Demand Side Management in India: An Overview of State Level Initiatives

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Abbreviations

Ag-Pump	Agricultural Pump
AP	Andhra Pradesh
APCPDCL	Andhra Pradesh Central Power Distribution Company Limited
APEPDCL	Andhra Pradesh Eastern Power Distribution Company Limited
APERC	Andhra Pradesh Electricity Regulatory Commission
APGENCO	Andhra Pradesh Power Generation Corporation Limited
APNPDCL	Andhra Pradesh Northern Power Distribution Company Limited
APSPDCL	Andhra Pradesh Southern Power Distribution Company Limited
ARR	Annual Revenue Requirement
BEE	Bureau of Energy Efficiency
BESCOM	Bangalore Electricity Supply Company
BEST	Brihan-Mumbai Electric Supply and Transport
BLY	Bachat Lamp Yojana
BRPL	BSES Rajdhani Power Limited
BYPL	BSES Yamuna Power Limited
BU	Billion Units
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CFL	Compact Fluorescent Lamps
CSO	Civil Society Organization
DEDA	Delhi Energy Development Agency
DG	Diesel Generator
DGVCL	Dakshin Gujarat Vij Company Limited
DHBVNL	Dakshin Haryana Bijli Vitran Nigam Limited
DISCOMs	Distribution Companies
DL	Delhi
DPR	Detailed Project Report
DSM	Demand Side Management
DSM-CC	DSM Consultative Committee
EC	Energy Conservation
EEREMC	Energy Efficiency and Renewable Energy Management Centre
EESL	Energy Efficiency Services Limited
ESCO	Energy Service Company
FoR	Forum of Regulators
GEDA	Gujarat Energy Development Agency
GERC	Gujarat Electricity Regulatory Commission
GESCOM	Gulbarga Electricity Supply Company Limited
GJ	Gujarat
GoAP	Government of Andhra Pradesh

GoI	Government of India
GoK	Government of Karnataka
GoTN	Government of Tamil Nadu
GUVNL	Gujarat Urja Vikas Nigam Limited
HAREDA	Haryana Energy Development Agency
HDPE	High Density Polyethylene
HERC	Haryana Electricity Regulatory Commission
HESCOM	Hubli Electricity Supply Company Limited
HT	High Tension
HVDS	High Voltage Distribution System
HY	Haryana
IGA	Investment Grade Audits
KA	Karnataka
KERC	Karnataka Electricity Regulatory Commission
KREDL	Karnataka Renewable Energy Development Limited
LMC	Load Management Charge
LT	Low Tension
MEDA	Maharashtra Energy Development Agency
MESCOM	Mangalore Electricity Supply Company Limited
MGVCL	Madhya Gujarat Vij Company Limited
MH	Maharashtra
MoU	Memorandum of Understanding
MSEDCL	Maharashtra State Electricity Distribution Company Limited
MSME	Micro Small and Medium Enterprises
MU	Million Units
MYT	Multi-Year Tariff
NPC	National Productivity Council
NREDCAP	New and Renewable Energy Development Corporation of Andhra Pradesh Limited
PGVCL	Paschim Gujarat Vij Company Limited
RE	Renewable Energy
RInfra	Reliance Infrastructure
SDAs	State Designated Agencies
SECF	State Energy Conservation Fund
SERC	State Electricity Regulatory Commission
TANGEDCO	Tamil Nadu Electricity Generation and Distribution Corporation Limited
TANTRANSCO	Tamil Nadu Transmission Corporation Limited
TES	Thermal Energy Storage
TGNPDCL	The Northern Power Distribution Company of Telangana Limited
TGSPDCL	The Southern Power Distribution Company of Telangana Limited
TN	Tamil Nadu

TNEDA	Tamil Nadu Electricity Development Agency
TNEI	Government of Tamil Nadu – Electrical Inspectorate
TNERC	Tamil Nadu Electricity Regulatory Commission
ToD	Time of Day
TPC-D	Tata Power Company- Distribution
TPDDL	Tata Power Delhi Distribution Limited
TPL	Torrent Power Limited
TRC	Total Resource Cost
TSSPDCL	Telangana State Southern Power Distribution Company Limited
UGVCL	Uttar Gujarat Vij Company Limited
UHBVN	Uttar Haryana Bijli Vitran Nigam Limited
WB	West Bengal
WBERC	West Bengal Electricity Regulatory Commission
WBSEB	West Bengal State Electricity Board
WBSEDCL	West Bengal State Electricity Distribution Company Limited

Demand Side Management in India: An overview of state level initiatives

Summary

India's demand for electricity is growing and there are ever increasing resource, environmental and social constraints on increasing supply. Hence, improving end use energy efficiency (EE) is important. Several studies have also shown that improving energy efficiency is often the most economical measure to meet demand. Various state level actors like the state governments, regulatory commissions and Distribution Companies (DISCOMs) have an important role to play in facilitating end use efficiency improvements. Not only is EE important in reducing the overall demand, but it can also alleviate the financial stress of DISCOMs. These benefits have spurred various activities related to Demand Side management (DSM) at the state level in recent years. Regulators are notifying regulations and issuing directives to DISCOMs, DISCOMs are conducting different DSM programmes, and state governments are appointing designated agencies to improve energy efficiency and DSM activities in states.

In this report, we have systematically studied the activities of all actors involved in this process in eight states. The study has three objectives:

(a) to increase awareness of such activities among active civil society organisations (CSOs) in order to enable them to hold these actors accountable; and

(b) to facilitate learning by state actors, and enable states to learn from one another's experiences;

(c) to recommend a coherent and coordinated strategy to scale up these activities at the state level based on the study's findings and analysis.

A number of polices are in place in this regard. Some states have issued regulations regarding DSM, whereas others have issued directives to DISCOMs asking them to make DSM a part of their day-to-day activities. Quite a few states have tariff mechanisms like Time of Day (ToD), power factor incentives, etc. A number of state governments have issued government orders encouraging EE/Energy Conservation (EC) and set up energy conservation committees and energy conservation missions. Several DISCOMs have also implemented new and innovative DSM programmes.

However, we also observe that the programmes implemented by DISCOMs have remained at the pilot scale. Regulators have been lax in ensuring compliance with the regulations and directives. State governments too have been lax in following up on the ambitious projects and targets that they have announced. This may be due to several reasons. Both regulators and DISCOMs do not believe that EE/DSM can have any large scale impact. There is also a lack of ownership of activities to promote EE at the state level. Regulators and DISCOMs are busy with several other issues and don't consider EE a priority. The state designated agencies (SDAs) are understaffed and in most cases focused more on renewable energy (RE). There is also very little political visibility for EE. There is no public pressure on

these state actors to actively pursue measures to promote EE. These reasons allow the concerned actors to escape accountability. Also, there is very little information on DSM in the public domain. There is no information on the monitoring and evaluation of ongoing programmes, and there is almost no communication between different actors to share their experiences either between states or within each state.

Based on this study, we recommend a multi-pronged approach going forward: create awareness and public pressure, promote ownership of EE activities, and develop a prototype for the implementation mechanism for adoption by regulators and DISCOMs. First, CSOs and active consumers should be aware of and intervene in the regulatory processes with submissions related to DSM. The DISCOMs can be held accountable because in all these states, DSM regulations are in place or appropriate directives have been issued, which can increase public pressure. The individual state reports in the annexure of this document can help CSOs to identify different areas of intervention. Some CSOs and individuals are already intervening, but their efforts need to be scaled up. Secondly, DISCOMs should be mandated to ensure complete transparency in their DSM projects. The programme design document, and their evaluation and its impact should be made public. Also, a platform is needed where DISCOMs can share their experiences. To tackle the lack of ownership, we recommend that a state level committee be convened by the principal secretary to co-ordinate all related activities. This state committee, in consultation with the DISCOMs, regulators and others, can set targets for the DISCOMs and also act in an advisory role. Finally, DSM programmes should be designed at national level, and implemented by the DISCOMs at a state level. With increased public pressure, specific targets and strict follow-up, the DISCOMs can respond positively to such programmes.

Demand Side Management in India: An overview of state level initiatives

1 Introduction

India's demand for electricity has been growing by about 8% every year for the last 5 years, but power generation is lagging behind. India has consistently faced an energy deficit of 8-10% over these last five years[1]. The demand for electricity will further increase significantly, as 1/3rd of Indian households which are currently without electricity access will be connected to the grid soon. More electricity generation cannot be the only solution to meet the increasing demand. There are various resource constraints to generation such as limited land, fuel and water. There are also social and environmental concerns in the siting of new power plants. Hence, it is imperative that India adopts energy efficiency measures to reduce its demand for electricity. The Integrated Energy Policy[2] and the report by the Low Carbon Committee of the Planning Commission[3] have estimated an electricity reduction of about 15-20% of the total generation through energy efficiency measures. Realising the importance of energy efficiency, the Government of India (GoI) passed the Energy Conservation (EC) Act[4] in 2001 and established the Bureau of Energy Efficiency (BEE) to develop and implement energy efficiency and conservations policies and programmes.

State level actors like the State Electricity Regulatory Commissions (SERC), DISCOMs, and the SDAs established by the state governments under the EC act have an important role to play in improving India's energy efficiency. Every state is different with its own consumer mix, power purchase profile, load curve and other factors. Hence, it is necessary that each state develop its own action plan for energy efficiency with active involvement from all the actors. Also, most of the DISCOMs are unable to meet their peak demands and are burdened with financial losses. EE and DSM activities can help them address these problems. DISCOMs can play an important facilitative role in improving end use efficiency because a) they have extensive reach and contact with consumers b) they have a monthly financial transaction with consumers and c) DSM can help them in meeting the overall demand at lower costs. Hence, DISCOMs can potentially impact consumer behavior to reduce and manage their consumption significantly. There has been an increase in the EE/DSM activities by the SERCs, DISCOMs and SDAs in recent years, particularly after regulations for DSM were enacted by various states. There are also guidelines being prepared by the regulators for DSM programme-related issues like cost-benefit analysis, monitoring and evaluation. A number of DISCOMs are setting up DSM cells, drawing action plans and implementing pilot programmes. State governments are coming up with various government orders on energy efficiency, and setting up energy conservation missions. These activities have not been reviewed systematically prior to our study.

This report compiles information on various EE/EC/DSM activities of the SERCs, DISCOMs, and SDAs in eight states: Maharashtra (MH), Gujarat (GJ), Andhra Pradesh (AP), Karnataka (KA), Tamil Nadu (TN), Delhi (DL), Haryana (HY), and West Bengal (WB). We have studied various documents in the public domain and also met officials and representatives from different CSOs and other stakeholders.

The study has three objectives:

(a) to facilitate learning by state actors, and enable states to learn from one another's experiences;

(b) to increase awareness of such activities among the active CSOs in the state in order to enable them to hold these actors accountable; and

(c) to recommend a coherent and coordinated strategy to scale up these activities at the state level based on the study's findings and analysis.

In the following section 2, we provide a background on the policy and institutional framework for the EE/EC/DSM activities at the state level. In section 3, we describe the methodology adopted for the study. In section 4, we summarise the activities by different actors in different states. In section 5, we present key findings and conclusions. Based on these conclusions, we provide a set of recommendations that can help develop a coordinated, coherent strategy to scale up EE/EC/DSM activities at the state level. In Annexure I, we attach individual state reports which provide details of the consumer and power purchase mix in the state, rationale for EE/EC/DSM, and EE/DSM activities by state actors.

At the outset, we would like to clarify the use of the term Demand Side Management (DSM) in this report. Energy Efficiency (EE) is using advanced and appropriate technology to reduce the energy consumption without impacting the service, for example, a ceiling fan using an efficient motor consumes less electricity but provides the same air delivery. Energy Conservation (EC) is a behavioural change which reduces energy consumption either by cutting down use or by avoiding wastage, for example, switching off a light or using a ceiling fan instead of an air-conditioner. Demand Side Management (DSM) activities are conducted by DISCOMs with an objective to flatten the load curve, thus reducing the peak demand and leading to a reliable, good quality system. In this report, we have widened the definition of DSM to include EE and EC as well. Any further reference to DSM activities should be assumed to include EE and EC activities as well unless specified otherwise.

2 Methodology

We carried out a systematic study of DSM activities of SERCs, DISCOMs, and SDAs in eight states: Maharashtra, Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Delhi, Haryana, and West Bengal. We chose the states with high electricity consumption, a record of implementing DSM measures, and an active presence of civil society organisations in the regulatory processes. We adopted a mixed approach of desk research and interviews with stakeholders.

For our research, we first reviewed the most recent tariff petitions and orders to learn about the power purchase scenario, the consumer mix, and the category-wise revenue realisation in order to emphasise the importance of DSM activities in the state. We then reviewed the petitions and orders up to the last five years in order to find information on DSM related directives issued by the SERCs, responses by the DISCOMs, and any information on DSM activities carried out by DISCOMs and budgets set aside for this purpose. We also looked for individual presentations made by the DSM cell officials of DISCOMs at various meetings and conferences. Another source of information was the programme completion reports by independent organisations like international funding agencies.

After this research, we met with officials of several state organisations involved in the process, to get more information on DSM activities that may not be available in the public domain, and also to understand their perspective on the DSM activities and the barriers they face. We conducted telephonic interviews with officials whom we could not meet in person.

While reviewing the DSM activities, we considered only those activities conducted at the consumer end. Some SERCs and DISCOMs have considered load management activities like agriculture feeder separation, installation of High Voltage Distribution Systems (HVDS), and installation of capacitor banks at the sub-station level as DSM activities. We have not considered such activities in our study.

Despite our best efforts to be as comprehensive as possible, we may have missed some documents, and request the reader to inform us of any such documents to help us update our state reports.

3 The background: DSM activities at the state level

3.1 Rationale for DSM at the state level

Power scenario

The electricity consumption of the eight states selected for this study adds up to about 57% of the electricity consumption in India.[5] All the states face energy and peak demand deficits. The energy deficit in these states ranges from 138 Million Units (MU) (in Delhi) to 17,000 Million Units (MU) (in AP[a]), whereas the peak deficit ranges from around 1,000 MW (in Maharashtra) to as high as 3,000 MW (in Andhra Pradesh). Additionally, the energy requirement in all the states is expected to grow at about 5.7% to 7.5% annually over a ten year period (2012-2021). Table **1** summarises the energy deficit and savings potential in these states[b]; all figures are for the year 2012-13:

Table 1: Power scenario

State summary	AP	DL	GJ	HY	KA	MH	TN	WB
Energy deficit, MU	17,521	138	149	3,198	9,230	4,012	16,141	301
Peak deficit, MW	2,952	300	39	707	1,363	1,169	1,683	73
CAGR of electrical energy requirement for 2021-22 over 2012-13[6]	7.54	6.22	6.72	6.86	6.43	5.79	6.83	7.65

Financial scenario

State-owned DISCOMs in India are facing a serious financial crisis. A scheme for Financial Restructuring of state-owned DISCOMs to promote financial turnaround and long-term viability has been launched by the central government through a Transitional Finance Mechanism (TFM), with a budget of about Rs. 1.9 lakh crores. According to the Annual Report for 2011-12 on 'The Working of State Power Utilities and Electricity Departments' brought out by the Planning Commission, the reasons for the poor financial health of the DISCOMs are non-revision of tariffs, non-payment of subsidies, high cost of power purchase, and high distribution losses[7]. Of the four main reasons stated above, DSM can minimise at least two of them (subsidies and power purchase) considerably. To further strengthen the need for DSM we also looked at the Ministry of Power (MoP) report[8] on integrated rating for state power distribution companies. The report rates the operational and financial performance capability of all the state power

[a] For this report, the state of AP includes current day Telangana.

[b] The energy deficit is as per the Load Generation Balance Report for 2013-14, the savings potential is from the NPC report, 2009, and the CAGR is arrived at using the 18th Electric Power Survey (both years inclusive). For more details, please see the Annexure I that contains individual state stories. Power Purchase numbers for 2013-14 are from the respective tariff orders.

DISCOMs, from A+ for very high capability, to C for very low capability. Of the states reviewed, only Gujarat DISCOMs were rated A+, West Bengal SEDCL and Maharashtra SEDCL were rated A, while Karnataka, Andhra Pradesh, Tamil Nadu and Haryana DISCOMs were rated at moderate and below average performance capabilities.

In our study, we also observe that for almost all DISCOMs in these eight states, the average cost of supply is greater than the average revenue realisation, barring a couple of exceptions. The state DISCOMs have a huge revenue gap which translates to a tariff increase for consumers. The DISCOMs have to resort to costly power purchases, particularly the short term power purchases, to maintain their demand and supply positions. Also, in quite a few states the bulk of the power purchases are a little lower, or in some cases marginally higher, than the average power purchase costs. Considering the huge investment requirement in capacity addition, these costs can easily increase over a period of time. It is also observed that the revenue realisation for the domestic and agricultural categories in all these eight states is less than the average revenue realisation, and also that the consumption for these two categories is more than that for other categories. These conditions provide a stronger rationale for DSM to be implemented for these two categories.

This brief overview of the power scenario in these states shows that there is a strong case for utilities to undertake large-scale DSM activities. These activities can reduce high power purchase costs by reducing the demand during peak load, which will also help to reduce the peak deficit. The reduction in consumption from consumers paying a low tariff can be used to supply those paying a high tariff. In fact, we suggest that instead of targeting only those consumers with tariff less than the average cost of supply, we should consider all consumers with tariff less than the marginal power purchase costs for DSM activities. Consider the following example of Maharashtra. Around 48% of the total consumption earns revenues less than the marginal cost of power (around 20% of the total power purchase). Any reduction in this consumption can either reduce the marginal power purchase cost, or saved units can be supplied to categories that earn better revenue, like commercial and industrial consumers.

In the above context, subsequent sections review the extent of DSM activities being undertaken by different states.

Box 1: Consumers with tariff less than marginal cost of supply

In Maharashtra, for MSEDCL, the consumers with tariff less than the marginal cost of supply are shown below:

Consumer category	Consumption, MU for 2012-13	Revenue realisation, Rs./unit	Weighted average marginal power purchase costs (last 19%), Rs./unit
LT-IV Agriculture	21340	1.05	4.55
HT-V Agriculture	714	2.89	4.55
LT-I Domestic	15149	4.36	4.55
LT-VI Street light	831	4.46	4.55
% of total	48.4	25.3	18.6

Thus it makes sense to conduct DSM programs for all the above categories. This will in turn make available those units that can be sold to consumers of high tariff categories.

3.2 Policies and institutions enabling DSM in states

In this section, we describe policies and institutions that facilitate the implementation of DSM in the states.

Energy Conservation Act-2001[4]

The Government of India enacted the Energy Conservation Act in 2001 to coordinate various energy efficiency and energy conservation activities, particularly for designated consumers. It created the Bureau of Energy Efficiency (BEE) under the Ministry of Power. All the power supply DISCOMs are included in the list of designated consumers. More importantly, it facilitated the creation of State Designated Agencies at the state level to coordinate activities between the BEE and the state. It further entrusted the state government with the responsibilities of amending the Energy Conservation Building Code (ECBC) as per the regional climate, creating awareness and disseminating information in the state about EE and EC, according preference to the use of EE appliances, and directing designated consumers to adopt EE standards. The Act however is silent on DSM activities by state DISCOMs.

Electricity Act-2003[9]

The preamble to the act states that 'efficiency' and 'promotion of environmentally benign policies' are key objectives. However, the Act does not have any direct provision related to DSM, except that SERC's should consider the efficient use of resources while determining tariff.

National Electricity Policy: National Action Plan[10]

In compliance with section 3 of the Electricity Act, 2003, the central government notifies the National Electricity Policy. Some important aims and objectives of the National Electricity Policy are access to electricity for all in the next 5 years, reliable and quality power at reasonable rates, commercial viability of the electricity sector, and protection of consumer interests.

The policy also emphasises DSM and EC. The 12th plan states that the BEE will provide technical assistance for the establishment of DSM cells in DISCOMs, and help them in capacity building in order to enable them to undertake various strategies and schemes for DSM like load survey, load strategies to be adopted by DISCOMs for modifying load profiles, DSM financing, etc. Total funds required for providing technical assistance to DISCOMs in the 12th five year plan are estimated to be Rs. 300 crores.

Tariff Policy

The primary objectives of the Tariff Policy are to ensure electricity to consumers at competitive rates, promote transparency and competition in the sector, and ensure financial viability of the electricity sector. The Tariff Policy provides for time of day tariffs but does not have any specific provisions related to DSM or EE.

Forum of Regulators (FoR)

The FoR consists of the chairpersons of all regulatory commissions, along with the Chairperson of the Central Electricity Regulatory Commission (as the Chairman of the FoR), and the Director General of BEE (as a permanent invitee). In 2008, FoR constituted a working group on 'DSM and Energy Efficiency' to develop methodologies for the implementation of 'Energy Efficiency and Demand Side Management' in the distribution sector in the country. A Final Report was published in 2008[11] with recommendations to be implemented by SERCs, DISCOMs, SDAs and state governments. The recommendations for state regulators were: direct DISCOMs to constitute DSM cells, submit DSM plans along with Annual Revenue Requirement (ARR), allow cost of DSM programmes as pass-through in the ARR, consider appropriate tariff interventions to support DSM, give higher returns on equity for investments made by DISCOMs towards DSM, and identify their own (SERC) staff to handle DSM aspects. The FoR also suggested that state governments financially support DSM programmes which are aimed at categories that receive state subsidy, enhance effectiveness of SDAs, and reduce taxes on efficient appliances. One of the recommendations was information dissemination amongst DISCOMs about DSM implementations so as to help DISCOMs identify suitable programmes in their areas. The FoR was in turn responsible for training and designing a draft regulation for DSM. During the last six years, the FoR has conducted five training programmes in different states to sensitise officers of ERCs about various issues related to DSM.

The FoR also meets twice a year to discuss issues related to the electricity sector. In its 40th meeting in New Delhi in April 2014, several issues related to DSM were discussed. The DG, BEE suggested the need for capacity enhancement of SDAs as well as for robust monitoring and verification of DSM programmes, tariff interventions and provisions in the ARR for the implementation of DSM programmes. The BEE committed to fund preparatory and capacity building activity for DSM in 30 DISCOMs along with the Energy Efficiency Services Limited (EESL) as an implementer, provided the DISCOMs create DSM cells,

request SERC to issue regulations, and design, implement, monitor and verify at least one DSM programme.

3.3 State actors in DSM

The SERCs, DISCOMs and SDAs are important state actors that can facilitate DSM in each state. We have described below the powers and functions of each state actor in order to facilitate such activity in the state.

State Electricity Regulatory Commissions (SERCs): The SERCs are responsible for determining tariff for electricity as well as regulate power purchase. The Time of Day tariff mechanism is an important DSM tool that the regulators can use to shift peak load. Their other functions are to promote efficiency in the electricity sector, and issue licenses and formulate plans and schemes in coordination with others for the generation, transmission, distribution, supply and utilisation of electricity. Through this process, the regulators can require licensees to formulate DSM plans and integrate these plans daily with their power purchase requirement. Another function of the regulator is to aid and advise the state government to formulate the state power policy. When Telangana state was formed recently, the regulator in Andhra Pradesh asked the state government to include agricultural DSM and issue pre-paid meters to government offices to improve electricity usage. Yet another function is to collect and publish data on forecasts on the demand for and use of electricity in the state, and to require the licensees to collect and publish such data.[12] This helps the DISCOMs as well as the licensees to formulate DSM action plans and load research activities in the state.

DISCOMs: DISCOMs are the interface between consumers and regulators, and hence hold a crucial position in the success of any state DSM programme. They stand to benefit from the DSM programmes along with the consumers. India had monopoly electricity boards which generated, transmitted and distributed electricity. However, in 2000, the re-structuring of the electricity sector resulted in different companies being dismantled. Except for a few private sector DISCOMs, most of the DISCOMs are government-owned. Most of them are facing financial difficulties, reeling as they are under poor operational efficiencies and cross-subsidies. These DISCOMs should take the lead in conducting load research studies and include DSM in their power purchase plans. For all programmes designed centrally, say by BEE and implemented by an energy service company (ESCO), the DISCOMs can play the crucial role of a facilitator and reap benefits of reduced consumption.

SDAs. : SDAs are statutory bodies set up by the states to implement the EC Act, 2001 and DSM measures at the state level. The states were supposed to designate one of the existing organisations as the SDA in the state. Most states have their Renewable Energy Development Agency as their SDA, followed by the Electrical Inspectorate and DISCOM. As majority of these SDAs are focused on renewable energy, and have limited experience in energy efficiency, hence energy effiency has not received the attention it deserves. Of the eight states reviewed, only a couple of states have very active SDAs, and Department of Renewable Energy, Govt. of Haryana (HAREDA) has been performing these activities very admirably. In all other states, the SDAs either face a shortage of manpower, or of financial or technical resources.

4 Review of DSM activities

In this section, we have summarised the DSM activities of SERCs, DISCOMs, and SDAs in eight different states.

Activities of state actors

4.1 State Electricity Regulatory Commissions (SERCs)

SERCs have mostly relied on tariff mechanisms such as the Time of Day (ToD) tariff, incentives and surcharges based on the power factor and load factor, as well as kVAh billing. The SERCs in Maharashtra, Gujarat and Tamil Nadu have issued DSM regulations, while Delhi has put out draft DSM regulations which are yet to be notified. Maharashtra also has regulations on the procedure to determine the cost-effectiveness of DSM programmes. A number of SERCs have issued general as well as specific directives to the DISCOMs regarding DSM in their periodic tariff orders. Also, quite a few SERCs have allowed the DSM expenses to be included in the ARR to be recovered from the consumers. In a few states, the SERCs have asked DISCOMs to include savings from the DSM activities in their power purchase planning. Table **2** shows the various DSM measures adopted by different SERCs. We have briefly described each activity below.

Table 2: DSM measures by SERCs

Type of measure	MH	KA	AP	TN	GJ	HY	DL	WB
ToD tariff	✓	✓	✓	✓	✓	✓	✓	✓
DSM based tariff	-	-	✓	-	-	-	-	-
PF surcharge		✓	✓	✓	✓	-	-	✓
PF incentive	✓	-	-	-	✓	-	-	✓
kVAh billing	-	-	✓	-	✓	✓	✓	✓
Load factor incentive	✓	-	-	-	-	-		✓
DSM regulations	✓	-	-	✓	✓	-	-	-
Cost effectiveness regulations	✓	-	-	-	-	-	-	-

4.1.1 Tariff mechanisms

The Time of Day (ToD) tariff is the most common tariff mechanism adopted by SERCs. Under this tariff, peak hours are specified depending upon the system peak. The peak hours can be morning peak hours, evening peak hours, or both. There is a surcharge on the energy charges if the consumption is in the specified peak hours. Barring two states, AP and WB, all the SERCs that have been reviewed offer a

rebate on the energy charges for the consumption in specified off-peak hours. In Delhi, the ToD tariff varies depending on whether the season is a peak season or an off-peak season. The ToD is mandatory in some states, typically for High Tension (HT) consumers, and some categories of Low Tension (LT) consumers as well. ToD meters should be fitted by the DISCOMs in order to measure time-wise consumption.

Table 2 compares the ToD tariff features in different states. The two common barriers for the ToD tariff implementation in the states have been opposition from consumers who state their inability to shift loads, and delay by DISCOMs in their efforts to install ToD meters. Most of the states seem to have overcome this barrier and the ToD tariff is in place. However, there has been no systematic study to evaluate the impact of the ToD tariff on the peak demand. In many cases, the ToD peak hour timings and tariff have been determined on an ad-hoc basis.

Almost all the states have surcharges for low power factor. These are mostly directed towards the HT consumers, but are also applicable to some LT categories of consumers. There is a minimum value specified for the power factor, and the surcharge increases in steps as the power factor goes down. The surcharge ranges from 7% to 22%. Some SERCs have also approved incentives for consumers with power factors above the specified limit. Also, some SERCs adopt the lead + lag logic in calculating the power factor, whereas some ignore the lead power factor. A number of states have also introduced kVAh billing which incorporates the power factor, thus eliminating the need for levying the surcharge additionally. Nonetheless, the SERCs have continued with the power factor surcharge as well as the kVAh billing. Also, some SERCs have mandated LT consumers to install measures like capacitors, or ISI marked motors. This won't have any tariff impact, but in case the DISCOMs observe that these measures are not being complied with, then they can levy penalties and also cut power supply. State specific details of these tariff design issues are provided in annexure I.

Andhra Pradesh has a unique differential tariff for agricultural consumers based on the implementation of DSM measures. The agricultural connections with DSM measures like frictionless foot-valves, capacitors, good piping and ISI marked pumps have a lower tariff than the connections without DSM measures. All new connections are supposed to be provided with DSM measures. However, there is no information about whether this is being followed, and about the impact of the differential tariff. Table **3** provides a snapshot of ToD tariffs and rates in these states.

Table 3: Time of day tariffs and rates (above the energy charge)

	MH[13]	KA[14]	AP[15]	TN[16]	GJ[17]	HY[18]	DL[19]	WB
ToD tariff	✓	✓	✓	✓	✓	✓	✓	✓
Applicable consumers	Most HT and some LT consumers	HT 2 (a) & HT 2 (b) with connected load above 500 kVA, optional below 500 kVA	HT-I-General, HT-II- Others, HT-III- Airports, Railway stations and bus stations	HT-Industrial consumers	All HT consumers and water works consumers with connected load above 50 HP	HT - Industrial consumers	All consumers with sanctioned load more than 100 kW except domestic consumers	
Morning peak	0900 hrs to 1200 hrs	-	-	0600 to 0900 hrs	0700 hrs to 1100 hrs	05300 hrs to 0800 hrs	-	
Evening peak	1800 hrs to 2200 hrs	1800 hrs to 2200 hrs	1800 hrs to 2200 hrs	1800 hrs to 2100 hrs	1800 hrs to 2200 hrs	0530 hrs to 2200 hrs	April to September – 1500 hrs pm to 0000 hrs October to March – 1700 hrs to 2300 hrs	
Morning peak C	MSEDCL : 80 paise Other DISCOMs : 50 paise	-	-	20% extra	Up to 500 kVA - 35 paise Above 500 kVA – 75 paise	30% of average daily consumption of the immediately preceding billing period @ Rs. 2/kWh If the consumption exceeds 30% then Rs. 4/kWh	-	
Evening peak C	MESDCL : 110 paise Other DISCOMs: 100 paise	100 paise	Re. 1/kWh	20% extra	Up to 500 kVA - 35 paise Above 500 kVA – 75 paise	Same as morning peak	April to September - 15% October to March – 10%	
Off peak time discount or incentive	2200 hrs to 0600 hrs, MSEDCL : 100 paise Other DISCOMs : 75 paise	2200 hrs to 0600 hrs, 125 paise	-	2200 hrs to 0500 hrs, 5% reduction	75 paise if the energy consumed is in excess of one third of total energy consumed during the month	2200 hrs to 0530 hrs, 25% discount on peak hour energy charges for consumption of 20% of the average daily consumption of the immediately previous billing period	April to September – 0000 hrs to 0600 hrs October to March – 2300 hrs to 0600 hrs	

4.1.2 Regulations

The Forum of Regulators (FoR) issued model DSM regulations in 2008[20]. Most of the states have adopted these regulations with minor changes. These regulations provide guiding principles for several aspects of DSM measures such as core objectives, research activities, planning, funding sources, programme approval, monitoring, evaluation, and sharing of information. The regulator is required to establish DSM targets for each DISCOM, and the DISCOM in turn is required to make DSM an integral part of their day-to-day operations, and plan, design, and implement various programmes. SERCs from Maharashtra, Gujarat, and Tamil Nadu have notified DSM regulations in their states, while Delhi has published draft DSM regulations. The SERCs in Maharashtra and Tamil Nadu have also established a DSM Consultative Committee (DSM-CC) at the commission. The primary objectives of the DSM-CC are (a) to assist the commission in evaluating, reviewing, and monitoring the DSM measures by DISCOMs; (b) to advise the DISCOMs on conducting various studies like load research, consumer behavior, etc. and (c) to act as a platform to enable the DISCOMs to share their experiences, and interact with the commission on DSM. The members of the committee are from the commission, DISCOMs, SDAs, academic institutions, and consumer organisations. Along with the DSM regulations, the SERC in Maharashtra has also notified regulations to determine the cost-effectiveness of DSM programmes. Only those programmes meeting the cost-effectiveness criteria are approved by the commission, and the costs can be included in the ARR.

4.1.3 Directives

Almost all the SERCs have been consistently issuing directives to DISCOMs asking them to conduct DSM programmes. These directives have tended to be generic, for example: DISCOMs should pursue DSM activities; they should conduct load research studies; they should submit annual reports on the DSM activities. However, the SERCs have been lax in ensuring compliance from DISCOMs. The DISCOMs have been submitting standard responses with no specific information. In states like Andhra Pradesh and Maharashtra, a number of individuals and consumer organisations have raised questions about the progress of the DISCOMs regarding various DSM activities, but the responses from the DISCOMs have been evasive with no follow-up by the ERCs. In this context, it will be insightful to learn the fate of two important directives issued by the SERC in Maharashtra, with a strict follow-up on ensuring the compliance of these directives by the DISCOMs. These are described in Box 2 and Box 3.

Box 2: Experience of considering DSM savings in power purchase planning in Maharashtra

In the Multi-Year Tariff (MYT) tariff order for the period 2007-10, the Maharashtra ERC (MERC) set a target for the DISCOMs in Mumbai of reducing 2% of the costly power purchase from the ARR by adopting DSM measures. However, none of the DISCOMs reduced the amount from ARR in their subsequent petitions. The justification provided was that DSM is a new concept, savings from it are unreliable, and there is no methodology to estimate these savings. Nonetheless, the MERC reduced the amount equivalent to 2% of the costly power purchase from the ARR for two years. However, this target was discontinued in subsequent tariff orders. Also, the Appellate Tribunal for Electricity (ATE) in its order on the appeal by one of DISCOMs (ref True up petition for 2009-10, TPC-D) ruled that such a deduction in the power purchase cost on account of the DSM which is an uncontrollable factor is not valid legally. Hence, the deducted power purchase cost was trued up in subsequent orders. In the MYT petitions for the period 2013-16, the MERC has asked DISCOMS to consider the savings from DSM measures before estimating power purchase. The DISCOMs from Mumbai have estimated the total cumulative savings of about 100 MU in the MYT control period (2012-13 to 2015-16), which is just 0.1% of the total estimated sales in the four years accounting to about 75,000 MU. Also, these regulations have been followed only by the DISCOMs from Mumbai. The MSEDCL, the largest of all DISCOMs, which contributes to 84% of sales in Maharashtra, has grossly ignored all the directives regarding DSM in its ARR petitions.

Box 3: Load Management Charge (LMC) in Maharashtra[21]

In 2006, the MERC introduced LMC and Rebates (LMR) in Mumbai for all the residential and commercial consumers with consumption of more than 300 units, and for all the industrial consumers regardless of their level of consumption (ref TO 2006-07 TPC & RInfra). According to the directive, the consumers had to reduce their monthly consumption to less than 80% of the corresponding month of the previous year. Consumption above 80% would be charged at a rate twice that of the highest tariff chargeable in the respective tariff category. Similarly, a reduction of consumption below 80% was incentivised at 50% of the normal chargeable rate. The money collected through this charge was to be maintained in a separate fund used for energy conservation and demand side management. However, the order sparked off considerable protests from consumers since it had a considerable impact on the tariff. Subsequently, the MERC had to discontinue the LMC and LMR. The MERC reiterated that economic signals are important to encourage consumers to undertake energy efficiency and energy conservation measures, but also agreed that the LMC had caused economic hardships to consumers, especially industrial consumers, and hence discontinued the measure. It asked DISCOMs to refund the money collected through LMC.

4.2 DISCOMs

DISCOMs in a few states have been significantly active in undertaking DSM activities like awareness drives, load research, and energy audits, and also innovative DSM programmes like appliances exchange, thermal energy storage, and demand response (DR). Table 4 shows the different DSM activities and programmes adopted by DISCOMs in different states.

Table 4: DSM activities by DISCOMs

	MH	KA	AP	TN	GJ	HY	DL	WB
DSM cell	✓	✓	✓	✓	✓	★	✓	★
Awareness programmes	✓	✓	✓	✓	✓	✓	✓	✓
Lighting	✓	✓	✓	✓	✓	✓	✓	✓
Ag DSM[c]	✓	✓	✓	✓	✓	✓	-	-
Appliance exchange/replacement	✓	-	-	-	-	-	✓	-
Thermal energy storage	✓	-	-	-	-	-	✓	-
Demand response	✓	-	-	-	-	-	✓	-

★ Could not get information

4.2.1 DSM planning

The first step by most of the DISCOMs towards DSM has been to set up DSM cells. In states with DSM regulations, it is usually mandated that the cell is headed by a chief engineer or his or her superior. The cell is responsible for all the DSM activities conducted by the DISCOM such as load research, multi-year work planning, programme design, and implementation and monitoring. Our review shows that there are very few dedicated officers in the DSM cells (typically less than 3), and that these cells are not geared up for implementing large scale DSM programmes.

The next logical step has been to conduct load research for different consumer categories and develop an action plan for DSM based on the outcome. A number of DISCOMs have claimed to conduct load research studies but very few are in the public domain. Fewer DISCOMs have prepared a coherent action plan based on the outcome of the load research. Most of the DSM activities conducted by the DISCOMs have been ad hoc. Some DISCOMs have carried out detailed load research and an action plan. However, there is no information on whether these plans have been put into action. The Tamil Nadu Generation and Distribution Company (TANGEDCO) is a good example. It got a DSM action plan developed based on a detailed load research study done by TERI, but there is little information available about its implementation. More details are provided in Box 4.

[c] The Ag DSM programs were initiated by BEE or other agencies like the United States Agency for International Development (USAID) etc., but were implemented with the help of DISCOMs and ESCOs.

Box 4: Load research and action plan for Tamil Nadu

On behalf of Shakti Sustainable Energy Foundation, The Energy and Resources Institute (TERI) undertook a study to prepare a detailed action plan for the state of TN. TN had initiated DSM activities like time of day tariff, power factor penalties, replacement of inefficient pump-sets with efficient pump-sets, and efficient lighting including the BLY programme. In the study, predominant feeders were selected as samples, and month-wise hourly averages were calculated and normalised on a scale of 100 to understand the load pattern across different seasons for each consumer category. This data was later analysed. The analysis was then used to create a DSM action plan that included measures like promotion of energy efficient appliances and energy efficiency in new commercial buildings, education and awareness campaigns, improvements in the process and operational efficiency in the industrial sector, public procurement of energy efficient appliances, feeder segregation, strategic utilisation of the energy conservation fund, regulatory measures to promote DSM, and strengthening of the SDA. This plan was prepared in 2012, but very little information is available about the implementation of this plan.

4.2.2 Awareness generation and energy audits

Awareness generation is the most common DSM activity conducted by DISCOMs. The common channels of communication have been leaflets, emails, electricity bills, celebrating the energy conservation day and week, etc. A number of DISCOMs have electricity consumption calculators on their website. These calculators help the residential consumers to estimate the total electricity consumption from different appliances, as well as the possible savings from a switch to energy efficient appliances. Tata Power (Mumbai) runs an innovative campaign called Club Enerji[d], by way of which an informal energy conservation club formed in 2007 creates awareness about energy conservation among the general public with a focus on children. Its activities include publishing energy conservation booklets, conducting essay competitions and quizzes, and several workshops and events.

The second most common DSM activity conducted by the DISCOMs is the energy audit for commercial and industrial consumers. Certified BEE energy auditors conduct these audits and identify areas of improvement of efficiency. Tamil Nadu has made an energy audit mandatory for designated consumers.[22] However, most of the DISCOMs do not follow-up with consumers on whether they have taken any action based on the energy audits. Hence it is difficult to evaluate its impacts.

4.2.3 Lighting Programs

Almost all the DISCOMs have undertaken energy efficient lighting programmes in some form or the other. The most common programme was the Bachat Lamp Program (BLY) by the BEE. It was an

[d] http://www.clubenerji.com/

ambitious programme to replace 400 million incandescent bulbs with Compact Fluorescent Lamps (CFLs). The programme was particularly attractive for DISCOMs as it did not require capital investment. An aggregator or manufacturers invested the money to cover the cost difference of the CFL, and then recovered it through the Clean Development Mechanism (CDM). The programme received a good response initially, but has since been stalled due to the fall in carbon markets. The manufactures are not participating in the programme due to the lack of a cost recovery mechanism.

Taking a cue from BLY, some DISCOMs have started implementing their own lighting exchange programmes, where they provide CFLs or LEDs at a discount to consumers. They strike a deal with the manufacturers because they purchase in bulk, and the costs are generally claimed in the ARR to be recovered from the consumers. There has been one interesting pilot programme that the MSEDCL (a DISCOM in Maharashtra) conducted to promote CFLs. The CFLs were sold to consumers with a financing scheme through the company billing collection centres, retail outlets, and some self-help groups. The consumers paid a small amount (equivalent to the cost of the incandescent bulb), and the rest of the money was recovered through monthly bills. See Box 5 for more details.

Some DISCOMs have been replacing the existing High Pressure Sodium Vapour (HPSV) lamps and other inefficient types of lamps with LED lighting. DISCOMs have also installed timer switches in some areas to automatically control the switching on and off of street lights. Although a number of DISCOMs have adopted street lighting projects, they have reported difficulties in coordinating with the local municipal bodies for the execution of the project.

Box 5: CFL financing programme in Nashik, Maharashtra[23]

The Maharashtra State Electricity DISCOM (MSEDCL) implemented a pilot program of selling 3 lakh CFLs in Nashik leading to a saving of about 10 MW. The MSEDCL did not provide any financial incentive on the purchase of CFLs, but only acted as a facilitator. The consumers had the option of either buying a CFL by making a one-time payment, or through installments which would be recovered by the MSEDCL from the monthly bills. Three vendors were selected through a bidding process, and the CFLs were available at the bill collection centres, retail shops and through women self-help groups. The programme was widely marketed by the MSEDCL. Prayas (Energy Group) conducted a systematic evaluation of the programme. It was found that the programme was successful in achieving a high level of penetration of CFLs and resulted in a greater awareness. However the savings were less than the estimated savings because people used CFLs to replace FTLs and bulbs in areas with less use. There were some issues on the quality of the CFLs. The power factor was observed to be low and there were significant failure rates as well. The learning from the pilot program was supposed to be incorporated in a statewide CFL program, but this never happened.

4.2.4 Agricultural DSM programmes

Agricultural consumers all over India are heavily subsidised by the state government and pay either nothing or a tariff much lower than the average cost of supply. Since there is no economic incentive for the consumers to invest in efficiency, inefficient agricultural pump-sets are commonplace. A number of

DISCOMs have targeted agricultural consumers for DSM programmes. The most common type of programme has been to replace inefficient pump-sets with 5-star pumps. BESCOM's programme in Karnataka and MSEDCL's programme in Maharashtra are good examples. A number of DISCOMs have also installed capacitors on the pump-sets to improve the power factor. One serious concern of these programmes has been the performance of the energy-inefficient pumps and the capacitors in the field, given the poor quality of power supply to most agricultural consumers. The MSEDCL addressed this issue by providing a 5-year warranty/free-maintenance contract. Another concern has been the measurement of savings from these programmes. Most of the connections are unmetered, and consumers strongly resist any installation of meters.

4.2.5 Appliance exchange programmes

DISCOMs in Delhi and Mumbai have launched appliance exchange programmes for their consumers and have received a good response. Under these programmes, the DISCOMs provide a substantial rebate to the consumers (to the tune of 40-50%) to replace their old inefficient appliances with new 5-star rated appliances. The old appliances are scrapped in an environment friendly manner. Some DISCOMs are also extending the scheme to new purchases. In some cases, an additional warranty is offered. These programmes have been offered for ceiling fans, refrigerators and air-conditioners. For the latter two, only models less than a specified size are incentivised.

The primary reason these programmes have received a good response is the substantial discounts given for the purchase of appliances, which are attractive for consumers. However, the programmes have remained at the pilot scale. Scaling up these programmes will require significant budget outlays and can have a substantial tariff impact especially for the non-participating consumers who cannot avail of the benefits from energy-efficient appliances. Also, the DISCOMs have faced barriers in getting the manufacturers to participate in the programme. One reason is the lack of availability of a 5-star products which comply with the latest standards. Another reason is that the dealers are side-lined because under most of these programmes, the DISCOMs deal directly with the manufacturers and reduce the sales markup by the dealers. Manufacturers are not keen on displeasing dealers since they have to depend on them to sell other models. On the consumer side, there have been some issues as well. Some consumers have complained that there is no visible impact on their electricity bills. The bills may not have reduced due to a number of other reasons such as the hot summer, new appliances, etc. but the consumer's perception of a lack of bill reduction despite participation in the programme persists. Also, in some cases where the appliances have faced quality issues, consumers have held DISCOMs accountable for the quality of the appliance.

4.2.6 Solar Water Heater programmes

A number of DISCOMs have provided incentives to residential consumers to shift to the solar water heater since electric water heaters account significantly for morning peak hour electricity consumption. In some states, there are subsidies given by the state government. The Bangalore Electricity Supply Company (BESCOM) has made it mandatory to install solar water heating systems in order to get a new connection. Additionally, a rebate of 0.50/kWh or up to Rs. 50/-, whichever is less, is given to the

consumer.[24]Central government assistance is also available for those who install solar water heaters. The Table 5 states the assistance available.[25]

Table 5: Financial Assistance for Solar water heaters

Device	Central financial assistance	Benchmark cost
Solar water heater (ETC)	Rs. 2550/- per m^2 or 30% of the cost, whichever is less Rs. 2400/- per m^2 or 30% of the cost, whichever is less	Rs. 8500/- per m^2 for domestic Rs. 8000/- per m^2 for commercial
Solar water heater (FPC)	Rs. 3300/- per m^2 or 30% of the cost, whichever is less Rs. 3000/- per m^2 or 30% of the cost, whichever is less	Rs. 11000/- per m^2 for domestic Rs. 10000/- per m^2 for commercial

4.2.7 Thermal energy storage

Tata Power launched India's first Thermal Energy Storage (TES) programme for commercial and industrial consumers in Mumbai. The idea behind the TES is to run the central AC plants of buildings at night and convert water to ice which can be stored in ice tanks. During the day, the AC plants are switched off and the building is cooled with the energy stored in ice. The TES has benefits for consumers as well as the DISCOM. The consumers can also avail of the ToD tariff incentives where applicable. The TES system also improves the load factor and the power factor and consumers can benefit from the incentives based on these. With the decrease in overall load, the investment in transformer capacity also goes down. The backup Diesel Generation (DG) capacity can be reduced. For the utility, it results in a flatter load curve and saves on high power purchase costs. Under this programme, the TPC educates the consumer on installing TES system and provides an online measurement and verification system for the consumer's chillers. It provides an additional rebate of Re. 1/kWh on consumption during the night. As of January 2014, the TPC had engaged 15000 tons of refrigeration (TR) capacity in the programme and achieved a load shift of 3.6 MUs.[26]

4.2.8 Demand response

Demand Response (DR) is the consumer's ability to reduce electricity consumption at their location when wholesale prices are high or the reliability of the grid is threatened. There are two types of interventions possible in a DR programme, automatic and manual. The manual DR programme is most basic, wherein the system operator sends a manual signal to the customer through the telephone to curtail his load. The Automated Demand Response consists of fully automated signaling from a utility to provide automated connectivity to customer end-use control systems and strategies. The Tata Power Company – Distribution (TPC-D) in Mumbai has launched a Demand Response programme which is manual. TPC-D in Delhi has launched an automatic DR programme.

TPC-D has a manual DR programme where commercial and industrial consumers with a connected load above 500 kW offer voluntary load curtailment to manage peak demand. The consumers enroll in the

programme and a Memorandum of Understanding (MoU) is entered into. In case of events, the TPC-D calls the aggregator who in turn calls individual consumers and asks them to curtail their load. The consumption data during the event is compared with the baseline estimated using the load profile of 4-5 similar days. The events last up to 2 hour each and there can be 50 maximum events in a year. The TPC-D offers an incentive of Rs. 2.25/kWh for every unit curtailed. The incentive is paid to the aggregator who in turn pays the consumers. The aggregator also helps the consumers with energy audits to identify the curtailable load at a short notice. In 2012, the contracted capacity was around 12 MW and they were planning to reach for 25 MW[27].

4.3 State governments/State Designated Agencies (SDA)

SDAs have been the least active of all the three actors. In most of the states, the renewable energy development agency is the SDA because of which their focus is mostly on RE. All of them started with about Rs. 2 crores from BEE and equal amount from the state government for the programmes. However, by and large there has been no activity on this front. The most common programmes by SDAs have been awareness programmes and street lighting programmes. One example of this programme is the Belaku programme under which Rs. 20 crores were provided for implementation to the Karnataka Renewable Energy Development Limited (KREDL) during 2012-13 by the Government of Karnataka (GoK). The main objective of the scheme was to replace approximately 20 lakhs incandescent bulbs of beneficiaries with CFL lamps in select villages and towns in all districts in the state. The KREDL website shows no information on the progress of the scheme.[28] Similarly, a number of state governments have come up with orders, such as the Maharashtra government issued Government Resolution (GR) to procure only 4-star and 5-star labelled appliances in all government/semi-government/local bodies, etc. Only where the above appliances are not available, 3-star appliances can be purchased. There is a need to review to what extent these orders have been followed.

There have been a number of missions and policies declared by SDAs like the Karnataka Renewable Energy Policy that claimed savings of about 7,000 MU per year. Andhra Pradesh has the Energy Conservation Mission that claims savings close to 15,000 MU. Tamil Nadu has a similar energy conservation mission with targets, but no activity so far has been observed. These targets have been set in Government Orders over the last two years, however, no information is available on the implementation plans or the progress of these schemes. Similarly the states have constituted some committees to develop and implement the state energy policy. Maharashtra has constituted an energy conservation committee which has members of the cadre of principal secretaries of various departments, but the committee has remained on paper.

On the industrial front, the SDAs are also responsible for implementing the Perform, Achieve and Trade (PAT) programme, which is a market based mechanism to enhance cost effectiveness of improvements in energy efficiency by designated consumers. These consumers will be provided with energy savings certificates that could be traded. The baseline studies have already been conducted, and the scheme is in the implementation phase.

It is imperative to analyse the implementation of these programmes carried out by the SDAs. For this purpose, the BEE comes up with an annual savings report which mentions the energy saved by the SDAs, and there are three such reports available in the public domain. These savings are said to be verified by the National Productivity Council (NPC). For the states that have been reviewed in this study, the latest available report estimates energy savings of a hundred MUs by SDAs of GJ, AP and KA, whereas the estimated potential or self-imposed targets was close to ten to fifteen thousand MUs. The MEDA had started reducing the VAT on CFLs by 4% due to which there were increased sales of CFLs, which in turn saved around 900 MUs [29] which is still very short of the actual potential.

5 Conclusions and recommendations

Key findings

The review brings out some key findings about the activities at the state level. The regulatory commissions have been active by either notifying DSM regulations or issuing directives to DISCOMs to undertake DSM programmes. They have asked DISCOMs to consider DSM while planning power purchase, and recovering the costs from the ARR. The DISCOMs have also conducted a number of innovative DSM programmes. State governments have set up energy conservation committees and missions to direct energy conservation. However, the scale of the activities has been very low overall as compared to the savings potential. The SERCs have not been ensuring that the DISCOMs comply with the regulations and directives. At times, the SERC's jurisdiction to mandate DSM and to hold utilities accountable for DSM is also under question. The DISCOM programmes have been implemented on a pilot scale. No information is available on how the numerous government orders or targets have fared so far. Although some CSOs have been active in raising questions about DSM, their efforts have yielded limited success due to inaction by many other actors.

We have identified three main reasons for the current state of affairs of DSM activities:

Lack of Belief: . They are not sure whether the DSM programmes can have predictable and sustainable savings. Even the DISCOMs undertaking the DSM programmes are hesitant to include the future savings from DSM programmes in their Multi-Year Tariff (MYT) petitions. They look at DSM as a brand building exercise and an opportunity to connect with the people. A primary reason for this lack of belief is the absence of demonstration of definite savings achieved by the pilot cases. There have been a number of pilot DSM programmes. However, there have been very few cases where the savings were monitored, and the programme was evaluated and scaled-up incorporating the learnings from the pilot programme. Also, there have been very few opportunities for DSM officials to exchange knowledge and discuss barriers among themselves. There is also uncertainty about the scale of savings that could be achieved. The DISCOMs are more confident about the outcome of the investment they make for generation, compared to investments of a similar amount in DSM programmes.

Lack of ownership: There is no ownership for DSM at the state level. The electricity act requires ERCs to encourage DSM activities in the state. Similarly, the EC act requires the SDAs to push for EE activities in

the state. DISCOMs are burdened with their own problems and don't consider DSM to be a solution. Hence, their participation is merely to ensure compliance or as a form of a brand building exercise. As a result, there is no clear mandate for any organisation to undertake energy efficiency programmes. This lack of ownership stems from the lack of belief discussed above. However, it also comes from a lack of political visibility for the cause of DSM. The lack of political visibility is the primary reason for the neglect of DSM by state governments. This is further exacerbated by the fact that there is low CSO awareness about DSM, which results in a lack of public pressure and in turn no progress on the DSM front.

Lack of implementation framework: As of now, the responsibility of designing, monitoring, and implementing the framework is entrusted mostly to DISCOMs. Even if the DISCOM is enthusiastic about implementing DSM measures, it may lack the skill and resources to implement these. Companies like Energy Efficiency Services Limited (EESL) and other private ESCO companies are emerging, but they are still operating on a small scale. This lack of an implementation framework discourages DISCOMs from implementing large scale programmes.

Based on the above conclusions, we recommend a multi-pronged approach: create awareness and public pressure, create ownership of EE initiatives, and put in place a ready implementation framework. These recommendations are detailed below:

Increased CSO awareness and cross-learning: Increased awareness among the state CSOs about the benefits of DSM, and an update of their DISCOM's DSM activities (or the lack thereof), is essential. The CSOs can either participate in the regulatory processes, or conduct a campaign to increase the accountability of the existing programmes and scale them up. This will lead to an increase in public pressure on all the state actors. This report aims to compile available information in the public domain and make it available to the CSOs.

Also, more information about DSM programmes should be made available to the public. DISCOMs are regularly asked by the SERCs to submit annual reports, but none of these reports are available in the public domain. Making the data available in the public domain can help significantly the learning process. A number of regulations require DISCOMs to place this information in the public domain, however this has not happened yet. Also, even the tariff mechanisms like ToD should be evaluated for their efficacy and modified if required.

DSM officials should meet once or twice a year for learning from one another's experiences. The Utility DSM CEO forum shares the activities that have taken place in the field of DSM. A similar forum or activity on a large scale should be organised, with participation from the DSM cells of the DISCOM.

Formation of State Energy Conservation Committees: Lack of ownership of energy efficiency measures has been discussed earlier in this report. One of the most important beneficiaries of DSM activities is the state government, since it pays a significant amount to subsidise agricultural and low income residential consumption. Hence, it should take ownership of EE programmes and measures in the state. A conservation committee should be constituted at the state level to review the activities including research, set targets, etc. Maharashtra already has such a committee but there is no information on the

status of its current functioning. Similarly, the energy conservation missions coming up in states like AP and TN can also serve a similar purpose. The committee can have members from the state government, regulators, DISCOMs, and other stake holders.

Putting in place an implementation framework: The BEE should develop programmes which are centrally designed but executed at the state level. The BEE already has programmes like BLY and the current ones for agricultural pumps. They need to be scaled up. Companies like EESL can also scale up their work. Essentially, the DSM cell of the DISCOMs should not be burdened with the operational part of the programmes such as design, implementation and monitoring. They can review the programme and also modify the central programme to meet the priorities of the state and DISCOM. Local requirements should be considered and the central programmes should be designed to be flexible such that the participating DISCOMs can modify them according to their requirements. These programmes should also require a low investment from the DISCOMs as they are always hard pressed for cash.

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Annexure I: State-wise overview of the DSM scenario

1. Andhra Pradesh

Power scenario

AP consumed around 70 BUs of electricity in 2012-13. There was an energy deficit of 17% and peak deficit of 20% during 2012-13.[5] The approved average power purchase cost for AP DISCOMs is Rs. 3.74[e] according to the tariff order for the year 2013-14[15]. Figure 1 shows the power purchase costs plotted against the total number of units purchased by AP DISCOMs from different sources. It can be seen that around 17% of the power was purchased at a range of Rs. 4.00 to Rs. 10.00 per unit, of which around 10 Bus was purchased through market and other sources.

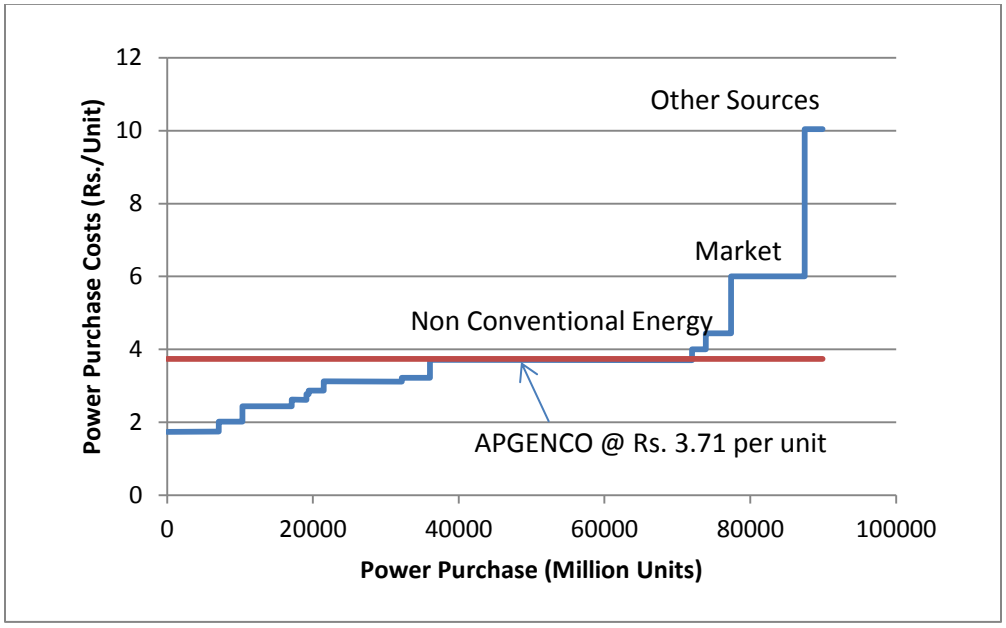

Figure 1: Approved power purchase costs for AP DISCOMs 2013-14

The average cost of supply for AP DISCOMs was Rs. 5.61[f] per unit. Figure 2 shows the approved revenue realisation from the major consumer categories for AP DISCOMs for the year 2013-14.[15] It can be seen that the revenue realisation from domestic and agricultural categories is lower than the average cost of supply. These two categories account for more than 50% of the total electricity consumption in Andhra Pradesh.

[e] Pg. 266 of tariff order 2013-14
[f] Pg. 156 of tariff order 2013-14

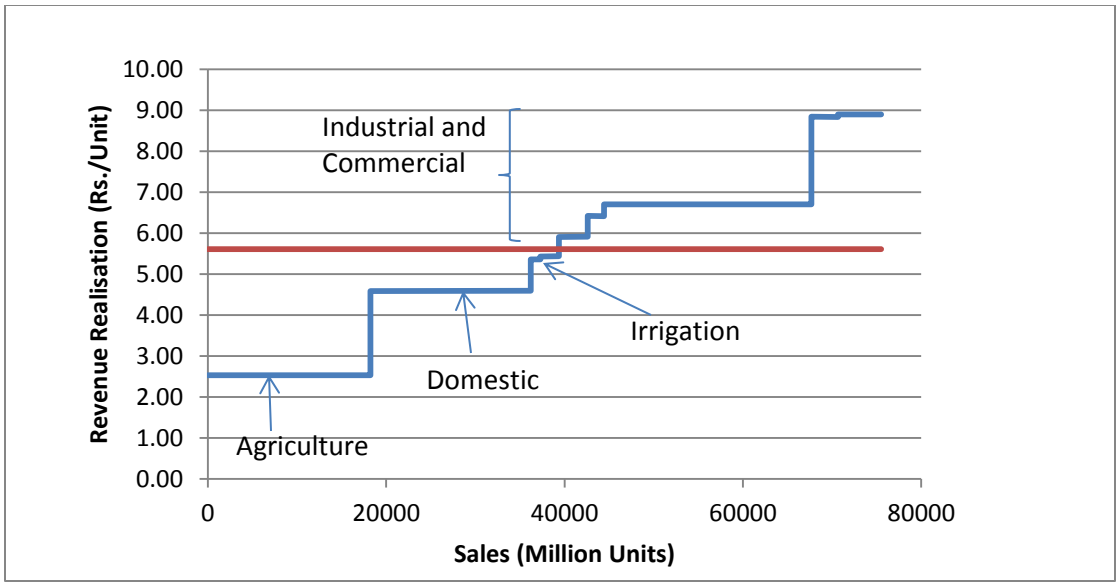

Figure 2: Average revenue realisation for AP DISCOMs 2013-14

It is estimated that there will be a peak deficit of 12.4 % during 2013-14[6]. Andhra Pradesh has an available capacity of around 17,500 MW as on 31.12.2013. The Andhra Pradesh Power Generation Corporation Limited (APGENCO) has planned a capacity addition to the tune of 15,000 MW requiring an investment of around Rs. 85,000 crores[30] which includes thermal as well as renewable projects. These projects are expected to be commissioned by 2016-17.

There is a significant savings potential from DSM measures in AP. A study[31] conducted by NPC under BEE has estimated a savings potential of about 15.6% of the total annual energy sold in AP. The savings potential was around 7 BU in 2008 for four important sectors (See Table 6).

Table 6: Savings potential in Andhra Pradesh

Sector	Electricity consumption (2007-08) (BUs)	Savings potential (BUs)
Domestic	10	2
Agricultural	14	4
Industrial	19	1
Commercial	0.9	0.1

EE/DSM activities in the state

This section presents an overview of EE/DSM related activities by different actors in the state.

Andhra Pradesh Electricity Regulatory Commission (APERC)

In AP, the Regulatory Commission has not notified DSM regulations. Since 2005-06, the commission has been emphasising the study of load curve studies and consumption patterns to incorporate DSM measures to reduce the peak[32].In 2009, the APERC, sensing the need for price signals to reduce peak demand, again directed the DISCOMs to prepare an approach paper for introducing ToD tariff. After receiving comments from the public, it was later decided to introduce ToD only during the evening period (6.00 pm 10.00 pm) and the rate would be Re. 1.00/kWh more than the energy charges. The APERC currently has ToD only for the evening peak hours. However, there is no incentive for consumption during off-peak hours as is the case in many other states.

A committee was formed under the chairmanship of the Chairman and Managing Director, APEPDCL, which recommended certain measures for energy conservation. The DISCOMs were directed to submit a report about the implementation of these recommendations and the resultant savings, and post this report on their websites. However, we have not come across any such report on the individual websites of DISCOMs. The commission also directed the licensees to raise awareness among consumers through publicity campaigns at minimum possible costs, which the DISCOMs have adhered to.

AP is the only state where its electricity regulatory commission, the APERC, allows free supply to dry and wet land farmers who implement DSM measures. It has directed the DISCOMs to provide new connections only with meters, and ones which have DSM measures implemented. However, it is necessary to assess whether such differential tariffs have really prompted consumers to implement DSM measures. For this purpose, there were a series of objections raised by consumer groups, and the commission has been directing the DISCOMs to submit a report on energy efficiency measures adopted for agricultural pump-sets and savings achieved as a result. The details were also to be posted on their respective websites, but there is no response from the DISCOMs. Only the APNPDCL has posted a quarterly reports on directives on its websites. Some consumer representatives as well as the commission have also categorically pointed out that the claim by DISCOMs that around 95% pump-sets are provided with capacitors is false, and none or very few of the agricultural pump sets have capacitors fixed.

In the wake of the recent formation of the new state of Telangana, the APERC issued an advisory to the Government of Telangana which raised two important points:

a) There should be prepaid metering for government organisations as their consumption is unrestricted. The total bill due to the DISCOMs by the government is Rs. 742 crore, and

b) DSM should be implemented aggressively in the agricultural sector. The commission observed that there is a savings potential of 1,500 MU in this sector, and DISCOMs would save Rs. 750 crores annually if appropriate DSM measures were adopted.

AP DISCOMs

The four DISCOMs in AP – the Telangana State Southern Power Distribution Company Limited (TSSPDCL), erstwhile Andhra Pradesh Central Power Distribution Company Limited (APCPDCL); the Northern Power Distribution Company of Telangana Limited (TGNPDCL), erstwhile Northern Power Distribution Company

of A.P. Limited (APNPDCL); the Andhra Pradesh Eastern Power Distribution Company Limited (APEPDCL) and the Andhra Pradesh Southern Power Distribution Company Limited (APSPDCL) – cater to around 58 million consumers. The DSM programmes by the DISCOMs in AP can be categorised into: a) awareness programmes b) capacitor installation on pump-sets for improvement of the power factor, and c) efficient lighting programmes. It is observed that almost all DISCOMs have made some efforts in creating awareness through meetings and distribution of brochures. They have requested consumers to use less energy by switching off appliances, avoiding unnecessary usage, and using more natural sunlight and air. They have made periodic appeals through TV scrolling and press releases.

The capacitor installation on pump-sets is another programme that is being implemented by the DISCOMs. All the DISCOMs claim that they have installed capacitors on more than 95% of the agricultural pumps except for APCPDCL. In the recent tariff order of 2013-14, the APEPDCL mentions that it submitted a proposal to the APERC for introducing an incentive scheme for agricultural consumers who adopt proper metering, DSM measures, EE pump sets and grow irrigated dry crops. The APEPDCL has also implemented a couple of energy efficiency and conservation measures in its own premises, like LED based lighting in its corporate office, and the adoption of 5-star rated distribution transformers DTRs. The details of all the programmes by the DISCOMs are mentioned in the section 'Specific DSM activities by AP DISCOMs'.

All the DISCOMs have either started to distribute CFLs, or have partially completed their distribution, but the progress is very slow or is hampered by the crash in the CDM market.

New and Renewable Energy Development Corporation of Andhra Pradesh (NEDCAP)

The NEDCAP was appointed as the SDA by the Government of Andhra Pradesh (GoAP) in 2007 as per the EC act. Their website[33] has a special section on energy efficiency, with generic information on energy efficiency, energy auditing, efficiency in different sectors like agriculture, industry, municipalities, etc. There is no information on the website about the activities conducted by the organisation or its budget. A booklet by the NEDCAP provides a list of small pilot programmes conducted by it like replacing bulbs and T12 tube lights with efficient lights like LEDs, CFLs and T5 tube lights. These pilots have been carried out in gram panchayats, government hostels, villages and municipal corporations resulting in savings of 13 MUs[34–39].

In December 2012, the GoAP constituted the State Energy Conservation Mission (SECM)[40] to enhance consumer awareness of energy efficiency, develop a comprehensive communication strategy, and also quantify the tangible and intangible benefits from energy conservation. The committee is chaired by the Chief Secretary of the GoAP, and its members include principal secretaries from major departments such as energy, industries, and agriculture, Chairman and Managing Director (CMD) of the Transmission Corporation of Andhra Pradesh Limited (APTRANSCO), CMD of one DISCOM (on a rotation basis), a member, Vice Chairman and Managing Director of the New and Renewable Energy Development Corporation of Andhra Pradesh Limited (NREDCAP), two experienced experts in this field to be nominated by the government, and the Chief Executive Officer of the Energy Conservation Mission who will act as convener. A corpus fund will be created for activities recommended by the mission, and the

expenditure for these activities will be arranged by pooling funds from DISCOMs and the NREDCAP. Accordingly, in February 2014, the energy department of the GoAP sanctioned 1.5 crores to APTRANSCO for conducting energy efficiency programmes. The chief secretary recently talked about a plan being formulated to strengthen Andhra Pradesh's State Energy Conservation Mission (SECM). He said that about 15,000 MU of energy can be saved leading to a monetary benefit of Rs. 9,500 crores[41]. He directed all key departments to set up energy conservation cells and come up with plans to help Andhra Pradesh become an energy-efficient state. The SECM is being registered as a society under the Societies Act. Also, the GoAP is nominating it as the SDA.

The GoAP constituted a technical committee to prepare a draft Energy Conservation Building Code (ECBC). The committee after consultations with various stakeholders prepared a draft and submitted it to the GoAP. The code shall be applicable to commercial buildings that have a plot area of more than 1000 m^2, or a built-up area of more than 2000 m^2. Certain categories of buildings like multiplexes, hospitals, hotels and convention centers are included irrespective of their built-up area. The code is mandatory for all new buildings to comply with the AP one-star rating. The ECBC is supposed to be implemented from 1st August 2014.[42]

Specific DSM measures by APERC

Low Power Factor Surcharge

For HT consumers, there is a surcharge if the power factor falls below 0.95. The surcharge is 0.5% to 10% or more of the energy charges for the power factor (pf) of 0.94 to 0.75. It was made effective in 2009. If the pf remains below 0.75 for two consecutive months, then the consumer has to bring it to 0.95 in 6 months or else the supply will be discontinued.

Consumers from LT non-domestic, commercial and industry categories provided with meters capable of measuring active and reactive power will also pay this surcharge. It is also applicable to government lift irrigation schemes.

In 2010-11, the APEPDCL proposed to fix the reactive power tariff at Re. 0.25/kVARh for 0.95 to 1.0, and at 0.50/kVARh for a power factor less than 0.95. For the time being, the power factor surcharge is still effective. The commission thinks that a kVAh-based tariff is the way to go. It asked that all DISCOMs explore implementing it from the coming year.

The kVAh-based billing would encourage consumers towards a unity power factor. In 2011-12, it was applicable to all HT and LT consumers fitted with tri-vector meters. The power factor surcharge was then discontinued. LT consumers without kVAh billing are required to set up shunt capacitors of the ratings supplied by the licensees. If during inspection, no capacitor is found, or the capacitor is found damaged, the consumer is charged 25% of his monthly bill. The commission directed the licensees to install tri-vector meters capable of recording kVAh consumption for all industrial services with a rating of 20 HP and above, and for all LT II services with a rating of 10 kW and above.

The requirement of pf not being less than 0.75 in 2009 was now changed to 0.95. It has to be brought back to 0.95 in three months, otherwise the service will be discontinued. Consumers have requested for incentives for a pf value greater than 0.95. But DISCOMs have denied them any incentives with the justification that a higher pf value is anyway beneficial to consumers and need not be incentivised.

Time of day (ToD) tariff

In 2009-10, in order to compensate the DISCOMs for high power purchase costs during peak periods, the APERC asked them to prepare an approach paper on the Time of Day (ToD) tariff. It also directed the DISCOMs to file for ToD in the 2010-11 retail supply tariff. Accordingly, the DISCOMs proposed the ToD tariff as an additional charge over the normal tariff for all HT-1(A) industrial consumers (at all supply voltages - 11kV/33kV/132kV) in following Table **7** .

Table 7:Additional charge over normal tariff (Rs./kWh)

Time of day	Charge
1000 hrs to 1400 hrs	0.75
1800 hrs to 2200 hrs	1

There were objections raised against the ToD tariff, specifically that: the ToD rates are too high, there are two peak time periods, they should be applied only during peak seasons like the summers, and that there is no incentive in the form of rebates for shifting to off-peak. The commission approved the ToD tariff with only the evening peak time period. The additional charge was about 22-40% of the energy charges across all HT consumers.

In 2011-12, the DISCOMs proposed an incentive of Re. 0.5/kWH for the HT-1(A) consumers to shift to off-peak hours (12 am to 4 am) in the period June to January (off-season). They were paying Re. 1/kWh extra for the time period 6 pm to 10 pm every day. However, the APERC ruled out the incentive with the justification that the difference between the normal tariff and the ToD tariff itself was an incentive for the consumers to shift to off-peak demand. The DISCOMs also proposed a Time of Season (ToS) tariff wherein the HT and LT-II consumers would pay an additional charge of Re. 0.75/unit and Re. 0.5/unit in the months of February to May, the high season period. However, the APERC rejected the proposal after a careful consideration. There are no details on what this careful consideration involved.

In 2012-13, the DISCOMs proposed to extend the ToD tariff to HT-II consumers. There were objections that the load for HT-II consumers is mostly commercial such as lights, ACs, fans, etc. and hence not flexible. However, the commission approved the extension with the justification that there is a need for consumers to undertake extensive energy conservation measures including the planning of loads to shift to off-peak times. Given the diversity of loads in this category, it is expected that at least part of the load will be shifted to off-peak times.

In 2013-14, there was no change in the ToD tariffs. Although the tariff has increased substantially, the ToD surcharge has remained the same at Re. 1/unit. The surcharge is now in the range of 18-23% of the normal tariff. However, there is no information on consumption during the peak and off-peak time periods. This will help us to understand the efficacy of the ToD tariff.

Agriculture tariff

The APERC mandated that new connections be issued only with DSM measures implemented. DSM measures include a frictionless foot-valve, a capacitor of adequate rating, high-density polyethylene (HDPE) or R Polyvenyl Chloride piping at suction and/or delivery, and ISI marked mono-block or submersible pump-sets. However, all agricultural consumption is not being metered. There is no report on even the metered connections to see whether the differential tariff has had any impacts. For this purpose, we need the consumption data across each category. Not all agricultural consumers are metered, so the commission is also asking DISCOMs to install meters for all agricultural consumers.

Specific DSM activities[g] by AP DISCOMs

APEPDCL

Efficient lighting

Consumers in the APEPDCL service area were requested to utilise CFLs instead of incandescent bulbs. A proposal for distributing 3.8 lakh CFLs to rural residential consumers in Vizianagaram district under a special purpose vehicle financing mode with assistance from the GoAP was also submitted to the regulator in the financial year 2013-14. The current status of this proposal could not be ascertained. In its own office, the APEPDCL has replaced HPSV lamps with LED lamps in 5 sub-stations and a tender has been floated to do so for 600 sub-stations. They have also floated a tender for LED-based retrofits in their corporate office.

Efficient pumping / Reactive power management

In the agricultural sector, a proposal has been sent to the APERC for introducing an incentive scheme to consumers in the agricultural sector who adopt proper metering, DSM measures including energy efficiency pump-sets, and grow irrigated dry crops.

A free of cost pilot was executed for the replacement of old existing 5 HP pumps with 5-star labelled pump-set in Karada Mandal ,Vizianagaram District, which resulted in an established savings of 31%. [43] Another project to replace 2,204 pump-sets with EE star labelled pump-sets in Rajanagaram Mandal is being explored.

Other Programs

The APEPDCL has adopted 5-star rated DTRs and replaced about 12,000 DTRs so far for enhanced energy efficiency. For all new service connections to be released by the APEPDCL in the towns and for the agricultural sector, 5-star rated DTRs are being used.

APCPDCL

Efficient pumping / Reactive power management

The APCPDCL has installed 1075 capacitor banks of 2 MVAr rating, and 927 capacitor banks of 600 kVA rating on agricultural pump-sets with an average power factor of 0.96. The power factors are being monitored at 33 kV level regularly. As per calculations in the recent tariff petition (2014-15), the payback time is 10 months. It is estimated that an investment of Rs. 34.14 crores will achieve a load reduction of 250 MW. Apart from this, frictionless foot-valves, HDPE/PVC pipes and ISI motors have also been installed.

Efficient lighting

[g] The current status is as per the tariff order of 2013-14/ ARR filings of 2014-15 and other documents available on the website.

16.5 lakh CFLs were distributed among six divisions under the Bachat Lamp Yojana (BLY) in coordination with BEE. M/s C-quest Capital Green Ventures Pvt. Ltd. are the implementers. The APCPDCL has estimated that the quantum of demand saved will be approximately 100 MW, however, this is only an estimate, and we do not know whether the measurement and verification after installation was carried out or not.

APSPDCL

In response to the directive of the regulator on energy conservation and DSM, the APSPDCL stated in its ARR filing of 2014-15 that they have been conducting awareness programmes in schools, and that the use of CFLs instead of incandescent lamps is being advertised through pamphlets.[44]

Some other DSM measures that are carried out by the APSPDCL are the installation of capacitors, frictionless foot-valves, HDPE/PVC pipes and ISI pump sets.

APNPDCL

In response to the directive of the regulator on energy conservation and DSM, the APNPDCL has also installed capacitors on 92% of agricultural services, along with frictionless foot-valves, HDPE/PVC pipes and ISI pump sets. They have printed energy conservation slogans on the electricity bills of consumers and in pamphlets. They are also installing new capacitor banks and maintaining the existing banks.[45]

2. Delhi

Power Scenario

Delhi consumed around 26 billion units (BUs) of electricity in 2012-13, about 2.6% of the total national consumption. The peak demand was about 5,900 MW, of which 5,600 MW[5] was met, leaving a deficit of about 5%. The approved average power purchase cost for all the distribution companies (DISCOMs) in Delhi was Rs. 3.98 according to their tariff orders for the year 2013-14.[19,46,47] Figure 3 shows the power purchase costs plotted against the total number of units purchased by all the DISCOMs from different sources. It can be seen that more than 17% of the power was purchased at Rs. 5.00 per unit through state generating stations, which is higher than the power purchase cost for all other sources.

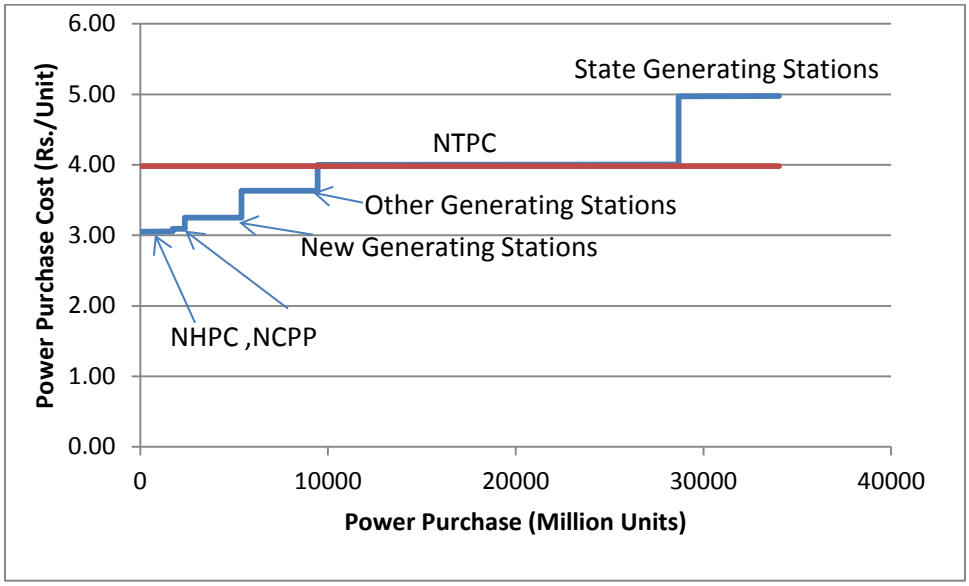

Figure 3: Approved power purchase costs for Delhi DISCOMs 2013-14

The average cost of supply for all the DISCOMs was in the range of Rs. 6.2 to Rs. 6.5 per unit. Figure 4 shows the approved revenue realisation from the major consumer categories for all the DISCOMs for the year 2013-14.[19,46,47] It can be seen that the average revenue realisation from domestic, Delhi Metro Rail Corporation (DMRC) and irrigation categories is below the average cost of supply. These three categories account for more than 50% of the total electricity consumption in Delhi. Irrigation and DMRC are just a minor portion of the entire consumption, whereas domestic consumption is much more.

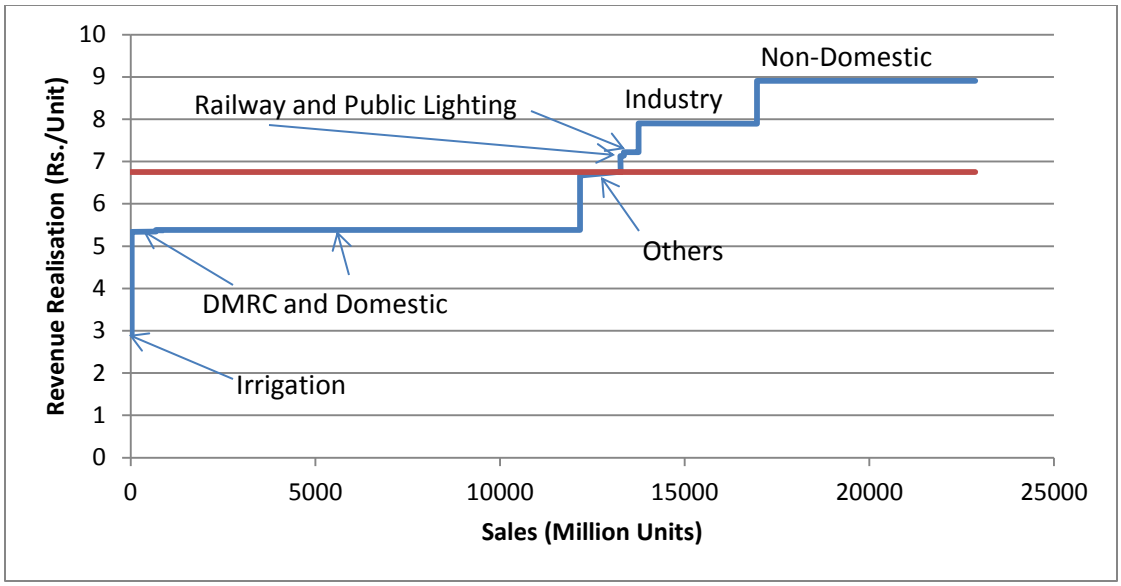

Figure 4: Average revenue realisation for Delhi DISCOMs 2013-14

It is estimated that there will be a peak deficit of 0.9 % during 2013-14[6] in Delhi. Delhi has an available capacity of around 7,500 MW as on 31.12.2013.[48] Indraprastha Power Generation Company Limited and Pragati Power are the state owned generation companies with a capacity of 995 MW, and have planned future capacity addition of 3,000 MW.

There is a significant savings potential from EE/DSM measures in Delhi. A study by NPC[31] has estimated a savings potential of about 12% for Delhi. Considering the sector-wise electricity consumption of 2007-08, it can be seen that there is a potential of saving about 2 BU in the various sectors, which has increased substantially in the last six years (See Table 8).

Table 8: Savings potential in Delhi

Sector	Electricity consumption (2007-08) (BUs)	Savings potential (BUs)
Domestic	7	1.4
Industrial	3	0.2
Commercial	1.2	0.2

EE/DSM activities in the state

This section presents an overview of EE/DSM related activities by different actors in the state.

Delhi Electricity Regulatory Commission (DERC)

DERC had issued a set of directives in 2009 to integrate DSM in day-to-day operations, bring out a DSM plan, and carry out systematic load research, to find methods to shift peak loads and stagger load to achieve reduction in peak demand, but nothing seems to have moved forward. An important way in which DSM could be implemented in the state is by notifying DSM regulations. In an attempt to boost DSM, in February 2012, the DERC made the draft regulations for a DSM implementation framework[49], but has still not notified them. The draft regulations were similar to the model DSM implementation framework regulations issued by the FoR. The DISCOMs were asked to create DSM cells, and these cells were to be managed by designated officials. They were asked to submit DSM plans for the approval of the commission, and conduct load research in a systematic manner. The commission has subsequently asked the DISCOMs to submit a report on the impact of DSM on the power procurement plans as well. Not much information is available on the status of the submission of these reports.

One of the other mechanisms for implementing DSM is price signals through Time of Day tariffs. Initially, several stakeholders expressed concern over ToD tariffs, and hence the commission advised DISCOMs to implement them on a pilot basis. During 2011-12 the commission analysed the load profile data submitted by the DISCOMs, and found that there were several errors in capturing the data. Therefore it did not allow DISCOMs to impose ToD during that year. In 2012-13, the DERC introduced ToD for large consumers (of commercial and industrial categories, above 300 kVA). It was to be extended to customers having connected load 50 kW and 10 kW in subsequent years, but the commission has not yet made a decision. The details of ToD tariff in Delhi are provided in the next section,'Specific DSM measures by DERC'.

The DERC also allows a certain amount in the ARR of DISCOMs for DSM related activities. It assesses the schemes on the basis of their cost effectiveness, reduction in peak demand, and other benefits. During 2009-10, it allowed an expense of Rs. 10.00 crores towards DSM. If found useful, the commission was ready to increase the amount in subsequent years based on the merits of the programmes. The actual expenses incurred by the DISCOMs, and whether the budget for DSM was further increased or not, is not known.

Further, the commission had recommended that the Government of National Capital Territory of Delhi (GoNCTD) bring out notifications for using efficient appliances like CFLs, LEDs as well ISI/star-labelled appliances. The commission also helped DISCOMs to understand the technicalities of DSM by arranging various technical sessions conducted by the Lawrence Berkeley National Laboratory. A lot of information was exchanged during these sessions to better understand implementation of DSM in Delhi.

Distribution Companies (DISCOMs)

There are mainly three DISCOMs – BSES Rajdhani Power Limited (BRPL), BSES Yamuna Power Limited (BYPL), and Tata Power Delhi Distribution Limited (TPDDL) – catering to the electricity needs of Delhi's population. The programmes DISCOMs have been implementing for DSM are awareness programmes and efficient lighting programmes using CFLs/LEDs. The DISCOMs have been creating awareness on energy efficiency through printing leaflets on energy conservation, promoting CFLs and the Bijli Gyan Abhiyan, tree plantation drives, and street plays.

The efficient lighting programme was conducted by the BRPL in 2010-11. The BRPL and BYPL have implemented programmes to promote exchange of incandescent bulbs with CFLs, a discount-based programme for 7 W LEDs, and a pilot project for LED street lights.

It is observed that in each of the tariff orders the DISCOMs have earmarked a certain amount towards DSM activities, but the details on the programmes conducted using these funds is not available on their websites or in the subsequent tariff orders.

TPDDL had submitted eight detailed project reports in 2011-12 for the approval of the commission. These included programmes like load research, energy audits for commercial and industrial consumers, an efficient lighting programme using LEDs and T5, as well as solar and gas water heaters. There is no information available about whether the commission has approved these programmes or not.

DEDA

A Centre for Civil Society report states that the Delhi Energy Development Agency (DEDA) had to be shut down due to mismanagement of resources, corruption and wasteful expenditure.[50] In August 2010, the Energy Efficiency and Renewable Energy Management Centre (EEREMC) was designated as the SDA for Delhi by a government notification. The centre acts as State Nodal Agency (SNA) for renewable energy programmes and the SDA for energy efficiency programmes in the state, but the focus has remained on renewable energy projects.[51] A few programmes that they have been implemented for energy efficiency are programmes on building EE, efficient lighting, mandatory use of efficient pump-sets in the agricultural sector, and promotion of solar water heaters. A more elaborate list of the programmes is available in the section 'Specific DSM activities by Energy Efficiency and Renewable Energy Management Centre (EEREMC)'. To analyse the impact of the programmes, there needs to be much more data available in the public domain on the numbers and types of lamps/pump-sets replaced.

Specific DSM measures by DERC

Details about the various tariffs that are used as DSM measures by the DERC are as follows:

Time of Day tariff

In 2008, when the ToD tariff was proposed, a number of consumers objected because they felt it would lead to an increase in the overall tariff.[52–54] Hence, the DERC decided to introduce ToD on a voluntary basis. In 2009 and 2011[55–57], the DERC asked DISCOMs to provide more information on load research, the impact of ToD on the ARR, and the installation of ToD meters. Finally, in 2012[58–60], the ToD tariff was introduced for all consumers (other than domestic) with a sanctioned load higher than 300 kVA. In 2013[19,46,47], the ToD was extended to all consumers (other than domestic) whose sanctioned load was more than 100 kW/108 kVA. The peak hours considered for the ToD tariff vary with the season, and only the evening peak is considered. However, the duration of the evening peak is considerably long (7-9 hours). The tariff is as follows.

Table 9: Time of day tariff for Delhi

Month	Peak hours	Surcharge (%)	Off-peak hours	Rebate (%)
April-September	3 pm – 12 am	15%	12 am – 6 am	15%
October-March	5 pm – 11 am	10%	11 am – 6 am	15%

Power Factor Surcharge/Incentive

There is no scheme to provide power factor based incentives/surcharge in Delhi. However, the DERC introduced the kVAh billing for some consumer categories in 2001. Since then, the DERC has extended the kVAh billing to all consumers with a sanctioned load above 10 kW.

Pre-paid Meters

In 2008, the Government of Delhi proposed to install pre-paid meters in all government offices. The primary objective of such an initiative was to improve the collection efficiency, but no systematic information is available about the implementation of the scheme and its impact.

Specific DSM measures by Delhi DISCOMs

TPDDL

Efficient lighting programmes

The TPDDL has replaced 150 W metal halide lamps with 40 W LEDs, and has achieved an 80% reduction in the energy consumption. They have replaced 250W HPSV lamps with 100 W LEDs for 18 street light fixtures, and the savings achieved was 65%. The TPDDL has also used efficient lights like LEDs and T5 in its own offices and buildings to promote energy efficiency.[61]

In association with two LED manufacturers, the TPDDL launched a discount-based scheme for 7W LEDs. The discounted price was Rs. 349 against an MRP of Rs. 450 , and the LEDs were sold with a three years warranty. Over 3,500 bulbs were sold. The data for the savings achieved is not available.

Load Research

The TPDDL has carried out load research for 10,000 residential customers. The objective of the study was to understand the energy use and penetration of appliances in these areas. After the study, they could identify programmes like replacement of air-conditioners and refrigerators as well as efficient lighting programmes and awareness drives.

Appliance replacement

They developed an appliance replacement programme for refrigerators and air-conditioners which was launched in August 2012. Star-rated refrigerators and air-conditioners were offered at discounted rates. The information on how many appliances were exchanged and the savings due to the programme is not available.

Building energy efficiency

In their endeavor to promote energy efficiency, the TPDDL had launched an in-house inter-district star rating competition for office buildings. They expect enhanced awareness, adoption energy efficient practices, and reduction in the carbon foot print of organisations as a result.

Policy advocacy

Due to various pilots conducted by them, the MoEF issued directives to DISCOMs to switch from metal halides to LEDs for hoardings and use of LED street lights in the premises of six universities across Delhi. The MoEF also issued guidelines to increase the temperature settings of ATMs from 16-17 degrees to 24 degrees Celsius.

Demand Response Program

The TPDDL had launched the first utility based automated demand response programme. Its objectives were to reduce peak demand and manage grid stress. The target consumers were the Delhi Jal Board, hospitals, industries, commercial complexes, the Delhi Metro Rail Corporation. The target load reduction was 34 MW.

BSES

Efficient lighting[62]

The BRPL engaged media and CFL manufacturers to propagate the adoption of CFLs. They sold over six lakh CFLs which reduced the CO_2 emissions by 200 thousand tons/year, and reduced the electricity consumption by 35 MW in the BRPL designated areas.

Green club initiative

Consumers who will allow remote connection or disconnection of non-essential load during power shortages join this initiative voluntarily.

Energy Storage

The initiative follows the principle of storing energy when it is surplus, and consuming it when the availability is low. The DPR has been submitted to the DERC.

Specific DSM measures by Energy Efficiency and Renewable Energy Management Centre (EEREMC)

- Adoption of the mandatory Energy Conservation Building Code (ECBC) in all government buildings and in all new building projects. Energy efficiency of existing government buildings through retrofitting to be carried out so as to achieve at least a rating of one-star from BEE under their building labelling programme. 100 such buildings have been identified, and in the first phase, work is being done on 15 buildings.
- Mandatory use of CFLs and electronic chokes in government buildings / government aided institution / boards and corporations.
- Mandatory use of solar water heaters in Delhi in different categories of buildings like industries, hotels, hospitals, canteens, corporate and residential building having an area of 500 m^2 or above, government buildings, etc.
- Mandatory use of ISI marked motor pump sets, power capacitors, and foot-reflex valves in the agricultural sector.
- Promotion of CFLs/LEDs in all buildings, as well as for street lightings, hoardings, and advertisements.
- Subsidy for promoting battery operated vehicles.

3. Gujarat

Power scenario

Gujarat consumed around 93 billion units (BU) in 2012-13. The peak demand for 2012-13 was around 12,000 MW, and the peak met was only 0.3% lower than that required.[5] The total power purchase costs approved by the commission for 2013-14 for all Gujarat DISCOMs are to the tune of Rs. 26,966 crores. It can be observed that the revenue realisation from agricultural and domestic sectors is below the average revenue realisation. Figure 5 shows the average revenue realisation for all DISCOMs.

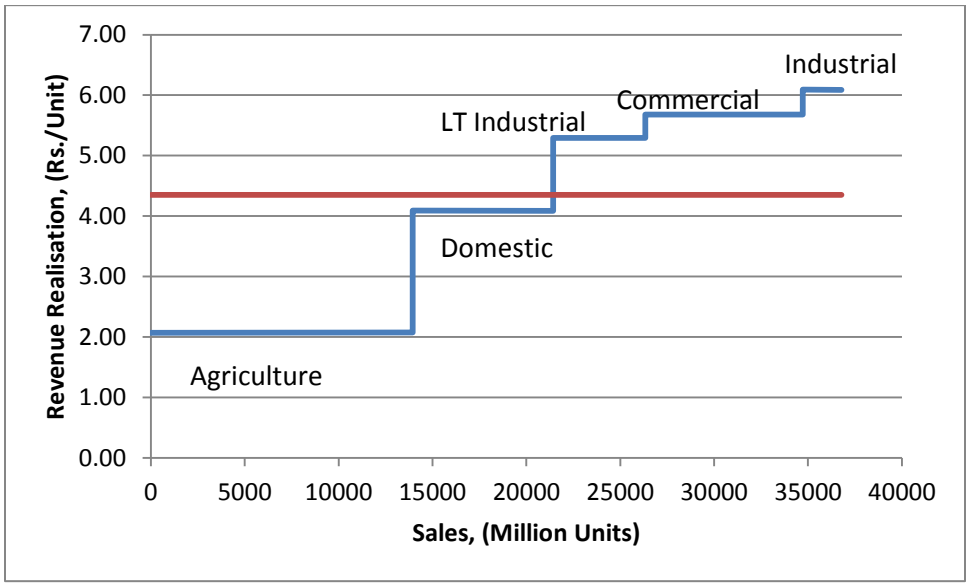

Figure 5: Average revenue realisation for Gujarat DISCOMs 2011-12

It is anticipated that Gujarat will be a power surplus state in 2013-14 having around 6% surplus energy available than required, though it might face a small peak deficit of around 0.2%. The state generation company Gujarat State Electricity Corporation Limited (GSECL) has planned a capacity addition of 3,295 MW to be completed by 2017-18[63].

There is a significant savings potential of around 13% from EE/DSM measures in Gujarat. A study[31] by the National Productivity Council (NPC) has estimated savings of about 20-35% in the domestic and agricultural sector in Gujarat. Considering the sector-wise electricity consumption in 2007-08, it can be seen that there is a potential of saving about 5 BU in the agricultural and domestic sectors. (See Table 10).

Table 10: Savings potential in Gujarat

Sector	Electricity consumption (2007-08) (BUs)	Savings potential (BUs)
Domestic	7.5	1.5
Agricultural	11.9	3.5
Industrial	38.7	2.7
Commercial	0.1	0.03

EE/DSM activities in the state

This section presents an overview of EE/DSM related activities by different actors in the state.

Gujarat Electricity Regulatory Commission (GERC)

The GERC had published a 'Distribution Code' in 2004.[64] The code specifies methods of incorporating DSM while doing demand projections and load forecasting. In addition to the code, the GERC has notified DSM regulations in May 2012.[65] The details of these regulations are provided in the section 'Specific DSM measures by GERC'. Several state advisory committee meetings were held by GERC since 2004, and in the meeting held in July 2013, DISCOMs reported that the DISCOMs had appointed TERI as a consultant for the identification of technical potential and the preparation of a DSM plan.[66] The GERC also specified that while doing the study of load research, it may include a) consumer load that is responsible for peak demand b) possibility of shifting the load from peak to off-peak c) Time of use tariff determination d) scope of improvement in end-use energy efficiency. In the meeting held in August 2014, the GERC has directed the DISCOMs and Torrent Power Limited (TPL) to submit a detailed DSM programme document within two months for which a budgetary provisions of Rs. 50 crores for each DISCOM and Rs. 20 crore for the TPL have been allocated.

On the tariff front, the GERC allows the DISCOMs in Gujarat to levy time of use charges for consumption during peak hours for a billing demand up to 500 kVA and above 500 kVA. The GERC also allows power factor incentives and penalties to consumers. The details of these measures are available in the section 'Specific DSM measures by GERC'.

Distribution Companies (DISCOMs)

There are four state owned DISCOMs – the Uttar Gujarat Vij Company Limited (UGVCL), the Madhya Gujarat Vij Company Limited (MGVCL), the Paschim Gujarat Vij Company Limited (PGVCL), and the Dakshin Gujarat Vij Company Limited (DGVCL) – in Gujarat, as well as one private DISCOM – Torrent Power Limited – which cater to the electricity needs of Gujarat. An analysis of the tariff orders over the last five years [17,67–81] shows that around Rs. 60.00 crores were planned to be used for energy efficiency and energy conservation activities by the state owned DISCOMs. These were the provisions made by the

DISCOMs in their tariff petitions. But, we were unable to assess how these funds were utilised in the true-up petitions.

The other programmes that the DISCOMs have been implementing are to raise awareness and improve pump-set efficiency. For example, the Uttar Gujarat Vij Company Limited (UGVCL) has incurred expenses to the tune of Rs. 62.66 lakhs in the year 2013 towards energy conservation by way of awareness programmes, an agricultural pump-set efficiency monitoring system, and the preparation of a DSM plan[82]. The details of all the programmes implemented by the DISCOMs are provided in the section 'Specific DSM activities by Gujarat DISCOMs'.

While reporting developments in the state advisory committee meetings, the GERC has stated that the DISCOMs have submitted the DSM action plans to it in January-February 2014.

Gujarat Energy Development Agency (GEDA)

The Gujarat Energy Distribution Agency is the SDA in Gujarat. A number of energy conservation measures have been adopted by the GEDA, resulting in a savings of 1.6 BUs with an investment of Rs. 12.8 million.[83] Some activities that were carried out by the GEDA since its inception are walk-through energy audits for Micro Small and Medium Enterprises (MSMEs), an LED village campaign in Amrapura, replacement of inefficient pump-sets with energy efficiency pump-sets, and investment grade audits (IGAs) in government buildings. More details on these activities are available in the section 'Specific DSM programmes by GEDA'.

One of the unique programmes started by the GEDA is the mobile energy conservation demonstration van. This mobile van travels across the state spreading awareness about energy conservation and energy saving measures among various sections of energy consumers – mainly industrial and domestic consumers and educational institutions. The demo van has been equipped with various energy efficient hardware (EE electrical gadgets and appliances as well as energy monitoring instruments) and soft learning tools such as exhibition panels, educational slide shows, films and publications.

Specific DSM measures by GERC

DSM regulations

The Gujarat DSM regulations have been adopted as per the model DSM regulations published by the FoR. They specify the objectives of DSM, guidelines, as well the process of achieving the set DSM targets. The GERC formulated the DSM objectives subsequently in August 2012 which include: implementation of suitable policies and measures to influence electricity demand, changing the electricity consumption pattern both in terms of timing and level, avoiding or postponing costly capacity addition by slowing demand growth, economical and efficient use of resources in order to reduce costs to the consumers, reduction in emissions, implementation of DSM schemes set out by the BEE, increased adoption of efficient technologies, and services through structural and behavioural changes. It is not known whether specific targets towards DSM have been set by the GERC for the DISCOMs.

Time of use / time of day and power factor penalties and incentives

As a DSM tool, the GERC has approved the following time of use charges/time of day for its DISCOMs.

Table 11: Time of use charges for Gujarat

Energy consumption during peak hours 0700 to 1100 hrs and 1800 hrs to 2200 hrs	
Billing demand up to 500 kVA	35 paise per unit
Billing demand above 500 kVA	75 paise per unit
Energy consumption during off-peak hours 2200 hrs to 0600 hrs	
Energy consumed in excess of one-third of the total energy consumed during the month during off-peak hours	75 paise per unit

The discount for water works consumers having connected load of 50 HP and above for energy consumption during off-peak hours – 1100 hrs to 1800 hrs – is 30 paise per unit, and for the time period 2200 hrs to 0600 hrs it is 75 paise per unit.

To maintain a healthy power factor (above 0.95) there is a rebate, and also a penalty if the power factor is below 0.90.

Table 12: Power factor adjustment charges

Average power factor below 90% and up to 85%	**1% penalty on total electricity bill for every 1% drop**
Average power factor below 85%	2% penalty on total electricity bill for every 1% drop
Average power factor above 95%	0.5 %rebate on total electricity bill for every 1% rise

Specific DSM activities[h] by Gujarat DISCOMs

MGVCL

The MGVCL had conducted a feasibility study on an agricultural DSM pilot in Anand.[84] The main aim of this pilot project was to enable and facilitate the implementation of the project throughout the entire state. The project covered 533 agricultural pump-sets connected to four feeders in Anand circle under the MGVCL. After the initial study, the MGVCL decided to implement the project by using its own funds. The baseline energy consumption was 13.25 MUs, and the energy savings potential was 3.3 MU at the pump end on a conservative side. The total project cost was estimated at Rs. 256.44 lakhs. The detailed cash flow analysis showed a payback period of 4 years and a project IRR of 11.30%. The DPR was prepared in 2011, but the project is not yet implemented.

[h] The current status is as per the tariff order of 2013/ ARR filings of 2014-15 and business plans.

As per their business plan for financial year 2012 to financial year 2016, the programmes they have implemented or intend to will replace all conventional tube lights in their offices by T5 tube lights. They have tried to reduce co-incidental peak by providing different time slots for agricultural consumers. Some power factor correction measures undertaken have reduced the technical losses in the system. Several awareness measures like distribution of pamphlets, publicity campaigns, short films and advertisements have been implemented by the MGVCL.

UGVCL

The business plan for the UGVCL for the financial year 2012 to the financial year 2016 lists the following DSM measures that will be/have been adopted by them.[85]

Under the action plan for energy conservation by the Gujarat Urja Vikas Nigam Limited (GUVNL), the UGVCL purchased a total of 6,100 CFLs and 5,000 electronic ballasts. These were provided in the premises of the UGVCL offices. On the BLY front, expressions of interest were put up on the websites. Further updates on the programme are not available.

The Government of Gujarat had introduced a scheme for replacement of inefficient pump-sets by energy efficient pump-sets. The scheme was launched with an intention to reduce the power consumption and peak demand in the agricultural sector, and was applicable to unmetered consumers only. The cost of the efficient pump-set is to be borne by the consumer, the UGVCL and the Government of Gujarat in equal proportions. The GEDA had approved 29 manufacturers from which the consumer can select a pump-set. In one year (2009-10), the UGVCL had replaced 12,929 old pump-sets of agricultural fixed tariff consumers by energy efficient pump-sets through a pilot programme in nine talukas under its jurisdiction. The scheme resulted in energy savings of 10% for approximately 11,066 pumps, but less than 10% for balance pump sets, hence it was on hold in 2010-11. They have reintroduced the scheme in 2014.

PGVCL and DGVCL

Load forecasting along with load management is being implemented by the DSM cell of DGVCL. No other DSM programmes or expenses towards these programmes have been listed in the business plans of either of these two DISCOMs.

Specific DSM programmes by GEDA

- In the walk-through energy audit scheme of the GEDA for MSMEs, it had proposed to carry out 500 energy audits in 2013-14. The cost of these audits was to be borne by the GEDA. The clusters that were selected are metal-processing, re-rolling and foundry industries. The scheme was in force up to March 2014.
- LED village Amrapura, Gandhinagar : The project was jointly funded by BEE. All lights, indoor and outdoor, were converted to LEDs in this village. A total of 1,405 LED bulbs, tube-lights and street lights have been distributed. The project cost was Rs. 25 lakhs, and the estimated annual electricity savings is of the order of Rs. 8.00 lakhs, with a payback period of a little over 3 years.

- Investment Grade Energy Audit in government buildings: The broad objective was to review the present energy consumption, and after analysis prepare a detailed recommendation report for improving energy efficiency. 26 government buildings were audited in phases I and II. .
- Replacement of incandescent bulbs with T5 tube lights in government buildings is being done.
- Various outreach activities like Bal Urja Rakshak Dal, capacity building programmes, outdoor and on-air publicity, exhibitions and sponsorship of events have been conducted by the GEDA.

4. Haryana

Power scenario

Haryana consumed around 38 billion units (BUs) of electricity in 2012-13. The peak demand for 2012-13 was about 7,400 MW, of which 6,700 MW[5] was met, thus leaving a deficit of about 9.5%. The approved average power purchase cost for all the Distribution Companies (DISCOMs) in Haryana for 2013-14 is Rs. 3.36 according to the tariff order for the year 2013-14.[18] Figure 6 shows the power purchase costs plotted against the total number of units purchased by all the DISCOMs from different sources. It can be seen that more than 80% of the power was purchased in the range of Rs. 3.39 to Rs. 3.46 per unit, marginally higher than the average power purchase cost, through the Haryana Power Generation Corporation Limited and other sources.

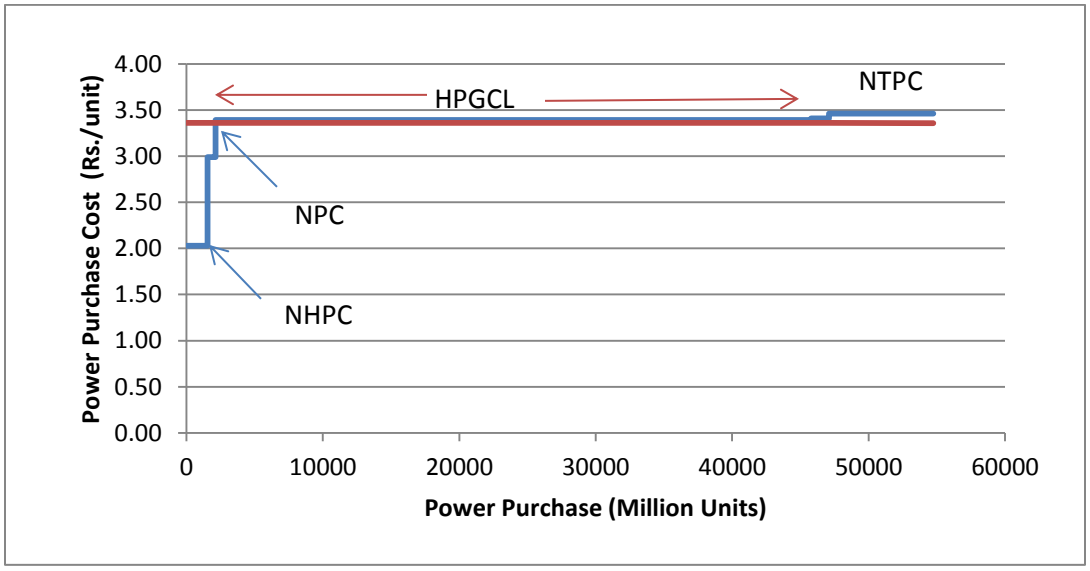

Figure 6: Approved power purchase costs for Haryana DISCOMs 2013-14

The average cost of supply for all the DISCOMs for bulk supply (domestic) is calculated to be Rs. 6.56/unit. Figure 7 shows the approved revenue realisation from the major consumer categories for Uttar Haryana Bijli Vitran Nigam Limited (UHBVN) for the year 2013-14.[18] It can be seen that the average revenue realisation from agriculture is the lowest. The revenue realisation from domestic consumers is marginally higher than the average. These two categories account for more than 60% of the total electricity consumption in Haryana.

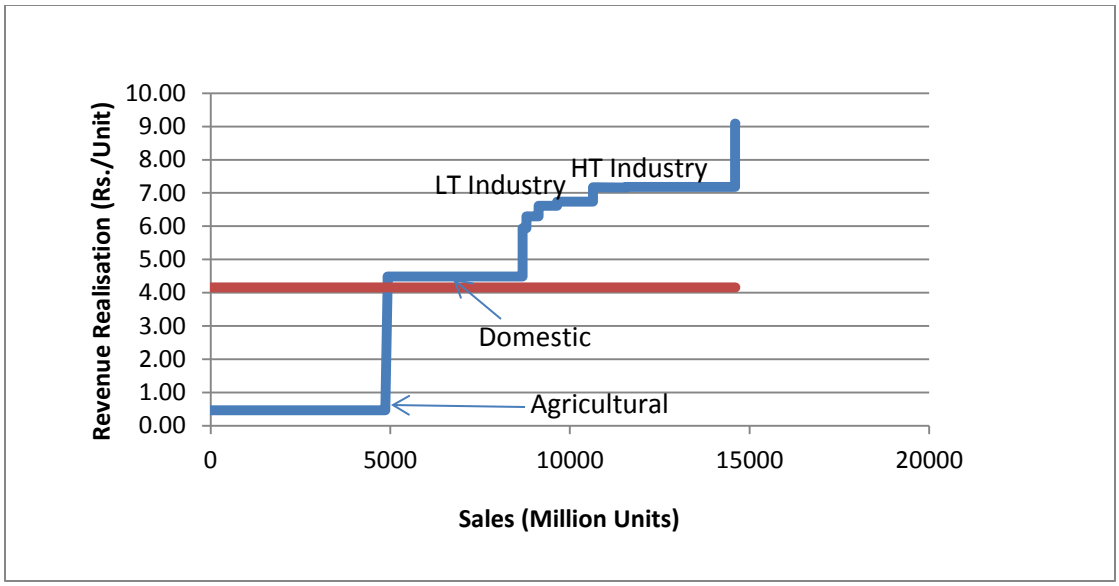

Figure 7: Average revenue realisation for UHBVN 2013-14

Haryana's electricity consumption is expected to increase to 49 BUs by 2017-18.[6] The state has available capacity of around 8200 MW as on 31.12.2013[48], and has planned a capacity addition of 5,560 MW[86].

There is a significant savings potential from DSM measures in Haryana. A study[31] by the National Productivity Council (NPC) has estimated a total savings of about 16% in all the categories. Considering the sector-wise electricity consumption in 2007-08, it can be seen that there is a potential of saving about 3 BU in the agricultural and domestic sectors, with the savings potential in the commercial sector being very negligible (See Table 13).

Table 13: Savings potential in Haryana

Sector	Electricity consumption[i] (2007-08) (BUs)	Savings potential (BUs)
Domestic	3.4	0.6
Agricultural	6.7	2
Industrial	6.1	0.4
Commercial	0.2	0.04

EE/DSM activities in the state

This section presents an overview of EE/DSM related activities by different actors in the state.

[i] The electricity consumption figures are taken from the 18th EPS as the consumption figures were not available in the tariff orders / ARRs.

Haryana Electricity Regulatory Commission (HERC)

The HERC has not notified DSM regulations in the state. The commission has issued directives and issued guidelines to the DISCOMs to incorporate DSM while load forecasting on a regular basis. The commission in 2009 had forwarded the FoR recommendations to the DISCOMs for implementation, and had asked to submit a report . Also, the commission has been issuing directives to submit statements and all relevant reports about reduction in energy consumption after installation of CFLs in CFL districts, but there is no information available about the submission of these reports by the DISCOMs.

The commission had approved around Rs. 3.00 crores as capital expenditure for DSM related work consecutively for two years starting 2008-09, and Rs. 1.00 crore in 2011-12, but there is no information available about how it was utilised. It had specifically asked DISCOMs to deploy staff at their offices and field level to do DSM related activities. In 2010, the commission again stated in its tariff order that the report on the outcome of the implementation of CFL installation is not reported by DISCOMs.

Another mechanism to promote DSM is tariff signals. The HERC, in its tariff order of 2010, directed the DISCOMs to ascertain the consumption pattern of HT industrial (categories- general and furnace), non-domestic (11 kV independent feeder), and railway (traction) sectors and submit a report on hourly load, daily consumption, number of consumers and their connected load, maximum demand recorded, hourly load data of Haryana, and the lowest and highest load factor. The DISCOMs were also asked to submit a proposal for the introduction of ToD tariff. There was no action on this front for three years; in the 2013-14 tariff order the DISCOMs are still proposing a phased introduction of time of day tariffs. The other price signal is kVAh billing for improving the power factor so that the system operates more efficiently. The commission in its tariff order of 2013-14 has approved kVAh billing. It is optional for domestic consumers having consumption above 800 units, and compulsory for all HT and LT consumers consuming above 50 kW. More details about both these charges are provided in the section 'Specific DSM measures by HERC'.

The commission in its recent tariff order[18] has expressed concern that the Dakshin Haryana Bijli Vitran Nigam Limited (DHBVNL) and the Uttar Haryana Bijli Vitran Nigam Limited (UHBVNL) have not proposed any measures for inducing customers to use electricity such as discounted tariff for shifting load from peak hours to off-peak hours, suitable metering arrangements for ToD tariff, use of energy efficient equipment, etc. It also directed the DISCOMs to form DSM cells but the status is not known.

Distribution Companies (DISCOMs)

The DISCOMs in Haryana have been implementing programmes on CFL distribution. It can be estimated from the tariff order of 2010-11 that around 23.5 lakh CFLs have been distributed by the DISCOMs in Sirsa, Yamunanagar, and Sonepat districts under the BLY programme. The energy savings achieved through these programmes is not known.

A presentation was made by the Managing Director of the UHBVNL before the FoR working group on DSM in 2010 about inducing farmers to use energy efficient pump-sets. These pump sets were to be provided and maintained by the licensee. The cost of the pump and its maintenance was proposed to

be recovered by savings made in electricity consumption as well as by avoiding purchase of costly power. However, the scheme could never take off.[87] There is no information on other DSM programmes conducted by UHBVNL and DHBVNL after 2010-11.

Haryana Energy Development Agency (HAREDA)

Contrary to other states, the HAREDA is very active in the area of promoting energy efficiency programmes. It has prepared DPRs for four municipal DSM programmes. Apart from being the nodal agency for implementing energy efficient lighting system in all government building and institutions, it is implementing schemes for energy audits for industries and commercial buildings as well. The HAREDA has also formed a state level steering authority to formulate, review and monitor activities under the State Energy Conservation Fund. It has formulated a financial assistance scheme for industries, institutions, municipal and commercial buildings, for implementation of measures suggested in the energy audit report.

The HAREDA has conducted a number of activities since 2009. It has organised interaction meetings with potential industrial and commercial customers for performing energy audits. Walk-through energy audits of around 179 industries was done, and later on these audits were analysed, that estimated a savings of 51.79 MU with an investment of Rs. 51.66 crores. Thereafter, detailed energy audits of industrial and commercial establishments were also conducted. The HAREDA also conducted a number of demonstration projects along with training and capacity building. It has launched a scheme to provide interest-free loans for implementing energy conservation measures, and is also implementing the standards and labelling scheme of BEE in the state.

Haryana government has also funded several activities which include energy conservation, gram panchayat awards doing DSM through renewable energy, for example, LED based solar home lighting systems, a pump replacement programme, demonstration projects and awareness campaigns.

Specific DSM measures by HERC

ToD tariff

The ToD tariff is currently being introduced in a phased manner by the HERC. In the first phase, it will be implemented for HT industrial consumers only. The peak hours and rates are as follows:

Morning peak - 0530 hrs to 0800 Evening peak - 0530 hrs to 2200 hrs	**30% of average daily consumption of the immediately preceding billing period @ Rs. 2/kWh above normal tariff. If the consumption exceeds 30%, then Rs. 4/kWh over and above the normal tariff.**
Night hours as non-peak hours (2200 hrs to 0530 hrs)	25% discount on peak hour energy charges for consumption of 20% of the average daily consumption of the immediately preceding billing period.

kVAh billing

Any domestic consumer who at his own cost installs a kVAh meter may opt for the kVAh tariff of 538/kVAh instead of 598/kVAh for consumption above 800 units. This is for maintaining a power factor of 0.9 and above (598*0.9 = 538).

For non-domestic consumers opting for kVAh billing, the tariff is 526/kVAh (585*0.9 = 526)

For HT and LT consumers above 50 kW only the kVAh billing option is available. For LT consumers between 20 kW and 50 kW, the kVAh billing is optional and the charges are 526/kVAh.

Specific DSM activities[j] by Haryana DISCOMs

The DISCOMs in Haryana have distributed CFLs in their respective service areas. The UHBVNL has distributed around 3.5 lakh CFLs at a subsidised rate of Rs. 63/- in Yamunanagar and Sonepat districts. The DHBVNL has distributed around 20 lakh CFLs in Sirsa district. However, there is no information available about the savings achieved due to these installations.

The UHBVNL is implementing a scheme to replace 210 agricultural pump sets in Mohanpur with the help of the HAREDA. In 2011-12, tenders were invited, and an amount of Rs. 25 lakhs was earmarked from the State Energy Conservation Fund (SECF).

Specific DSM programmes by HAREDA[88]

- DPRs for municipal DSM programmes for Ambala, Hiwani, Fatehabad and Yamunanagar.
- Responsible for procuring efficient lighting systems for all state government departments and organisations

[j] The current status is as per the tariff order of 2013 / ARR filings of 2014-15.

- Mandatory use of solar water heaters in various categories of buildings
- Mandatory use of CFLs in government buildings and government aided institutions/corporations
- Mandatory use of ISI marked motor pump-sets, power capacitors and foot-reflex valves in the agricultural sector
- Promotion of energy efficient building design
- Mandatory use of T-5, 28 Watt tube-lights in government buildings and government-aided institutions/corporations
- Implementation of a scheme on an interest free loan for energy conservation measures
- Energy audits of government buildings, industries and commercial establishments
- Effective implementation of ECBC with the help of architects and BEE empaneled consultants
- Changes in the building bye-laws to incorporate ECBC
- Effective utilisation of SECF for energy conservation in small and medium enterprises (SMEs), energy audits, capacity building, etc. [89]

5. Karnataka

Power scenario

Karnataka consumed around 57 billion units (BUs) of electricity in 2012-13; about 6% of the total national consumption. The peak demand was about 10,000 MW, of which 8,700 MW[5] was met leaving a deficit of about 13%. The approved average power purchase cost for all the distribution companies (DISCOMs) in Karnataka was Rs. 3.08 according to the tariff order for the year 2013-14.[14,90,91,92] Figure 8 shows the power purchase costs plotted against the total number of units purchased by all the DISCOMs from different sources. It can be seen that more than 50% of the power was purchased in the range of Rs. 4.14 to Rs. 4.96 per unit, significantly higher than the average power purchase cost, through the spot-market or through short term contracts with independent power producers (IPPs).

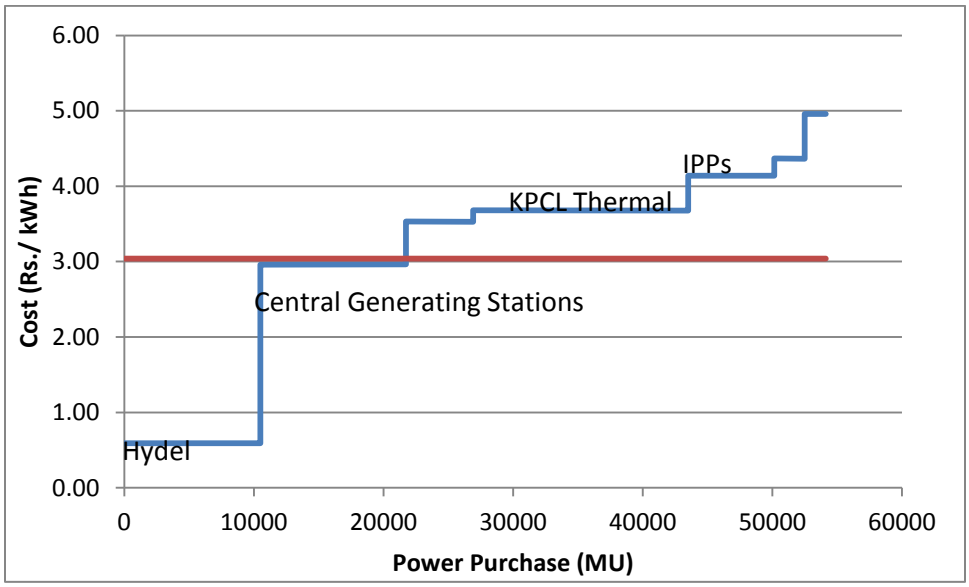

Figure 8: Approved power purchase costs for Karnataka DISCOMs 2013-14

The average cost of supply for all the DISCOMs in Karnataka was in the range of Rs. 4.81 to Rs. 5.04 per unit. Figure 9 shows the revenue realisation from the major consumer categories for all the DISCOMs for the year 2013-14[14,90,91,92]. It can be seen that the average revenue realisation from two categories viz. agricultural and domestic, is below the average cost of supply. These two categories account for more than 40% of the total electricity consumption in Karnataka.

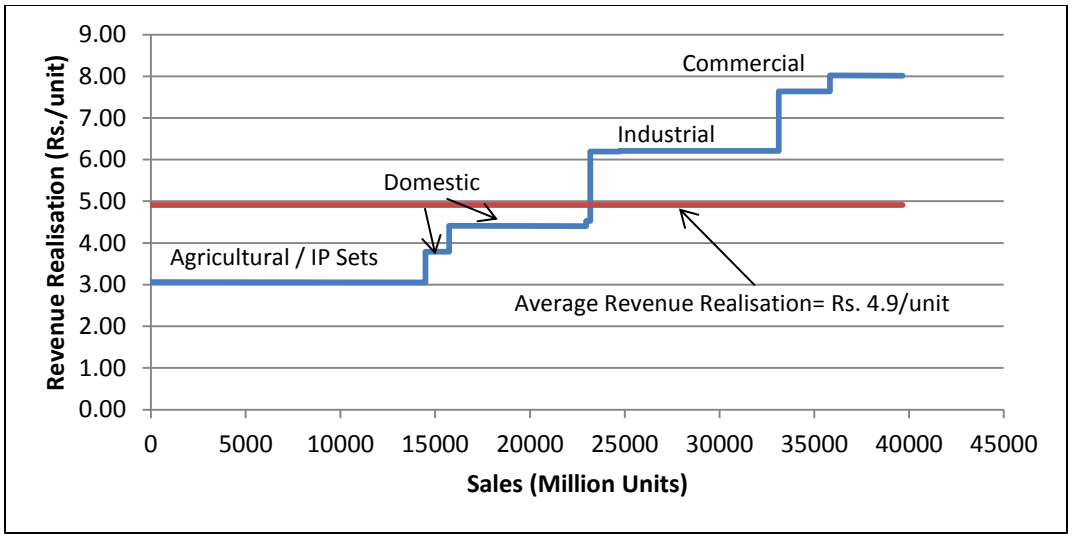

Figure 9: Average revenue realisation for Karnataka DISCOMs 2013-14

Karnataka's electricity consumption is expected to increase by almost 70% to 71 BUs by 2017-18.[6] The state has an available capacity of around 14,000 MW as on 31.12.2013, and has planned a capacity addition of 12,500 MW by adding thermal power plants, and 4,300 MW through Renewable Energy (RE) projects.[93] This would require total investments of about Rs. 80,000 crores.

There is a significant savings potential from EE/DSM measures in Karnataka. A study[31] by National Productivity Council (NPC) has estimated savings of about 20-35% in the domestic and the agricultural sectors in Karnataka. Considering the sector-wise electricity consumption of 2007-08, it can be seen that there is a potential of saving about 5 BU in the agricultural and domestic sectors, which has increased substantially in the last six years (see Table 14).

Table 14: Savings potential in Karnataka

Sector	Electricity consumption (2007-08) (BUs)	Savings potential (BUs)
Domestic	6.2	1.2
Agricultural	10.9	3.5
Industrial	14.6	1
Commercial	1.2	0.2

EE/DSM activities in the state

This section presents an overview of EE/DSM related activities by different actors in the state.

Karnataka Electricity Regulatory Commission (KERC)

In Karnataka, the KERC has not notified any regulations related to EE/DSM for the DISCOMs. Regulations could mandate the DISCOMs to conduct EE/DSM activities, and also lay down clear rules for establishing the cost-effectiveness of the programme, evaluate savings, and make data available. Instead, the commission has been issuing periodic directives to DISCOMs through the tariff order to adopt EE/DSM measures, but without any mandatory specific targets on energy or peak savings. A review of the tariff orders over the last five years reveals that the directives issued by the commission related to EE/DSM have been more or less the same. A list of the directives can be found in the 'Specific DSM measures by KERC'. Some directives that are considered under DSM by the commission like HVDS and feeder separation are strictly speaking measures that improve the supply side efficiency, hence we have not looked at them in our study.

The DISCOMs have been periodically reporting compliance with the directives or an explanation in case of non-compliance. However, the absence of specific targets and deadlines in the directives makes it difficult to hold the DISCOMs responsible for low or non-compliance. The commission has also periodically asked the DISCOMs to submit time-bound EE/DSM action plans while filling the annual tariff petitions. It is not clear whether the DISCOMs have submitted these action plans. However, in case they have, there is no reflection in the tariff orders on whether these action plans are being followed.

Distribution Companies (DISCOMs)

DISCOMs have been reporting compliance with the periodic directives issued by the KERC. There has been good progress on some directives, while limited or no progress on others. The Time of Day (ToD) tariff is mandatory for all the industrial and commercial consumers above 500 kVA of all the DISCOMs. All new connections under this category are now being supplied with ToD meters. The details of this process are available in the section 'Specific DSM activities by Karnataka DISCOMs'. Feeder separation for non-agricultural load is being implemented in a phase-wise manner since 2013. The Bangalore Electricity Supply Company Limited (BESCOM), the Hubli Electricity Supply Company Limited (HESCOM) and the Gulbarga Electricity Supply Company Limited (GESCOM) seem to have made some progress with about 33% of the total feeders in these DISCOMs separated. On the directive of installing timer switches for street lights, only BESCOM seems to have made considerable progress. Other DISCOMs are still in talks with local municipal bodies. Under the Bachat Lamp Yojana, only BESCOM replaced some 37 lakh incandescent bulbs by CFLs in 2012. There have been no replacements after that due to a lack of response from the manufacturers possibly due to crash in carbon prices. In addition to the directives, BESCOM has conducted some additional EE/DSM programmes like replacing inefficient agricultural pumps, replacing copper ballasts by electronic chokes, installation of solar water heaters, etc. The details of these programmes are available in 'Specific DSM measures by DISCOMs' .

As mentioned earlier, the compliance with the directives by the DISCOMs is not as expected and they could not be held responsible for non-compliance. The commission has not been rigorously following up on ensuring compliance. For example, on the directive of installing timer switches for street lights, the Mangalore Electricity Supply Company Limited (MESCOM) offered the same reply saying that it had sent letters to the concerned authorities of local bodies, for three years in a row. EE/DSM is the lowest priority for all the DISCOMs. None of the DISCOMs have published action plans for EE/DSM on their

websites. There are only a few dedicated employees working in the DSM cells of DISCOMs. There is no dedicated funding source for EE/DSM programmes. Although the expenditure incurred on the above programmes must have been accounted for in the ARR, there are no separate heads. For example, BESCOM lists its expenses for EE/DSM programmes under the head 'DSM and other civil expenses'. No evaluation studies of the benefits of the programmes conducted are available in the public domain. Even in the case of pilot programmes, there has been no evaluation to facilitate their scale-up.

Karnataka Renewable Energy Development Ltd. (KREDL)

KREDL is the State Designated Energy (SDA) appointed by the Government of Karnataka (GoK) as required by the Energy Conservation Act, 2001 to conduct energy efficiency activities in the state. There is extremely scant information available about KREDL's EE activities. In 2009, the GoK, through its Government Order (GO), set a target of saving around 1500 million units (MUs) of electricity every year by 2014[94]. The GO also proposed to set up a fund named Akshaya Shakti Nidhi and set aside Rs. 5 crores annually from the fund towards energy efficiency and conservation activities to achieve the above targets. There is no documentation in the public domain on the status of the savings achieved and the utilisation of the fund. In KREDL's latest annual report of 2011-12[95], the Akshaya Shakti Nidhi fund is reported to be around Rs. 35 lakh. However, the report also mentions establishing a State Energy Conservation Fund of Rs. 4 crores, with 2 crores from the Bureau of Energy Efficiency (BEE) and 2 crores from the state government. There are no details on the utilisation of this fund and the savings achieved from programmes conducted if any. In a 2009-10 report by the National Productivity Council (NPC), it was estimated that the KREDL saved about 11 MU annually[29], a far cry from the target of 1,500 MUs. In 2013, the GoK, through a GO, announced a scheme to replace 20 lakh incandescent bulbs by CFLs at a cost of Rs. 20 crore[96]. This is a very ambitious scheme with estimated savings of about 384 million units. The scheme was supposed to be implemented in a very short time-frame of 8 weeks. However, there is no documentation on the current status of this scheme in the public domain. The KREDL has also implemented some public awareness programmes by conducting workshops and seminars. They have also implemented a few lighting replacement programmes in Udupi, a couple of national parks and a flyover.

Specific DSM measures by KERC

ToD tariff

Initially, the ToD tariff was optional for HT and LT consumers. Later in 2012, after the state advisory committee meeting, it was made mandatory for HT 2 (a) and HT 2 (b) consumers with a contract demand of 500 kVA and above. The commission now allows optional ToD to HT 2(a), HT 2(b) consumers having connected load less than 500 kVA, LT 5, HT-1 as well. The details of ToD tariff levied by the DISCOMs are in Table **15**.

Table 15: ToD tariff in Karnataka

Time of day	Energy charges applicable over the normal tariff
2200 hrs to 0600 hrs	-125 paise per unit

0600 hrs to 1800 hrs	0
1800 hrs to 2200 hrs	+100 paise per unit

Specific DSM activities[k] by Karnataka DISCOMs

BESCOM

As per the KERC directives, BESCOM has installed timer switches on around ten thousand street lights. The remaining 6,500 installations are yet to be fitted with timer switches. There is no information available about the savings achieved due these installations.

The BESCOM Efficient Lighting Program (BELP) initiated in 2005-06 resulted in the nation-wide Bachat Lamp Yojana programme. Around 37 lakh CFLs were distributed in 9 lakh households by BESCOM under the BLY. Due to a crash in the CDM market, there has been no activity in this area after 2012.

In the DRUM-WENNEXA[97] programme, 277 inefficient pump-sets were replaced by high-efficiency pump sets in the Doddaballapura sub-division. A savings of 29.23 MUs was achieved from April 2011 to June 2013. The programme was implemented under the aegis of the United States Agency for International Development (USAID) and the Ministry of Power (MoP). Recently, an agreement was signed with Energy Efficiency Services Limited of Delhi to replace one lakh inefficient pump-sets under the Energy Service Company (ESCO) model. A DPR is being prepared for this purpose.

BESCOM has tried various pilot scale DSM programmes. In another in-house programme, 5,298 copper ballasts were replaced by electronic ballasts during 2011-12 in various BESCOM buildings at a cost of Rs. 66.9 lakhs. The savings achieved were to the tune of 0.35 MUs. Also, installation of a solar rooftop photovoltaic (RTPV) grid-connected power plant in the premises of BESCOM's corporate office was initiated as a pilot to promote large scale rooftop PV (RTPV). Contract value of the programme is Rs. 58.10 lakhs, after availing a subsidy of 30% from the Solar Corporation of India. M/s Thermax Limited is supposed to implement this programme.

As per the Karnataka Government scheme of solar water heating systems, one lakh solar water heating systems have been installed as on 31.07.2013. A rebate of 50 paise per unit is given to consumers, up to a maximum of Rs. 50/- per installation per month.

HESCOM

Around 970 street light installations are fixed with timer switches as of December 2013 in the service area of the Hubli Electricity Supply Company Limited (HESCOM). It is constantly pursuing municipal authorities to install more timer switches.

A total of 77 lakh CFLs are proposed to be distributed in the HESCOM area with the assistance of KREDL.

GESCOM

The Gulbarga Electricity Supply Company Limited (GESCOM) has installed 110 timer switches on street lights as of September 2013. They propose to complete all installations by March 2014.

[k] The current status is as per the tariff order of 2013 / ARR filings of 2014-15.

GESCOM received no response to tenders floated for implementation of the BLY programme. It proposes to contact other sources that supply CFLs/LEDs for the implementation of the programme.

MESCOM

After issuing letters to the concerned authorities continuously for last three years, the Mangalore Electricity Supply Company Limited (MESCOM) has provided timer switches for 10 street light circuits in Mangalore in the first phase.

There was a bid inquiry by MESCOM in April 2011 for the CFL programme, but since there was no response, no replacements materialised. The Belaku Yojana of GoK has proposed 2 CFLs per household for around 10.5 lakh households of BPL, schedule castes and schedule tribes. The scheme is to be implemented with the help of the KREDL.

Specific DSM measures by KREDL

- Energy audit programmes
- Lighting replacement programmes in Udupi, Richmond Flyover, Rajkumar Park and J P park
- Public awareness campaign
- GoK's Belaku Yojana to be implemented by the KREDL

6. Maharashtra

Power scenario

Maharashtra consumed around 119 billion units (BUs) of electricity in 2012-13; about 13% of the total national consumption. The peak demand was about 18,000 MW, of which 16,700 MW was met leaving a deficit of about 6.5%[5]. The average power purchase cost of MSEDCL was Rs. 3.26 according to the tariff order for the year 2012-13[13]. Figure 10 shows the power purchase costs plotted against the total number of units purchased by the Maharashtra State Electricity Distribution Company Limited (MSEDCL) from different sources.

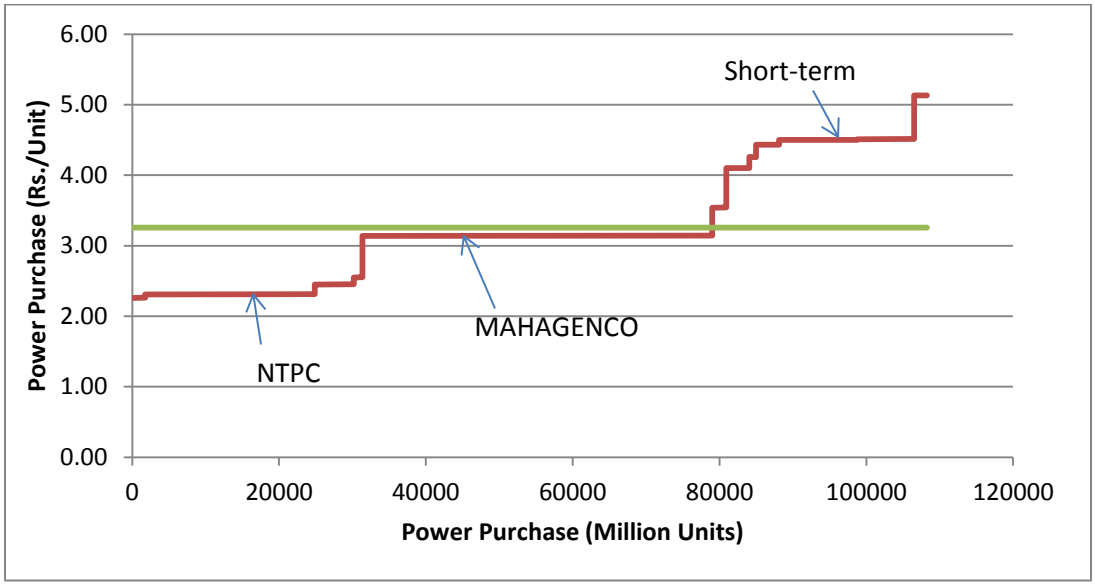

Figure 10: Approved power purchase costs for MSEDCL 2012-13

The average cost of supply for all the DISCOMs was in the range of Rs. 5.56 to Rs. 11.82 per unit. Figure 11 shows the revenue realisation from the major consumer categories for all the DISCOMs for the year 2013-14[13,98–100]. It can be seen that the average revenue realisation from two categories, agricultural and domestic, is below the average cost of supply. These two categories account for more than 40% of the total electricity consumption in Maharashtra.

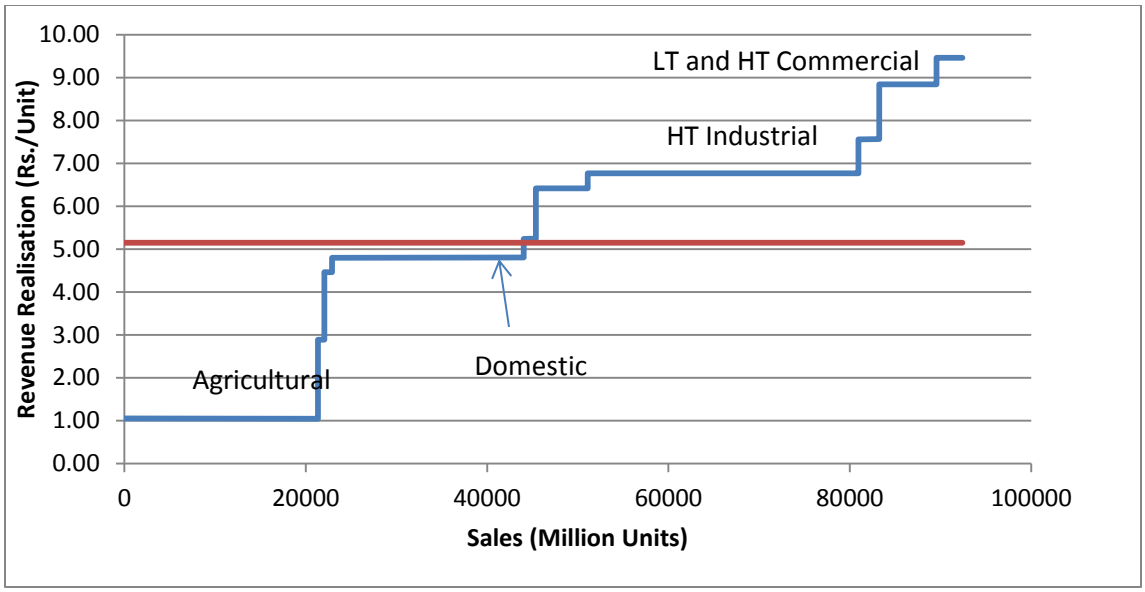

Figure 11: Average Revenue Realisation for Maharashtra DISCOMs 2013-14 as per MYT

Maharashtra's electricity consumption is expected to increase by almost 34% to 145 BUs by 2017-18[6]. The state has an available capacity of around 32,505 MW as on 31.12.2013, and MAHGENCO has planned a capacity addition of 11,000 MW for the 13th five year plan. The ongoing projects to be commissioned latest by 2015 are of around 3,000 MW[101].

There is a significant savings potential from EE/DSM measures in Maharashtra. A study[31] by the National Productivity Council (NPC) has estimated savings of about 10.6% in the state. Considering the sector-wise electricity consumption of 2007-08, it can be seen that there is a potential of saving about 4 BU in the agricultural and domestic sectors in Maharashtra, which has increased substantially over the last six years (see Table 16).

Table 16: Savings potential in Maharashtra

Sector	Electricity consumption (2007-08) (BUs)	Savings potential (BUs)
Domestic	15.3	3.0
Agricultural	4.8	1.4
Industrial	33.9	2.3
Commercial	1.7	0.3

EE/DSM Activities in the State

This section presents an overview of the EE/DSM related activities by different actors in the state.

Maharashtra Electricity Regulatory Commission (MERC)

The MERC has been active in promoting and facilitating DSM in the state. It was one of the first commissions to approve the time of day (ToD) tariff for High Tension (HT) industrial consumers in May 2000.[102] Today, ToD tariff is mandatory for several HT consumer categories and some of the Low Tension (LT) categories with ToD meters. The MERC has also approved incentives and penalties for certain categories of consumers based on the power factor and load factor. In 2010, the commission notified two regulations regarding DSM in the state. The first set of regulations on the DSM implementation framework [103] cover the guiding principles, the planning for and implementation of specific activities, funding sources, the programme approval process, and sharing of information. The second set of regulations [104] has prescribed the methodology to assess the cost effectiveness of the DSM measures and programmes to be implemented in the state. The commission has also formed a DSM consultation committee convened by its secretary with members including the representatives of DISCOMs, the Maharashtra Energy Development Agency (MEDA), the Bureau of Energy Efficiency (BEE), and consumer representatives. The committee regularly meets to review the progress of DSM plans and programmes conducted by the DISCOMS. It also acts as a platform for the DISCOMs to share their experiences and gain knowledge from expert presentations.

Although the regulations require DISCOMs to make DSM a part of their day-to-day activities and consider DSM while planning long time power purchase, there are no specific targets set for the DISCOMs. In the MYT order 2007-10[105–107], the commission did specify a target of 2% of the high cost power purchase to be avoided through DSM. However, it was later discontinued. Hence, even though the DISCOMs have come up with various innovative DSM programmes and measures, the scale has been very small. Also, there are no studies available in the public domain that evaluate the impact of the different tariff mechanisms to encourage DSM like the differential tariff based on time of use, load factor, and power factor. Such studies can measure the actual impact and also lead to better design of such mechanisms. For instance, in the case of the MSEDCL, we found that despite the ToD tariff, the percentage of consumption by the LT industry in the off-peak hours has actually gone down from 33% to 18% in last three years (more details in the section on specific activities by MERC). This point needs to be analysed further. Finally, the commission has been lax in ensuring that the information and data on DSM programmes and measures is put up in the public domain as required by the regulations. The information on the DSM 5-year plans, annual work plans, programme documents, expenditure, and evaluation should all be in the public domain. The commission should also put the minutes of the DSM consultative committee (DSM-CC) in the public domain as well. This is crucial for increasing the accountability of the DISCOMs on the DSM issue.

Distribution Companies (DISCOMs)

The DISCOMs in Maharashtra, particularly the ones in Mumbai, have been actively pursuing DSM activities. All the DISCOMs have a DSM cell and are undertaking various innovative DSM programmes like appliance exchange programmes, agricultural pump replacement, thermal energy storage, and demand response. Each DISCOM's DSM activities are described in detail in 'Specific DSM activities by Maharashtra DISCOMs'. Also, compared to their counterparts in other states, the DISCOMs have been submitting the information on their DSM activities to the MERC.

However, the programmes have mostly remained on the pilot scale. The total expenditure on DSM activities and consequently the estimated savings are just a fraction of the total expenditure on the power purchase cost and the total sales. Although there is some information in the public domain, it is much less than that required by the DSM regulations notified by the MERC. Also, none of the DISCOMs is keen to consider the savings due to DSM in their power purchase planning as required by the regulations. There are several reasons put forth by the DISCOMs as to why they avoid doing so. The success of a DSM activity is based on number of factors such as the approval of specific programmes by the MERC, the consumer response, and the response by the technology provider. Hence, the actual savings realised are beyond the control of the DISCOMs, because of which they cannot consider the savings in their multi-year projections. Also, there are no regulations for monitoring and verification of savings achieved by DSM measures, which makes it difficult to determine the extent of savings.

The general observation is that DISCOMs, particularly private DISCOMs from Mumbai, look at the DSM programmes more as a branding strategy and an opportunity to connect with the consumers rather than something that can actually achieve substantial impact on electricity consumption. In fact, in one of the ARR petitions, a private DISCOM actually clubbed the DSM expenses with the Corporate Social Responsibility (CSR) expenses, thus summarising the DISCOMs' approach to the DSM measures.

Maharashtra Energy Development Agency (MEDA)

In 2003, the Maharashtra Energy Development Agency was designated as the state nodal agency to coordinate, regulate and enforce the provisions of the EC act and implement various programmes in the state. In 2005, the government of Maharashtra created a State level committee under the chairmanship of the Principal Secretary (Energy) and 15 members from various government departments and the energy sector.[108] The members included secretaries from different government departments like urban development, water supply and sanitation, agriculture, and public works, a technical member from the MERC, executives of DISCOMs, representatives of financial institutions and industry associations, and experts from academic institutions. There is no information available about the current activities and status of this committee. The strategic energy conservation plan available on the agency's website[109] is an undated document that plans to implement 11 energy conservation programmes on sectors including residential and commercial lighting, municipalities, agriculture, small and medium enterprises, etc. Again, there is no information available about the current status of the plan. The government of Maharashtra has issued several orders related to energy efficiency during 2008-10[110–112] which includes (a) awards to organisations which get their employees certified under the BEE energy auditor programme, (b) financial help to organisations to prepare detailed project reports for waste heat recovery, (c) providing 90% incentive to street lighting programmes in villages, and (d) mandating all the government agencies to purchase only 4-star or 5-star appliances and T-5 or T-8 tube-lights with electronic ballast. However, there is no information available about the progress of these schemes and whether they are still being undertaken. In the annual reports published by the BEE, the MEDA has claimed that it has achieved the savings in Table 15. However, details about how these savings were achieved, and the expenditure of the MEDA on these activities, are not available.

Table 17: Estimated savings claimed by the MEDA

Year	2007-08	2008-09	2009-10	2010-11
Estimated savings (MU)	48	743	917	530

Specific DSM measures by MERC

Time of day (ToD) tariff

The MERC introduced the time of day (ToD) tariff for High Tension (HT) industrial consumers in the tariff order of May 2000 for the erstwhile Maharashtra State Electricity Board (MSEB).[113] Since then, the MERC has mandated ToD for most HT consumers as well as some LT consumers. The time slots for the applicability of the ToD tariff are the same for all the DISCOMs based on the system peak and off-peak hours. The present incentive/penalty for the ToD tariff for MSEDCL and other DISCOMs is provided in Table 18.

Table 18: Time of day incentive/penalty over the energy charges in Maharashtra

Time slots	**Incentive/Penalty (paise)**	
	MSEDCL	Other DISCOMs
0600 to 0900	0	0
0900 to 1200	80	50
1200 to 1800	0	0
1800 to 2200	110	100
2200 to 0600	-100.00	-0.75

The ToD tariff has been in existence for about 14 years now, but there is no systematic study available in the public domain on the impact it has had over the load curve. A preliminary analysis of data in MSEDCL's ARR petitions for the financial years 2009-10, 2010-11, and 2011-12 shows that for the HT industries consumer category, the percentages of units consumed in the off-peak time period (10 pm – 6 am) has remained constant at about 33%. However, interestingly, in the LT consumer category, despite the ToD, the percentage of units consumed in the off-peak time period has gone down from 33% to 18%. This can be seen in Table 19. This shows that it is important to evaluate the actual impact of the ToD and take corrective measures if required.

Table 19: Annual consumption in off-peak time for HT and LT industrial consumption in Maharashtra

Consumer category	**FY 2009-10**			**FY 2010-11**			**FY 2011-12**		
	Off-peak time consumption (MU)	Total consumption (MU)	%	Off-peak time consumption (MU)	Total consumption (MU)	%	Off-peak time consumption (MU)	Total consumption (MU)	%
HT industrial	7321	22646	32	8258	25024	33	9383	28435	33
LT industrial	1885	5828	32	1169	4549	26	963	5347	18

Load Factor and Power Factor incentive

Load factor indicates the percentage of the contracted demand utilised by the consumer. It is defined by the MERC as the ratio of actual consumption in a month to the maximum possible consumption based on the contracted demand and the total number of hours in a month less the hours of load shedding. The rationale behind incentivising high load factor is to encourage consumers to shift load to different hours of the day so that the load curve is flat and their contracted demand is less. All the DISCOMS have the same load factor incentive scheme which is limited to some categories of HT consumers. Consumers are entitled to a rebate of 0.75% on the energy charges for every percentage point increase in the load factor from 75% to 85%, i.e. the consumer with an 85% load factor will get a rebate of 7.5% on energy charges. A further increase in the load factor is entitled to a rebate of 1% on the energy charges for every percentage point increase in the load factor from 85%, with the maximum ceiling on the rebate set at 15%. If the billing demand exceeds the contracted demand, then the load factor incentive is not applicable for the month. However, the billing demand for the load factor incentive scheme excludes the demand recorded during the off-peak hours (10 pm to 6 am). So if the consumer has exceeded the contracted demand by consumption in the off-peak hours (10 pm to 6 am), then the consumer can avail the load factor incentive but will pay penal charges for exceeding the contracted demand.

The MERC also has a power factor penalty and incentive scheme for most HT and LT consumers. The incentive/penalty is determined as the percentage of the amount of monthly bill including everything except taxes and duties. For consumers with an average power factor more than 0.95, the incentives are in the range of 1-7% as shown in Table 20. The power factor is measured or computed up to 3 decimals after universal rounding off. If it is not possible to measure the power factor by the meter, the commission has prescribed a method for calculating it.

Table 20: Incentive for the high power factor in Maharashtra

Level No.	Range of power factor	Power factor level	Incentive
1	0.951 to 0.954	0.95	0%
2	0.955 to 0.964	0.96	1%
3	0.965 to 0.974	0.97	2%
4	0.975 to 0.984	0.98	3%
5	0.985 to 0.994	0.99	5%
6	0.995 to 1.000	1.00	7%

The penalty for the consumers with an average power factor less than 0.95 are in the range of 2%-10% as seen Table 21.

Table 21: Penalty for low power factor in Maharashtra

Level No.	Range of power factor	Power factor level	Penalty
1	**0.895 to 0.900**	**0.90**	**0%**
2	**0.885 to 0.894**	**0.89**	**2%**
3	**0.875 to 0.884**	**0.88**	**3%**
4	**0.865 to 0.874**	**0.87**	**4%**
5	**0.855 to 0.864**	**0.86**	**5%**
6	**0.845 to 0.854**	**0.85**	**6%**
7	**0.835 to 0.844**	**0.84**	**7%**
8	**0.825 to 0.834**	**0.83**	**8%**
9	**0.815 to 0.824**	**0.82**	**9%**
10	**0.805 to 0.814**	**0.81**	**10%**

Similar to the ToD tariff, the load factor and the power factor scheme has been in place for a long time. However, there is no systematic study available in the public domain that evaluates the impact of these incentives and penalties on consumer behavior, and the subsequent improvement in the power factor and the load factor. Such a study is a necessary requirement in order to effectively design tariff mechanisms.

Load management charge and rebate

In 2006, the MERC introduced a Load Management Charge (LMC) and Rebates (LMR) in Mumbai for all the residential and commercial consumers with consumption of more than 300 units, and all the industrial consumers regardless of their level of consumption.[114,115] According to the directive, the consumers had to reduce their monthly consumption to less than 80% of the corresponding month of the last year. Consumption above 80% would be charged at a rate twice that of the highest tariff chargeable in the respective tariff category. Similarly, reduction of consumption below 80% was incentivised at 50% of the normal chargeable rate. The money collected through this charge was to be maintained in a separate fund used for energy conservation and demand side management. However, the order sparked off considerable protests from the consumers since it had a significant impact on the tariff. Subsequently, the MERC had to discontinue the LMC and LMR[21]. The MERC re-iterated that economic signals are important to encourage consumers to undertake energy efficiency and conservation measures, but also agreed that the LMC had caused economic hardships to consumers, especially industrial consumers, and hence discontinued the practice. It asked DISCOMs to refund the money collected through LMC. Most of the DSM programmes conducted in the recent past have been made possible by the LMC fund.

DSM implementation framework regulations

The MERC notified the regulations to guide the DISCOMs on the DSM implementation framework in 2010.[103] The regulations require the DISCOMs to make DSM an integral part of their day-to-day

operations and plan, design, and implement DSM measures on a sustained basis. The DISCOMs have to consider DSM in their long-term power purchase planning, and can recover the costs from the Annual Revenue Requirement (ARR), provided the measures are cost-effective. The regulations also mention that the commission may direct the DISCOM in the future to adopt other funding mechanisms such as a public benefit charge. The DISCOMs are required to make DSM plans for the MYT term, annual work plans and programme documents, and make them all available on their websites. The targets and the annual budgets are to be decided by the DISCOMs themselves. The DISCOMs are also required to conduct load research, consumer surveys, Integrated Resources Planning (IRP), load forecasting, and other studies on a regular basis. The regulations have also established a DSM Consultative Committee (DSM-CC) convened by the secretary of the MERC and including representatives from DISCOMs, the Maharashtra Energy Development Agency (MEDA), the Bureau of Energy Efficiency (BEE), consumer organisations, educational and research organisations, and also experts from industry and the government nominated by the convener. The primary objectives of the DSM-CC are (a) to assist the commission in evaluating, reviewing, and monitoring the DSM measures by DISCOMs; (b) to advise the DISCOMs on conducting various studies like load research, consumer behavior, etc. and (c) to act as a platform for the DISCOMs to share their experience and interact with the commission about DSM.

The DSM implementation framework regulations have definitely been the key driver of the various innovative DSM programmes implemented by the DISCOMs. The DSM-CC has been regularly meeting over the last few years in the commission's office. However, one key lacuna of the regulation is the absence of specific targets for the DSM budget and savings. It is left to the DISCOM's discretion to identify the targets. This may have been one of the reasons for the low scaling-up of the pilot DSM programmes. Also, the commission has been lax about ensuring compliance with some of the directives of the regulations such as the availability of DSM plans, annual work plans and programme documents on the DISCOM websites. This information is critical both for sharing experiences and also making the DISCOMs accountable.

Cost effectiveness assessment regulations for DSM measures and programmes

These regulations[104] were notified in 2010 along with the regulations on the DSM implementation framework. According to these regulations, the DSM measures and programmes have to pass three cost-effectiveness tests in order to be approved by the MERC. The Total Resource Cost (TRC) test is the main test which requires the net present value (NPV) of the DSM programme i.e. the difference between the NPV of benefits and costs, to be positive. The benefits constitute the avoided power purchase cost due to the estimated savings from the DSM measure, and the costs includes the cost of technology, installment, maintenance as well as the programme's operating cost. The DSM measures should have a positive value in the Total Resource Cost (TRC) test in order to be approved. The second test is the Ratepayer Impact Measure (RIM) test in which the impact on the tariff is estimated by including the loss of revenues due to the avoided sales from the DSM measure as a cost in the cost-benefit equation of the TRC test. When the RIM test yields a negative number for DSM programmes, such programmes have to pass the Life-cycle Revenue Impact – RIM (LRIRIM) test, in which the tariff impact as calculated in the RIM test over the total annual sales of the DISCOM has to be less than Re. 0.01/kWh or less than 0.01% of the existing tariff.

DSM measures and Power Purchase Planning

The DSM regulations[103] require DISCOMs to consider savings from DSM measures while planning for their power purchase but do not specify any targets. In MYT 2007-08[105,106,116], the MERC set a target for the Tata Power Company – Distribution (TPC-D), Reliance Infrastructure (R-Infra) and Brihan-Mumbai Electricity Supply and Transport (BEST) for two years to reduce 2% of the costly power purchase in the ARR. However, none of the DISCOMs reduced the amount in the ARR in their subsequent petitions, citing different reasons: they said DSM is a new concept, the savings are unreliable, and there is no methodology to estimate the savings. Nonetheless, the MERC reduced the amount equivalent to 2% of the costly power purchase from the ARR. However, this target was discontinued in subsequent tariff orders. Also, the Appellate Tribunal for Electricity (ATE) in its order on the appeal by TPC-D[117], ruled that such deduction of the power purchase cost on account of DSM which is an uncontrollable factor is not valid legally. Hence, the deducted power purchase cost was trued up in subsequent ARR petitions. In the MYT 2013-16, the MERC has asked DISCOMS to consider the savings from DSM measures before estimating power purchase. The DISCOMs from Mumbai have estimated total cumulative savings of about 100 MU in the MYT control period (2012-13 to 2015-16), which is just 0.1% of the total estimated sales in the four years accounting, to about 75,000 MU. Also, these regulations have been followed only by the DISCOMs in Mumbai. The MSEDCL, the biggest of all DISCOMs contributing to 84% of sales in Maharashtra, has ignored the directives regarding DSM in its ARR petitions.

Specific DSM activities by DISCOMs in Maharashtra

Tata Power Company – Distribution (TPC-D)

TPC-D established a DSM cell in 2007[118] and has been active in designing and implementing various DSM programmes such as appliance exchange, demand response, thermal storage, and consumer awareness. These programmes (briefly described in the next section 'DSM programmes by TPC-D') are implemented under the 'My Mumbai, Green Mumbai' campaign and are funded either through the balance of the Load Management Charge (LMC) fund or recovered through the ARR. The DSM cell has a top-level management officer, two mid-level management officers and three executive level officers.[119] In their business plan to the MERC, the TPC-D submitted that it plans to spend about Rs. 56 crores on DSM which includes expenditure on relevant research studies, DSM cell employees' salaries, and about 15 DSM programmes including new programmes like the ones for gas and solar water heaters, standard offer programmes, and an energy efficiency power plant. However, the MERC approved only a Rs. 17 crores cumulative budget for the MYT based on the programmes already approved. The TPC-D can take approval of the new programmes following which the expenditure can be recovered from the ARR. The detailed work plan is not available on their website. Although the TPC-D has implemented various DSM programmes, most of the programmes are on a pilot level basis. The total annual expenditure (as submitted in the ARR) has been less than Rs. 1 crore from financial year 2009-10 to financial year 2011-12. Even if the expenditure from the LMC fund is considered, it is just a fraction of their annual revenues as shown in Table 22: Load management charge expenditure. Also, there are no details regarding the MYT plans, the annual work plan, monitoring and evaluation of reports, and programme design documents on the website as required by the DSM regulations.

Table 22: Load management charge expenditure by TPC-D

	Actual				Projected (Approved)			
Year	2008-09	2009-10	2010-11	2011-12	2008-09	2009-10	2010-11	2011-12
Expenditure (Rs. crores)	0.16	0.9	0.9	0.91	2.21	4.28	5.33	5.56

DSM programmes by the TPC-D

Appliance exchange programme:

Under this programme, consumers are given discounts to replace their existing inefficient appliances with 5-star appliances. The old inefficient appliances are scrapped in an environmentally friendly manner so that they do not find their way back to the market, and cause no harm. The TPC-D has tied up with vendors to provide these 5-star appliances according to the technical specifications provided by the BEE. Decorative ceiling fans are also included. The rebates are to the tune of 50-60% of the MRP and hence the programmes have got a good response from consumers. The consumers can register for this programme through the 'My Mumbai, Green Mumbai' website[120]. The programme is funded from the LMC fund, and after its exhaustion, will be recovered from the ARR. The TPC-D initiated this programme with 2000 fans, and then extended it to about 10,000 ceiling fans. The TPC-D is now extending the programme to other appliances like refrigerators, air-conditioners and tube-lights. It is also extending the programme to new purchases. In the case of refrigerators, consumers can buy both Direct Cool and Frost Free refrigerators with the maximum size limit of 300 litres. The TPC-D is also offering an additional one-year warranty on refrigerators under these programmes. The AC programme is limited to a 1.5 tonnes AC. The savings are estimated using a deemed savings method where a baseline efficiency model and the annual consumption pattern is assumed based on market study and load research. The savings are then estimated based on the difference between the consumption of the efficient and inefficient appliance.

The primary reason these programmes have worked is because of their substantial discounts to the tune of 40-60%. However, scaling up these programmes will require significant budget outlays and consequently substantial tariff impact especially for the non-participating consumers. The DISCOMs have found it difficult to encourage manufacturers to join this programme. One reason is the lack of availability of 5-star products which will comply with the latest standards. The other reason is that since consumers deal directly with manufactures under these programmes, the dealers are sidelined and upset, which the manufacturers are keen to avoid. There are also some issues regarding consumers. Consumers treat the product as one bought with the DISCOM's guarantee. Hence, if the product fails to operate, consumers complain to the DISCOM instead of the manufacturer. There have also been some complaints of the savings not being directly visible in the monthly electricity bill.

Thermal Energy Storage programme:

TPC-D has launched India's first Thermal Energy Storage (TES) Program for commercial and industrial consumers. The idea behind the TES is to run a building's central AC plants at night and convert water to ice which can be stored in ice tanks. During the day time, the AC plants are switched off and the building is cooled with the energy stored in ice. The TES provides benefits for consumers as well as the DISCOM. The consumers can avail the ToD tariff where they are benefited by Rs. 1.5/kWh. The TES system also improves the load factor and the power factor and consumers can benefit from the incentives based on them. With the decrease in overall load, the investment in transformer capacity also goes down. The backup Diesel Generation (DG) capacity can be reduced. For the utility, it results in a flatter load curve and saves on the high power purchase cost. Under this programme, the TPC educates the consumer about installing TES system and provides an online measurement and verification system for the consumer's chillers. It provides an additional rebate of Re. 1/kWh on night consumption. As of January 2014, the TPC has engaged 15,000 tonnes (TR) capacity in the programme and achieved a load shift of 3.6 MUs[26]

Demand response:

The TPC-D has a manual Demand Response (DR) programme where commercial and industrial consumers with a connected load above 500 kW offer voluntary load curtailment to manage peak demand. The consumers enroll in the programme and a MoU is entered into. In case of events, the TPC-D calls the aggregator who in turn calls individual consumers and asks them to curtail load. The consumption data during the event is compared with the baseline estimated using the load profile of 4-5 similar days. The events last up to 2 hours each and there can be a maximum of 50 events in a year. The TPC-D offers an incentive of Rs. 2.25/kWh for every unit curtailed. The incentive is paid to the aggregator who in turn pays the consumers. The aggregator also helps the consumers with energy audits to identify the curtailable load at short notice. In 2012, the contracted capacity was around 12 MW, and they were planning to reach 25 MW[27].

Awareness activities:

The TPC-D has generic information about DSM on their website[120], and a booklet with tips on saving energy from different appliances[121]. The TPC-D also initiated Club Enerji, an informal energy conservation club in 2007, to create awareness about energy conservation among the public with a focus on children. Its activities include publishing energy conservation booklets, conducting essay competitions and quizzes, and several workshops and events. The TPC-D has also conducted energy audits of different commercial and industrial consumers.

Reliance Energy Infrastructure (RInfra):

Reliance Energy Infrastructure (RInfra) also initiated the DSM cell around 2007 and is currently headed by a vice president (VP). Appliance exchange programmes form the bulk of RInfra's DSM programme portfolio. These programmes are similar to those undertaken by the TPC-D as they are common programmes approved by the MERC. In the financial year 2011-12, business plan order, RInfra replaced 3,939 numbers of existing lighting fixtures of residential and commercial consumers with T5 Fluorescent

Tube Lights (FTLs), 3,766 ceiling fans and 50 5-star AC programmes. The total savings were less than 0.5 MU.

Rinfra has been very sketchy in their submissions to the MERC on DSM. In the tariff orders of 2008-09 and 2009-10, Rinfra mentioned a budget of Rs. 42 crores for 2008-09 and Rs. 70 crores for 2009-10. This expenditure was not recovered from the ARR as it was said to be covered by the LMC. However, in 2009-10, the LMC fund balance was under Rs. 8 crores. There has been very little information on RInfra's expenditure on DSM in subsequent years. In their MYT petition for the financial years 2012-13 to 2015-16, they have estimated an annual savings of about 7 MU. However, there are no details on how to achieve these savings.

Brihan-Mumbai Electric Supply and Undertaking (BEST)

BEST has a separate website for DSM[122]. Along with the generic information on energy efficiency, conservation and DSM, they also have programme design documents from 2010 on providing incentive to about 25,000 T-5 FTLs at the rate of Rs. 200/FTL, and replace about 5000 inefficient fans with 5 star ceiling fans. However, there is no information on the progress of these programmes. There is also no clarity in its submissions to the MERC. Since most of the expenditure is covered through the LMC, there are no details about the expenditure in the tariff orders. At the end of 2011-12, BEST had about Rs. 6 Crore in their LMC fund.

BEST has their detailed DSM plan for the MYT control period 2012-13 to 2015-16 on their website, the only DISCOM to do so. In the plan, they have ambitious appliance exchange programmes to replace 50,000 tube-lights with FTLs, 15,000 ceiling fans, and 1,500 ACs, a thermal energy storage programme of 1,000 TR, and measures to replace inefficient chillers. They plan to spend about Rs. 19 crores over the 4 years saving about 8.6 MU per year. Table 23 shows the savings and expenditure of the 5 year plan and compares it with the total sales and power purchase by BEST for the MYT.

Table 23: Savings and expenditure on DSM for BEST

BEST	2012-13	2013-14	2014-15	2015-16
Projected savings (MU)	8.6	8.6	8.6	8.6
Total sales (MU)	4300	4700	5000	5300
%	0.2%	0.2%	0.2%	0.2%
Expenditure (Rs. crores)	4.2	4.4	4.6	4.8
Total power purchase cost (Rs. crores)	2300	2600	2500	2200
%	0.2%	0.2%	0.2%	0.2%

Maharashtra State Electricity Distribution Company Limited (MSEDCL)

MSEDCL is the largest DISCOM in Maharashtra. Limited information is available about DSM activities by MSEDCL. A document available on the MSEDCL website has provided information on two

programmes.[123] Under the first programme, the MSEDCL replaced about 5,000 inefficient ceiling fans at its own 33/11 kV sub-stations and section offices. The MSEDCL mentioned that the sub-stations and the section offices are its commercial consumers and hence the programme is a DSM measure for consumers!

The second programme undertaken was a pilot project on replacing inefficient agricultural pump-sets in Solapur district. The MSEDCL initiated this pilot with the Bureau of Energy Efficiency (BEE) in 2010. The pilot was to test the ESCO based programme for Agricultural DSM through public private partnership. The pilot's target was to replace 3,530 pump-sets and provide free replacement/maintenance for 5 years. The ESCO would pay for the initial capital cost and would recover the cost from MSEDCL annually from the benefits accrued due to savings from the efficient pump-sets. About 2,200 pumps were replaced before the programme was closed in December 2012 due to a scarcity of water[123]. More details on this programme can be found in: RFQ, presentation and IEA document[124],[125].

Another programme worth mentioning is the pilot programme in Nashik in 2005 to distribute 3 lakh CFLs resulting in savings of about 10 MW. MSEDCL did not provide any financial incentive on the purchase of CFLs but only acted as a facilitator. The consumers had the option of either buying CFLs with a one-time payment or through installments which would be recovered by the MSEDCL through monthly bills. Three vendors were selected through a bidding process and the CFLs were available at the bill collection centres, retail shops and through women self-help groups. The programme was widely marketed by the MSEDCL. Prayas (Energy Group) conducted a systematic evaluation of the programme.[23] It was found that the programme was successful in achieving a high level of penetration of CFLs and resulted in a greater awareness. However, the savings were less than the estimated savings because people used CFLs to replace FTLs and bulbs in areas with less use. There were some issues about the quality of the CFLs. The power factor was observed to be low and there were significant failure rates as well. The learning from the pilot programme was supposed to be incorporated in a statewide CFL programme, which never happened.

Specific DSM Programs by MEDA[109]

MEDA has been conducting various energy conservation programmes in the state. A strategic action plan has been developed for EC activities in the state. Some objectives of the plan are to achieve substantial reduction in energy consumption and peak loads, implement cost-effective programmes to enhance EE, reduce capital requirements for capacity expansion, and raise awareness. The current programmes of the MEDA are described in brief below. More details are available at their website[l].

The first programme is the Street Lighting and Water Pumping scheme for Municipal Corporations/Municipal Councils/MJP. The consumption of energy in water pumping and street lighting is 4% and 1.5-2% respectively in the state, with an energy savings potential of around 30% in these sectors. The savings could be achieved by using automatic light sensors, voltage dimmers, Supervisory Control and Data Acquisition (SCADA) and web based monitoring in street lighting, and using similar measures in the water pumping systems as well. The government has approved financial assistance to

[l] http://www.mahaurja.com/

implement these measures in the Municipal Corporations/Municipal Councils and MJPs. Financial assistance of Rs. 20 lakhs is provided for implementing street lighting measures and Rs. 5 lakhs for water pumping measures has been sanctioned by the government. One municipal corporation will be selected every year, and following energy audits and a proper tendering process, the measures will be implemented in these corporations.

The second programme is the Save Energy programme of the MEDA. The first step to assess the energy conservation potential in any sector is to perform an energy audit. To assist energy audits in industries, commercial buildings, government/semi-government undertakings and local self-government buildings, residential complexes, municipal street lights and water pumping, financial assistance is provided. The range of financial assistance is from Rs. 40,000 to Rs. 20,000 depending on the category of consumer and the type of the energy audit firm (category A or category B).

The third programme is the walk-through energy audit programme for SMEs. In order to identify the energy savings potential in SMEs, the MEDA provides financial assistance to the empanelled consultants. The MEDA assistance is Rs. 3000/-, and the SME unit is supposed to contribute Rs. 2000/-.

The fourth programme is the Waste Heat Recovery Programme which encourages industrial units to generate power and utilise waste heat. The assistance is for the preparation of detailed project reports (DPR) for the stated purpose. The financial assistance is for the preparation of DPRs, Rs. 1.00 lakh for power generation and Rs. 50,000 for heating.

The fifth programme is the Energy Conservation pilot project implemented in government/semi-government/urban local bodies. It is estimated that there is an energy conservation potential of around 25% in these buildings. The scheme provides financial assistance of Rs. 25 lakhs per financial year to run pilot programmes to conserve energy in these buildings. This includes replacement of inefficient appliances, modifications in the existing appliances, use of renewable energy, installation of building energy management systems, etc.

7. Tamil Nadu

Power Scenario

Tamil Nadu (TN) is one of the most industrialised states in the country. TN consumed around 76 BUs of electricity in 2012-13[5]. There was an energy deficit of 17.5% and peak deficit of 13% during 2012-13[5]. The approved average power purchase cost for Tamil Nadu Electricity Generation and Distribution Company (TANGEDCO) was Rs. 3.38 according to the tariff order for the year 2013-14[16]. Figure 12 shows the power purchase costs plotted against the total number of units purchased by TANGEDCO from different sources. It can be seen that around 4% of the power was purchased at Rs. 6.47 per unit through the IPPs and other sources, which is significantly higher than other power purchase costs.

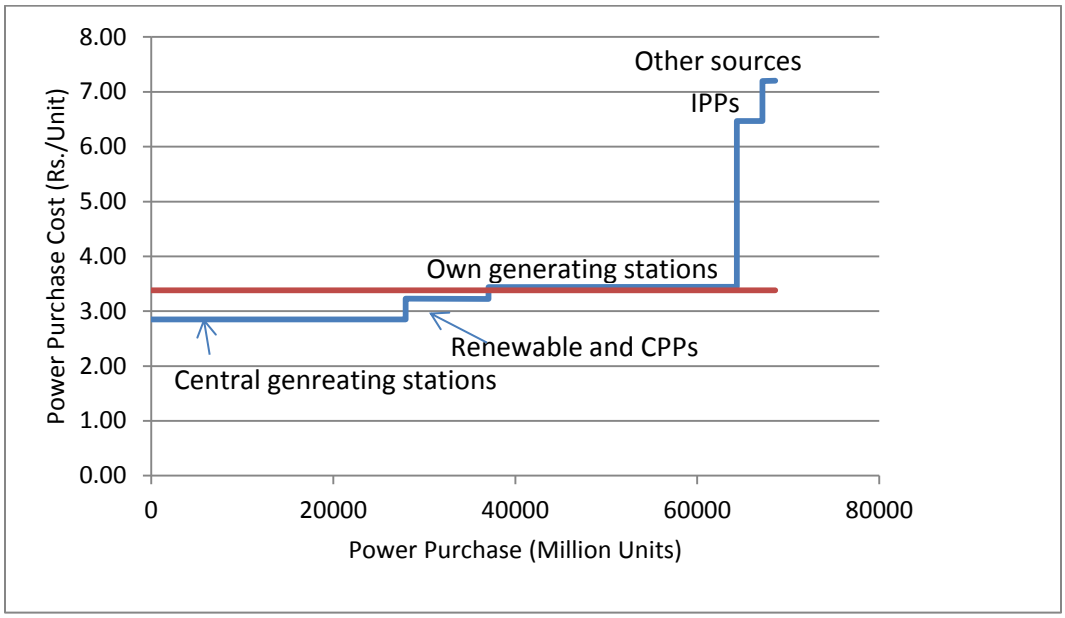

Figure 12: Approved power purchase costs for Tamil Nadu DISCOMs 2013-14

The average cost of supply for TANGEDCO was Rs. 5.24 per unit. Figure 13 shows the approved revenue realisation from the major consumer categories for TANGEDCO for the year 2013-14[16]. It can be seen that the revenue realisation from domestic and agricultural category is lower than the average cost of supply. These two categories account for more than 50% of the total electricity consumption in Tamil Nadu.

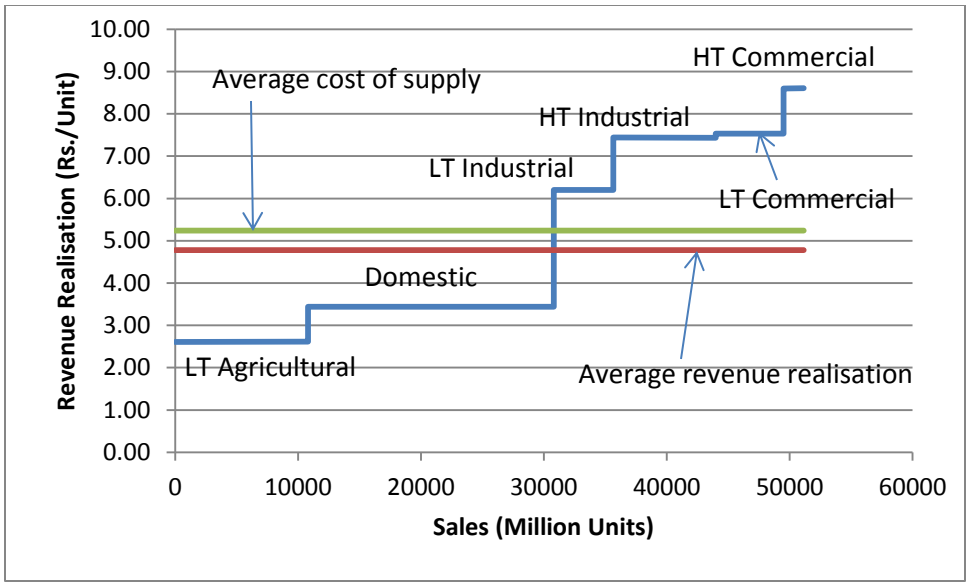

Figure 13: Average revenue realisation for Tamil Nadu DISCOMs 2013-14

It is estimated that there will be a peak deficit of 34% during 2013-14[5]. Tamil Nadu has an available capacity of around 17,500 MW as on 31.12.2013. TANGEDCO has planned a capacity addition of around 12,000 MW within the next five years which would need an investment to the tune of Rs. 65,000 crores.[126]

There is a significant savings potential from EE/DSM measures in Tamil Nadu. A study[31] by the National Productivity Council (NPC) has estimated savings potential of about 13% of the total energy sold. Considering the sector-wise electricity consumption of 2007-08, it can be seen that there is a savings potential of about 6 BU in the domestic and agricultural sectors. (See Table 24).

Table 24: Savings potential in Tamil Nadu

Sector	Electricity consumption (2007-08) (BUs)	Savings potential (BUs)
Domestic	13	2.6
Agricultural	10	3
Industrial	27	2
Commercial	0.9	0.1

DSM activities in the state

This section presents an overview of EE/DSM related activities by different actors in the state.

Tamil Nadu Electricity Regulatory Commission (TNERC)

In 2009, the commission issued an order asking the erstwhile Tamil Nadu Electricity Board (TNEB) to constitute a separate DSM cell along with dedicated staff for handling DSM activities. The order also asked the TNEB to submit DSM plans along with ARR requirements. In the subsequent tariff orders[16,127,128], the commission has emphasised the importance of DSM and asked TANGEDCO to undertake activities in industrial, commercial, and residential categories. However, the directives are generic with no specific actions and targets for savings. The TNERC also approved Rs. 10 Crore for expenses toward DSM to be included in the ARR. However, no information is available about the utilisation of these funds by TANGEDCO.

In February 2013, the commission notified the DSM regulations[129]. These regulations are based on the model regulations published by the FoR. The regulations cover the guiding principles, the planning and implementation of specific activities, funding sources, the programme approval process, and sharing of information. The regulations also require that the commission constitute a DSM Consultative Committee (DSM-CC) within one year of the regulations coming into force to oversee the DSM activities in the state, advice TANGEDCO on conducting various DSM activities, and also act as a platform to connect to different stakeholders. In May 2014, the commission issued a public notice[130] requesting nominations from experts in different fields to be members of the committee. The regulations also issued deadlines for TANGEDCO to conduct specific tasks including (a) undertaking a first assessment of technical potential within six months of the regulations coming into force; (b) preparing a DSM plan within one year of the regulations coming into force which includes the overall goals and detailed description of programmes. There is no information whether these specific tasks were met by TANGEDCO. On the tariff front, the TNERC has approved tariff mechanisms like Time of Day (ToD) tariff and low power factor surcharge since quite some time.

TANGEDCO

TANGEDCO has a DSM cell headed by a superintendent engineer which has about 7 employees. The cell was established in 2009 after the TNERC issued orders (July 2009) related to DSM. In response to the orders and directives of the commission, TANGEDCO formed in-house energy audit teams at the headquarter and circle levels. It convened regular meetings with the superintendent engineer and nodal officers for evolving EE/DSM activities for street lighting, water pumping, etc. It created awareness by celebrating the energy conservation day as well as the energy conservation week, along with distribution of pamphlets containing information on energy efficient devices in every circle. All the heads of department were addressed to implement DSM in government departments, and the superintendent engineer was appointed as a nodal officer to coordinate DSM activities**.**

In order to fulfill the rising energy demand, TANGEDCO adopted the Restriction and Control (R & C) measures first in 2008, by introducing 20% power cuts for HT industrial and commercial consumers on their base demand. It also implemented load shedding in various suburbs of Tamil Nadu. In spite of these measures, there was a deficit in the range of 2500 MW to 3000 MW. In February 2012, the power cuts were increased to 40%, and the number of hours of load shedding was also increased along with the introduction of power holidays for certain categories of consumers. In April 2012, TANGEDCO filed a petition to levy energy and demand charges for HT, LT and LTCT consumers exceeding their approved

quota. These measures were imposed so as to reduce the deficit. Subsequently, the Appellate Tribunal for Electricity directed that these measures be lifted. TANGEDCO then suggested various measures which included accurate load forecasting, DSM measures like reactive power management (imposing penalty for not maintaining the power factor of 0.9) , peak load management (time of day metering - 20% on energy charges for consumption during peak hours and 5% reduction for consumption during non-peak hours), energy efficiency measures (distribution of CFLs, awareness of star-labelled appliances, LED lighting, and preparation of a DSM action plan with TERI) and energy conservation measures to reduce the energy and peak demand.

TANGEDCO in the above petition had proposed to implement BLY across 1.4 crores domestic consumers, but this programme was not implemented due to an increase in the price of phosphor (an ingredient which goes into the making of CFLs). Subsequently, the Government of Tamil Nadu has sanctioned Rs. 14.63 crores to distribute CFLs in hut services, and a scheme for metered domestic consumers has also been initiated phase-wise. There is no information available about the progress of the above programme. Some in-house programmes like the use of LEDs and T-5 lamps were recommended for the offices and substations of TANGEDCO and The Tamil Nadu Transmission Corporation Limited (TANTRANSCO). The corporations were requested to use day light sensors and LED lights for street lights under their jurisdictions.

TNEI

In Tamil Nadu, the Electrical Inspectorate (EI) is the State Nodal Agency responsible for coordinating, regulating and enforcing the provisions of the Energy Conservation (EC) Act, 2001. The EI also has at its disposal the SECF for implementing the Government schemes, but it is observed that the fund is by and large unutilised. Of the Rs. 5.28 crores allocated to this fund, only Rs. 1.5 crores has been spent. The other schemes that the EI is responsible for are PAT, ECBC and S & L schemes. It is necessary to have adequate man power resources along with enough financial support to implement these schemes successfully. Currently, the EI has very scant resources available for its implementation.

The Government of Tamil Nadu has also formed a State Energy Conservation Mission on 18.10.2012[131] to coordinate and monitor as well as assist the government in policy formation related to energy conservation and efficiency schemes. Nevertheless, we have not come across specific targets issued by the SECM officials for energy savings in any of the references that we have perused.

Specific DSM measures by TNERC

DSM Regulations

TNERC has notified DSM regulations in February 2013. These regulations are broadly based on the FoR model regulations. These regulations are based on the basic principle that every DISCOM should make DSM an integral part of their day-to-day planning. The DSM activities undertaken by the DISCOM should be cost effective, protect the interest of the consumers, and result in overall tariff reductions. These guidelines are even applicable while planning for long-term power procurement, load management and while calculating the impact on the energy and demand. The DISCOM should carry out an assessment of the technical potential of DSM one year before the start of every MYT control period. Along with the DSM cell, there should be a DSM sub-cell at the region level headed by an officer not below the rank of executive engineer, and the sub-cells should be provided an optimum workforce for DSM related jobs. There is no information whether TANGEDCO has sub-cells in each region, and whether it has submitted the DSM plan for the MYT period after assessing the technical potential. The DSM regulations were notified one and a half years ago, but there seems to be little progress on this front in Tamil Nadu as is evident from the data available in the public domain.

The regulations clearly specify the formulation of a DSM consultation committee which shall assist TANGEDCO and the commission to drive the DSM programme. The functions of the DSM-CC in brief are to advise the licensee on conducting surveys, load research to assess DSM potential, approve awareness activities/campaigns, advise innovative tariff offerings to promote DSM, review DSM programmes and plans submitted by the licensee, and advise the commission and provide support to it for programme monitoring, review, evaluation, measurement and verification. The TNERC had issued a public notice to invite nominations from experts in different fields to be members of the consultation committee in May 2014, but there is no information available about whether the committee has been formed or not, and further progress.

Time of day (ToD) tariff

The ToD tariff or peak hour charges as they are referred to in Tamil Nadu have been in existence since 2002 (tariff order 2003). There was a 20% surcharge on normal tariff for HT industrial consumers using electricity between 6 am and 9 am, and 6 pm and 9 pm. In 2002, the commission decided to provide a rebate of 5% for HT industrial consumers for consumption between 10 pm and 5 am. The erstwhile TNEB was asked to submit data on ToD consumption, and depending on the impact and response to the ToD tariff, the commission was supposed to modify the rates and also consider extending it to other consumers in the subsequent tariff revision exercise. However, there was no change in ToD rates or timings in the next tariff order[127] which was issued in July 2010. The ToD rates and timings are still the same and only applicable to HT industrial consumers[16], and are included in Table 25 for HT1 (A) consumers.

Table 25: Time of day tariff in Tamil Nadu

Peak hours	Energy charges

0600 hrs to 0900 hrs 1800 hrs to 2100 hrs	20% extra on energy charges
2200 hrs to 0500 hrs	5% reduction on energy charges

There have been consistent objections from consumers regarding the basis for identifying the time slots for the ToD tariff. There was also a directive from the Appellate Tribunal[16] asking the commission to re-determine the ToD tariff based on a systematic study. In the last three tariff orders[16,127,128]the commission has been asking TANGEDCO to submit a report on the ToD consumption and its impact on the load pattern. However, TANGEDCO has paid no heed to the directives, and the TNERC in turn has continued with the tariff rates and time slots from 2002.

It is interesting to note that the peak consumption has not substantially decreased due to the ToD tariff, but there is a certain increase in the off-peak consumption (see Table 26).

Table 26: Time of day consumption in MU[132]

Sr. No.	Financial Year	Normal consumption	Peak	Off-peak	Total
1	2010-11	4,210	132	80	4,422
2	2011-12	9,550	300	181	10,032
3	2012-13	7,563	238	143	7,944
4	2013-14	8,670	273	164	9,107

Low Power Factor Surcharge

The TNERC has directed to levy a low power factor (PF) surcharge for all HT consumers and some LT categories with load above 25 HP. For HT consumers, the minimum allowable PF is 0.9. If the PF is below 0.9 then a surcharge is levied in the range of 1%-2% as shown in Table 27. For low tension consumers, the minimum allowable PF is 0.85. If the PF is below 0.85, then a surcharge is levied which can range from 1% to 2% as shown in Table 29.

Table 27 : Low power factor surcharge for HT consumers in TN

Power Factor Range	Low Power Factor Surcharge
Below 0.90 and up to 0.85	1% of the current consumption charges for every reduction of 0.01 in power factor from 0.90
Below 0.85 to 0.75	1.5% of the current consumption charges for every reduction of 0.01 in power factor from 0.90
Below 0.75	2% of the current consumption charges for every reduction of 0.01 in power factor from 0.90

Table 28: Low power factor surcharge for LT consumers in TN

Power Factor Range	Low Power Factor Surcharge
Below 0.85 to 0.75	1% of the current consumption charges for every reduction of 0.01 in power factor from 0.85
Below 0.75	2% of the current consumption charges for every reduction of 0.01 in power factor from 0.90

The lead + lag logic adopted to calculate the billable power factor has been opposed by many consumers. The consumers have also demanded incentive for higher power factor, but the commission has rejected the demand with the justification that a higher power factor is beneficial to the consumers themselves and hence does not require incentives. In the last two tariff orders, the commission has asked TANGEDCO to introduce kVAh billing, but the DISCOM has not introduced it yet.

Additionally, the commission also requires all the motors/pumps connected in the LT consumer category to be approved by BEE/BIS, and those above 3 HP to be provided with BIS certified capacitors to improve the power factor. Non-compliance shall invite compensation charges. It is not clear if this is being regularly checked by TANGEDCO.

Specific DSM activities by TANGEDCO

Efficient lighting

As announced by the GoTN in the budget assembly session 2012, TANGEDCO proposes to implement a one CFL to hut service across the state, and 1 crore CFLs to metered domestic consumers, at a subsidised rate of Rs. 15/- per CFL to offset peak demand. Villupuram and Kanyakumari districts were selected for implementing the scheme, and the procurement of CFLs is under process. In house, they propose to use LED lights in the cabins of head of departments.

Efficient Pumping

TANGEDCO has made it mandatory to use energy efficient pump-sets (3-star and above) for any new agricultural connection.

Other programmes

TANGEDCO has initiated a pilot study on the feasibility of implementing RE based DSM and demand response strategy at Tiruppur and Udumalpet. Along with this, they have undertaken a pilot study on the promotion of energy efficient appliances in the domestic and commercial sectors in Chennai.[132]

Specific DSM activities by Tamil Nadu – Electrical Inspectorate (TNEI)

- Capacity and training programmes as per BEE schemes
- LED village campaign

- Demonstration project in SME cluster – In the lime kiln industries -power optimisers and UPS based blowers were introduced due to which operating time has reduced, efficiency has increased
- Conducted investment grade audits in two government buildings — the secretariat and state planning commission building; replaced pumps with 5-star rated pumps, replaced normal air-conditioners with 5-star rated air-conditioners, and T5 with LED lights
- In the power minister's conference, the TNEI insisted on the procurement of 5-star labelled appliances for government offices.

8. West Bengal

West Bengal consumed around 41 BUs of electricity and faced a peak deficit of 73 MW in 2012-13[5]. There was an energy and peak deficit of 0.7 % and 1.0%[5]. The approved average power purchase cost for the West Bengal State Electricity Distribution Company Limited (WBSEDCL) is Rs. 3.53 for 2013-14. Similarly, the average cost of supply is projected to be Rs. 6.10 for the year 2013-14.[133]

WBERC

In 2005-06, the West Bengal Electricity Regulatory Commission (WBERC) advised the erstwhile West Bengal State Electricity Board (WBSEB) to take action towards DSM by using energy efficient gadgets; there have been no efforts on this front since then. The commission has concentrated mainly on price signals like ToD and power factor surcharge/rebates. In order to reduce the system demand during evening peak, a ToD tariff for industrial consumers was introduced where the peak period charge was 50% more than the normal energy charge, and off-peak period was 31% lower than the normal energy charge. An additional charge was also introduced for ToD and non-ToD consumers drawing power in excess of the sanctioned contract demand. Along with ToD tariffs, the commission has in place the power factor rebate which is higher if the PF is greater than 0.96, and if the consumption is in the peak period. In order to reduce the overall system transmission and distribution (T & D) loss, the industrial consumers receive a load factor rebate and surcharge as well. It is observed from the tariff orders that the load factor rebate has increased over the last five years. For industrial consumers above 1.5 MVA, there is an additional rebate. A detailed PF surcharge and rebate table as well as load factor rebate is provided in Specific DSM measures by WBERC'.

In 2008, the commission directed the WBSEDCL to avail of all the provisions of the tariff order for demand side management and energy conservation. The commission also directed the licensee to submit a detailed plan for energy conservation for the next five years and asked for a DSM implementation programme. There is no indication of such a plan being submitted in the next tariff order, and also about the expenses incurred by the DISCOMs towards DSM programmes. There were no directives issued in the tariff order after 2009-10 because the WBSEDCL had not complied with earlier directives.

DISCOM and SDA[134]

In West Bengal, the WBSEDCL, apart from being the distribution company, is also the state designated agency.[135] The programmes that have been initiated in the past by the WBSEDCL are the implementation of BLY, Investment Grade Audits (IGA) in government buildings, LED based street lighting, and LED village programmes.

The BLY programme was launched in June 2011 and three crore CFLs were to be distributed to domestic consumers (3 pieces per consumer). The current status of the programme is not known. The IGAs have been initiated in 17 buildings in the first phase and 15 buildings in the second phase. The implementation will take place after the completion of energy audits in a phased manner in the next 5 year plan. As for the LED street light project, an amount of Rs. 66.8 lakhs was distributed by the BEE

through the WBSEDCL out of the total project value of Rs. 1.31 crores (for 273 street lights under its service area). The WBSEDCL has replaced 173 street lights of 273 street lights, and the balance will be replaced by the Kolkata Municipal Corporation.

The LED village campaign has been completed in March 2012 and 250 LED lamps (200 in households and 50 street lights) have been distributed. Some of the other programmes are an assessment of energy conservation potential in commercial buildings, government buildings and the municipality sector, and displaying energy conservation tips on their website.[136]

In their ongoing projects list, the first project is the sector specific annual energy savings plan that will be prepared by the Energy Efficiency Services Limited (EESL) for the government and municipality sectors along with other sectors. The target consumers are those that have a connected load above 120 kVA. The implementation is planned through ESCO mode after the plan is submitted. The second project is the waste heat recovery project for which the DPRs were to be prepared by NPC for rice, tea, cement, jute, steel re-rolling, and sponge iron sectors. Implementation is planned after the DPRs are approved by the industries. The third project of LED street lighting at five different municipalities will be taken up in a phased manner during the next five year plan.

Specific DSM activities by WBERC

The power factor rebates and surcharge for 2013-14 are given in Table 29.

Table 29: Power factor rebate and surcharge for WB

Power factor range	**For consumers under ToD tariff**						**For consumers under non-ToD tariff**	
	Normal period (0600 hrs to 1700 hrs		Peak period (1700 hrs to 2300 hrs		Off-peak period (2300 hrs to 0600 hrs)			
	Rebate	Surcharge	Rebate	Surcharge	Rebate	Surcharge	Rebate	Surcharge
PF > 0.99	8	0.00	9	0.00	7	0.00	5	0.00
PF > 0.98 & PF ≤ 0.99	7	0.00	8	0.00	6	0.00	4	0.00
PF >0.97 & PF≤ 0.98	5	0.00	6	0.00	4	0.00	3	0.00
PF > 0.96 & PF ≤ 0.97	4	0.00	5	0.00	3	0.00	2.5	0.00
PF > 0.95 & PF ≤ 0.96	3	0.00	4	0.00	2	0.00	2	0.00
PF > 0.94 & PF ≤ 0.95	2.5	0.00	3	0.00	1	0.00	1.5	0.00
PF ≥ 0.93 & PF ≤ 0.94	1.5	0.00	2	0.00	1.5	0.00	1	0.00
PF ≥ 0.92 & PF ≤ 0.93	0.75	0.00	1	0.00	0.5	0.00	0.50	0.00
PF ≥ 0.86 &	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PF ≤ 0.92								
PF ≥ 0.85 & PF < 0.86	0.00	1	0.00	1.25	0.00	0.75	0.00	0.75
PF ≥ 0.84 & PF < 0.85	0.00	2	0.00	2.5	0.00	1.50	0.00	1.50
PF ≥ 0.83 & PF < 0.84	0.00	2.5	0.00	3.25	0.00	1.75	0.00	1.75
PF ≥ 0.82 & PF < 0.83	0.00	3	0.00	4	0.00	2	0.00	2
PF ≥ 0.81 & PF < 0.82	0.00	4	0.00	5	0.00	3	0.00	2.50
PF ≥ 0.80 & PF < 0.81	0.00	5	0.00	6	0.00	4	0.00	3
PF < 0.80	0.00	6	0.00	7	0.00	5	0.00	3.50

The load factor rebate for industrial consumers is provided in Table 30.

Table 30: Load factor rebate for industrial consumers (tariff order 2013-14)

Range of load factor		**Supply voltage**		
		Below 33 kV	33 kV	Above 33 kV
Above 55%	Up to 60%	1	2	3
Above 60%	Up to 65%	7	8	9
Above 65%	Up to 70%	14	29	39
Above 70%	Up to 75%	20	35	45
Above 75%	Up to 80%	25	40	50
Above 80%	Up to 85%	30	45	55
Above 85%	Up to 90%	35	50	60
Above 90%	Up to 92%	40	55	65
Above 92%	Up to 95%	45	60	70
Above 95%		50	65	75

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