Utility CEO Forum on DSM

Barriers and Enabling Mechanisms for Advancing Megawatt scale DSM Programs in India

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Utility DSM Forum India

SHAKTI SUSTAINABLE ENERGY FOUNDATION

Abstract

This paper is prepared for the members of Utility CEO Forum with the objective of identifying critical barriers towards advancing mega-watt scale Utility sponsored DSM programs in the country. The Paper also aims to discuss the mechanisms to overcome these barriers. In the context of energy efficiency and DSM, the barriers have been extensively discussed by experts (both national and international) in the industry, but mostly from the perspective of market transformation. However, this paper attempts to identify challenges within the context of DSM resource acquisition by Utilities.

Another contributing section in this paper provides examples of best of practices (both local and international) that have been adopted by DSM market participants to demonstrate the enabling mechanisms that can successfully promote Utility DSM in the country. The paper also presents a detailed account of the history and evolution of DSM in India. This account is provided in the context of the evolution of 'Energy Conservation' and the emergence of relevant institutions to administer such activities in the country. Apart from this, the paper also presents an in depth assessment of the current status of Utility DSM programs in the country. This assessment is based on the survey of 73 utility DSM programs spread across 20 major Utilities.

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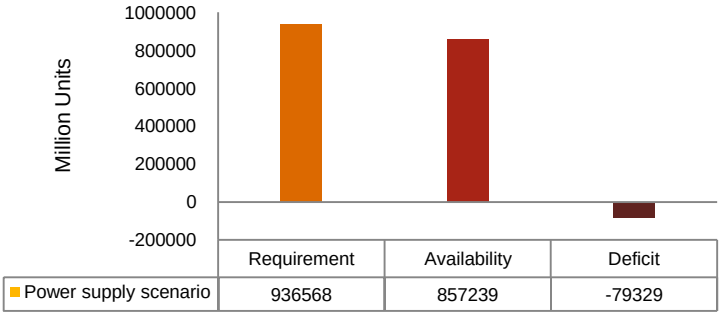
Background - Supply Demand scenario in Indian Power Sector

In India, our power sector faces formidable challenges in meeting the demand in a reliable, economic and sustainable manner. We have seen persistent electricity shortages for several years now, and this has quite significantly constrained our growth rate. The recent statistics released by the Central Electricity Authority (CEA) show that the country experienced an energy shortage of 8.5% and peak shortage of 11.10% during April'11-March'12.

Power supply scenario in India, 2011-12 (MU)

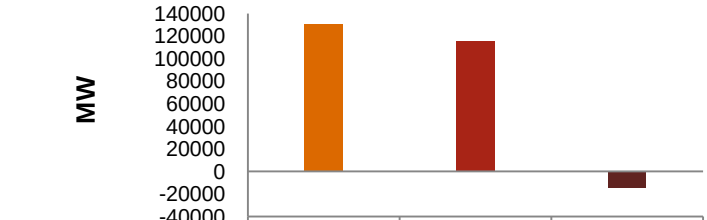


	Requirement	Availability	Deficit
Power supply scenario	936568	857239	-79329

Source: Central Electricity Authority, 2012

The National Electricity Policy (NEP), published by the CEA, in January, 2012, has considered energy and peak demand requirement of 1354874 MU and 199540 MW respectively by the end of 12th plan and the same as 1913050 MU and 287348 MW respectively by the end of 13th plan period. These demand forecasts make projections of unrestricted demand while accounting for nominal impact of existing Energy Efficiency and Demand Side Management measures.

Peak Demand position in India, 2011-12 (MW)



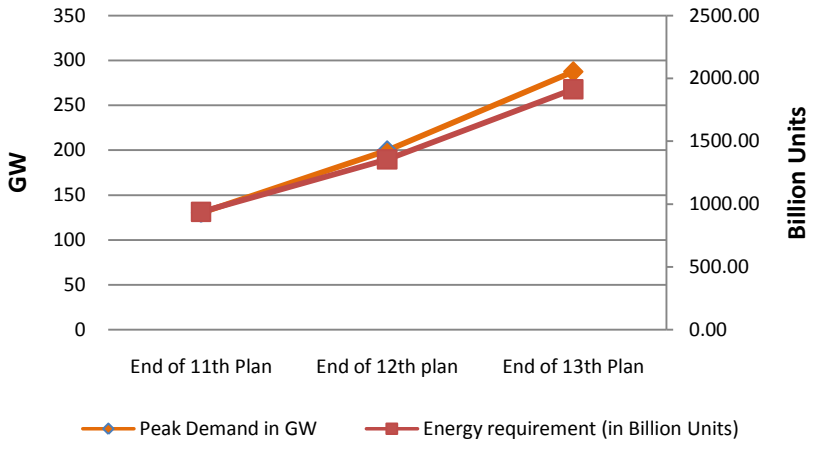
	Peak Demand	Peak Met	Deficit
Peak Demand position	130250	115847	-14403

Source: Central Electricity Authority, 2012

The per capita consumption of electricity in the country has been increasing from 15 kWh in 1950 to about 814 kWh in 2011 and currently is about 24% of the world's average and 35% & 28% respectively that of China and Brazil.

Apart from this, the National Electricity Plan, by CEA in January 2012, has also suggested that the current energy supply position may have to increase at a rate of 8.36% in order to meet the expected demand projections over the next decade.

Indian Power Demand scenario



Source: National Electricity Plan, 2012

Demand Side Management (DSM) - Rationale and Meaning

Given such accelerated growth in the expected electricity demand over the next decade, supply side measures alone cannot help India meet the expected demand. In recent times, we have also witnessed increasing difficulties in ensuring among other things, adequate fuel linkages for new generation facilities, and so the supply side has its own set of problems. Therefore energy efficiency measures on the demand side are a crucial requirement. Such complementary efforts will help us narrow significantly the power demand supply gaps in a relatively shorter time frame. Transformation of the electricity sector in India with strong and sustained commitments to energy efficiency would improve the energy security of this nation. One tool that has proven effective in many countries for delivering energy efficiency is demand-side management, or DSM.

The Ministry of Power, Government of India has defined DSM as 'actions of a utility, beyond the customer's meter, to alter the end-use of electricity - whether it be 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 interests of reducing utility costs'.

Another definition of DSM, widely accepted by Indian industry, is that the '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 a whole'.

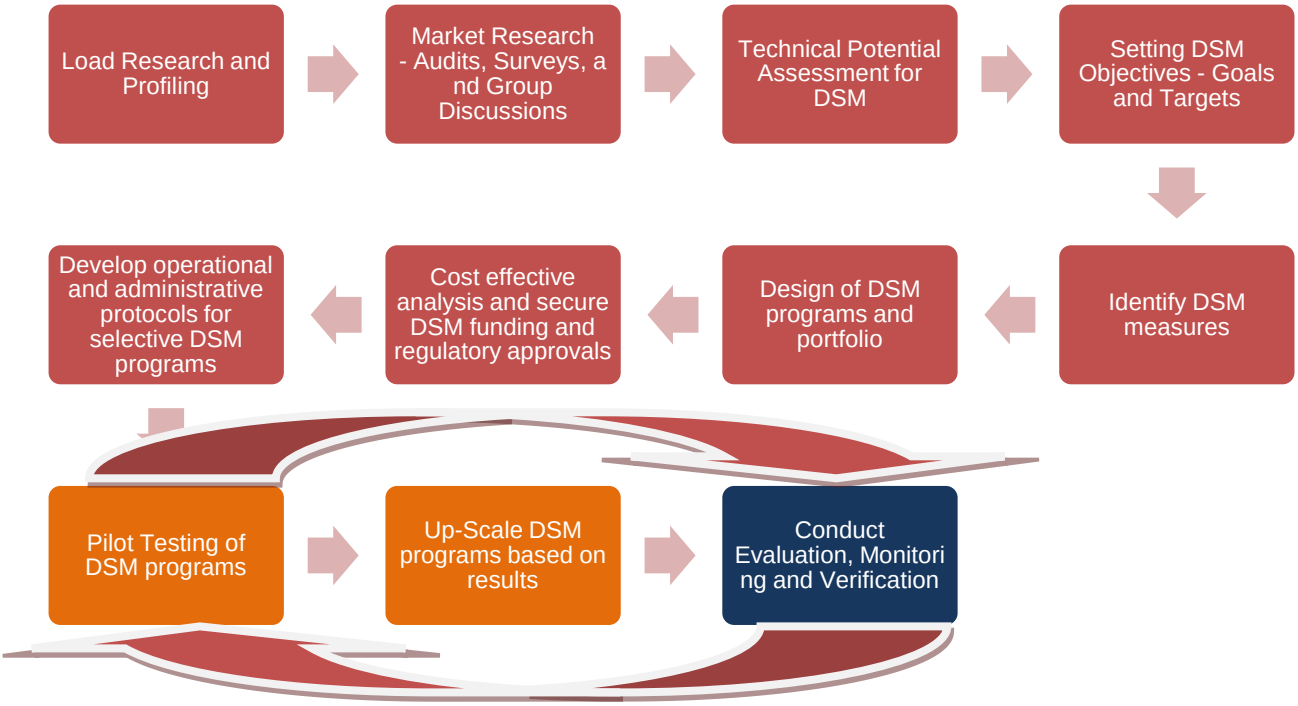
Often the terms energy efficiency and DSM are used interchangeably. However, it is important to point out that DSM explicitly refers to all those activities that involve deliberate intervention by the utility in the marketplace so as to alter the consumer's load profile. Energy efficiency is used in an all encompassing sense and can be defined any activity that would directly or indirectly lead to 'using less energy to provide the same service'. To make this distinction precise, a program that encourages customers to install energy efficient lighting systems through a rebate program would fall under DSM. On the other hand, customer purchasing energy efficient lighting as a reaction to the perceived need for conservation is not DSM but energy efficiency gains. Thus DSM cannot be undertaken in the absence of Utility participation and leadership.

The benefits of DSM are manifold and are discussed extensively in the literature. Primarily the DSM programs can reduce energy costs for both the utility, and its customers, and in the long term, it can limit the requirement for further generation capacity augmentation. It also offers co benefits such as improvement in system reliability and efficient end use electricity by Utility customers. In summary well designed DSM measures can improve the service quality of the utility and enhance customer satisfaction. Apart from the direct benefits to Utilities and their customers, there are environmental benefits derived from DSM programs. DSM programs substitute for power plants and result in lower green house gas emissions and also help the country improve its energy intensity.

DSM Planning, Process and key Strategies

In the DSM planning process, load research and profiling marks the beginning of strategising DSM interventions. Load research also guides the policy makers to set DSM objectives, goals and targets over a defined period of time. Broadly the DSM strategies can be categorised as Utility driven load management measures and energy efficient (EE) technology penetration. For EE technology penetration, the estimates of available demand side resources are obtained by conducting market research studies in potential end use segments to quantify the scale of achievable efficiency and demand savings under different economic and programmatic scenarios. If the decision is made to pursue any of the resources identified in a market potential study, the Utility in charge would design a pilot program, or more likely a portfolio consisting of multiple pilot programs, to reach the target customers and motivate them, usually with incentive payments and information campaigns, to install efficient and demand controlling equipment and strategies. In this phase, the Utilities would also complete all the regulatory approval processes by carrying out a comprehensive cost effectiveness assessment of the targeted pilot programs. Subsequent to the regulatory approvals, the Utilities develop operational and administrative protocols to guide the market participants to participate in these programs. After the pilot DSM initiative begins operations, a separate evaluation, measurement and verification (EM&V) review is launched to objectively assess how well it is meeting its stated goals, and to quantify the resulting

savings impacts. The EM&V review results are used to modify the design to improve progress towards goals, and to upscale the successful pilot programs. The Figure depicts the planning, operational, and evaluation phases of the demand side management process.



Some of the commonly adopted measures for implementation of DSM are summarised in the following sections:

Load Management helps electricity utilities to modify customer load profiles and thereby reduce or shift their peak demands. They include:

- **Dynamic/Real Time Pricing**: This pricing mechanism is based on real time system of supply & demand characteristics
- **Feeder segregation/bifurcation/up-gradation**: These measures involve monitoring and easy management of load to various classes of consumers. They are particularly effective in rural areas to manage agriculture load and domestic load.
- **Advanced Smart Metering**: This allows for online communication, accurate measurements, local intelligence, load connect-disconnect facility and a consumer friendly display unit.
- **Demand response**: This is a voluntary load curtailment measure adopted to manage peak system load. Electronic media including Web-based Communication Systems/ tools can be used to convey to the customer information on the prevailing demand, supply, prices on a real time basis and the incentives and options for him.

Enhanced penetration of energy efficient packages provides support to design, finance, and install a package of energy efficient technologies/equipment/appliances across various classes of end users.

- Improving the efficiency of various end-use applications through better housekeeping correcting energy leakages, system conversion losses, etc ;
- Enhanced adoption of energy efficient technologies and end use appliances

- Enhanced adoption of renewable energy systems, combined heat and power systems, independent power purchase, etc, that can bridge the demand-supply gap at the lowest possible cost.

Annexure -1 provides a snapshot of the widely recognised load management options and other DSM programs that adopt end use energy efficient appliances/equipments across various customer segments.

History and Evolution of DSM in India

Globally, the DSM programs began modestly in the U.S. in 1970s, as a response to the growing concerns about dependence on foreign sources of oil and environmental consequences of electricity generation, especially nuclear power. The DSM programs grew rapidly during the late 1980s as state regulators in the U.S. provided incentives for utilities to pursue least-cost or integrated resource planning principles. Electric utility DSM programs reached their largest size in 1993, accounting for $2.7 billion of utility spending or about one percent of U.S. utility revenues[1]. After 1993, the peak year of utility spending on DSM according to the Energy Information Administration (EIA), electric utility spending on energy conservation and DSM started to decline as electricity markets were being restructured to introduce more competition, and expenditures on efficiency programs were reduced or eliminated as utilities sought to reduce costs. However the expenditure picked up in the last decade owing to rising energy prices and maturity of electricity markets.

In India it is very difficult to isolate the evolution of Utility DSM programs from that of the energy conservation and efficiency industry. Therefore the following sections provide a detailed account of the history of DSM in the context of the evolution of energy conservation in the country.

The Indian power distribution sector has been the bane of the Indian energy sector ever since the time of Independence, with demand exceeding supply and consequently resulting in severe peak demand deficits and energy shortages constantly in the economy. During the late 1980s, the all-India power deficit was about 7.9%[2]. However the benefits of energy conservation were recognised in the early 1980s, and the initial thrust to overcome the crippling energy scenario resulted from the strategy to promote energy conservation in energy intensive sectors by assessing the efficiency of energy use through energy audits, fixing specific energy consumption targets and evolving action plans for reducing the level of energy consumption per unit of production. In the mid 1980s, the government formed an energy conservation cell within the Department of Power, with the responsibilities for carrying out energy conservation activities[3]. The Department of Power was made the nodal point for facilitating the implementation of co-ordinated strategy on energy conservation. The strategy promoted energy-savings measures and technologies through demonstration projects, fiscal incentives and setting performance standards for electrical equipment. For example in 1983/84 a policy initiative allowed 100% depreciation for energy conservation devices in the first year of their installation. Apart from this some energy efficient technologies and equipment were exempted from customs and excise duty and soft loans were provided by financial institution for technology up-gradation. The other important elements of this strategy were undertaking studies to evaluate specific technical and policy options, training professionals to create a cadre of energy managers and auditors, and educating consumers through publicity campaigns to create mass awareness on the need and benefits of energy conservation (Nadel, Gopinath and Kothari, 1991).

One of the most recognised efforts towards institutionalisation of energy conservation came in 1989, with the Department of Power establishing the 'Energy Management Centre', an autonomous organisation, to assist in energy conservation programmes along with bilateral and multilateral assistance from ACEEE, World Bank, UNDP, EEC etc (Joshi and Chaturvedi, 1995).

The first major initiative, recorded and highlighted in the literature, by an Indian Utility towards energy conservation was in 1982, with the formation of an Energy Conservation Cell by the erstwhile Gujarat Electricity Board. The cell supported preliminary walk-through audits in over 150 industrial units (Lele and

[1] Joseph Eto, "The Past, Present, and Future of U.S. Utility Demand-Side Management Programs", EETD, LBNL, University of California, 1996
[2] Steven Nadel, S Gopinath, Virendra Kothari, "Opportunities for Improving End-Use Electricity Efficiency in India", A report of the Office of Energy and Infrastructure Bureau of Research and Development, United States Agency for International Development, 1991
[3] Pradeep Chaturvedi, Shalini Joshi, "Strategy for energy Conservation in India", Rajeev Gandhi Institute for Contemporary studies and Institution of Engineers (India), 1995

Raval, 1990; Lele, 1991). This step kick started Utility driven DSM activities in India. 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 functionaries of State Electricity Boards, Agricultural Departments of State Governments, and banks (Nadel, Gopinath and Kothari, 1991). Information dissemination in the form of publications, brochures, posters, stickers and other publicity to create mass awareness or the need for and benefits of energy conservation were carried out by many government departments and organizations such as the Department of Power, Energy Management Centre, Petroleum Conservation Research Association, Department of Coal, State Electricity Boards, industry associations, and private organizations (Nadel, Gopinath and Kothari, 1991).

In the 1990s, there were three major attempts at utility DSM programs in India, and only one of them was fully operational. The first and largest of these programs, at Ahmadabad Electric Company (AEC), had produced many surprises, and lessons applicable for private, profit-making utilities anywhere in the globe[4]. This was also the first Utility driven DSM program in India established at the nation's largest private electric utility company–Ahmadabad Electric Company (AEC) in Ahmadabad, India (population 3 million). The evolution of this DSM program at AEC was comprised of four phases—(1) feasibility research, (2) initial testing and program design, (3) pilot programs and (4) full-scale program roll-out. Each of these phases was characterized by a significant learning process and surprises for both the American consultants involved in the program and Indian administrators (Glen Weisbrod, Mark Tribble and Vijay Deshpande, 1998).

Beyond the AEC program, there have been only three other DSM programs in India in the 1990s, one by the Orissa SEB, one by the Haryana SEB and another by the GRIDCO, which was a Private-owned utility responsible for electricity transmission throughout the state of Orissa. As per the literature, until 1998, both Orissa and Haryana SEB programs involved World Bank funding and were still in the planning stages (Glen Weisbrod, Mark Tribble and Vijay Deshpande, 1998). Whereas, the DSM program by GRIDCO was active during 1997-98 and resulted in significant savings. However, the involvement of GRIDCO in this initiative was only limited to a negotiated stand-by charge[5].

The beginning of 21st century marked a phenomenal step towards establishing a legislative framework for energy conservation in India with the introduction of energy conservation act in 2001. This act also led to the inception of Bureau of Energy Efficiency (BEE) as a principal nodal agency for energy conservation in the country. The erstwhile Energy Management Centre was merged with BEE subsequently. This was followed by notification of state level nodal agencies for energy conservation that further strengthened the institutional framework for energy conservation in the country. In this scenario of unprecedented governance, the bilateral and multilateral assistance accelerated into the country that kick started many innovative models of energy efficiency including the Utility driven DSM programs.

During the Tenth Five year plan (2002-07), with the help of foreign assistance and guidance under BEE, several pilot DSM programs were undertaken by state owned and private sector Utilities. Some of the prominent ones included BESCOM (The Bangalore electricity supply company) of Karnataka, Reliance Mumbai (a private Utility in Mumbai circle), and MSEDCL (a state owned utility of Maharashtra). The primary areas of these pilot programs were lighting, rural load management, Smart Metering, DSM awareness, and agriculture pumping. During this period, the BEE promoted Utility sponsored DSM by reforming the electricity tariff policy with the help of Forum of Regulators (FOR). Following this several Utilities under the directions of state regulatory commissions introduced Time of day tariffs, power factor improvement incentives and load factor incentives in their tariff structures. This marked the beginning of Utility sponsored DSM programs in India at a wider scale. Many of these incentives are active even today. Another prominent Utility sponsored DSM program initiated during the Tenth plan is the Rural feeder segregation. This program was supported by soft loans and incentives

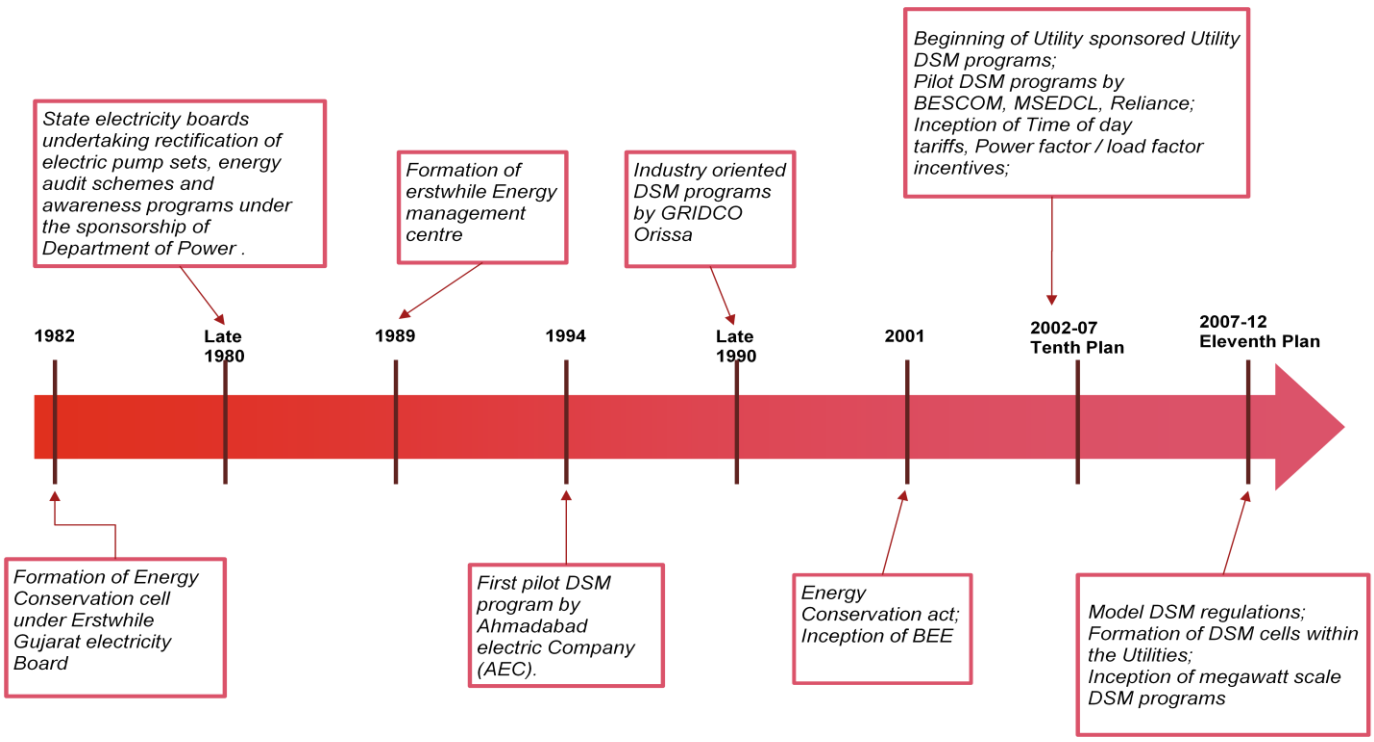
[4] Glen Weisbrod, Mark Tribble and Vijay Deshpande, "Learning from India - Defining Profitable DSM and ESCO Programs for a Utility", National Energy Services Conference in 1998 and Electricity Journal 1998.

[5] "DSM Best practices Guidebook", ECO II, IIEC, 2006-07

under the APDRP scheme of the Ministry of Power, targeted to strengthen the electricity distribution infrastructure in the country. Utilities have gained significant savings via cost effective load management by virtue of rural feeder segregation. This program has continued into the eleventh plan also under the restructured APRDRP scheme.

Subsequently, during the Eleventh Five year plan (2007-11), the BEE planned to transform the lighting market in India and launched the Bachat lamp Yojana (a CFL promotion scheme). The program required significant involvement from the Utilities for implementation on a wider scale. BEE developed a programmatic framework that channelled the rebate from private sector to the customer through a Utility and cost recovery through the Clean Development Mechanism (CDM). The primary role of Utilities under the program has been marketing, distribution, program administration, monitoring and evaluation. Today CFL promotion and distribution has become the flagship DSM initiative for many Utilities in the country. During the XI plan period, BEE launched a national Agriculture DSM program designed to enhance pump set efficiency through public private partnership mode. The program was successful with MSEDCL implementing a pilot program in Solapur, Maharashtra. 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. This period also saw a significant progress towards the need for DSM regulations and with bilateral assistance, the state of Maharashtra pioneered the first of such draft regulations, followed by Himachal Pradesh, Delhi, and Gujarat. In the appliances

The following diagram represents a simple event timeline reflecting the history and evolution of DSM in India.



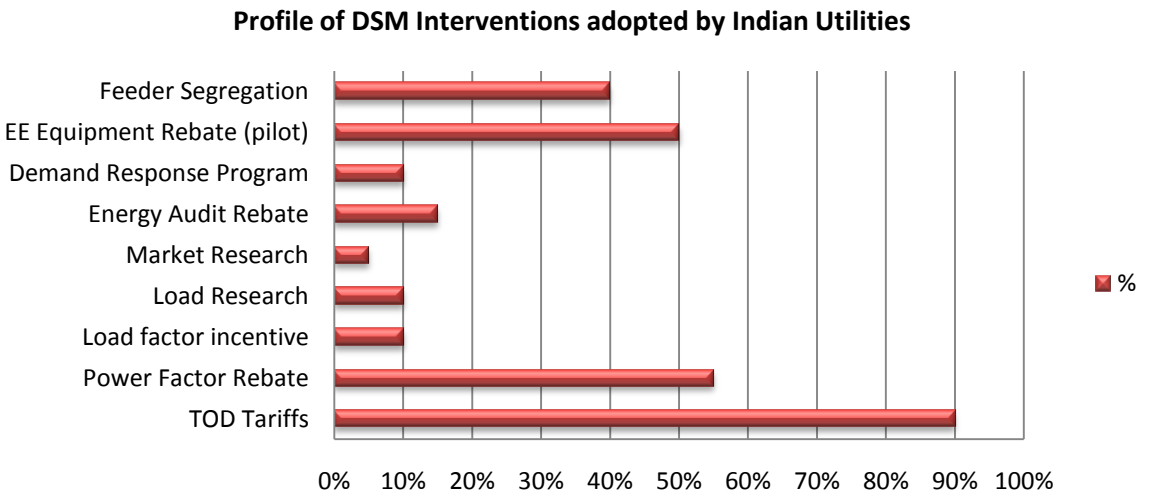
There are many Utility sponsored DSM programs in various states that are currently ongoing. The following section provides an assessment of the current status and profile of Utility DSM activities in India.

Current status of DSM programs in India

This assessment is based on the DSM activities of 20 major Utilities (both private and state owned) in the country. Most of the DSM interventions considered for this analysis are either currently active/ongoing or recently completed.

A survey of DSM of about 73 DSM programs across 20 Utilities in the country has shown the following profile of DSM measures adopted in the current scenario (see chart). 90% of the Utilities have adopted TOD tariffs in their tariff structure to influence peak time usage of electricity by end users. However, most of the Utilities have

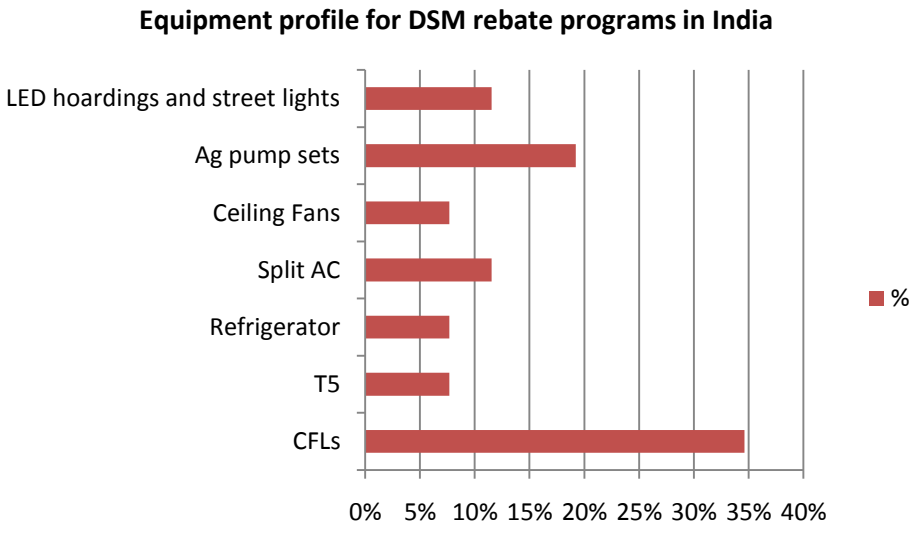
introduced such tariffs only in the HT category (mostly large industrial and commercial consumers). Therefore, TOD tariffs in the residential category are yet to be explored by many utilities in the country. The major barrier in this case is the huge upfront cost of smart meters and poor financial health of Utilities. We can also observe that 50% of the Utilities have some kind of equipment rebate program in their distribution circles. But one should realise that most of these programs are still in the pilot stage. The chart also shows that 40% of the Utilities have implemented feeder segregation programs. As discussed earlier in the 'history of DSM in India', these programs are primarily funded by soft loans and incentives under the 'Restructured Accelerated Power Development & Reforms Programme' (RAPDRP) scheme of the Ministry of Power. Some of the Utilities have initiated these programs on a very large scale and have gained significant savings from these programs by virtue of cost effective rural load management. They have also been able to reduce losses significantly by bifurcating the domestic feeders from the agriculture ones.



Source: PwC Analysis

The energy audit rebate programs in some of these Utilities are also at pilot scale with limited funds. DSM preparatory studies such as Load research and Market research are initiated by very few Utilities even though it is a critical and important preparatory step in the overall DSM process. This shows the lack of motivation on part of Indian Utilities to undertake DSM programs. One of the most effective load management initiatives, the Demand Response (voluntary load curtailment) program has been completely ignored by most of the Indian Utilities despite its extensive application by globally. Only Tata Power and Reliance (both pertaining to Mumbai distribution circle) have put these programs in place at pilot scale with some success so far.

After analysing the equipment profile considered by many Utilities, which are offering some kind of rebate programs to its customers, the following trend can be inferred (see adjacent chart). 35% of the equipment rebate programs offer rebates on CFL lighting, which is a matured and proven technology with sufficient technical standards in place for quality control. Also there is not much financial liability to the Utilities in CFL rebate programs because they are mostly financed by private sector with minimal costs to the Utility administration.



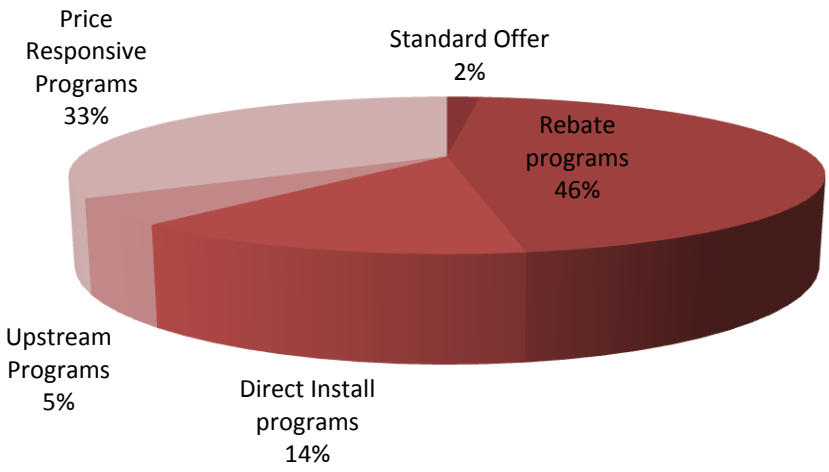
Agriculture pump sets are the Major equipment targeted by Indian Utilities since the 1980s. Power distribution to agriculture pumping sector is crippled with huge losses and poor quality in most parts of the country. Enhanced end use efficiency in this segment results in direct benefits to the Utility finances and the state exchequer. However only few Utilities (Eg: PGVCL, BESCOM and MSEDCL) in the country have made visible strides in this segment. MSEDCL, the state owned Utility in Maharashtra, has successfully replaced about 2000 pump sets by leveraging private sector financing through the use of ESCO model (or commonly called performance contracting). However, there is enormous potential in this segment yet to be tapped by the Indian Utilities.

Beyond CFLs and Ag pump sets, few Utilities have sponsored rebate programs for other potential appliances/equipment in the household, commercial & Industrial sectors. Only Tata Power and Reliance (in Mumbai and Delhi circles) have some kind of pilot rebate programs in place for equipment like T5 lamps, Ceiling fans, refrigerators, and split ACs. One utility has experimented with LED street lights and hoardings in West Bengal. One can clearly infer that many Utilities have failed to tap the enormous potential existing in the residential appliances segment, which can directly impact the Utilities' peak power problems. There is also significant potential for rebate programs for standardised Industrial equipment.

This section of the paper also attempts to analyse the profile of DSM program design options adopted by Indian utilities so far (see chart). DSM program design is an integral part of the overall DSM process. After a decision has been made to proceed with a demand-reduction program, which results from DSM strategy and planning, the Utility would design a program to reach the target customers and motivate them, usually with incentive payments and information campaigns. This phase is generally perceived as program design in the Utility industry.

There are broadly four DSM program design options adopted globally by the Utilities. The following provides a brief summary of these options.

Profile of DSM Program design options adopted by Indian Utilities



Source: PwC analysis

Rebate programs operate by offering cash to offset the differential cost involved in purchase of high-efficiency equipments such as CFL, LED, five star refrigerators or motors. The cash is usually paid directly to the purchaser, who submits a proof-of-purchase receipt. The cash can also be paid to wholesalers and distribution centers, typically requiring proof-of-sale to a retail customer.

Direct-install programs use utility or contractors to directly install low-cost, quick pay-back energy efficiency measures in customer facilities. These programs would deploy teams of technicians into factories and facilities to identify and install low cost, low risk measures; In exchange the DSM program is able to achieve reliable and highly cost-effective energy savings.

Bid programs solicit private contractors to submit proposals to improve energy efficiency levels within a targeted group of customers. The programs set broad goals such as location and measure and facility types, and then rely on the bidders to propose projects. Proposals include estimated savings and price.

Standard offer programs offer to purchase energy savings from a list of pre-approved measures at a fixed price for each avoided kWh or thermal energy. Contractors and facility owners can develop projects that conform to any program requirements that are itemized in the offer. The offer price can vary by measure type, region, size of project, or any other parameter that helps to improve the program's potential to succeed. Standard offer programs can also accept custom measures not on the pre-approved list; project developers submit a description of the measure with estimated savings and costs, and the program manager calculates an offer price unique to the proposal.

Price responsive Programs are Programs involving demand response to price signals. They fall into one of two categories:

- Load curtailment programs that pay the customer for reducing peak load during critical times
- Dynamic pricing programs that give customers an incentive to lower peak loads in order to reduce their electricity bills.

Upstream Programs are DSM preparatory studies that involve load research, market research and DSM potential assessment.

One can observe that about 46% of the DSM programs are rebate programs. This is primarily because of the equipment rebate programs adopted by the utilities. Standard offer programs comprise only 2% as it requires an initial investment by private sector or the end user. The rural feeder segregation is the only direct install program implemented by the Utilities. The price responsive programs comprise 33% because many utilities have some kind of TOD tariffs/incentives for the HT consumers. The Upstream programs are only 5% as very few Utilities have carried out the load/market research studies to understand the overall load profile.

Barriers for Advancing Megawatt scale DSM programs in India

From the assessment of the current status of Utility DSM programs in India (previous section) it is observed that most of the programs existing till date (negating TOD, and power factor incentives) have remained largely in form of pilot projects and are not scaled up for larger masses. Moreover, these schemes have been largely limited to the lighting segment and the experience has not been utilised to develop programmes for other segments or sectors. Review of these programmes has also revealed that most of the programs are not derived from proper load research and post evaluation of these programmes is largely missing.

The barriers to energy efficiency have been extensively discussed from the market transformation perspective by experts (both national and international) in the industry. However, this paper attempts to identify barriers within the context of resource acquisition through Utility sponsored DSM programs. Therefore the barriers identified in this paper pertain to factors internal or external to Indian Utilities affecting their operations and survival. The following sections highlight some of the key barriers to megawatt scale DSM programs.

Uncertainty pertaining to the benefits of Utility DSM programs

Recently a private Utility based in India presented the 'Emerging trends in DSM' during the national conference on DSM held in January, 2012. This Utility clearly stated that the return on investment (ROI) against any DSM program is possible **if and only if** there is peak load reduction. This utility also stated that there are many schemes where consumer will have attractive ROI but DISCOM will be in loss, a scenario reflecting a Reduction of load during non peak hours. Another challenging scenario presented was the 'surplus energy'. It was stated that in such scenarios the ROI for DSM is very uncertain.

All these apprehensions may belong to a single private Utility and may not reflect the views and opinions of other Utilities in the country. However it is important to discuss these factors in the context of a transforming power distribution business in India. The important question to be addressed in this regard is 'whether only DSM programs that focus on peak power reduction fetch benefits or can other programs also do the same?' The key parameters that determine the net benefits of DSM are the marginal cost of power and the tariff realisation

from sale of power. Lack of comprehensive load research studies is another critical barrier contributing to this uncertainty.

Many state commissions and the Utilities are still uncertain about the benefits of DSM. The Utilities may fail to establish that the reduction in marginal power purchase expenses (during the true up of ARR) is derived from DSM activities. This is due to the uncertainty and volatility in demand, fuel costs, load shedding schedules etc. In this scenario of uncertainty it becomes very difficult for the Utilities and the state commissions to monitor and verify the savings resulting from the DSM programs.

Lack of adequate regulations on load shedding

Extensive Load shedding has become an acceptable standard in today's scenario of power supply in India. Several states (especially in the southern region) are experiencing load shedding up to 5000 MW during certain months of the year[6]. Load shedding is also the least cost alternative in the country to bridge supply demand gaps in the system. The willingness to shed load in the events of challenging supply scenarios may be perceived as the biggest barrier for DSM in India.

Lack of regulations on DSM implementation and cost recovery mechanisms

The Indian electricity sector has transitioned from a vertically-integrated, public-owned, and unregulated business to an unbundled, public- and private-owned, and regulated business. The shift in the decision-making structure, the increasing transparency, and consequently, public accountability in a period of chronic power shortages is hampering both state commissions and utilities to focus on DSM in a systematic manner. The Model DSM regulations, 2010, by FOR provides an implementation framework for Utility DSM programs, and also allows the Utilities to recover DSM expenses either through tariffs or any other recovery mechanisms. However, they are not effective unless the state commissions adopt those guidelines and notify appropriate regulations at the state level. Till date, very few states in the country (Maharashtra, Delhi, Gujarat and Himachal Pradesh) have notified DSM regulations, detailing the DSM implementation framework and cost recovery mechanisms.

Lack of skilled manpower and institutionalisation

Almost all utilities across India are facing several other serious issues such as shortages of supply, transmission and distribution losses, theft, and others that carry a higher priority for the utility management than DSM. Although the model DSM regulations of FOR in 2010 has clearly stated the requirement of separate DSM cells within the Utilities with essential authority, these regulations are not binding unless the state commissions adopts them with necessary provisions. Today, even the Utilities that have already established 'DSM cell' have them significantly understaffed. Therefore many Utilities in the state do not have essential capacity to plan, design and implement megawatt scale DSM programs. Without separate DSM cells, this situation will only worsen.

Also there is a lack of understanding and expertise regarding DSM among the Utility staff and a serious lack of high quality manpower in the Utilities, who can understand the intricacies in DSM measures and investments. This can be overcome by capacity building exercises and training of relevant Utility staff within the DSM cell. Another critical barrier normally ignored at this stage is the sustenance of the built capacity of the DSM cell staff. There should also be some mechanisms to retain or transfer the built capacity to new employees, joining the cell or replacing the cell staff. The transfer policies within the utility must incorporate such provisions for retaining the built capacity.

Lack of DSM policy framework

There are no specific provisions related to Utility driven DSM program implementation in either the Energy Conservation Act of 2001 or the Electricity Act of 2003 pertaining to the electricity sector. Also, the National Electricity Policy, a statutory policy under the EA does not provide any clear guidance on any institutional

[6] CEA Monthly reports on Power cuts, 2012

framework for implementing Utility sponsored DSM. This can create a challenging scenario to the state commissions to interpret the relevant laws and create strong binding regulations on DSM.

Generally, the utilities are not opposed to DSM, but they tend to be risk averse. Therefore, they are often reluctant to propose and design DSM programs on their own that could fail and force the utility to shoulder the financial consequences. However, utilities appear to be quite willing to implement DSM programs that have been already been designed, approved by some higher authority/agency or policy maker, and in which they have no or minimal perceived risk.

Poor Financial health of Utilities

Ever since the Independence, the Indian Electric Utilities have undergone a deteriorating financial health and have been unable to finance any capital intensive programs including DSM. The situation in today's scenarios is also the same except for a few private ones operating in Maharashtra, Gujarat and Delhi. As per the report published by Power Finance Corporation (PFC), during the year 2009-10, the utilities incurred combined losses of Rs.635 billion (without accounting for subsidy) (PFC, 2011).

Deteriorating financial condition and resources is another major reason that inhibits utilities to experiment with DSM and instead focus on only improving supply system and augmentation of new capacities. In such conditions, the financial institutions in the country may also perceive greater risk in lending commercial loans to large scale DSM programs, which are relatively risky and posed with regulatory hurdles.

Apart from this, in many states there is only one distribution utility and that is public-owned while in other states the largest distribution utility is also, usually, public owned. Unlike private utilities that today serve only a few urban areas, the public utilities serve large masses and are less likely to be proactive in addressing their deficits as they are essentially operating in a not-for-profit mode.

Factors overcoming mega watt scale DSM barriers

Given the magnitude of barriers for advancing DSM in the country, a coordinated effort should be put in place to monitor and quantify the parameters, driving the benefits of DSM, via regulatory framework. This would help the utilities to assess the benefits of DSM programs in a more transparent manner. Technical assistance for conducting detailed load research studies should be made available to all the Utilities in the country. This will allow the utilities to strategically plan for the right interventions and achieve the desired objectives. With regard to the poor financial health of the Utilities, the government has recently restructured the SEB loans bailing out a portion of senior debt with the public sector banks in the country. This may open up opportunities for commercial loans for funding DSM resource acquisition. The utilities must also be provided with specific regulations for overall implementation framework of DSM programs and cost recovery to safeguard themselves from the regulatory risks. There have to be strict regulations and laws that require Utilities to improve reliability by avoiding load shedding.DSM should be proposed as a suitable alternative to achieve this. The regulations must define the “loading order”, which should be binding upon the Utilities, to specify/prioritise the order of resource alternatives to meet its energy needs under conditions of demand supply mismatch. The 'Loading Order' should specify that the Utilities may first invest in energy efficiency and demand-side resources before considering other alternatives during the periods of demand supply mismatch. Finally the DSM cells within the Utilities must be empowered with adequate resources and authority to plan and implement megawatt scale DSM programs.

Examples of Best Practices in advancing Utility sponsored DSM Investments

California Energy Efficiency Policy

Energy Efficiency and Demand Response have been the first priority in California's 'loading order' for energy resources since 2003. The California Public Utilities Commission (CPUC) and the California Energy Commission (CEC), in 2003, came together to develop one high-level, coherent approach to meeting California’s electricity and natural gas needs. As an outcome of this unprecedented approach, the 'Energy Action Plan, 2003' was published that defined California state's broad energy policy. In this policy document, the “loading order” established that the state, in meeting its energy needs, would invest first in energy efficiency

and demand-side resources, followed by renewable resources, and only then in clean conventional electricity supply. As a result of this unambiguous policy, the California Public Utilities Code, which is the California state law for operation of utilities, had amended Section 454.5(b)(9)(C), 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.[7]"

Subsequently, in 2005, the CPUC, which regulates the Investor owned Utilities' (IOUs') energy efficiency programs in California, approved 2 billion$ ratepayer funded energy efficiency investments by the Utilities for 2006-08 cycle[8]. For the 2009 bridge funding period another 786 million$ investments were approved[9]. Further in 2010-12 cycle, the CPUC approved another 3.1 billion$ investment portfolio. These energy efficiency programs have reported savings of 1069 MW and 5736 GWh for 2010-12 cycle and 6000GWh and 1175 MW savings for 2006-08 cycle[10]. These programs and related energy savings are a key component of California's broader energy policies and CPUC's coordinated efforts with the IOUs.

Regulatory Framework for DSM by MERC

In 2010, Maharashtra Electricity Regulatory Commission had successfully interpreted the EA to allow for promotion of utility-implemented and rate-payer-funded DSM activities. MERC was the first state regulator to notify regulations on 'DSM implementation framework' and 'Cost effectiveness of DSM measures and Programs' in India. Many other states like Himachal Pradesh, Delhi, and Gujarat have followed only recently.

The basic principles of MERC regulations on DSM Implementation framework enables every Distribution Licensee in its Jurisdiction, to make DSM an integral part of day-to-day operations, and undertake planning, designing and implementation of appropriate DSM programmes on a sustained basis. It also allows Distribution Licensees to recover all justifiable costs incurred by them in any DSM related activity, including planning, designing, implementing, monitoring and evaluating DSM programmes, by adding these costs to their Annual Revenue Requirement to enable their funding through tariff or by implementing programmes at the Consumers' premises that would attract appropriate Return on Investment.

The regulations on DSM Implementation framework primarily guide Utilities in the following aspects of the overall DSM process:

- DSM Programmes Eligibility Criteria
- Development and Submission of DSM Portfolio and Plans
- Role of DSM Consultation Committee (DSM-CC)
- Responsibilities of the Distribution Licensees Related to DSM Planning and Implementation
- DSM Funding
- DSM Programme, Portfolio and Annual Work plan and its approval Process
- Evaluation, Measurement & Verification (EM&V)
- Monitoring & Reporting
- Methodology for Selection of DSM Programmes to be Included in the DSM Plan
- Selection Criteria for other Programmes to be included in the Plan

The regulations on Cost Effectiveness provide guidance to the utilities in Maharashtra for assessing the cost effectiveness of the DSM programmes and to reduce the uncertainty faced by utilities in regulatory approval, as well as to reduce the regulatory burden while scrutinising DSM programme proposal from the utilities. They provide a consistent set of methods for cost-benefit assessment of DSM measures and programmes to be followed by the licensees in the State and thereby provide transparency to the regulatory process of DSM programme appraisal and approval. Cost effective tests are proposed from four different perspectives i.e. Utility's perspective, Participants/consumers perspective, Total resource cost perspective, and the Societal perspective.

[7] 2008 Update, Energy action Plan, State of California
[8] 'Aligning Utility Incentives with Investment in Energy Efficiency', US EPA, November, 2007
[9] 'Energy Efficiency Evaluation Report for the 2009 Bridge Funding Period', CPUC, 2011
[10] '2010 – 2011 Energy Efficiency Annual Progress Evaluation Report', CPUC, 2012

DSM Action Plan for Tamil Nadu

In order to realize the energy efficiency potential, and upscale the implementation of DSM programmes by utility, load research should be the starting point. One of the key objectives of load research is to understand and analyse the utility's load profile. In this regard, a study was carried out by TERI for the state of Tamil Nadu with financial support from the Shakti Sustainable Energy Foundation. TANGEDCO, the state owned distribution Utility, was a key stakeholder in this study.

TANGEDCO adopted "top-down" approach to understand its load profile by starting from the total system load shape and breaking it down to customer end-use. The demand pattern for the entire state over the day and during different seasons was captured from the hourly load data recorded by the state load dispatch centre (SLDC). Further to understand consumer category-wise load behaviour, detailed analysis of load data for the predominant consumer feeders was undertaken. A sampling approach was adopted to select the predominant feeders from the entire state. Both the overall state load curve and consumer category wise load curves were analysed to identify potential strategies for DSM Based on the findings of the load research study the following key elements were proposed as part of the DSM action plan:

- Promotion of energy efficient appliances
- Promotion of energy efficiency in new commercial buildings
- State-wide education and awareness campaign for energy conservation
- Improvement in process and operational efficiency in the industrial sector
- Public procurement of energy efficient appliances
- Feeder segregation
- Strategic utilization of energy conservation fund and DSM fund approved by the regulator
- Regulatory measures for promoting DSM
- Strengthening of SDA

Finally a roadmap was provided for initiating each of the above mentioned DSM strategies. The recommendations expected that implementation of this action plan would accelerate DSM activities in the state and also provide market signals to private investors and encourage Energy Service Companies (ESCOs) to support the energy efficiency market.

DSM Funding through Eskom IDM program in South Africa

Eskom is a state owned Utility with a mandate to generate and supply electricity in South Africa. The state of the electricity system in South Africa in itself is one of the major drivers for energy efficiency services. In 2002, Eskom had formally established a DSM fund approved by the country's regulator. The DSM funding is now more commonly known as Integrated Demand Management (IDM). Eskom has established an IDM division, which is dedicated to ensuring short-term security of electricity supply through coordinating and consolidating the various initiatives aimed at optimising energy use and bridging the demand supply gap. A key aspect of this IDM programme is the promotion and implementation of energy-efficient technologies, processes and behaviours amongst all consumers. IDM's role is to ensure single ownership of demand side management strategies, objectives and operations throughout Eskom. Eskom adopted a market-driven approach to understanding and meeting consumer requirements and provided a platform from which Eskom can collaborate with government, external stakeholders and consumers.

Eskom is the largest funder for energy efficiency initiatives through its IDM funding initiatives and programs. In an effort to enable industrial customers to reduce their energy consumption, Eskom has designed six funding models.

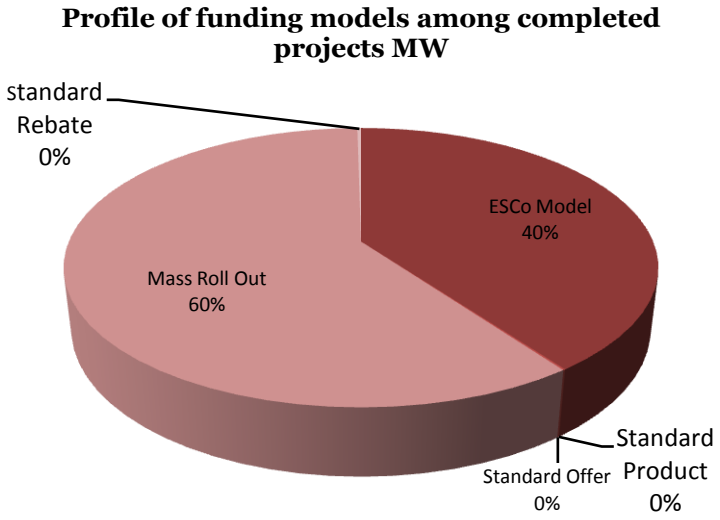
- The **rebate model** is structured around paying consumers an incentive for converting their inefficient technologies to energy saving solutions, provided the suppliers are registered on the programme.
- The **Standard Product** is for customers with a potential load saving of between 1kW to 250kW.
- The **Standard Offer** is for customers with a potential load saving of 50kW to 5MW. This model was developed to streamline the project approval process and time frame and to facilitate a quicker payment process.
- The **ESCO funding** process is for Energy Services Companies (ESCO) which are specialists in energy efficiency, and who submit projects with a potential load saving of 100kW or more.

- The **Performance Contract** aims to purchase bulk verified energy savings across multiple sites and technologies by contracting with a single Project Developer. The minimum project size will be more than 30GWh of savings over a three year sustainability period.
- The **Customer Model** is designed to allow electricity end users to participate in energy reduction initiatives of their own.

For Residential consumers, Eskom has the Mass Roll out program, in which the demand for energy efficient appliances is bundled and then deployed with the services of ESCOs and demand aggregators.

The total value of DSM projects funded through Eskom initiatives is around R5.6 billion of which R4.7 billion is for projects in the implementation phase. A total of 2375 MW of contracted demand has been initiated. A total of 1814 MW has been completed and verified (completed phase). This corresponds to over 75% of the total contracted performance of all the IDM projects. A further eight percent of the projects are still in the development phase and the remaining 16% are currently in the implementation phase.

About 60% of the completed DSM projects are funded through the Residential Mass Rollout scheme, whereas the remaining 40% of the projects are funded through the ESCO model.



Source: Eskom IDM database 2011

Conclusion

In spite of several efforts towards promoting DSM in India, there is very little application of this innovative concept in the light of the enormous untapped potential that exists. The Indian Utilities have failed to take off DSM measures on a large (megawatt) scale. Clearly the barriers are manifold. The Ministry of Power recently restructured the SEB loans providing opportunities for fresh investments focused towards bridging the supply demand gap and improved operational efficiency. This is a positive step towards adopting DSM resources for meeting the growing demand. However there are several other barriers derailing the progress of DSM resource acquisition by Indian Utilities.

This situation demands for increased interaction among the Chief Executive Officers (CEOs) and Senior Management of distribution utilities in India in order to identify and advance solutions driven dialogue among the stakeholders. Many Utilities in India especially in the state of Maharashtra, Gujarat, Delhi and Karnataka have performed relatively better as compared to other states. In this regard knowledge and experience sharing could generate fresh program ideas and thoughts. This will eventually pave the way for accelerated implementation of megawatt scale DSM activities in the country.

The interaction among the CEOs of Utilities could focus on the following topics:

- Factors contributing to the success of megawatt scale DSM programs by overcoming/circumventing the existing barriers
- Role of DSM cells in the overall process of DSM - Essential Authority and Resources
- DSM policy and regulations required to facilitate megawatt scale DSM programs
- Tools and Resources for administering megawatt scale DSM programs over specified time frame

The CEO interactions on above mentioned topics would be converted to appropriate Tools and Resources that could assist all the Utilities in the country towards administering mega watt scale DSM programs. This could also be a blueprint for administering DSM programs in India. The interactions could also provide significant inputs to provide appropriate policy recommendations to the senior policy makers in the country.

Annexure - 1: Load management strategies and DSM programs

Load Management strategies adopted worldwide	
	**Peak clipping** (reduction in peak demand) is reduction of peak load through Utility's direct control on equipment/appliance used by the consumer or through tariff adjustments whereby consumers curtail load at certain peak hours of the day.
	**Valley Filling** (increased demand at off peak) involves increasing the load during off-peak hours. Valley filling consists of building off-peak loads. This may be particularly desirable where the long-run incremental cost is less than the average price of electricity.
	**Load Shifting** (demand shifting to non peak) involves shifting peak loads to off peak hours. Popular applications include use of storage water heating, storage space heating, and coolness storage. In this case, the load shifting associated with thermal storage involves load shifting related to conventional electricity applications e.g. building heating by electric convectors.
	**Strategic Conservation** (the reduction of utility load, more or less equally, during all or most hours of the day) is one of the non traditional approaches to load management and results from utility-stimulated conservation. Not normally considered load management, it also involves a decrease in sale as well as modifications in the way electricity is used.
	**Strategic Load Growth** (the increase of utility loads) is the load-shape change which refers to overall increase in sales. Load growth may involve increased market share of loads through the development of new applications (electric cars, microwave technologies, automation).
	**Flexible Reliability** (interruptible agreements by utility to alter customer energy consumption on an as-needed basis) is a concept which may be conveniently perceived as a load-shape change. Reliability is actually a planning constraint. Utilities must make sure that they can curtail a customer's load demand if need be (either for an immediate need or as a constituent for their energy reserves), in exchange for various incentives.

Description of DSM Programs	
Residential Programs	
Refrigeration	Provide incentives (rebates) for the purchase of a higher than standard efficiency refrigerator or provide services for the removal, disposal & recycling of an operating second refrigerator or freezer
Air Conditioning/ Space Heating	Designed to increase the likelihood of purchasing more efficient air conditioners, increasing the market penetration of heat pumps, providing incentives for installing direct load control devices on air conditioners, or providing incentives to improve home insulation
Lighting	Offer incentives (rebates) to purchase compact fluorescent lights and replace standard incandescent bulbs and fixtures
Water Heating Programs	Designed to offer: • Rebates/Incentives to install Solar water heaters • Rebates to install jackets and low-flow, shower heads or high efficiency water heaters • Direct load control of water heaters • Water heating storage for load shifting
Comprehensive Building	Offer technical and financial assistance to builders and architects to incorporate energy efficient technologies into new building construction, energy audits to customers and incentives to incorporate energy saving technologies recommended
Time of Day Rates	Offer time of day pricing to encourage residential customers to shift usage to off-peak periods
Commercial Programs	
Refrigeration	Provide an incentive to replace existing compressors and motors with high efficiency models
Commercial Heat/ Vent/ AC	Offer incentives: • To replace existing fan and pump motors with high efficiency units • For installing commercial office building and retail building cool storage systems • To install office building economiser controls
Lighting	Offer incentives (rebates) to upgrade existing fluorescent bulbs and fixtures with high efficiency lights and electronic ballast
Comprehensive Building	Offer: • Time of day rates • Technical and financial assistance to builders and architects to incorporate energy efficient technologies into new building construction • Energy audits to customers and incentives to incorporate energy saving technologies recommended
Stand-by Generator	Provide an incentive to customers to use stand by generation during peak demand periods
Water Heater	• Rebates/Incentives to install Solar water heaters • Provide a water heater wrap and installation through an independent contractor
Time of Day Rates	Offer time of day pricing to encourage commercial customers to shift usage to off-peak periods
Industrial Programs	

Motor Program	Provide an incentive to replace standard efficiency motors at time of failure with high efficiency motors
Lighting	Offer incentives (rebates) to upgrade existing fluorescent bulbs and fixtures with high efficiency lights and electronic ballast
Interruptible Rates	Designed for industrial customers so the utility may interrupt service during utility need
Comprehensive Building	Includes energy audits and various energy efficiency improvements, motor programs and industrial water heater programs. Utilities that implement this program are effectively combining other programs which are listed separately
Time of Day Rates	Offer time of day pricing to encourage industrial customers to shift usage to off-peak periods
Stand-by Generator	Provide an incentive to customers to use stand by generation during peak demand periods

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