DSM Action Plan for Tamil Nadu

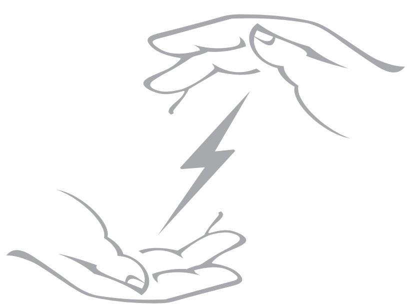
Saurabh Gupta • Ramit Malhotra
P R Krithika • Tanushree Bhattacharya
K Ramanathan

SHAKTI
SUSTAINABLE ENERGY FOUNDATION

teri
The Energy and Resources Institute

DSM Action Plan for Tamil Nadu

Saurabh Gupta • Ramit Malhotra
P R Krithika • Tanushree Bhattacharya
K Ramanathan



SHAKTI SUSTAINABLE ENERGY FOUNDATION

teri
The Energy and Resources Institute

Suggested citation

TERI 2012
DSM Action Plan for Tamil Nadu
New Delhi: The Energy and Resources Institute.

DISCLAIMER

The views expressed in this document do not necessarily reflect those of Shakti Sustainable Energy Foundation. The foundation does not guarantee the accuracy of any data included in this publication and does not accept responsibility for the consequences of its use.

Published by
The Energy and Resources Institute (TERI)
TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003
India

Tel. 2468 2100 or 4150 4900
Fax 2468 2144 or 2468 2145
India +91 • Delhi (0)11
E-mail teripress@teri.res.in
Website www.teriin.org

Table of Contents

Foreword

Energy efficiency is now seen as an important element in meeting the growing challenges on the energy front both globally and at the national and sub-national levels. However, the achievement of desired results in improving energy efficiency involves a combination of strategies which include policy, regulatory, technological and institutional interventions. In recent years particularly with the adoption of the National Action Plan on Climate Change (NAPCC) India has taken several steps to move along a path of higher energy efficiency. These build effectively on the enactment of the Energy Conservation Act of 2001, launching of the National Mission on Enhanced Energy Efficiency which is part of the NAPCC, and many other programmes that aim at reducing the energy intensity of various sectors of the Indian economy.

The power sector has been one of the focal areas in these efforts, especially in view of the high capital intensity of infrastructure required and the extensive resources that are expended in supply of fuels for production of power. This makes energy efficiency measures extremely attractive in economic terms, particularly with the generally poor record of existing performance of the sector as a whole. Concerns related to poor energy efficiency in this sector are compounded by the urgent need to provide access to almost 400 million people who have no access to electricity in this country, the imperatives of improving quality of supply, and mitigating negative environmental and social impacts created by the current system. The urgency for appropriate interventions to improve the performance of the different power utilities in India is now fully realized both at the central and state levels. A study at the level of each state needs to be undertaken covering consumer load patterns, state specific socio-economic conditions, existing policy frameworks and regulatory practices, and complex market conditions particularly as they relate to technical, financial and institutional barriers.

This publication presents the findings of such a study carried out by TERI for the state of Tamil Nadu with financial support from the Shakti Sustainable Energy Foundation. It is based on research covering various aspects of load characteristics of the system in that state and close stakeholder interactions including with senior officers of the Tamil Nadu Electricity Board Limited. I do hope that the recommendations of this study will get translated into action and the book will interest policy makers, regulators, utility managers as well as different consumer groups in the state of Tamil Nadu as well as other states of the Indian Union. The practical nature of this study makes this work highly policy relevant.

R. K. Pachauri
Director General, TERI

Preface

India requires a minimum growth rate, sustained for at least two decades, to help it meet its development goals. But for sustained growth it will need an assured supply of clean energy. Presently, its supply is neither assured nor so clean. Energy security is the most important issue facing India today and needs be resolved at the earliest.

There are many ways to do it. However, in the context of depleting resources and climate change, the two-pronged path of efficiency and renewable resources is the best way forward. Efficiency ensures that existing resources last longer and emit less. It also ensures that the renewable sector gets ample incubation time.

As an organisation that works to strengthen the future of clean energy in the country, efficiency is an area of focus for us. We aid the design and implementation of smart energy policies that focus both on energy efficiency as well as renewable sources. While we work to bring efficiency in buildings, appliances, industry and transport - it is Demand Side Management (DSM) that is of special interest to us.

The power sector has ample opportunity to improve its avoided-generation capacity if consumers use energy efficient appliances, lights and devices. But one needs to catalyse this behavioural change. It is an accepted fact that electric utilities, if equipped with an enabling regulatory framework as well as funds, can incentivise this consumer behaviour and become the catalyst.

However for DSM programmes to take off, what is needed is a comprehensive analysis of load use behaviour; one that maps users against usage. DSM programmes need to based as much on robust data as consumer insight; the former unfortunately is conspicuous by its absence.

In order to scale up DSM, it is important to plug this gap. This study is a step in the right direction. It was undertaken to understand the load pattern in Tamil Nadu. The study looks into the consumption pattern of each consumer category – agricultural, industrial, domestic and commercial, and identifies possible intervention opportunities for DSM in each. It also recommends a set of regulatory and institutional measures to promote demand side management and energy efficiency in the state.

The study is one of the few of its kind in India and the only one for Tamil Nadu. On behalf of Shakti, I would like to thank TERI for having undertaken it. The DSM landscape will be richer for it.

Krishan Dhawan
CEO, Shakti Sustainable Energy Foundation

Acknowledgements

This research has been made possible due to research grant provided by Shakti Sustainable Energy Foundation. We are grateful to Mr Chinmaya Acharya and Ms Natasha Bhan from Shakti Sustainable Energy Foundation for their consultation, suggestions and inputs. The research team gratefully acknowledges the excellent support and cooperation received from officials at different levels of the state utility, in particular from Mr Rajeev Ranjan, CMD, TANGEDCO, and Chairman, TANTRANSCO and Mr R Murugan, MD, TANTRANSCO.

The support of all stakeholders with whom the team interacted including Chief Electrical Inspector of Tamil Nadu, industrial organizations, farmer associations, commercial and consumer groups is also gratefully acknowledged. The team wishes to put on record their appreciation and thanks to Mr K Venugopal, Member, TNERC for valuable inputs provided during the course of the study.

The research team also acknowledges Ms Ligia Noronha, Mr Shahid Hasan, Mr Gurudeo Sinha, and Mr S Narayan for their guidance and support.

The team would also like to acknowledge Ms. K Radhika, Mr. Soy Joseph, and Mr. John Andruse for efficient secretarial assistance. The publication would not have been possible without the support of the dedicated team of professionals from TERI Press.

Abbreviations

AC	Air Conditioner
BEE	Bureau of Energy Efficiency
BLY	Bachat Lamp Yojana
CFL	Compact Fluorescent Lamp
DSM	Demand Side Management
ECBC	Energy Conservation Building Code
EMC	Energy Management Centre
ESCO	Energy Service Company
FTL	Fluorescent Tube Lights
GoTN	Government of Tamil Nadu
GRIHA	Green Rating for Integrated Habitat Assessment
ICB	Incandescent Bulb
KSEB	Kerala State Electricity Board
LED	Light Emitting Diode
LSG	Lighting Science Group
NSSO	National Sample Survey Organization
PWD	Public Works Department
R&C	Restriction and Control
SAVE	Serve as a Volunteer for Energy Programme
SDA	State Designated Agency
SECF	State Energy Conservation Fund
SLDC	State Load Dispatch Centre
SWHS	Solar Water Heating System
TANGEDCO	Tamil Nadu Generation and Distribution Corporation Limited
TANTRANSCO	Tamil Nadu Transmission Corporation Limited
TEDA	Tamil Nadu Energy Development Agency
TNEB	Tamil Nadu Electricity Board
TNERC	Tamil Nadu Electricity Regulatory Commission
ToD	Time of Day
TPDDL	Tata Power Delhi Distribution Limited

Introduction

India is witnessing a tremendous growth in the demand of electricity. This increased demand has outpaced supply, leading to significant overall energy and peak shortages. Energy and peak shortages across India stood at 8.5 per cent and 9.8 per cent respectively in 2010-11. Increasing supply is an option; but inadequate capacity additions in the past and associated environmental concerns merit the promotion of energy efficiency/Demand Side Management (DSM) as an important strategy to reduce demand.

DSM is the implementation of measures designed to facilitate the efficient utilization of electricity at the consumer end. It aims to modify consumer behaviour and enable adoption of energy-efficient technologies. As per the Integrated Energy Policy of the Planning Commission of India, the electricity demand saving potential of DSM measures is about 15% of the total electricity demand.

In order to realize the energy efficiency potential, and upscale the implementation of DSM programmes by utility, load research should be the starting point. One of the key objectives of load research is to understand and analyse the utility's system load profile. It may either be conducted by starting from customer end use to build and develop the total system load shape ("bottom-up" approach), or by starting from the total system load shape and breaking it down to customer end-use ("top-down" approach). In this study, top-down approach is used.

Further, any DSM strategy should be state-specific, as the priorities and needs of consumers differ from state to state depending on the socio-economic status, load mix of the utilities, end-use energy consumption pattern, consumer awareness, and so on.

Given this context, The Energy and Resources Institute (TERI), with support from Shakti Sustainable Energy Foundation, undertook a detailed study to prepare a DSM action plan for Tamil Nadu. The study was based on in-depth analysis of electricity consumption of different consumer categories such as domestic, commercial, agriculture, and industries. The objectives of the study were as follows:

a) To understand the load pattern (over the day and across seasons) of different categories of consumers of Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO), and
b) To suggest DSM interventions that would help in bringing down the overall energy requirement and peak demand of the state.

1

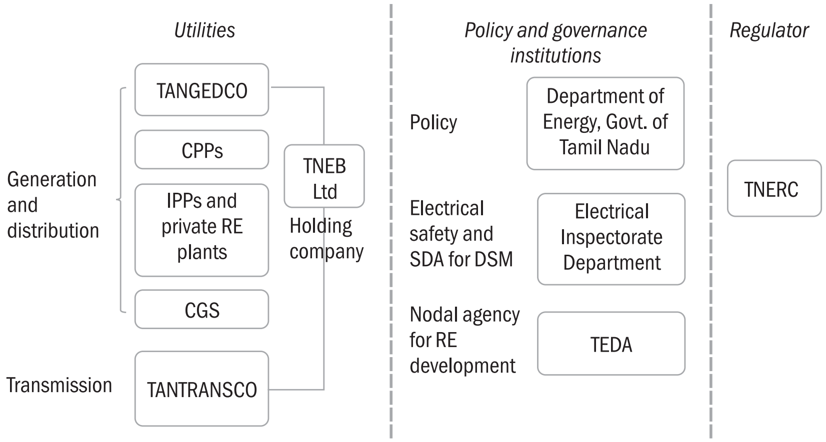
Overview of Tamil Nadu Power Sector

Overview of Tamil Nadu power sector

The Tamil Nadu Electricity Board (TNEB) was functioning as a vertically integrated utility responsible for generation, transmission, and distribution of electricity until 2010. In 2010, it was restructured into a holding company, viz., TNEB Ltd, and two subsidiary companies – TANGEDCO responsible for generation and distribution and Tamil Nadu Transmission Corporation Limited (TANTRANSCO) responsible for transmission of electricity. The utilities are under the regulatory purview of the Tamil Nadu Electricity Regulatory Commission (TNERC).

The policies and guidelines for power sector development are framed by the Department of Energy, Government of Tamil Nadu(GoTN). In addition, there are agencies such as Electrical Inspectorate Department responsible for electrical safety and energy conservation and Tamil Nadu Energy Development Agency (TEDA) responsible for renewable energy development in the state. Figure 1 presents the institutional set up of power sector in Tamil Nadu.

Figure 1 ▸ Institutional set up of power sector in Tamil Nadu



Notes: CGS - Central Generation Stations, CPP - Captive Power Producer, IPP - Independent Power Producer, RE - Renewable Energy, SDA - State Designated Agency, TANGEDCO - Tamil Nadu Generation and Distribution Corporation Limited, TANTRANSCO - Tamil Nadu Transmission Corporation Limited, TEDA - Tamil Nadu Energy Development Agency, TNEB - Tamil Nadu Electricity Board, TNERC - Tamil Nadu Electricity Regulatory Commission

Generation

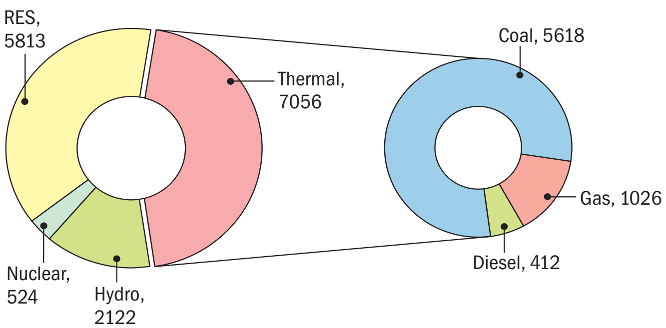
The total installed capacity in Tamil Nadu is about 15515 MW as on 31st March 2011 (including share from central generating stations), of which thermal constitutes the highest share (46%), followed by renewables (37%), hydro (14%), and nuclear (3%) (Figure 2). Of the total installed capacity in the state, TANGEDCO's own capacity is to the tune of 5704 MW (CEA, 2011).

As on 31st October 2011, Tamil Nadu ranks first in wind-installed capacity contributing around 47% of the country's total share (TEDA, 2011).

In terms of the sector-wise breakup, the private sector contributes the highest share of installed capacity (44%), followed by the state and central sector with a share of 37% and 19%, respectively.

Tamil Nadu met about 33% of the power requirement of 69 GWh in 2010-11 from the state-owned generating utility TANGEDCO, while the rest of the requirement was met

Figure 2 ▸ Installed capacity in the state (MW) as on 31st March 2011



Source: CEA, 2011
Notes: RES (Renewable Energy Sources) includes small hydro, biomass, wind, etc.

from external sources and open market (Table 1). The state was one of the major buyers of power in the short-term market in 2010-11, accounting for about 17.3% of the total volume of 11800 MU of power traded in the Indian Power Exchange and 32.2% of total volume of 1740 MU of power traded in Power Exchange India Limited. It was also the third major buyer of electricity in the bilateral trading segment in the same year, accounting for approximately 11% of the total volume through trading (CERC, 2011).[1]

1 Total volume of power traded through bi-lateral trading was around 27.7 billion units.

Further, in order to meet the increasing demand, capacity additions to the tune of 13,540 MW have been planned through the state sector, central sector, and joint venture sector routes in the short and long-term. In addition, Ultra-Mega Power Project of 4000 MW capacity at Cheyyur is expected to be commissioned during the 12th Plan period (GoTN, 2011).

Table 1 ▸ Source-wise power generation in 2010-11

Description	(in MUs)
TANGEDCO's own generation	
Thermal stations	17,357
Hydro stations	4,515
Gas stations	1,349
Wind stations	13
Total (I)	**23,234**
Total purchases	
Central generating stations	21,633
Non-conventional energy sources (including CPP, wind solar, biomass, and co-generation)	6,833
IPPs	6,945
Others	10,540
Total (II)	**45,951**
Gross Generation (I + II)	**69,185**

Source: TNERC, 2012

Transmission

TANTRANSCO has a network infrastructure consisting of EHT/HT lines of 1.77 lakh Ckt km, LT lines of 5.58 lakh Ckt km and a total of 1,343 substations. TANTRANSCO has one State

Load Despatch Centre (SLDC) at Chennai and three sub load despatch centres at Chennai, Madurai, and Erode. Table 2 gives the details of transmission infrastructure in the state.

Table 2 ▸ Details of transmission infrastructure in Tamil Nadu

Particulars	Total
400 kV SS	13
230 kV SS	77
110 kV SS	707
66 kV SS	33
33 kV SS	513
Total SS	1343
Distribution Transformers	2.05 lakh
EHT/HT Lines	1.77 lakh Ckt km
LT Lines	5.58 lakh Ckt km

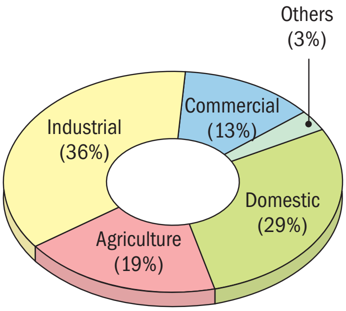
Source: GoTN, 2012

Distribution

Electricity consumption and sales

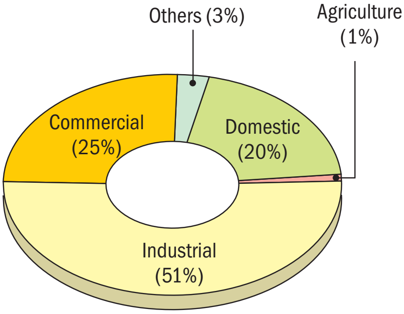
In FY 2010-11, industries dominated the consumption mix with a share of 36%, followed by domestic (29%), agriculture (19%) and commercial categories (13%) (Figure 3). In terms

Figure 3 ▸ **Category-wise consumption in 2010-11**



Source: TNERC, 2010

Figure 4 ▸ **Category-wise share in revenue in 2010-11**



Source: TNERC, 2010

of revenue contribution, industries contributed more than 50% of revenue, followed by commercial and domestic categories with a share of 25% and 20%, respectively, while agriculture contributed a meagre 1% of the revenue (Figure 4). This clearly indicates that domestic and agriculture categories are heavily cross subsidized by the industrial and commercial categories.

The per capita consumption of electricity has also steadily improved in the state from 960 units in 2006-07 to 1040 units in 2010-11, clocking a growth of 8.3% (TANGEDCO, 2011; GoTN, 2011).

Metering

Tamil Nadu has not achieved 100% consumer metering so far. Agriculture and hut service connections[2] are provided free supply of power and they are entirely unmetered, accounting for almost 15% of the total consumers.

AT&C losses

The approved AT&C losses by TNERC were about 18.5% in 2010-11 (TNERC, 2010). TANGEDCO has been reporting low loss levels of 16 % - 18% since 2002. The loss levels are much lower as compared to the national average. This, however, is based on the estimated consumption in the agricultural sector (in absence of agriculture metering in the state).

Financial health of the utility

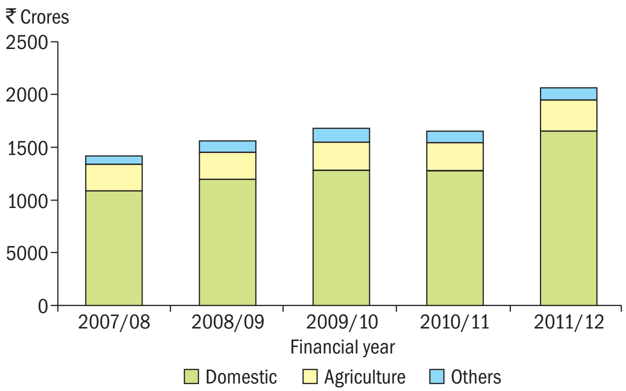
The financial health of the utility has deteriorated over the years. The total accumulated deficit / losses of TANGEDCO as on 31st March 2011 were approximately ₹38,000 crore (GoTN, 2012). The primary reason of financial deterioration has been the increasing gap between average cost of supply and average revenue realization. The widening of this gap has been attributed to the fact that the tariffs in Tamil Nadu have not been revised over several years[3]. In 2010-11, the revenue gap per kWh was ₹1.35 accounting for 28% gap between average revenue realization and average cost of supply (TNERC, 2010).
The financial problems have been accentuated by provision of free power supply to agriculture and hut services by GoTN. The agriculture subsidies are determined on the basis of the existing agriculture pump set capacity records with TANGEDCO. As the records are outdated, the subsidies are underestimated and are, hence, inadequate to cover the actual expenditure.

---

2 Hut is defined as a living place not exceeding 250 square feet area with mud wall and the thatched roof/ tiles/asbestos/metal sheets.

3 The tariff was revised in FY 2010-11 after 7 years.

Figure 5 ▸ Trend in subsidy allocated for various categories



Source: Subsidy orders for various years, TNERC
Notes: Agriculture includes normal and self-financing scheme connections and others include power loom, handloom, streetlights, places of worship, etc.

Subsidies provided by GoTN

The subsidies provided by GoTN have been progressively increasing over the years. In 2011-12, different consumer categories were given either free or subsidized electricity. This includes agriculture, hut services, power loom, handloom and lift irrigation cooperative societies, places of public worship, streetlights, and public water supply. Figure 5 shows that the domestic sector accounts for major share of subsidies as compared to other sectors including agriculture.

Power supply position

Tamil Nadu has been plagued with acute power shortages since the last few years. The energy and peak shortages stood at 6.5% and 11.0% respectively in 2010-11.

Figure 6 and Figure 7 show the trends of energy requirement versus availability and peak demand versus demand met respectively.

Restrictions and control measures

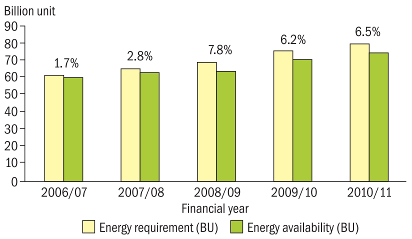
In view of the high power shortages, TANGEDCO imposed certain restrictions and control (R&C) measures to manage the demand. Restrictions were imposed in the evening period in the peak hours (18:00 to 22:00 hours) wherein the HT industrial consumers were not allowed to draw more than 5% for lighting and security purposes. Further, the agriculture consumers were provided with six-hour three-phase supply during daytime and three hours at night on a roster basis. Moreover, the state had also imposed load shedding for other consumer categories.

DSM initiatives in Tamil Nadu

Several DSM initiatives have been undertaken in the state. These include:

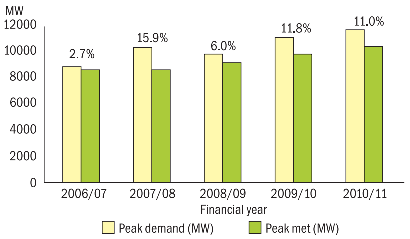
a) *Time of Day (ToD) tariff for HT industries* - 20% extra charge is levied on the energy consumed during peak hours (6:00 to 9:00 hours and 18:00 to 22:00 hours) on all HT industrial consumers. Further, 5% rebate on energy consumption during off peak hours (22:00 to 5:00 hours) is given as an incentive (TNERC, 2010).

Figure 6 ▸ Trend of energy requirement vs availability



Source: CEA, 2010, 2010a, 2010b

Figure 7 ▸ Trend of peak demand vs the demand met



Source: CEA, 2010, 2010a, 2010b

b) *Power factor penalties:* In order to reduce the difference between the energy consumed and the apparent power, reactive power charges are being levied to reduce energy losses. HT consumers are stipulated to maintain a power factor of 0.90, failing which a penalty is levied. Similarly, for some of the LT consumers, the upper limit of power factor is kept at 0.85 (TNERC, 2010).

c) *Replacement of inefficient with efficient agriculture pump-sets:* The GoTN has launched a scheme for replacement of old pump-sets with energy efficient pump-sets. Under this scheme, pump-sets are provided free of cost for small and marginal farmers and at 50% subsidy for big farmers.

d) *Usage of energy efficient appliances:* GoTN has banned the usage of incandescent bulb (ICB) in all government departments, public sector undertakings, boards, societies, and local bodies.

e) *Bachat Lamp Yojana (BLY):* TANGEDCO is implementing BLY scheme, which involves replacing the inefficient ICB with energy efficient compact fluorescent lamp (CFL).

2

Approach and methodology for load research

Approach and methodology for load research

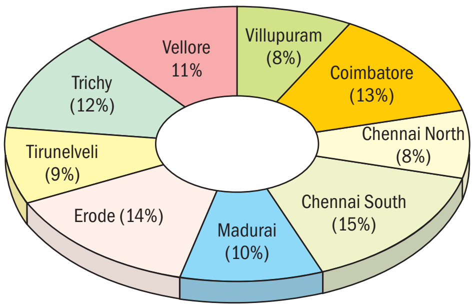
In order to design effective DSM programmes for the utility, it is important to understand load behaviour of different categories of consumers. The demand pattern for the entire state over the day and during different seasons can be captured from the hourly load data recorded by the SLDC. However, to understand consumer category-wise load behaviour, it is important to undertake detailed analysis of load data for the predominant consumer feeders. Since, many feeders are serving mix of different consumer categories and feeder level hourly load data is not maintained at a centralized location and is being recorded manually in the logbooks of respective substations, sampling approach was adopted to select the predominant feeders from the entire state.

Sampling

Five regions namely; Coimbatore, Chennai North, Chennai South, Erode, and Trichy were selected for collection of feeder level data based on predominance of consumption of different consumer categories. Further, these regions represent 62% of the connected load of the state (Figure 8).

From the selected regions, feeders with more than approximately 70% of connected load serving to particular consumer category were selected as the representative feeder of that consumer category[4]. District-wise feeder classification is presented in Figure 9. In total, approximately 200 feeders were analysed in the study.

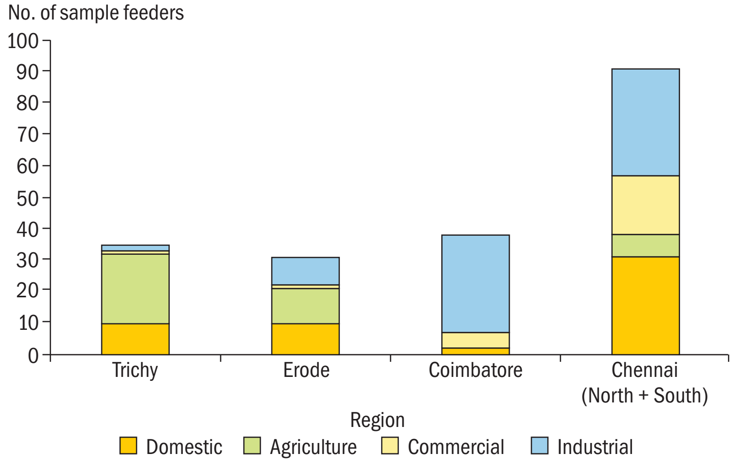
Figure 8 ▸ Region wise connected load (March, 2010)



Source: Data collected from TANGEDCO

4 Feeder wise connected load was taken as proxy for consumer category wise sales for each feeder due to lack of consumer indexing and metering for certain consumer categories in the state.

Figure 9 ▸ Region and category wise number of sample feeders



Source: TERI analysis

Normalization & estimation of indicative share

Month-wise hourly averages were calculated and normalized on a scale of 100 to understand the variation in load pattern during the day and across different seasons for each of the consumer category. Further, indicative share of different consumer categories in aggregated demand was estimated for summer and winter. In order to calculate the indicative share, annual electricity sales were divided into monthly electricity sales in the ratio of monthly electricity consumption at the sample feeder[5]. Further, load factor of each consumer category was calculated from the recorded data at feeder level. The monthly average peak demand of a consumer category was then estimated by using the load factor thus computed, monthly electricity sales and annual T&D losses (since voltage wise or consumer category wise loss data is not available, uniform level of losses were assumed for all categories). The load at any hour of a consumer category was calculated on the basis of ratio of recorded load at that hour to the peak load at the sample feeder level.

5 For the month of September 2010, adequate data was not available for domestic, commercial, and industrial feeders of Chennai. Hence, to estimate the monthly sales in the month of September 2010, average of August and October months was considered.

Stakeholder consultation

In order to understand the perspective of different stakeholders with regard to energy efficiency and DSM measures in Tamil Nadu, extensive interactions were carried in all the regions with different stakeholders such as utility officials, industrial and consumer associations, research institutions, and farmer groups. This provided an understanding of ground-level realities, barriers to energy efficiency and possible solutions to address the barriers.

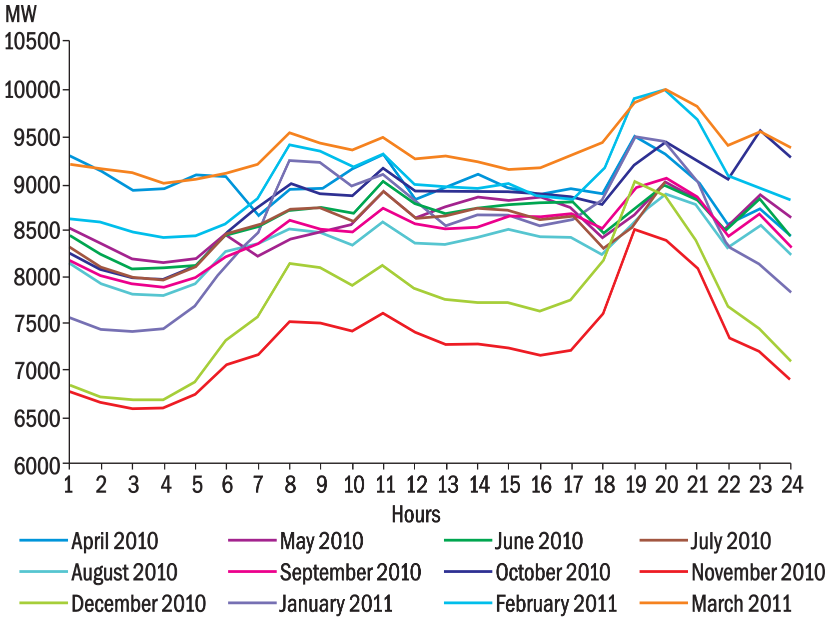
3

State load curve analysis

State load curve analysis

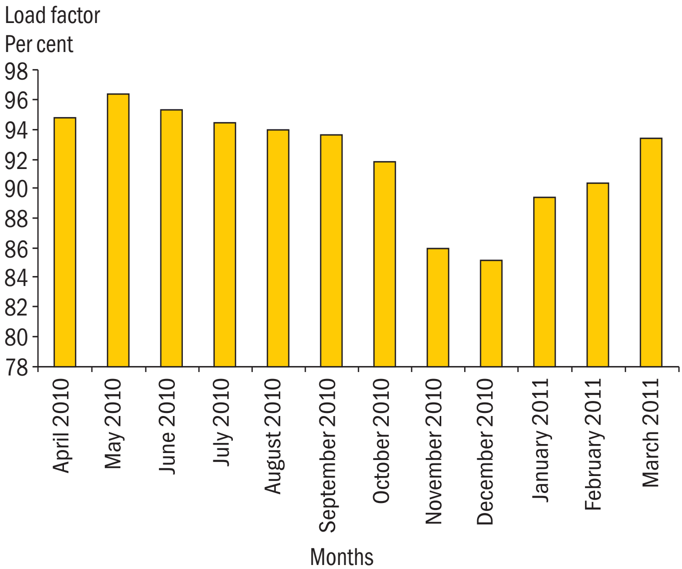
State level load data was analysed to assess the variation in overall consumption pattern across seasons and different hours of day. Figure 10 presents the monthly average load curves for FY 2010-11.

Figure 10 ▸ Monthly average load curves for FY 2010-11



Source: TERI analysis

Figure 11 ▸ Load factors of monthly average load curves for FY 2010-11



Source: TERI analysis

Peak demand

The state demand peaks in the evening at around 18:00-22:00 hours; however, this is restricted demand, as during this time period, R&C measures are imposed on HT industrial consumers. Further agriculture consumers are not supplied power during these hours to manage the demand.

Seasonal variation

Figure 11 shows the monthly average load factor for state-level load curves of FY 2010-11. It was observed that the average load factor in winter months is much less as compared to rest of the months. This is primarily because the load is restricted during summer months by regular spells of load shedding. In winter months, however the demand is lower as compared to summer months and hence the extent of load shedding to manage load is less. Further, in winter months even though there is a distinct evening peak, sharp rise in load is also observed during morning hours.

4

Consumer category wise load data analysis

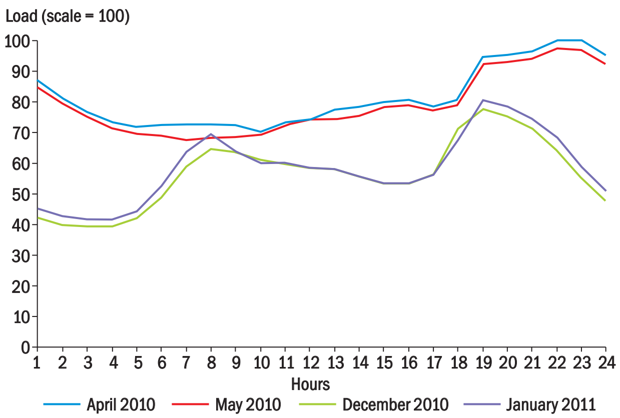
Consumer category wise load data analysis

This section presents consumer category wise load analysis for the sample feeders with respect to consumption pattern across a day as well as seasonal and regional variation.

Domestic load pattern analysis

Figure 12 shows the load pattern of domestic consumer category for the representative summer and winter months. Load pattern for remaining months is presented in Annexure-1.

Figure 12 ▸ Pattern of load demand for domestic category



Source: TERI analysis

Significant variation in load is observed across different seasons of the year. During summer, sharp rise in load is observed during peak period and peak takes the shape of plateau. This is primarily due to high usage of household electrical appliances especially space cooling appliances. High level of urbanisation and increasing level of penetration of household appliances are one of the major reasons for high domestic consumption in the state. As per National Sample Survey Organization (NSSO) data, the penetration of commonly used household electrical appliances such as ceiling fans, Air Conditioners (ACs), and refrigerators shows an increasing trend over the years across all decile groups[6].

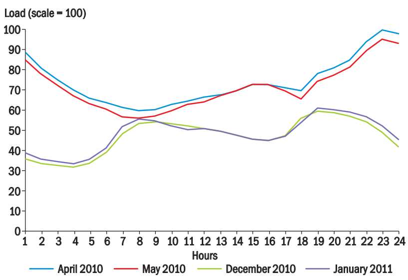
6 Deciles are formed by dividing households into 10 groups, ranked by expenditure. Decile 1 is the lowest 10 percent of the population in terms of expenditure, while decile 10 is the highest 10 percent of the population.

In winter, overall demand is relatively less. It peaks around 19:00 hours and then gradually decreases since there is not much air-conditioning load. Further, in winter, morning peak is also observed primarily due to the water-heating load.

Regional variation

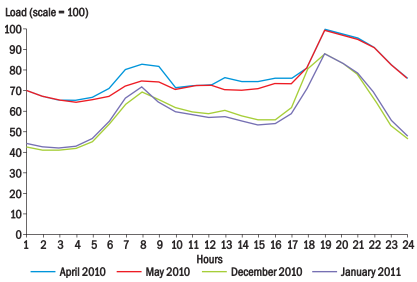
It is observed from Figure 13 and Figure 14 that the pattern of load in Chennai is different vis-à-vis other parts of the state. Sharp increase in load can be observed in Chennai during the evening hours, and non-coincidence peak of Chennai is observed during the late evening hours, i.e., around 22:00 hours in summer. Further, load remains high during late night hours and decreases gradually. This can be attributed to the usage of ACs during these hours. This is also corroborated by the NSSO data, which shows that Chennai has a relatively high level of penetration vis-à-vis other parts of the state for key domestic appliances especially ACs.

Figure 13 ▸ Pattern of load demand for domestic category of Chennai



Source: TERI analysis

Figure 14 ▸ Pattern of load demand for domestic category excluding Chennai



Source: TERI analysis

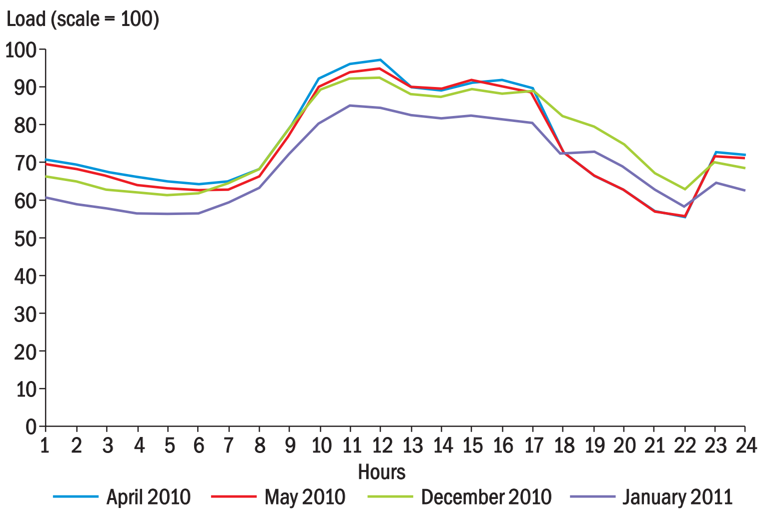
Industrial load pattern analysis

Figure 15 shows the load pattern of industrial consumer category for the representative summer and winter months. Load pattern for remaining months is presented in Annexure-1.

Industrial sector has the highest share in the total electricity consumption of the state in 2010-11. The major industries in the state are highly power intensive, which includes automobile and auto components, textile, leather, cement, sugar, engineering industries, etc.

No significant seasonal variation can be observed in the load pattern of industries in Tamil Nadu. However, overall consumption of the category during winter is slightly lower

Figure 15 ▸ Pattern of load demand for industrial category



Source: TERI analysis

as compared to that in summer. Further, the consumption of industrial category is highest during 12:00 to 16:00 hours, after which it gradually decreases, due to applicable R&C measures and ToD tariff on HT consumers. Hence, their demand is lower during the system peak hours as compared to average demand over the day.

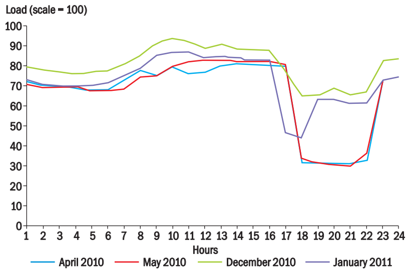
Variation in load pattern in HT and LT industrial categories

There exists a variation between the pattern of HT and LT industries primarily due to R&C measures and ToD tariff. The LT industries face intermittent load shedding in blocks throughout the day as opposed to R&C measures in the evening. Figure 16 and Figure17 show the average load pattern for HT industries in Coimbatore and LT industries (textiles) in Tirupur respectively.

Further, it is important to mention that LT industrial consumers and HT consumers on which R&C measures are not applicable[7] contribute to the demand during evening

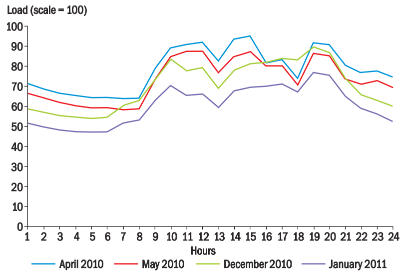
7 As per, Policy of GoTN 2003 for Special Economic Zones (SEZ), TANGEDCO has to ensure quality power supply to the SEZ units without any power cut.

Figure 16 ▸ Pattern of load demand of HT industrial consumers of sample feeder of Coimbatore



Source: TERI analysis

Figure 17 ▸ Pattern of load demand of LT industrial consumers of sample feeders of Tirupur



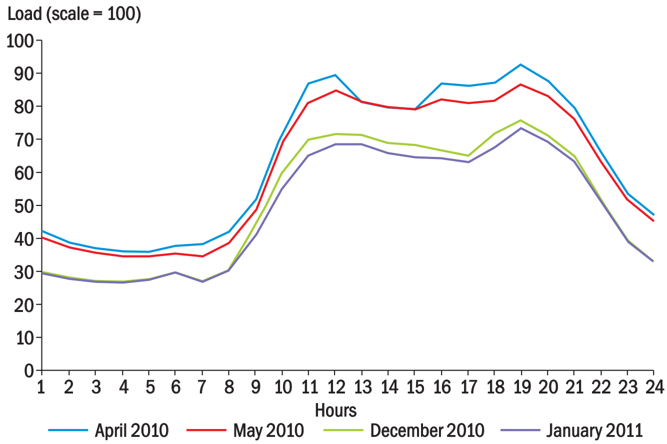
Source: TERI analysis

peak hours. Thus, it can be inferred that once R&C measures are lifted, industrial sector's contribution in peak demand will increase significantly.

Commercial load pattern analysis

Figure 18 shows the load pattern of commercial consumer category for the representative summer and winter months. Load pattern for remaining months is presented in Annexure-1.

Figure 18 ▸ Pattern of load demand for commercial category



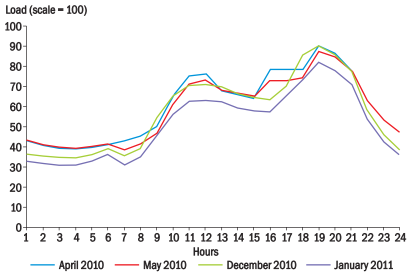
Source: TERI analysis

The load of commercial consumers increases during the evening peak hours, primarily because of incremental lighting load. The demand is significantly high during the day (11:00 hours to 16:00 hours) as compared to the late night and early morning hours. No significant seasonal variation can be observed in the load pattern of commercial consumers in Tamil Nadu. However, overall consumption during summer is higher vis-à-vis winter.

Regional variation

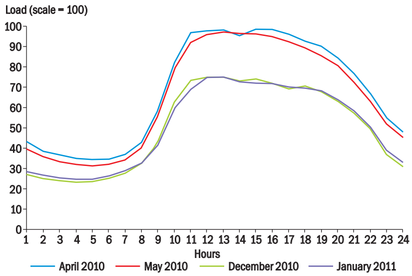
It can be observed from Figure 19 and Figure 20 that load pattern of commercial consumers in Chennai is different from that of other parts of the state. In Chennai, the peak sustains during the entire day. While in case of other cities, non-coincident peak occurs during the evening. The primary reason for such pattern is that Chennai is a metropolitan city with relatively high concentration of large offices and malls with dominant air-conditioning loads vis-à-vis other cities.

Figure 19 ▸ Pattern of load demand for commercial category excluding Chennai



Source: TERI analysis

Figure 20 ▸ Pattern of load demand for commercial category of Chennai



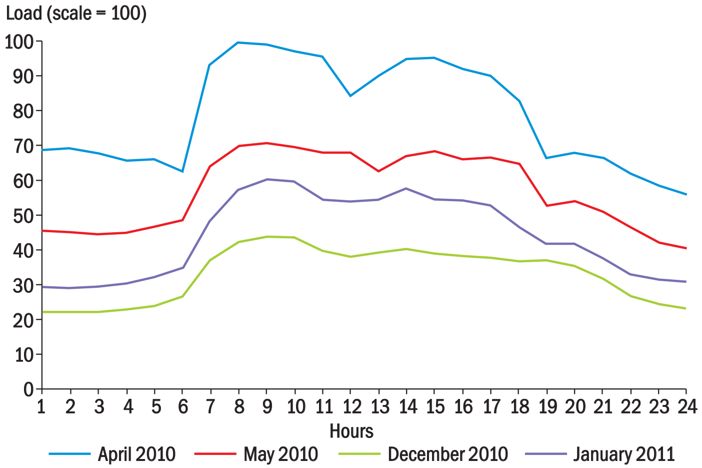
Source: TERI analysis

Agriculture load pattern analysis

Figure 21 shows the load pattern of agriculture consumer category for the representative summer and winter months. Load pattern for remaining months is presented in Annexure-1.

Agriculture is the third largest electricity consuming sector in the state with about 19% consumption in 2010-11. The state depends significantly on irrigation for the cultivation of some of its principal crops such as paddy, sugarcane, banana, etc., which are water intensive crops. Increased reliance on ground water for irrigation purposes has led to rise

Figure 21 ▸ Pattern of load demand for agriculture category



Source: TERI analysis

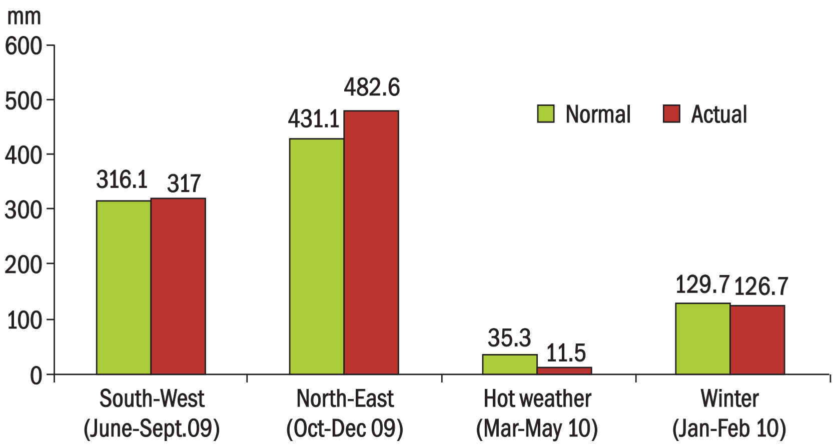
in demand for electricity in the agriculture sector. Moreover, ground water level in the state has been declining with nearly 60% of the total 385 blocks having been exploited and in different stages of criticality.[8] Declining ground water table has led to usage of high capacity pump sets, thereby increasing electricity usage creating a vicious circle for water-energy resources.

Significant variation in load is observed across different seasons of the year. The agriculture sector is dependent on the South-West and North-East monsoons. Most of the rainfall is received during October-December. Hence, electricity demand is relatively less during these months. Figure 22 shows season wise rainfall received in 2009-10.

The consumption of agriculture category is highest during morning between 8:00 to 10:00 hours, as agriculture consumers are being provided with nine hours of three-phase supply, which includes six hours during daytime and three hours during night-time on a roster basis. However, agriculture sector does contribute towards the peak. One of the major reasons for this, as also brought out during stakeholder discussions, is usage of pump sets during two-phase supply.

8 Ground water Year book 2011, Ministry of Water Resources, GoI, http://www.cgwb.gov.in/documents/Ground%20Water%20Year%20Book-2010-11.pdf

Figure 22 ▸ Season wise rainfall received in 2009-10



Source: Statistical handbook, 2011

Regional variation

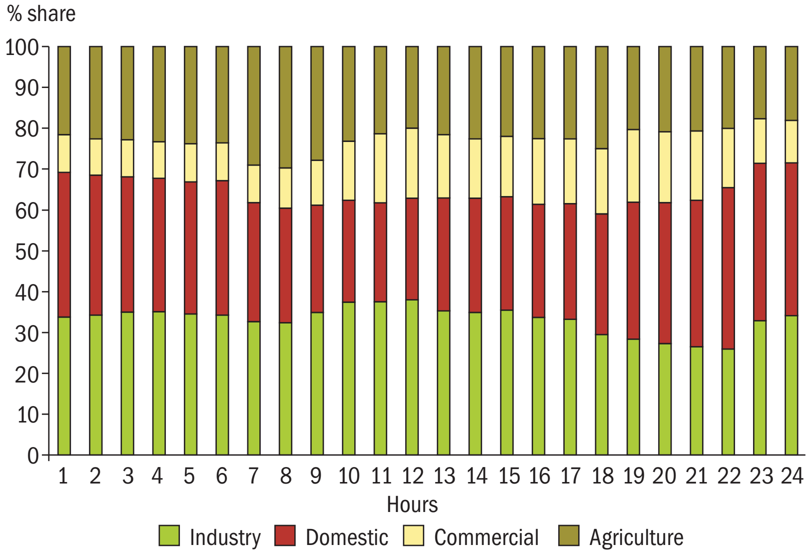
There exists significant regional variation in electricity demand across the state, as electricity demand of agriculture consumers depends upon number of factors such as rainfall, area of irrigation, source of irrigation, crop sown, etc. However, since electricity is being supplied for limited hours on roster basis, this variation cannot be explained through load pattern.

Indicative share of different consumer categories in the aggregated hourly demand

This section discusses consumer category wise load data analysis of the sample feeders with respect to their contribution in aggregated hourly load demand of the state across two seasons, viz., summer and winter (Figure 23 and Figure 24).

Figure 23 shows that during evening peak hours (18:00 to 22:00 hours) in the summer months, domestic category has the highest share ranging between 29% and 39%, followed by industrial (26%-30%), agricultural (20%-25%), and commercial categories (14%-18%). The share of domestic category increases sharply during the evening from 28% at 17:00 hours to 39% at 22:00 hours.

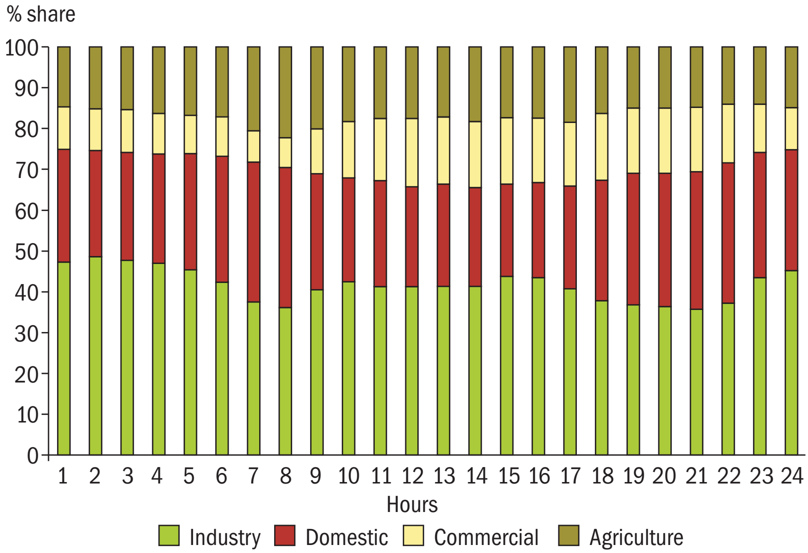
Figure 23 ▸ Indicative share of different consumer categories on aggregated hourly demand for summer months (Average of April and May 2010)



Source: TERI analysis

Figure 24 shows that during evening peak hours (18:00 to 22:00 hours) in winter months, the industrial category has the highest share ranging between 35% and 37%, followed by domestic (30%-34%), commercial (14%-17%), and agricultural categories (14%-16%). The high share of industrial category in winter can be attributed to lower overall demand and relatively lower demand of other sectors. In winter, due to high precipitation, the share of agriculture category is less as compared to summer. Further, during morning hours, share of domestic category increases from 28% at 5:00 hours to 34% at 8:00 hours. Moreover, share of domestic category increases steeply in evening as is observed in summer.

Figure 24 ▸ Indicative share of different consumer categories on aggregated hourly demand for winter months (Average of December 2010 and January 2011)



Source: TERI analysis

5

DSM action plan

DSM action plan

Based on the analysis of consumption pattern of different consumer catagories and their contribution in aggregated demand, a DSM action plan for Tamil Nadu has been prepared and presented in this chapter. The key elements of this action plan include the following:

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

It is expected that implementation of these suggestions would accelerate DSM activities in the state and also provide market signals to private investors and encourage Energy Service Companies (ESCOs) to support the energy efficiency market. These are discussed in this chapter along with the experiences of other states, wherever applicable.

A cost benefit analysis of each of these interventions has not been attempted here. This is because it will largely depend on the level of consumer acceptance. Pilot projects with suitable regulatory support (funds, close monitoring, and impact analysis) would, therefore, be an ideal way to make a start. Based on the outcome, interventions should be up-scaled.

» Promotion of energy efficient appliances

Improvement in the efficiency of various end-use electrical appliances used in different electricity consuming sectors such as domestic, commercial, and industrial sector can lead to significant reduction in overall electricity and peak requirements. However, lack of awareness and high initial cost of energy efficient appliances are some of the major barriers. Based on the load analysis, the focal areas of intervention include space cooling, refrigeration, lighting, water heating, and water pumping load.

Space cooling and refrigeration: Promotion of BEE star rated energy efficient ACs, refrigerators, and ceiling fans in the residential sector

As per NSSO data, ceiling fans have a high penetration across the state while penetration of ACs have increased over past few years, with Chennai having one of the highest penetration of ACs in the state. High load of air conditioner is also observed in the residential load pattern of Chennai city. Moreover, refrigerators also have high penetration level in the state and they are used throughout out the day for the whole year. Significant savings in energy, therefore, can be expected by replacing old inefficient ceiling fans, refrigerators, and ACs with appliances that are more efficient.

The model of bulk procurement of energy efficient appliances by the utility would be an effective strategy for this purpose. TANGEDCO should tie-up with the manufacturers for providing bulk procurement discount to consumers for replacement of existing inefficient appliances. For the distribution of appliances, one of the ways can be that utility either provides coupons along with the electricity bills or advertises the scheme at its consumer centres.

This benefits both manufacturers and utility as manufacturers are assured of the market for their products and utility is able to provide efficient appliances at a considerably low cost compared to market prices. This is also one of the least cost options for the utility, as it has to bear only the associated administrative and marketing costs of the programme. Further, buy back of replaced inefficient appliances and its disposal in an environmental friendly way by the manufacturers would restrict the replaced inefficient appliances from re-entering the market.

Reduction of Value Added Tax by the state government for this specific programme would further facilitate large consumer acceptance of the scheme due to reduced payback period/ decreased cost and, hence, ensuring the success of the programme.

To start with, the scheme for replacement of ACs should be launched for the city of Chennai only owing to the high penetration of ACs while scheme for ceiling fans and refrigerators can be launched for the entire state.

Utilities of Maharashtra and Delhi have launched similar programmes. In 2011, Tata Power under its DSM campaign "My Mumbai, Green Mumbai" has launched exchange programme for ceiling fans targeted towards residential sector and ACs targeted towards LT industrial consumers through bulk discounts[9]. Post the successful stint of this programme, second phase has been launched in 2012 widening the ambit of programme[10].

In 2011, Tata Power Delhi Distribution Limited (TPDDL) launched a pilot scheme for replacement of ACs and refrigerators; following which in 2012, it launched a similar appliance exchange scheme. The old appliances collected through the exchange will be disposed off in an environment friendly manner through associations with e-waste recycling agencies.[11]

Lighting: Promotion of CFL, T5 in residential sector and LEDs in commercial sector

The appliances used for lighting in a typical household encompasses (a) ICB (b) fluorescent tube-light (FTL), and in some cases (c) CFL. Most of the households have multiple lighting points and use a combination of the above three lighting devices, with the usage of bulbs and tube-lights being the most common. Replacement of bulbs with CFLs lead to considerable energy savings, as CFLs consumes one-fourth of energy and replacement of conventional tube lights (40W) used generally with copper chokes (15 W) with energy efficient tube lights (28 W), known as T5 used with electronic chokes (3W), lead to a saving potential of 43%.

9 http://www.tata.com/media/releases/inside.aspx?artid=/I/52YovNQo=,last accessed on 3rd March 2012

10 http://www.tata.com/article.aspx?artid=8ZC05sA09Oo=, last accessed on 15th June 2012

11 http://www.ndpl.com/DisplayMedia.aspx?mid=1560&RefIds=1, last accessed on 15th June 2012

Another emerging lighting option is light emitting diode (LED), which is one of the most efficient sources of lighting. In case of tube lights and LED, model of bulk procurement as suggested above may be adopted by TANGEDCO. However, cost remains a barrier in case of application of LEDs in residential sector; hence, focus should be to increase penetration of LED in commercial sector due to higher usage. Further, to replace ICBs with CFLs in the domestic sector, BLY could be implemented in the entire state.

Similar schemes have been launched in other states like Kerala, Maharashtra, and Delhi.

Kerala is the first state in India, which implemented BLY scheme. Under the scheme, 12.7 million CFLs were distributed jointly by Energy Management Centre (EMC) and Kerala State Electricity Board (KSEB) in all parts of the state leading to achieved energy savings of 300 MW during the peak hours of March and April 2010 (EMC, 2011).

As explained earlier, Tata Power under its "My Mumbai, Green Mumbai" programme also launched an exchange scheme for tube lights through bulk discounts.

In 2011, BSES Rajdhani, Delhi entered into an agreement with Lighting Science Group (LSG), a leading manufacturer of lighting solutions based on LED, to demonstrate and promote energy efficiency using LED lighting[12].

Water heating: Promotion of solar water heaters in residential, commercial, and industrial sector

Several industries have processes requiring hot water and steam, which provides immense scope for solar water heating systems (SWHS) (e.g. textile industries using process steam, dairy processing, pulp and paper, and food processing, etc.). Industrial clusters in Tamil Nadu such as Coimbatore have year round demand for hot water due to the presence of textile industries. In addition, residential consumers with rooftop space as well as large commercial consumers (hotels, government buildings, malls, hospitals, hostels, and educational institutions) are also a potential market for SWHS. Further, strong sales of electric geysers indicate good demand of hot water in households of Chennai (MNRE, 2010). To capitalize on this opportunity, the promotion of SWHS needs to be undertaken in a targeted manner for each sector – industrial, large commercial, and domestic.

---

12 http://articles.economictimes.indiatimes.com/2011-09-19/news/30175928_1_energy-efficiency-lighting-market-lighting-science-group, last accessed on 9th March 2012

It is recommended, therefore, that usage of SWHS in industries that require hot water/ steam for processing, large commercial consumers such as hotels and hospitals, and large residential complexes, be made mandatory through notification by the state government under Section 18 of the Energy Conservation Act, 2001.

Usage of SWHS has been made mandatory in many states of India, including Haryana[13], Punjab[14], and Orissa[15] for different sectors.

Water pumping: Promotion of energy efficient pump-sets in agriculture

Replacement of energy inefficient pump-sets with energy efficient pump-sets can lead to significant electricity savings. Though TANGEDCO has already initiated a plan for replacement for energy inefficient agriculture pump-sets, the scheme has not been successful among the farmers. One of the reasons has been lack of proper outreach to the farmer groups. This calls for trust building exercises targeted towards the farmer groups before introducing such schemes. Involvement of NGOs and farmer associations in this regard would facilitate awareness on energy efficiency in the sector.

Similar initiatives have been undertaken in various states of India. A project was undertaken by BESCOM, wherein inefficient pump-sets were replaced with efficient pumps in the Doddaballapur sub-division. After pump replacement, the average capacity was reduced by 2 HP and the average depth where pumps were placed also declined (156.3 m to 152.1m), all factors contributing to reduced energy usage. This pilot involved extensive capacity building and sensitization of farmers about the benefits of pump replacement, which led to their 'buy-in' in the project (Tetra Tech; USAID, 2011).

13 <http://hareda.gov.in/?model=pages&nid=82>,
14 <http://peda.gov.in/eng/Data/pdfs/GOVERNMENT%20OF%20PUNJA_%20Notificqation.pdf>
15 <http://orissa.gov.in/govtpress/pdf/2007/962.pdf>

» Promotion of energy efficiency in new commercial buildings

By making buildings, compliant with the Energy Conservation Building Code (ECBC), significant savings can be achieved vis-à-vis conventional buildings. The Government of India launched ECBC on 27th May 2007. The ECBC sets minimum energy standards for new commercial buildings having a connected load of 100 kW or contract demand of 120 kVA, as per the Energy Conservation Act, 2010. (MoP, 2011)

It is suggested that state government in exercise of its power under section 15 (a) of Energy Conservation Act 2001 amend the ECBC to suit regional/local climatic conditions and notify the same in the state. Further, to ensure smooth implementation the SDA should undertake capacity building/training programmes for architects, designers, builders, contractor, and town planning authorities. In this context, it is also suggested that the schedules and specifications to buildings that is followed in Public Works Department (PWD) and other construction agencies in the state needs to be modified to incorporate ECBC, which can be done through adopting GRIHA (Green rating for Integrated Habitat Assessment). GRIHA is India's National rating System for Green buildings, developed by TERI, and endorsed by the Ministry of New and Renewable Energy (MNRE).

In 2011, Rajasthan modified ECBC as per its climatic conditions and subsequently notified the same[16].

16 <http://www.rrecl.com/PDf/ECB%20Directives%202011.pdf>

» State-wide education and awareness campaign for energy conservation

One of the most effective areas for promotion of energy efficiency is the creation of public awareness about the costs and benefits of energy efficiency. Education and awareness programmes are some of the first steps to enhance awareness in such matters and to bring knowledge and understanding into the various sectors. TANGEDCO and SDA have undertaken steps to create awareness among consumers; however, these initiatives need to be scaled up in a massive way.

A collaborative effort is required between both TANGEDCO and SDA for launching a continuous and sustained awareness programme to educate students and public on the need of energy conservation. The required funds for organizing such campaigns can be sourced from State Energy Conservation Fund (SECF).

The state of Kerala provides some interesting success stories on energy efficiency through well-structured awareness programmes such as Energy Clinic, Serve as a Volunteer for Energy (SAVE) programme, use of television media, and panchayat libraries for awareness creation (EMC, 2011). (Box 1)

BOX 1 AWARENESS PROGRAMMES IN KERALA

Energy Clinic programme of EMC, Kerala has resulted in mass consumer movements led by women towards adoption of energy efficient appliances. This demonstration and awareness programme is implemented through women volunteers who are selected from all districts in Kerala and are given a day's training by the EMC. The women volunteers train rural housewives and spread awareness on various energy conservation activities in the households.

Serve as a Volunteer for Energy programme (SAVE) is a large-scale awareness creation programme targeted towards motivating schoolchildren wherein simple tips for energy conservation were published in the newspaper, which youngsters had to implement in their households. Participants with significant energy savings were rewarded. This initiative by Malayala Manorama newspaper along with KSEB and EMC bagged the international award "WAN- INFRA" in 2009 for creating awareness towards efficient appliances. It is reported that 217 million kWh of electricity savings were achieved through the programme. The initiative has successfully completed four years, and the EMC is planning to re-launch the programme.

Awareness programme in Kerala through television media - Many well-known Malayalam actors like Mohanlal, Suresh Gopi, Dileep, etc., actively take part to promote the importance of energy conservation through television media in the form of advertisements.

Awareness through Panchayat libraries - In every Panchayat library, EMC Kerala displays all the brochures and text material regarding the importance of energy conservation. Along with this, EMC provides one CFL lamp to every Panchayat library to promote energy conservation among the public.

» Improvement in process and operational efficiency in the industrial sector

The analysis shows high contribution of industrial category during the day as well as during peak irrespective of the R&C measures. Further, with the removal of R&C measures, it is expected that their contribution in the peak will increase and, hence, there is a need to focus on process and operational efficiency in industries.

The potential of energy savings differ with respect to scale, product type and processes of industry. As per the Energy Conservation Act 2001, only the designated consumers are mandated to undertake energy audits. However, in view of the huge untapped energy saving potential energy audit needs to be promoted beyond designated consumers.

The state government needs to mandate compulsory audit for all EHT/HT industries under section 18 of the Energy Conservation Act 2001. The SDA should facilitate the process by empanelling BEE accredited energy auditors and consultants for this purpose. It should also provide structured technical guidelines for carrying out detailed energy audit. Further, LT industries can be encouraged to carry out audits by providing them an incentive in form of rebate in energy audit/walk through audit fees. The rebate should be provided by the SDA from the SECF. Energy audit programme can also be extended to the commercial consumers.

States such as Kerala have mandated compulsory energy audit for all HT/ EHT Industries and commercial establishments[17]. Further, states such as Maharashtra[18], Madhya Pradesh,[19] and Haryana[20] have also launched promotional schemes offering financial assistance for carrying out energy audits.

---

17 <http://www.keralaenergy.gov.in/GO/Government%20Order%2020Mandatory%20Energy%20Audit%20in%20Kerala.pdf>
18 <http://www.mahaurja.com/PDF/SaveEnerProg.PDF>,
19 <http://www.mprenewable.nic.in/energyc.html>
20 <http://hareda.gov.in/?model=pages&nid=151>

» Public procurement of energy efficient appliances

In order to promote energy conservation in government buildings, GoTN has banned the usage of ICBs in all government departments and related bodies. However, there exists a substantial potential for energy conservation through further promotion of energy efficient appliances. One of the ways to achieve this potential is through promotion of energy efficient appliances in public procurement process.

The state government needs to make it mandatory for all government departments and related agencies to replace defective appliances by energy efficient appliances only and to procure minimum BEE 4-star rated products in the future.

In order to facilitate government departments and related agencies to procure energy efficient products, SDA may arrange rate contract with different manufacturers for procurement of energy efficient appliances.

States such as Haryana have made the purchase of minimum 4-star rated products like refrigerators, ACs, FTLs, and transformers mandatory for all government departments/corporations[21].

21 <http://hareda.gov.in/?model=pages&nid=124>

» Feeder segregation

In several parts of the state, it was observed that feeders serve to all consumer categories without any separation of agriculture loads from the non-agriculture loads (domestic and commercial). The analysis shows that there is usage of agriculture pump-sets during 2-phase supply, which causes overloading of distribution transformers, leading to harmonics in the system. This also has significant impact on the quality of power supply to rural domestic consumers. Segregation of agricultural loads from non-agricultural loads is a tested and proven strategy to address this concern. In this context, it is learnt that TANGEDCO has planned to take up segregation of 2000 feeders in a phased manner starting with 100 feeders in Villupuram region at the outset. Hence, feeder segregation needs to be facilitated at the earliest to increase system efficiency.

Government of Gujarat initiated "Jyotigram Yojana" in September 2003 on a pilot basis in eight districts, which was completed by October 2004. The scheme was later extended to other villages and was implemented throughout the state by March 2006 covering over 18,000 villages and about 9,700 hamlets. Erection of separate HT and LT lines and rearrangement of power supply schedule of agricultural feeders resulted in flattening of the load curve and reduction in the maximum and minimum demand of 1850 MW/1450 MW compared to the 2100 MW/900 MW (FOR, 2008).

» Strategic utilization of energy conservation fund and DSM fund approved by the regulator

In order to fund energy conservation activities in the state, two options of funding may be utilized which includes SECF and DSM fund approved by the regulator. Tamil Nadu has constituted SECF in accordance with the statutory requirement under section 16 (1) of Energy Conservation Act 2001. (MoP, 2011) Further, TNERC has also allowed ₹10 crores in the ARR for carrying out the activities of Energy Conservation and DSM. (TNERC, 2010)

It is recommended that the state government, in exercise of the powers conferred by the Energy Conservation Act 2001, should formulate rules for providing the person or authority to administer the SECF (in form of State Level Steering Committee), and the manner in which such fund shall be administered to ensure its effective utilization. Further, TANGEDCO should make effective utilization of DSM fund in formulating and implementing DSM schemes after receiving in principle approval of the TNERC.

States such as Kerala[22] and Madhya Pradesh[23] have already notified the SECF Rules.

22 http://www.keralaenergy.gov.in/pdf/EC%20Fund%20Rule%20Gazette%20Notification.pdf>

23 <http://govtpressmp.nic.in/pdf/extra/2011-01-28-035.pdf>

» Regulatory measures for promoting DSM

Regulators have an important role in the promotion of DSM activities by directing and encouraging the utility to undertake such measures.

DSM Regulations

Lack of any binding condition/commitment on part of the utility is one of the major barriers in implementation of DSM. There is a need to streamline the regulatory process for undertaking planning, designing, and implementation of DSM programmes on a sustained basis by TANGEDCO. Hence, it is suggested that TNERC notify DSM Regulations for the state. DSM Regulations have already been framed for states such as Maharashtra[24], Himachal Pradesh[25], and Gujarat[26].

Introduction of ToD tariff for LT industrial consumers

At present, ToD tariffs are applicable for HT industrial consumers only. However, LT industrial consumers also contribute in the evening peak demand. Introduction of ToD tariffs for LT industrial consumers can also facilitate peak demand management. It is suggested that ToD tariffs should also be introduced for LT industrial consumers. To start with, it can be introduced on a voluntary basis. Being a voluntary measure, it will not put additional burden on consumers and at the same time will encourage consumers to adopt ToD tariffs. TNERC could design the ToD tariff and provide guidelines for implementation of ToD tariff for LT industrial consumers.

States such as Maharashtra[27] and West Bengal[28] have introduced ToD tariffs for LT industrial category.

Introduction of kVAh billing

kVAh being a combination of both active and reactive load components can be a better reference to measure loads efficiently. kVAh billing will improve the power factor, which will lead to lower transmission as well as distribution losses as with a better power factor, the line loading shall be lower for the same KW requirement. It is recommended that TNERC introduce kVAh billing starting with industrial and commercial consumers at the earliest.

States such as Delhi[29], Himachal[30], and Uttrakhand[31] have introduced kVAh billing for some of its consumer categories.

---

24 http://www.mercindia.org.in/pdf/Order%2058%2042/DSM%20Regulation%20Notified%20_DSM%20Implementation%20Framework_April2010.pdf

25 http://www.hperc.org/rules/fdsm11.doc

26 http://www.gercin.org/regulationspdf/en_1338898507.pdf

27 http://www.mahadiscom.in/consumer/Comm_CircularNo.81.pdf

28 Tariff order, 2011 dated 30/12/2011 on "Redetermination of tariff of WBSEDCL for the year 2010-11"

29 http://www.derc.gov.in/ordersPetitions/orders/Misc/2010/Staff Paper on Supply Code & Performance Standards Regulations .pdf

30 www.hperc.org/tdl.doc

31 http://www.upcl.org/pdf/upcl_tariff_order_2012_13_summary.pdf

» Strengthening of SDA

Effective implementation of energy efficiency measures at the state level requires strong institutional structure. Under the Energy Conservation Act, 2001, the GoTN has designated Electrical Inspectorate as the SDA to coordinate, regulate, and enforce provisions of the Energy Conservation Act, 2001 within the State. Lack of adequate resources in terms of technical expertise, human and financial resources have limited the implementation of energy efficiency measures at large scale in the state.

In order to upscale implementation of energy efficiency measures in the state, there is a need to strengthen SDA. In this context, it is recommended that either a separate dedicated entity responsible for energy efficiency with adequate resources needs to be created or a dedicated unit of TANGEDCO needs to be designated as SDA.

In Kerala, EMC has been designated as SDA responsible solely for energy conservation related activities. Further, in state of West Bengal, West Bengal State Electricity Distribution Company Limited is performing the function of West Bengal SDA.

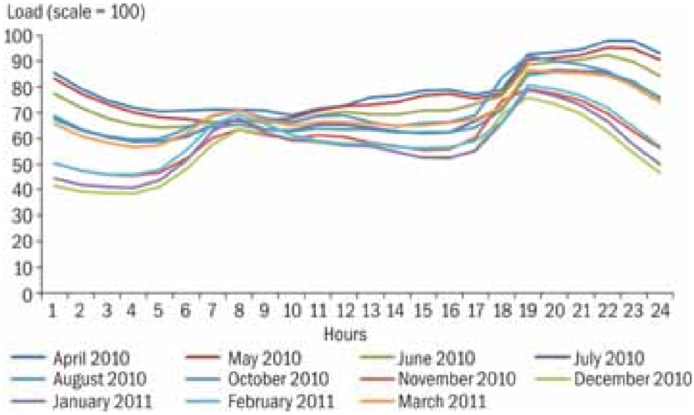
> The utility, government, regulator, appliance manufacturers, state designated agency, and financial institutions have a major role in propelling the energy efficiency market in Tamil Nadu

Annexure - 1

Category wise average monthly load pattern

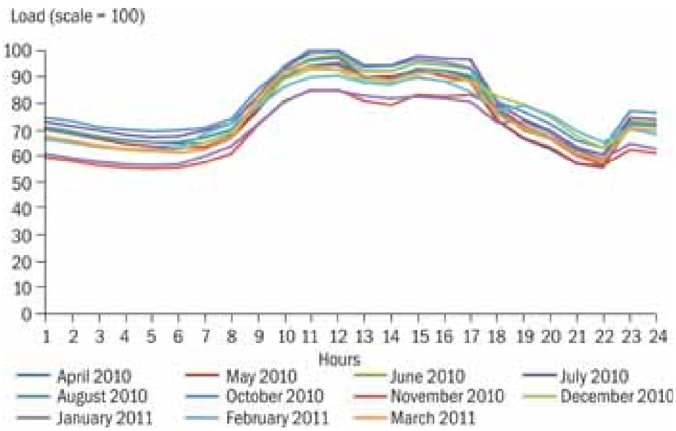
Category wise average monthly load pattern

Monthly pattern of load demand for domestic category



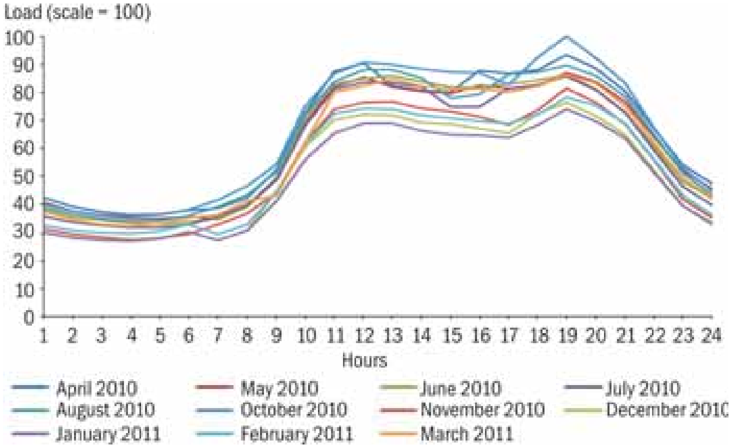
Note: Load pattern for the month of September 2010 is not shown, as sufficient feeder level, load data was not available for September 2010.

Monthly pattern of load demand for industrial category



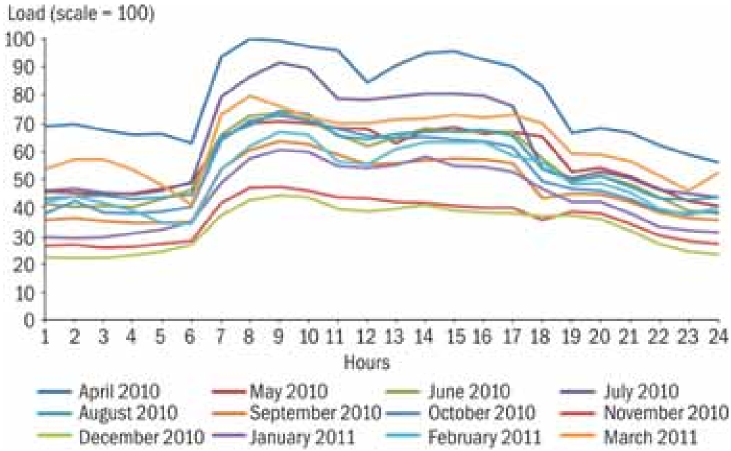
Note: Load pattern for the month of September 2010 is not shown, as sufficient feeder level, load data was not available for September 2010

Monthly pattern of load demand for commercial category



Note: Load pattern for the month of September 2010 is not shown, as sufficient feeder level, load data was not available for September 2010.

Monthly pattern of load demand for agricultural category



References

CEA, 2010. Power Scenario at a Glance. Integrated Resource Planning Division, New Delhi.

CEA, 2010a. Power Supply Position (Revised). Details available at http://www.cea.nic.in/reports/monthly/gm_div_rep/power_supply_position_rep/energy/Energy_2011_03.pdf

CEA, 2010b. Peak Demand and Peak Met (Revised). Details available at http://www.cea.nic.in/reports/monthly/gm_div_rep/power_supply_position_rep/peak/Peak_2011_03.pdf

CEA, 2011. Installed Capacity (In MW) of Power Utilities in the States/UTs located in Southern Region (Including Allocated Shares in Joint & Central Sector Utilities)

CERC, 2011. Report on Short-term Power Market in India: 2010-11. Economics Division, CERC, New Delhi.

EMC, 2011. Major Achievements of the Centre. Energy Management Centre Kerala, Thiruvananthapuram.

FOR, 2008. Report on DSM and Energy Efficiency. Forum of Regulators, New Delhi.

GoTN, 2011. Energy Policy Note, 2010-11. Department of Energy, Government of Tamil Nadu.

GoTN, 2012. Energy Policy Note, 2011-12. Department of Energy, Government of Tamil Nadu.

MNRE 2010. Solar Water Heaters in India: Market Assessment Studies and Surveys for Different Sectors and Demand Segments.

MoP, 2011. Annual Report 2010-11. Ministry of Power, Government of India, New Delhi.

Statistical handbook, 2011. Department of Economics and Statistics, Government of Tamil Nadu.

Tetra Tech, Inc, USAID. 2011. A Guide Book to Implement Agriculture Demand Side Management: Studies from Water-Energy Nexus Activity (Wenexa II) Project. India Core Publishing

TNERC, 2010. Order No. 3 of 2010 dated 31-07-2010 on "Determination of tariff for generation, intra-state transmission, and distribution".

TNERC, 2012. Order No. 1 of 2012 dated 30-03-2012 on "Determination of Tariff for Generation and Distribution".

TEDA, 2011. Details available at http://www.teda.in/index.php?r=site/index&id=1Y1e4 W1W4n

TANGEDCO 2011. Energy Scenario at a Glance. Details available at http://www.tangedco.gov.in/linkpdf/growth1.pdf

The Energy and Resources Institute (TERI) brings forth this publication on DSM Action Plan for Tamil Nadu based on a study carried out with support from Shakti Sustainable Energy Foundation. The study aimed at understanding the load patterns of different categories of consumers and identified pertinent DSM interventions that would help in demand management. The findings of this study are based on understanding of consumption pattern of different consumer categories and assessment of coincidence of category wise demand.

Based on analysis of consumption pattern and interactions with stakeholders DSM action plan was prepared in which a multi stakeholder approach has been suggested. These recommendations include policy and regulatory measures for improving end use energy efficiency at consumer level. Further, institutional framework for promotion of energy efficiency is also suggested. It is expected that implementation of these suggestions would accelerate DSM activities in the state and also provide market signals to private investors and encourage Energy Service Companies (ESCOs) to support the energy efficiency market. An active involvement of the state utility, government, regulator, appliance manufacturers, state designated agency and financial institutions is necessary for successful implementation of suggested measures.