero marginal cost for electricity use because of subsidized tariffs and, hence, disregard efficiency in energy consumption. Moreover, in the current structure of the EESL's program, the dismantling and installation costs are to be borne by the farmer. In this scenario, the large scale uptake of BEE 5 star rated pump sets by farmers could be a critical concern for the stakeholders.

Effective awareness campaigns can make a significant impact on the farmer's willingness to participate in the scheme. The awareness campaign must be designed to effectively communicate the benefits of BEE 5 star rated pump sets. Apart from this, there is an established eco system comprising of local electricians and dealers who enjoy the confidence of farmers for pump set selection, purchase, replacement, installation, repair & maintenance and operational performance reviews. The government must engage this eco system actively in the marketing and awareness activities to facilitate greater participation by farmers.

How to prevent misuse and ensure that the existing pump sets are effectively getting replaced with energy efficient ones by farmers?

There can be a genuine concern among the stakeholders about misuse of freely distributed BEE 5 star rated pump sets in an environment riddled with power theft and non-accountability of energy consumption due to unmetered connections. The reduction in the subsidy burden of state government is expected to pay off for the EESL's investment into the program. This reduction can be achieved only when the participating farmers effectively replace their existing pump sets with the BEE 5 star rated ones.

The EESL has envisaged a smart control panel solution for tracking the use of BEE 5 star rated pump sets by the participating farmers. The technology when integrated into the control panel of BEE 5 star rated pump set can enable third parties to track and verify the installation of BEE 5 star rated pump sets in a reliable way. The technology also allows remote monitoring of the electrical parameters of the BEE 5 star rated sets through a centralized web based application. This sort of facilitates virtual metering of irrigation pump set connections and provides several other indirect benefits to the Utility, state government and society as whole.

Quality of Power Supply: Several field studies conducted as part of the energy audit of agriculture pump sets have indicated that the farmers typically use higher capacity pumps than contracted load with the Utility leading to constant over drawl and low voltage in the network. Also, the three phase AC motors which are coupled to agriculture pumps are subjected to a wide voltage fluctuations depending on their distance from the distribution transformers. Supply voltages at motor terminals are never constant throughout the day and night. They are subjected to wide voltage fluctuations during different periods of the day and night. The most common problem faced by farmers is the burnout of motors.

Un-predictable and poor quality power supply poses a major threat to the performance of energy efficient pump sets, decrease farmers' acceptance and reduce bankability of projects. In such conditions, there is a need to improve the distribution infrastructure with rural feeder segregation and high voltage distribution systems (HVDS) to mitigate the performance risk of energy efficient pump sets.

Baseline establishment[44]: Baseline establishment is the key to determine energy savings realized in performance driven Ag DSM investments. Most of the agriculture service connections in India are un-metered, thus making this task very challenging. In addition, a significant share of the rural agriculture service connections receive electricity supply through rural feeders that supply to both agriculture and domestic service connections in block hours. Single phase to three phase converters and three phase to single phase converters are commonly used by farmers to serve both domestic and agriculture purposes on ad hoc need basis. This scenario makes it almost impossible to establish baseline energy consumption exclusively for agriculture service connections.

Separate electricity infrastructure for rural agriculture and non-agriculture power consumers, also known as rural feeder segregation is a critical requirement to establish accurate and reliable baseline for Ag DSM projects. A recent World Bank report has indicated that eight agriculture intensive states (viz. Andhra Pradesh, Gujarat, Haryana, Punjab, Karnataka, Maharashtra, Madhya Pradesh and Rajasthan) have either completed or are implementing rural feeder segregation programs[45]. Despite significant progress of rural feeder segregation, it is still not an alternative to metering agriculture service connections. Robust data collection and analysis is essential to mitigate this gap in order to facilitate transparent and reliable assessment of the agricultural consumption of electricity.

Dynamic operating conditions: Agriculture service connections in India, especially the ones that use groundwater for irrigation are exposed to wide variation in operating conditions (viz. ground water level, supply voltage, cropping pattern, irrigated area etc.) thereby raising the risk profile significantly for investors. 'Risk' here refers to the uncertainty that the expected energy savings will be realized. It is important to lower this risk profile for Ag DSM investments, especially when they are structured as EPC (energy performance contract) between Utilities and ESCO. This is because cost recovery and revenue realization is directly linked to realization of energy savings and high uncertainty in expected energy savings may lead to potential monetary consequences for investors. The risk is usually derived from varying operating conditions and usage factors,

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[44] The Quantum of energy savings in any DSM program is generally determined by comparing the measured electricity consumption and demand after the implementation with what it was before the implementation. These pre-implementation electricity use conditions are described by a baseline. The baseline represents the electricity use linked to a set of conditions under which the system in question was operating prior to the implementation of DSM measures.

[45] Lighting Rural India: Experience of Rural Load Segregation Schemes in States; World Bank; 2013

which are not under the control of Utilities or ESCOs. Such risk must be managed either by allowing the baseline adjustments based on measurements or by agreeing to the stipulated values of operating conditions and usage factors (Eg: pump set operating hours). Using stipulations means that the Utility, ESCO and the farmers agree to employ a set value for a parameter throughout the term of project, regardless of the actual behavior of that parameter. Stipulating certain critical usage parameters in the M&V plan of energy savings can provide cost effective ways to manage the risk of varying operating conditions. Energy savings determined on the basis of measurements and stipulations both (or just stipulations) are called as deemed savings. If no stipulated values are used and the savings are verified based entirely on measurements, then all risk resides with the ESCO. Alternatively, the Utility assumes the risk for the parameters that are stipulated. In the event that the stipulated values overstate the savings, or reductions in use decrease the savings, the Utility must still pay the ESCO as per the terms of EPC.

In this regard, there is a need to determine baseline adjustments, stipulate operating conditions and critical usage factors through engineering calculations and measurement protocols. The framework should ensure optimum risk allocation and at the same time not jeopardize the expected savings, the Utility's ability to pay for the savings or the value of the project to the Utility. ESCO should be held responsible for the controllable factors (risks), such as, maintenance of equipment efficiency.

Acceptance by farmers: Farmers view the monitoring of electricity consumption with suspicion, and are generally averse to pump replacement, since detailed site assessments show smaller optimal pump-size. Systematic awareness and publicity campaigns on the benefits to farmers can help overcome this skepticism.

Availability of inefficient pump sets - Studies have shown that only a fraction of marketed pumps are from organized sector with established brands and standards. Locally made pumps sold by the unorganized sector are designed to absorb the impact of wide variation in voltages. This resilience comes at the cost of efficiency. MSMEs dominate the market and their technical capacity must be augmented to conform to minimum performance standards. Complementarily, star labeling of pumps must be made mandatory and non -star labeled pump s should be gradually phased out.

Water Energy Nexus in the Agriculture Pumping sector

Several pilots conducted in the past, some with the help of donor assisted programs (Eg: USAID's WENEXA), have revealed that India's agriculture sector needs an integrated approach by considering both water and energy efficiency improvements to maximize resource (water and energy) savings and tackle the menace of inefficiency in a holistic manner. Studies have revealed that waterside interventions such as drip irrigation and other measures that improve irrigation efficiency can deliver energy savings almost equivalent to the pump set replacement. More importantly the integrated approach would also have substantial positive effects on the worsening ground water situation in the country.

Measure	Energy saving potential
Pump set replacement	15 – 25%
Piping and foot valve replacement	5 – 15%
Efficient irrigation systems (drip, sprinkler, etc.)	15 – 25%

In this regard, the state and central government institutions along with Indian electric Utilities must explore integrated DSM solutions with appropriate delivery models to maximize resource savings (both energy and water) in the agriculture intensive states.

5. Roadmap to scale up Utility DSM in India

Given that the market driven DSM mechanisms have gained significant momentum, India is at the cross roads for adopting the right policy approach that can effectively complement the market mechanisms in capturing the DSM potential and also delivering the promise of DSM. Demand side resources lack the kind of impetus laid for promotion of renewable energy sources in the current legal and policy framework governing the Indian power sector. There is a need to explicitly recognize 'demand side resources' as alternative resource option in the energy resource basket of electric Utilities. There are broadly two options available for the policy makers to achieve this.

- In the first option, the 'demand side resources' can be defined and emphasized as stand-alone independent resource apart from the conventional and renewable energy sources. This however requires legislative action to empower the state regulatory commissions for effective enforcement and consideration of DSM by the Utilities and central /state governments.
- In the second option, the 'demand side resources' can be recognized as a qualifying resource under the definition of renewable energy sources in the existing legal and policy framework.

In addition, there is a need for consideration of demand side resources at the planning stage to enable integrated resource planning by the electric Utilities and central /state governments. The importance of IRP cannot be over stated, especially in the India's power market conditions, because it not only creates a market for demand side resources but also saves on the enormous fixed costs otherwise paid by utilities towards the committed capacity for generation, transmission and distribution. This ensures that the enhanced penetration of demand side resources in the overall energy resource mix of Utilities effectively optimizes power resource costs and results in the reduced cost of power for consumers. This is one of the important promises of demand side management.

Under UDAY, there is a need to set clear DSM performance milestones in order to ensure effective adoption of this DSM by participating DISCOMs. These milestones, must be defined in terms of quantum of energy savings with a robust evaluation mechanism to verify such savings. Additionally, there is a need to review the incentive mechanism proposed under UDAY to adequately compensate the DISCOMs for scaling up DSM activities.

On the climate policy front, there is a need to evaluate whether the goal of 40% cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030 (one of key INDC commitments of India) should consider avoided generation capacity resulting from DSM measures. The role and significance of DSM in achieving India's INDCs must be clearly formulated and integrated with other sustainability actions, plans and policies.

On the regulatory front, the enforcement of DSM regulations continues to be limited in many states. There is a need to strengthen the DSM regulatory framework with regard to capacity and authority of DSM cells, establishment of DSM targets, cost effectiveness evaluation of DSM programs, EM&V of DSM programs, cost recovery mechanisms and incentive framework for Utilities.

The EESL's flagship UJALA initiative and its unprecedented scale of achievements has significantly enhanced the stakeholder confidence in the promise of DSM delivery models such as demand aggregation, bulk procurement, on-bill financing, standard offer and standard rebate. There is no single best delivery model for designing a successful DSM program. Indian Utilities must evaluate DSM program designs in the context of

Utility / state priorities, DSM goals, DSM technology / solution, customer participation, cost effectiveness, and the ability to overcome important local obstacles.

Agriculture pump set efficiency up-gradation is one of the important DSM markets in India with transcending benefits for the power sector and society as whole. However, several attempts to capture this market by both central and state level institutions have still remained at pilot scales primarily due to persisting market realities and implementation challenges. The EESL's new Ag DSM solution and program design offers hope and promise in overcoming many of these challenges. Some of the important actions to mitigate these challenges.

- Conduct systematic awareness and publicity campaigns to effectively communicate the benefits of BEE 5 star rated pump sets and other incentives to farmers
- The government must engage the eco system comprising of local electricians and dealers who enjoy the confidence of farmers in marketing and awareness activities to facilitate greater participation by farmers
- Improve the distribution infrastructure with high voltage distribution systems (HVDS) to mitigate the performance risk of energy efficient pump sets
- Accelerate rural feeder segregation and establish robust data collection and analytics to establish accurate and reliable baseline and savings resulting from Ag DSM projects
- Determine baseline adjustments, stipulate operating conditions and critical usage factors through engineering calculations and measurement protocols in transparent and inclusive ways
- Integrated DSM solutions must be scaled up by considering both water and energy side interventions with appropriate delivery models to maximize resource savings in the agriculture intensive states