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MASTER THESIS

DEMAND SIDE MANAGEMENT IN INDIA:

AN ANALYSIS OF STATE LEVEL INITIATIVES

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ABSTRACT

The background of the research is the effects of demand side management of energy in the states of Gujarat and Andhra Pradesh in India. Economic growth of India is dependent on its power consumption. Hence, to make India a self-dependent economic force, a large amount of power is needed. In India, there is a gigantic gap between power production and power demand. It is very difficult to realize this demand gap by expanding the installed capacity due to limited resources and economic constraints. For that, the energy being produced should be conserved to the utmost and it can be realized using Demand side management (DSM) measures. Demand side management is the way of managing the consumption of energy, for the most part to optimize available and planned generation resources. DSM assumes a critical part in improving energy efficiency, system reliability and security. DSM decreases costs for customers and services and mitigates environmental impacts. In India, there is an urgent need to marginalize the supply-demand gap. (Huang et. al,2012). The research aims to study the DSM activities of actors involved in the states of Gujarat and Andhra Pradesh. The research focuses on increasing awareness of DSM activities in civil society, to boost learning by state actors, and empower states to gain experience from each other and to recommend a rational and facilitated technique to scale up these activities at the state level in light of research findings.

DSM offers an extensive range either to increase or decrease the load. DSM permits utilities to adjust end-use electrical power consumption through energy efficiency or using load management to decrease demand often when the cost of the demand is less that the cost of adjusting it. The research focuses on the effects of DSM in India along with the implementation study. The research followed strategies such as: (i) review of relevant DSM initiatives in Gujarat and Andhra Pradesh, (ii) review of relevant initiatives of regional countries (Thailand, Vietnam, Philippines),

and (iii) review of actors involved in DSM implementation the states of Gujarat and Andhra Pradesh and (iv) assessing the DSM measures undertaken by the state actors in India and Thailand.

Desk research was applied to review Data on different EE/EC/DSM activities of the SERCs, DISCOMs, and SDAs in the states of Gujarat and Andhra Pradesh in India and DSM initiatives in Thailand. All these initiatives were evaluated by using Governance Assessment Tool matrix.

The results draw out the key issues about the activities of all the actors on DSM level. The issues include: lack of belief, lack of ownership and lack of implementation framework. The recommendations for overcoming these issues include increased awareness and cross learning, Formation of State Energy Conservation Committees and setting an implementation framework.

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List of Acronyms

AC	Air Conditioner
BEE	Bureau Of Energy Efficiency
BLY	Bachat Lamp Yojana
CFC	Chlorofluorocarbon
DEDP	Department of Energy Development and Promotion
DGVCL	Dakshin Gujarat Vij Company Limited
DISCOM	Distribution Companies
DLC	Direct Load Control
DSM	Demand Side Management
DSMO	Demand Side Management Office
EC	Energy Conservation
ECBC	Energy Conservation Building Code
ECF	Energy Conservation Promotion Fund
EE	Energy Efficiency
EER	Energy Efficiency Ratio
EGAT	Electricity Generating Authority of Thailand
ENCON	Energy Conservation Promotion Act
FTL	Fluorescent Tube Light
GAT	Governance Assessment Tool

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GDP	Gross Domestic Product
GEF	Global Environment Facility
GOT	Government Of Thailand
GWh	Gega Watt hour
MGVCL	Madhya Gujarat Vij Company Limited
MOIT	Ministry of Industry and Trade
MoP	Ministry of Power
MW	Mega Watt
NAPOCOR	National Power Corporation of Philippines
NEPO	National Energy Policy Office
NSW	New South Wales
OECF	Overseas Economic Cooperation Fund of Japan
PGVCL	Pashchim Gujarat Vij Company Limited
R & D	Research and Development
SDA	State Designated Agencies
SERC	State Electricity Regulatory Commission
TISI	Thailand Industrial Standards Institute
ToD	Time of Day
UGVCL	Uttar Gujarat Vij Company Limited
UNDP	United Nations Development Program

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CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

India's power demand has been rising by around 8% consistently throughout the last 5 years, but power generation is lagging behind. India has constantly faced power shortage of 8-10% over the last 5 years. (Central electricity authority,2013). The demand for power will additionally rise significantly, as one third of Indian households which are at present without access to electricity will be connected to the grid soon. Additional power generation cannot be the main solution to meet the rising demand. There are different resource limitations to generation for example, constrained land, fuel and water. There are also social and ecological worries in the siting of new power projects. Hence, it is essential that India takes up energy efficiency measures to lessen its demand for electricity. According to the report by Low Carbon Committee of the Planning Commission, it is estimated that there will be around 15-20% reduction of total generation through energy efficiency measures. (Planning commission,2014). The government of India passed the Energy Conservation (EC) act in 2001 and built up the Bureau of Energy Efficiency (BEE) to create and execute energy efficiency and conservation policies and projects.

State level actors such as the State Electricity Regulatory Commission (SERC), Distribution Companies (DISCOMs), and the State Designated Agencies (SDAs) set up by the state governments under the EC act have an essential part to play in enhancing energy efficiency of India. Each state is diverse with its own consumer mix, power purchase profile, load curve and other factors, Hence, it is important that each state builds up its own action plan for energy efficiency with active involvement of all the actors. Moreover, most of the DISCOMs cannot meet their peak demands and have a burden of financial losses.EE and DSM practices can help them tackle these issues. DISCOMs can assume a vital facilitative role in enhancing end use efficiency because

a) they have broad reach and contact with consumers.

b) they have a financial transaction with consumers on monthly basis and

c)DSM can help them in taking care of the overall demand at lower costs.

Hence, DISCOMs can potentially affect consumer behaviour to lessen and manage their consumption altogether. There are also some guidelines being prepared by the regulators to be used by DISCOMs for DSM related issues like cost benefit analysis, monitoring and assessment. Various DISCOMs are setting up DSM cells, action plans and carrying out pilot programmes. State governments are also introducing different government orders on energy efficiency, and arranging energy conservation missions.

1.2 PROBLEM STATEMENT

A number of policies have been placed by different state governments regarding DSM activities in respective states. Some states have issued regulations while others have issued mandates to DISCOMs requesting that they make DSM a part of their daily exercises. Many states have tariff mechanisms like Time of the Day (ToD)[1], power factor incentives etc. A few DISCOMs have likewise implemented new and innovative DSM programmes.

However, In the research conducted by Prayas (Energy Group), it was observed that the programmes implemented by DISCOMs have stayed at the pilot phase. (Dukkipati et al,2014). Regulators have been negligent in guaranteeing compliance with regulations and directives. State governments too have not met targets in following up on the resourceful projects and targets they announced. This might be due to a number of reasons. Both regulators and DISCOMs do not trust that EE/DSM can have a greater impact. There is additionally a lack of ownership of responsibility to develop EE at the state level. Regulators and DISCOMs are occupied with different issues and do not look at EE as a priority. There is also next to no political visibility for EE. There is no public pressure on these state actors to effectively seek after measures to promote EE. These reasons permit the actors to escape accountability. Also, there is a little information on DSM in public domain. There is next to no information on the follow up and evaluation programmes, and there is no correspondence

[1] The Time of Day (ToD) tariff is the most well-known tariff component adopted by SERCs. Under this tariff, peak hours are determined upon the system peak. The peak hours could be morning peak hours, evening peak hours, or both.

between various state actors to share their experience between states or within each state. Thus, there is an urgent need to analyse current DSM practices within different states in order to improve them for better management. (Dukkipati et al,2014)

1.3 RESEARCH OBJECTIVE

The objective of this research is to identify incentives for regulators and DISCOMs to adopt and implement EE and DSM measures.

CHAPTER 2: Theoretical concepts and an overview of DSM programmes in selected Asian countries

This chapter describes the basic concept of DSM, definition, purpose of DSM and its objectives and a brief description of DSM measures taken by India, Thailand, Vietnam and Philippines.

2.1 BASIC CONCEPT OF DEMAND SIDE MANAGEMENT

The term DSM emerged after the energy crisis in USA in 1973. DSM is also called as Energy Side Management or Energy Demand Management whose eventual aim is to reduce the peak demand of power generating units. DSM has diverse means for various stakeholders. For utility organization, DSM implies avoiding or delaying the need to build new power plant by reducing or shifting the consumer's energy use period. For domestic consumer, DSM means a chance to save money by lessening their electricity bill taking the advantage of financial incentive given by utility. For industrial customers, DSM means lowering the production cost and introducing a more competitive product. In other words, DSM refers to steps taken by utility and consumer on meter side to change the amount or timing of energy consumption. (Yun et al,2006).

2.1.1 Definition

In the electricity generation and distribution industry, the term 'demand side management' is currently used to refer to any activity which changes the electrical demand on the system. The term is used to refer to a number of activities, including:

- Actions undertaken on the customer side of the power meter (the 'demand side'), such as energy efficiency measures and power factor correction;
- plans for reducing loads on request for example, interruptability contracts and direct load control;
- fuel switching, for example, changing from electricity to gas for water heating;
- Distributed generation, for example, standby generators in offices or photovoltaic modules on rooftops; and
- pricing initiatives, for example, time of use pricing.

2.1.2 Purpose

In 2002, after a request by the premier of NSW[2] ,Independent Pricing and Regulatory Tribunal (IPART) undertook a noteworthy review of demand management, principally as related with the electricity sector (i.e. DSM). (Independent Pricing and Regulatory Tribunal of NSW,2002).

The report of this review recognized three principle types of demand management based on the general motivation behind the DM program[3]

- **Environmentally driven** – concerned with accomplishing ecological as well as social targets by decreasing energy use, leading to enhanced energy efficiency as well as reduced greenhouse gas emissions.

- **Network driven** – concerned with improving and/or preventing issues in the Electricity network by reducing demand in ways which maintain system reliability in the near term and over the longer term defer the need for network growth;

- **Market driven** – concerned with giving short term responses to power market conditions ('demand response'), especially by reducing loads during times of high market costs caused by reduced generation or system capacity.

Figure 2.1.2 represents the relation between these three types of demand management.

[2] The Premier of New South Wales is the head of government in the state of New South Wales, Australia. The Government of New South Wales follows the Westminster system, with a Parliament of New South Wales acting as the legislature. More info at https://www.nsw.gov.au/

[3] These are the types of demand management identified in the IPART report but with revised definitions.

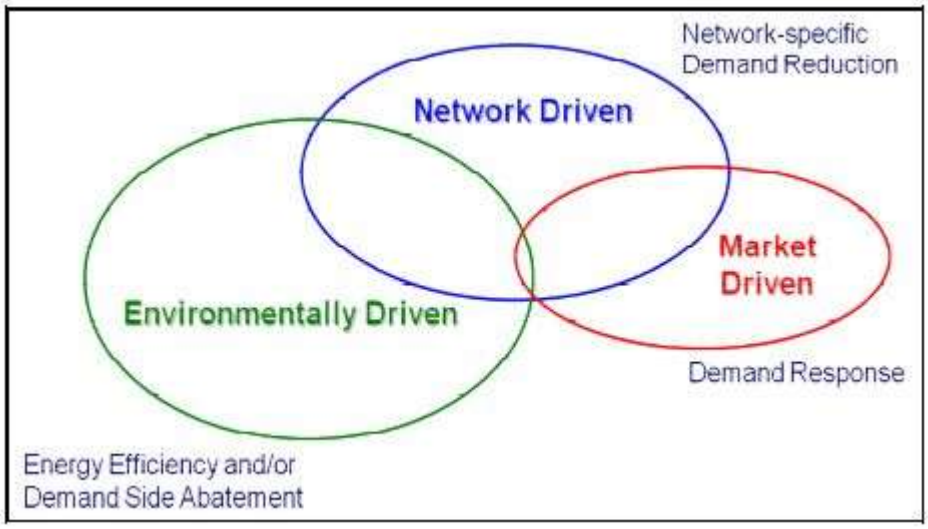


Figure 2.1.2 Interaction between three types of Demand Management (Gordon,2003)

2.1.3 Objectives

DSM programs are carried out to accomplish particular goals, for example,

- Overall load reductions (ex. to accomplish energy savings and additional reduction of greenhouse gas emissions);
- Peak load reduction;
- Targeted load increasing (ex 'valley filling');
- Increased operating reserves
- voltage control in power networks;
- Risk management in connection to power prices (ex. abstaining from buying power during high price events in competitive power markets).

2.2 DSM in Thailand and India

2.2.1 DSM in Thailand

Introduction

In the mid-1990s, Thailand had one of Asia's quickest growing developing economies, with GDP expanding more than 10 percent on an average from 1990-93, and hinted signs of continued economic growth.

Such economic expansion was dependent on considerable investment in the power sector, with average yearly growth anticipated at 15 percent every year, or around 2 GW every year. To meet this challenge, the Government of Thailand (GOT) set up a procedure for the power sector that required:

(a) expanding power sector investments considerably.

(b) accelerating the pace of privatization in the power supply industry;

(c) making a solid push towards energy conservation and

(d) putting an expanded emphasis on environmentally sound and sustainable development.

To help energy conservation exercises, the GOT passed the Energy Conservation Promotion Act, or ENCON Act, in 1992[4], to give a regulatory framework for energy conservation and efficiency programmes. This act incorporated the formation of an Energy Conservation Promotion Fund[5] (ECF) to give working capital grants and subsidies to promote and encourage energy conservation measures and choose renewable energy initiatives. Under the ENCON Act, the Department of Energy Development and Promotion (DEDP) was named as the executing agency for the mandatory[6] (energy audits and public/private building efficiency investments) and complementary (public relations and training) projects and the National Energy Policy Office (NEPO) was approved to deal with the voluntary program (demonstrations/pilots, renewables and R&D). In parallel, and by cabinet resolution, the Electricity Generating Authority of Thailand (EGAT), the national generation and distribution utility set up a National DSM Program, with help from NEPO, to enhance the ability of the power sector to deliver cost effective energy services and also promote endorsement of energy efficient equipment all through the nation.

In 1993, EGAT propelled a US$190 million DSM Program, with essential financing from auto tariff mechanism. In addition, the Program got a $9.5 million grant from the Global Environment Facility (GEF), $6.0 million grant from the Government of Australia and a $25 million concessional credit from the Overseas Economic Cooperation Fund of Japan (OECF).

[4] The ENCON Act was not made effective until the Ministerial Order was released in 1995.
[5] The ECF was at first supplied with 1.5 billion Baht (about US$60 million in 1992) and gets yearly revenues of around 2 billion Baht ($57 million) from a levy imposed on petroleum fuels.
[6] Responsibility for the Complementary Program was shifted from DEDP to NEPO in late 1999.

A DSM Office (DSMO) was set up inside EGAT to create, execute and evaluate national DSM projects and measures, with a general focus on reducing peak demand by 240 MW and accomplishing yearly aggregate energy savings of 1,427 GWh before the end of 1998[7]. The DSMO reports to EGAT administration for day-to-day operations, but is also regulated by a DSM sub-Committee, led by the Prime Minister's National Energy Policy Council, which audits Program plans, discusses related strategy issues and facilitates DSM working together with other energy related government organizations, and both regional power distribution companies, MEA and PEA[8].

2.2.1.2 Objectives

EGAT's mentioned objectives for DSM are:

- To execute and seek energy efficiency and load management projects to expand benefits for consumers and the nation.
- To offer learning, awareness and effectively promote energy conservation among electricity consumers and influence a change in public attitude
- To empower local manufacturers and importers to produce or import energy efficient appliances; and
- To create significant institutional capacity in the electricity sector and the energy related private sector to deliver cost effective benefits all through the economy.

2.2.1.3 Program Design

The first five-year DSM Master Plan called for EGAT to plan and execute programs directed to all three areas (e.g. Residential, industrial and commercial). The program parts included DSM program design, implementation and evaluation, DSM financing instruments, energy efficient codes and standards, testing facilities and conventions, integrated resource planning, load management and private segment DSM capacity building. At the time the DSM Program was set up, Thailand had little experience with designing or executing DSM programs. Subsequently, the World Bank, in collaboration with the United Nations Development Program (UNDP) and the

[7] Due to initial implementation delays, the project was extended and closed on June 30, 2000.

[8] MEA, the Metropolitan Electricity Authority, is in charge of distribution in the greater Bangkok region and PEA, the Provincial Electricity Authority, is in charge of distribution in the rest of Thailand.

International Institute of Energy Conservation (IIEC), a global non-governmental organization, helped EGAT in creating introductory program strategies.

The primary program design was to a great extent based on the U.S. experience, depending on manufacturer and consumer discounts, since there were no other established models at the time. During early implementation, DSMO staff decided such approaches to be conflicting with Thai culture, expecting that financial incentives to manufacturers and participating customers might be seen as inequitable. The DSMO thus moved its strategy during implementation to concentrate more on voluntary manufacturer negotiations than financial discounts, using its financial resources to bolster significant marketing and publicity campaigns, mass procurement of high-efficiency products, and other data publication activities such as energy audits, data analysis etc.

2.2.1.4 Program Staffing

The DSMO was staffed at first with around 40 EGAT employees in 1993, and developed to around 177 permanent staff in mid-2000. EGAT has moreover made broad utilization of temporary staff, local and international consultants, experienced advisors etc. to give particular skill sets and manpower in view of program needs. Such flexible staffing plans have served the DSMO well, as their DSM programs required changing skill mix and staff requirements during different phases of implementation, and temporary staff permitted a level of flexibility from EGAT's more rigid employment management. These staff work under two DSM divisions, DSM Planning and administration and DSM operations and Execution, and report to the Deputy
Governor, Policy and Planning within EGAT.

2.2.1.5 Implementation

During the initial couple of years, EGAT chose to launch a couple of activities first, keeping in mind the plan to achieve experience and frame in-house capabilities, prior to extending its activities. Therefore, between 1993-96, the DSMO started four projects to address energy use for lighting, refrigerators, air conditioners and commercial buildings and later on targeting the Residential sectors in their expanded program.

2.2.1.6 Initial DSM programs

Fluorescent Tube Lamps: With around 20% of power consumption credited to lighting and fluorescent tube light (FTL) sales expanding 10% every year, the DSMO focused on this end-use in its first DSM program in early 1993. Given the low number of domestic manufacturers (five in 1993), the DSMO chose to negotiate specifically with manufacturers to switch production from T-12 40 W/20 W to T-8 36 W/18 W FTLs, or "thin tubes." EGAT additionally entered into a collaboration with the Thailand Industrial Standards Institute (TISI) to test the FTL life and lumen output for every manufacturer to guarantee dependable quality under the program.

While T-8 lamps were at that point already proven technology in developed nations, the manufacturers were worried over public acceptance in such a drastic shift in production. EGAT agreed to support the cost of around US$8 million for a publicity campaign, bringing in major stars and TV promotions, to instruct public about the advantages of these "thin tubes" in exchange for the manufacturers' consent to eliminate production of T-12 lamps. Since the production technology was readily accessible and the incremental cost for T-8 FTLs was nominal (T-8s need less material for production), no extra financial incentives were offered to the manufacturers or consumers.

The outcomes were sensational. In a span of one year, all manufacturers had totally shifted production to thin tube lights and EGAT's publicity campaign drastically accelerated public acceptance of this shift. Within a short time thereafter, the one major importer of FTLs had also complied with the agreement to cease distribution of T-12 lamps. This fruitful collaboration with manufacturers gave the DSMO a positive reputation and experience that it then used to propel its subsequent projects.

Refrigerators: Building upon its experience and accomplishment with FTLs, the DSMO approached the five local manufacturers of refrigerators in mid-1994 and arranged a voluntary labelling plan for all single-door models[9], trusting that market forces would be adequate to accomplish a generous and sustainable change of the market. The labelling plan used a rating

[9] Initial program contained sizes ranging from 150-180 litres and was expanded in 1997 to include 90-210 litre capacities

scale, with the unweighted average of 480 kWh/yr (with load) as a level 3[10]. The DSMO collaborated together with TISI to test the locally available refrigerators and gave labels to manufacturers directly.

Similarly, as with the FTL program, EGAT promoted an wide-ranging publicity campaign to instruct consumers about energy labels and extensively promoted the level 5 label. Since large portions of the level 5 models just had a minimal incremental cost, no financial incentives were offered by the DSMO to the consumers. In mid-1997, GOT Carried out a complete elimination of CFC[11]-based coolants, which brought about a slight decrease in refrigerator efficiency. In this regard, the DSMO balanced the labelling plan upward by 10%.

In mid-1998, the DSMO worked with the Thai Customer Protection Agency and made single door refrigerator labelling obligatory and, in late 1999, the DSMO made an agreement with the manufacturers to increase the requirement for each label level for single-door models by 25% by January 2001, dependent upon EGAT's agreement to support promotional campaigns to notify consumers about this change. In mid-1998, the DSMO also started labelling two-door models and it was expected that these labels would become compulsory by 2002.

Program impacts were slower than with the FTLs but no less dramatic. In 1994, just a single model qualified as a level 5, in spite of the fact that it was manufactured in anticipation of the DSMO's labelling scheme, and just 2% of single-door models sold were level 5. To date, all single-door and 50% of the two-door refrigerators sold in 2000 met the level 5 prerequisites. The DSMO estimated that 84% of all refrigerators sold in Thailand now had the level 5 label and that the program had resulted into a 20% decrease in total energy consumption by refrigerators.

Air Conditioners: In late 1995, the DSMO targeted air conditioners (ACs) as its next end-use product and introduced a voluntary label system like refrigerator scheme. The labels depended on an energy efficiency ratio (EER) of 7.5, which represented the average of models sold locally, and rated on a scale like the refrigerators. TISI tested the models, including both split-system and

[10] Models with consumption inside 10% of the average get level 3 labels; those with 10-25% less than average get a level 4; models with more than 25% below the average are named as a level 5.
[11] A chlorofluorocarbon (CFC) is an organic compound that contains only carbon, chlorine, and fluorine, produced as volatile derivative of methane, ethane, and propane.

unitary (window) models[12], and, the DSMO started providing labels to the manufacturers by mid-1996.

In spite of initial positive signs from the label program, the DSMO found that level 5 ACs were more difficult to promote than the refrigerators. As opposed to the small number of FTL and refrigerator manufacturers, the Thai Air conditioning industry was more assorted and fragmented, with more than 50 different manufacturers, lot of which were small, local assembly operations. Moreover, the incremental cost for higher level ACs was significant. So the DSMO worked with local credit card providers to offer interest free credits for the incremental cost of level 5 ACs. The DSMO likewise offered 500 Baht (USD 15) discounts to shop owners (under a Green Shop initiative) who sold level 5 models during limited time summer periods.[13]. (Du Pont et al, June 1997)

The outcomes of the AC program had been less than expected. Because of the higher incremental cost, the DSMO estimated that roughly around 40% of ACs had a level 5 label and none of the lower efficiency models are labelled by any means. In spite of EGAT getting approval from the DSM Sub- Advisory group to make AC labels compulsory in 1999, the DSMO had not been able reach an agreement with the AC industry on an appropriate timetable for required labels or expanded requirement for each level of the labelling scheme. Without this agreement, it was not clear how further efficiency increase or energy saving effects could be accomplished under this program.

Green Buildings: In late 1995, the DSMO launched a program to promote the adoption of energy efficient end-uses as a part of existing commercial buildings. Under this program, the DSMO offered members preliminary and detailed energy reviews and in addition investment consultation for high return efficiency retrofits for lighting, cooling, load management and building envelope measures. This program was intended to help DEDP's Compulsory Program, which required reviews and adherence to the building code in "designated buildings."[14]Since the program started, more than 435 building owners had applied to take part in the program, with around 240 being designated buildings. The DSMO had targeted the designated buildings as the

[12] Program initially consisted of capacities from 7,000-25,000 Btu/hr and incorporated sizes up to 30,000 Btu/hr in late 2000
[13] Both financial incentive programs were suspended in 1999 due to budgetary constraints.
[14] Under the ENCON Act, a designated building is termed as a commercial building with demand over 1MW.

Program	Sector	Program Description	Incentive Mechanism

audit costs were reimbursable to an extent through the ECF. The DSMO had led 252 preparatory audits by mid-2000, but just 35 had been approved, due, in part, to a backlog of reviews by DEDP. (Du Pont et al, June 1997)

2.2.1.7 DSM program expansion

In 1996, the DSMO started to extend its portfolio of DSM projects and target new end-users and segments and, between 1997-99, launched around 15 new DSM operations. An outline of these projects can be found in Table 2.2.1.7).

Compact Fluorescent Lamps (CFLs)	Residential Commercial	Agreement with distribution outlets to sell CFLs from participating manufacturers. EGAT carried advertising expenses of program and tested/labelled lamps to ensure consistent quality	Bulk distribution and partnership with franchised retail outlets allowed significant reduction in transaction costs.
Street Lighting	Municipal	Pilot program with PEA to purchase and distribute high-pressure sodium vapour (HPS) street lamps to municipalities across Thailand.	Grant funds used to pay for higher incremental cost of HPS lamps to demonstrate technology.
Green Leaf	Commercial (hotels)	Audits and certification of energy-efficient hotels based on predefined measures; publication of information on energy efficiency and complete resource management in hotels.	Free workshops and audits/ certification for hotels. Results published through national tourism publications.
New Buildings	Commercial	Analysis of growth of all efficiency measures in buildings and support to construction companies for all viable efficiency measures that exceed building code requirements.	Demonstration buildings, technical help and possible financial incentives.
Brown Rice	Residential, Agricultural, Education	Promotion of less energy-intensive and nutritional brown rice through advertising and labelling; distribution of brown rice in public school lunch programs.	Promotional campaign in partnership with Ministries of Health, Agriculture, Interior and Education.
High- Efficiency Motors (HEMs)	Industrial	Actualization of HEM market through testing/ labelling, demonstrations, data publication and manufacturer negotiations. Future efforts could include brochures on motor sizing, HEM payback periods and technical assistance for rewinding and drive systems.	EGAT-sponsored promotional campaigns, interest-free credit demonstrations.
Low-Loss Ballasts	Commercial, Residential, Industrial	Promotion of low-loss magnetic ballasts through bulk distribution arrangement and through green buildings/industrial cost reduction programs. The program would promote new ballasts only and not retrofits of existing equipment.	Labelling and informational campaigns endorsed by EGA

Pilot ESCO	Industrial	Demonstration of ESCO concept through development of four pilot projects and dissemination of results.	EGAT bore development and audit cost for pilots and would seek an interest subsidy from t ECF.
Industrial Cost Reduction	Industrial	Similar to the Green Buildings Program, this program promotes retrofits and investments in	Audits and technical advice is provided to participants as well assistance in accessing ECF funding.
Small and Medium Enterprises (SME)	Commercial, Industrial	Preparation of action plan and workshop to support predefined efficiency measures in SME premises; proposed plan to include concessional ECF financing.	EGAT sponsored workshops, brochures and standardized applications for certain end-use concessional financing.
Load Management	Commercial, Industrial	Voluntary programs to encourage load management through stand-by generation, interruptible load and time-of-use tariff schemes.	Participants are eligible for a concessional tariff scheme.
Thermal Storage	Commercial	Demonstration 350 kW thermal storage system was constructed on EGAT premises for testing and assessment of commercial	Construction of demonstration facility.
Attitude creation	Residential, Commercial,	Comprehensive portfolio of publicity campaigns for specific DSM measures as well as conservation in general through all media. Program also includes a Green Learning Room in public schools to educate students on the importance of energy conservation and the link between energy and the environment.	EGAT-sponsored public campaigns and advertising grants to schools to support Green Learning Room equipment and training materials.

table 2.2.1.7 DSM program expansion (Singh et al,2000)

Complementary Programs

In addition to customer targeted programs, the DSMO started three projects to strengthen its program planning and execution efforts:

- end-use load research to make end-use profiles, decide future end-use needs and better estimate program effects;
- Integrated resource planning (IRP) to archive end-use and DSM measure for every sector and survey expected effects, cost effectiveness and feasibility; and

- A DSM information database to permit enhanced integration of program data to help plan, evaluate and administrate the efforts.

Program Evaluation

When EGAT's DSM Program was first set up, precise evaluation of its DSM programs was viewed as a critical component The evaluation component was intended to permit regular reporting to the DSM Sub-committee and Program donors and additionally to enhance program plans for existing and new DSM activities. The GEF additionally asked for the utilization of an Independent Monitoring and Evaluation Agency (IMEA) to survey and confirm the validity of EGAT's assessment outcomes.

Due to restricted in-house expertise, the DSMO depended on engineering estimates to decide energy/demand savings and harmful (GHG) emission reduction owing to each DSM program from 1997-1998. However, the DSMO recognized the requirement for expanding the accuracy of these estimates with supplemental data, for example, costumer/manufacturer surveys, vendor sales information, end-use metering, charging data, and so forth to help improve engineering assumptions and improve the accuracy of program effects.

In 1999, the DSMO employed consultants to lead market studies to determine different preliminary impact estimates, to help EGAT's evaluation efforts of the initial projects throughout 1999. The IMEA reviewed these studies and reported effect estimates. The outcomes, now complete, had offered various key discoveries with respect to program plan and execution and had been used to help EGAT's IRP and future DSM program design and implementation. In light of the experience picked up by DSMO staff from the consultant work, the 1999-2000 evaluation work was led altogether in-house, with methodology supported by the IMEA.

Conservation Programs

EGAT named five programs as conservation programs FTLs, refrigerators, ACs, CFLs and street lighting. The following evaluation work involved five major data collection measures: participating and non-participating residential consumer surveys, participating and non-participating non-residential consumer surveys, interviews with lighting/appliance manufacturers and importers, interviews with EGAT DSMO and, Systems Planning Department employees, and PEA staff

(street lights only); and sample end-use metering to decide operating hours for lighting and appliance compressors.

Reported Versus Evaluated Savings: There were some differences between EGAT's engineering assessments and those assessed by the consultants for these conservation programs, exhibiting that engineering estimates alone are not enough to decide accurate DSM program impacts. The fundamental factors included:

(i) difference in wattage estimated for baseline refrigerator and CFL programs;

(ii) measured coincidence factors changed from EGAT's assumptions for ACs and CFLs;

(iii) FTL sales information was lower than EGAT's assumptions, because of the 1997 economic crisis;

(iv) EGAT's low estimate for energy savings from using the thin tubes with the standard magnetic ballasts;

(v) difference in evaluated and measured average run time of AC compressors; and differences in the evaluated refrigerator efficiency loss during the time of non-CFC refrigerator introduction. (Sulyma, et. al August 2000).

Load Management Programs

EGAT assessed a few load managements as well as reduction efforts including the Green Buildings Program and NEPO's three tariff load reduction programs. The assessment work included survey of participating customers, interview with program staff and sample participant and non-participant metering to check and compare actual load shapes and consumption with EGAT's pre-program extensions. But because of extremely restricted information, poor monitoring of programs, and different issues, these impact numbers were not recorded.

Process Evaluations

The consultants additionally checked the DSM programs based on their overall effectiveness and market transformation effects. The outcomes from these efforts are mentioned in table below.

Program	Market Impacts		Recommendations
	Baseline %	Results %	
FTL (T8)	40%	100%	Promote low-loss (magnetic/electronic) ballasts
Refrigerators (single-door)	2.3%	100%	Update labelling plan Enhance testing speed and accuracy Target promotions to sales people Provide more info about CFC phase-out
Air conditioners (Level 5)	19%	38%	Introduce minimum performance standards Clarify loan programs Reduce testing lead time
CFL	6-10%	6-10%	Include all CFL sizes in program Use conventional outlets to sell CFLs Provide data on trade-offs between price and quality
Green Building	--	--	Define priority customer groups Improve and standardize customer services Improve customer communications
TOU Tariffs	--	--	Provide more information on differences between TOU and TOD tariffs
TOD Tariffs	--	--	Consider changing billing and charging annual subscribed energy demand level, beyond which excess energy demand will be surcharged

Table2.2.1.8: process evaluation of DSM programmes in Thailand (Singh et al,2000)

Regarding free ridership, none of the projects, except the AC program, offered financial incentives, so no free ridership was experienced. For the AC program, free ridership was evaluated at 15% of those that participated in the interest free loan initiative. Participants that reacted to surveys showing that they would have bought the efficient equipment with or without the DSMO programs were definitely not considered free riders, yet were accounted for in the standard projections.

Key Program Issues

Program Selection, Design and Evaluation

Since advancement of the preliminary DSM plans in the early 1990s, the DSMO's procedure for recognizing program priorities and planning proper promotional methods did not have a

methodical and a thorough approach. This was because of EGAT's view that its projects served a public purpose, and so, should offer projects for all key customer segments and end-uses. The absence of a formal procedure for distinguishing, choosing, executing and evaluating programs had prompted programs being laid out before they were completely developed, or before any market research that evaluated their potential. Due to this, most of the EGAT's programs were executed based on anecdotal data than market research. Another issue was the absence of appropriate standard information and end-use profiles to satisfactorily decide end-use needs, program selection and assessment impacts. While EGAT now has a dynamic end-use load research program, the effort was undertaken only in 1998 after huge numbers of the end-use programs had been chosen. It is noted, however, that EGAT had to face pressure to get programs on the ground and needed to make trade-offs between its data collection/market research attempts and program execution. Until mid1999, there had been no formal program assessment to identify region/ areas in the program designing process that could be enhanced. While the DSMO has found a way to cure this shortcoming, the assessment late in the Program averted adequate feedback to make improvements in program implementation.

Labelling: The success of EGAT's labelling attempts to move the market to higher efficiency refrigerators and AC models can be credited to two fundamental factors: willingness of manufacturers to label their products, and consumer awareness and perception of the labels. The labels have had an all-around reported, constructive effect on adjusting consumer purchasing behaviour, and assessment outcomes clearly exhibit that they accomplished
significant market shifts.

An unintended outcome of EGAT's exceptionally successful "level 5" label promotions has been that only the higher rated labels were perceived as quality models. Manufacturers who labelled their products voluntarily, were hesitant to affix any label below level 5 on their products, because of which the consumers had only two options: level 5 models and unlabelled models. EGAT's plans to extend its labelling efforts to a more extensive scope of refrigerators and AC models, and also low-loss ballasts and high-efficiency motors, would have limited outcomes unless EGAT found a way to educate consumers on the rating aspects of the labels.

2.4 DSM IN INDIA

India can be considered to be an example of an industrialising country with a range of problems linked to the interconnected phenomena of economic growth and energy demand. The Indian power sector has multiplied its installed capacity over the years from 30,000 MW in 1981 to more than 100,000 MW in 2001.Regardless of this development in supply, its energy system is struggling to defeat chronic power shortages and poor power quality. With the demand surpassing supply, serious peak (around 18%) and energy (around 10%) shortage keep on plaguing the sector. In 1991, IPP proposition exceeded 150,000 MW while in 2001, only 3500 MW IPP power was actually in operation. This resulted into US$6 billion of investment and a few million tons of extra pollutants however would in any case was not sufficiently close to meet the targeted capacity expansions. Steadily increasing demand for electrical power has turned into a striking element of present day civilization for quite a while now, we discover them in circumstances where the gap between demand and supply of electrical power is ceaselessly widening. We have been unable to take care of the energy demand. The supply-demand gap is growing at the rate of 3% day by day. Bridging this gap by setting up new power plants is extremely difficult and costly suggestion. This situation is most certainly not expected to improve in near future. As we realize that electrical energy is an essential input in all the areas of a nation's economy, hence there is a need to find methods to lessen peak demand and to save electricity. (Padmanaban et al., 2006)

Energy shortages are exacerbated by inefficiencies principally in end use systems. The inefficiency is due to unreasonable tariffs, absence of awareness and incompetent policy drivers. One of the routes to deal with this crisis is to overcome these inefficiencies through demand side management. (Rajan,2003) In India, huge opportunities are accessible for reducing power demand by using DSM in almost all the sectors. Many are low cost and can improve energy security and environment. (Mukhopadhyay, et al., 2010.)

2.4.1 FINANCIAL SCENARIO

State owned DISCOMs in India are confronting a genuine financial crisis. A plan for financial rebuilding of state owned DISCOMs to build up financial turnaround and long term viability has been launched by the central government through a transitional finance mechanism (TFM), with a financial budget of around INR. 1.8 lakh crores (190 million USD). As per the annual report for 2011-12 on 'The working of state power utilities and Electricity departments' presented by the Planning Commission, the reason behind the poor financial health of the DISCOMs is non-revision of tariffs, unreasonable tariff in most cases, non-payment of subsidies, increased cost of power purchase and high distribution losses. Out of the four reasons expressed above, DSM can substantially limit at least subsidies and the need for power purchase. (Ministry of Power,2012).

The research conducted by the Prayas (Energy Group) in India rated the operational and financial performance ability of all the state power DISCOMs, from A+ for very high capacity, to C for very low capacity based on their performances in their respective states. Among the states reviewed, only Gujarat DISCOMs were rated A+, while Andhra Pradesh, was rated below average abilities.(Dukkipati, et al.,2014)

In this research, it is observed that the state DISCOMs have an immense revenue gap which converts into tariff rise for consumers. The DISCOMs have to depend on expensive power purchases, especially the short-term power purchases, to maintain their supply and demand positions. Likewise, in many states the main part of power purchase is a little lower, or in a few cases even higher than the average power purchase costs. Considering enormous investment needed in capacity edition, these costs can easily rise over a timeframe.

This concise overview of the power situation in these states demonstrates that there is a solid case for utilities to take up large scale DSM activities. These activities can lessen high power purchase costs by lessening the demand during peak loads which in turn can help in reducing peak deficit. The reduction in consumption from buyers paying a low tariff can be utilized to supply to those paying a high tariff. After conducting a brief study, the Ministry of Power, suggested that as opposed to targeting just those customers with tariff less that the average cost of supply, all consumers with tariff less than the power purchase costs be considered for DSM activities. Around 49% of the total consumption acquires revenues not as much as negligible cost of power (around 21% of the total power purchase). Any decrease in this consumption can either decrease

the marginal power purchase cost, or saved units can be provided to categories that earn better revenue, like commercial and industrial consumers. (Ministry of Power,2012).

2.5 Review of Regional countries

Introduction

The review of regional initiatives is carried out to know about the measures adopted in different regional countries and gather detailed information on DSM initiatives and implementation. The sections in this chapter illustrate the review of the initiatives adopted in Vietnam and Philippines. Each section of this chapter starts with the description of background information of the country. Different measures such as formulation of policies, strategies have been illustrated in tabular format and review findings for each country has been described at the end of each section.

2.5.1 Vietnam

Background:

More aggressive efforts to expand the effectiveness of demand management and energy use are currently a critical imperative for Vietnam. Energy demand tripled throughout the most recent decade, and it is most likely to triple again over the following decade if economic development stays robust. Improving energy efficiency is by far the low cost and most environmentally benign way to meet energy demand. (The world Bank Group, 2010). Energy saving potential does not occur naturally, strategies and programs need to be instituted to empower the capture of energy saving opportunities. Vietnam has made a decent start with the launching of a new National Energy-Efficiency Program and the drafting of another Law on Energy Conservation and Efficient Use. These activities can establish a decent framework for near future. A review of different initiatives undertaken by Vietnam is described in table 2.5.1.1

Target	***Strategy***	***Measures***
from 2006 to 2010		

Developing and implementing energy efficiency measures	*Enactment of the proposed Law on Energy Conservation and Efficient Use*	*Introduction of a new mandatory system for energy management in large energy consuming industries and buildings*
Improving Energy Efficiency in Existing Industrial Plants	*collaboration with Ministry of Industry and Trade (MOIT) and its provincial affiliates to provide specific guidance on energy-use and energy conservation planning requirements*	➢ *Prepare new financing programmes for industrial retrofit projects.* ➢ *Ensure that technical assistance for projects blends well with financial program*
Encouraging More Energy Efficiency in New Industrial Plants	*Collaboration with government planning and policy makers*	*systematic weighing of cost effective developing of new energy-intensive industrial capacity*
Transforming Markets for Household Electrical Appliances	*increased penetration of more energy-efficient appliances into specific appliance markets through regulation and selective public intervention*	➢ *Government initiatives to work with suppliers.* ➢ *Programs to provide consumers with information about efficiency characteristics of the appliances.*

Table 2.5.1.1 Initiatives taken in Vietnam (The World Bank Group, 2010)

Name of the Project	*Aim*	*Actions Taken*
Promoting Energy Conservation in Small and Medium Sized Enterprises in Vietnam (PECSME) During: 2006-2010	*Reduce greenhouse gas emissions by removing the barriers to widespread transfer and adoption of energy conservation and energy efficiency technologies, management and maintenance and operational practices in SMEs in 5 industries of Vietnam comprising: ceramics, brick, paper, textiles, and food processing.*	*Six major components related to energy conservation and energy efficiency (EC&EE) have been included which are:* *(i) support for policy and institutional development;* *(ii) communication and awareness;* *(iii) technical capacity development;* *(iv) support to energy efficiency services providers;* *(v)financing support;* *(vi) EC&EE Demonstration and Replication.*

Table 2.5.1.2: Projects undertaken in Vietnam (The World Bank Group, 2010)

2.5.2 Philippines

Background:

Philippine is one of the fast growing economies in South East Asia. The Philippine economy has long been a champion of energy conservation measures. Learning from major drawbacks such as supply shortage, power outages, etc. strict measures to conserve energy are being implemented (APEC, 2012). The government has set its main goal to reduce the demand of energy consumption by ten percent (10%) during the period 2010-2030. To achieve this, the Government of Philippines has been working on adopting improved DSM strategies through formulating relevant policies and regulatory frameworks along with initiating different programmes and projects. These are illustrated in the following tables.

Target	*Strategy*	*Measures*
From 1992 to 2000 *Industrial programmes* ➢ *Time of Use tariff* ➢ *Interruptible and curtailable tariffs* ➢ *Motor efficiency programs* ➢ *Adjustable-speed drive (ASD) programs*	*NAPOCOR National Power Corporation of Philippines working together with distribution companies to charge the consumers two-part tariffs that charge for energy and contracted demand.*	*providing consumers incentives to shift loads from peak to off peak periods by offering low electricity prices.*
Power Factor Improvement	*Evaluating the maximum potential technical impact of deviation in power factor*	➢ *on site capacitor banks* ➢ *on site switch capacitors* ➢ *Utility distribution line capacitors to correct power factors*
Direct Load Control	*DLC program to reduce consumption of energy at consumer end*	*load control in residential air conditioners and water heating*
Lighting Efficiency Programs	*Raising awareness in public for Energy saving potential*	*replacing incandescent bulbs with compact fluorescent lamps (CFL)*

Table 2.5.2.1: Initiatives taken in Philippines (IIEC,2006)

Name of the Project	*Aim*	*Actions Taken*
Cagayan Electric Power And Light Company (Cepalco) – Industrial Demonstration Programme – Philippines	➢ *To promote efficiency in the use of electricity to meet the desired load shape* ➢ *To induce customers to adopt energy-efficient technologies and production processes in the industrial sector that can reduce system demand.*	➢ *Energy savings and demand reduction.;* ➢ *awareness generation* ➢ *technical capacity development;* ➢ *support to energy efficiency services providers*

Table 2.5.2.2: Projects undertaken in Philippines (IIEC,2006)

2.6 Conclusion

Based on the review of the measures adopted in the above two countries, it can be summarized that the activities of DSM have been introduced through different projects and programmes Vietnam and Philippines respectively. Since its inception, the regional countries (including Thailand) have been following various measures on, energy efficiency and demand management. Based on the review, the researcher has seen that the above three countries have followed the programmes which are cooperative, economic, education and research based. The Governments in the above three countries have followed motivating and supportive approach to undertake DSM measures.

CHAPTER 3: RESEARCH DESIGN

3.1 RESEARCH FRAMEWORK

OBJECTIVE OF THE RESEARCH:

The objective of this research is to identify incentives for regulators and DISCOMs to adopt and implement EE and DSM measures.

NATURE OF RESEARCH PERSPECTIVE

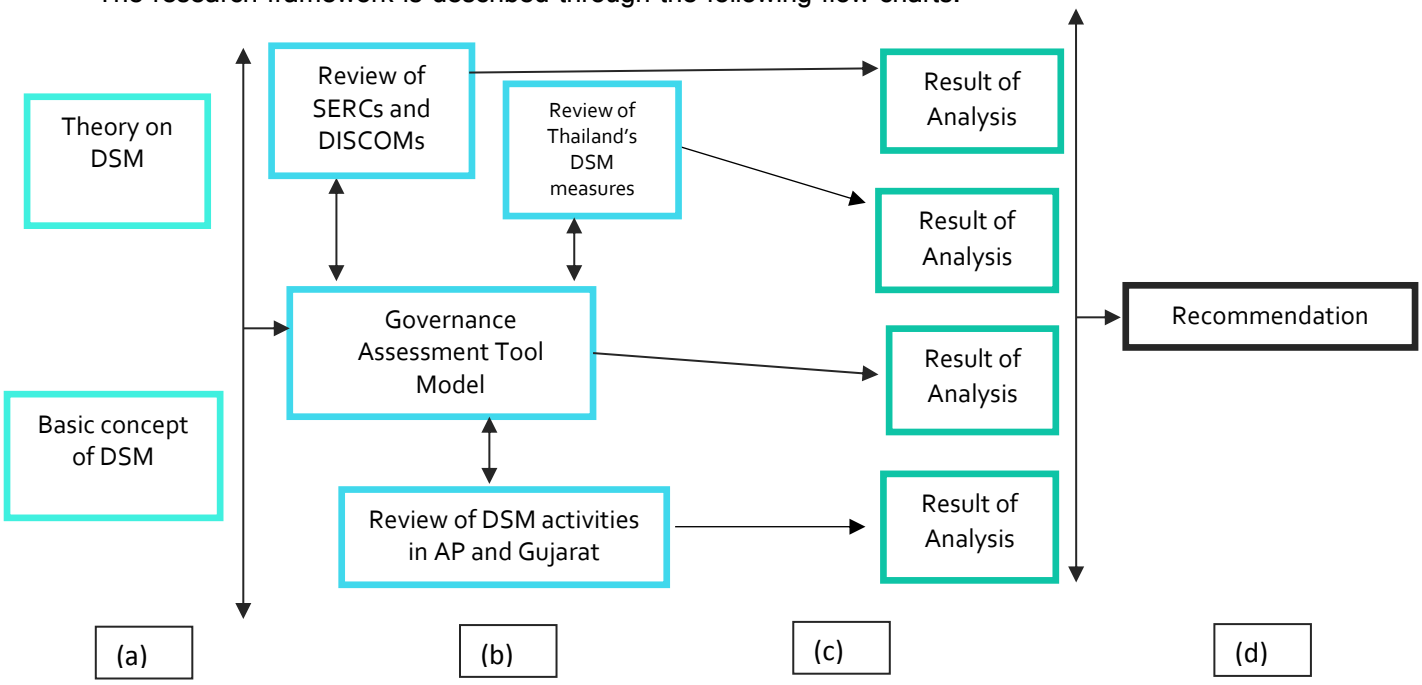
The research observes the DSM implementation work by various state actors in India such as DISCOMs, SERCs and SDAs and different DSM measures taken by countries like Thailand for

analysing the respective work and learning from each other to improve DSM programmes in India. The nature of the research in this thesis is problem analysis research. The research perspective is a conceptual model to determine learning from different actors on micro, meso and macro levels that influence the development of DSM.

THE SOURCES OF RESEARCH PERSPECTIVE

A schematic presentation of the research framework:

The research framework is described through the following flow charts:



Formulating the research framework in the form of arguments which are elaborated

(a) A review of the theories of DSM and the basic concepts and key definitions involved.

(b) Review of DSM in Andhra Pradesh and Gujarat and DSM measures of Thailand with the help of Governance assessment Tool Model.

(c) Confronting the result of the analysis as the basis for recommendation.

(d) Recommendations with regard to address the issue.

3.2 RESEARCH QUESTION

THE MAIN RESEARCH QUESTION:

What are the potential incentives for the regulators and DISCOMs to adopt and implement better EE and DSM measures?

SUB RESEARCH QUESTION

1. What are the current DSM programmes and implementation practices in the two Indian states chosen for the research?
2. What are the lessons to be learnt from the DSM models employed in Thailand?
3. Who are the main actors and what are their roles related to DSM implementation?

3.3 RESEARCH STRATEGY

The research focuses on the assessment of DSM activities carried out by Gujarat and Andhra Pradesh in India. Firstly, a literature review was performed to understand the concepts relevant to this research. Secondly, desk research was applied to review data on different EE/EC/DSM activities of the SERCs, DISCOMs, and SDAs in the states of Gujarat and Andhra Pradesh in India and DSM initiatives in Thailand. All these initiatives were evaluated by using Governance

Assessment Tool matrix[15] .Gujarat and Andhra Pradesh are chosen for the research because these states are facing peak energy shortage followed by limited success in DSM initiatives even though Gujarat was rated A+ for the operational Capacity and considered as a power surplus state. Andhra Pradesh though had a rating of 'C' which was considered as poor in operational capacity in a research led by Prayas (Energy Group). A brief recommendation will be proposed to overcome this issue by evaluating the programmes undertaken with the use of GAT matrix.

Thailand has made significant progress in their DSM programs from the introduction in 1993 to 2003 and it is clearly evident from the institutional and financial mechanisms used. Thailand's DSM programmes can be used as a starting point by India to develop the programmes of their own based on local conditions.

3.3.1 RESEARCH UNIT

The research unit of the research is Demand Side management (DSM) in India.

3.3.2 RESEARCH BOUNDARY

In this research of DSM activities, only those activities were looked into that were conducted at consumer end. Some SERCs and DISCOMs have considered load management exercises such as agriculture feeder partition, establishment of High Voltage Distribution Systems (HVDS), and installation of capacitor banks at sub stations as DSM activities. Such activities have not been included in this research because the data available for these activities is not available since the data for all these activities is not disseminated in the concerned states.

3.4 RESEARCH MATERIAL AND ACCESS METHOD

The information and data required for answering the research questions was collected by using different methods including desk research also by analysing the data available on public domain. The data analysis was carried out by studying the literature about DSM and the data available on

[15] In the Governance Assessment Tool Matrix, evaluative questions are formed and based on the evaluation judgement can be achieved whether the circumstances are supportive, restrictive or neutral. See section 3.6 for more information.

the official website of the actors. The data was then evaluated by using the Governance Assessment Tool (GAT) and the performance of the chosen states in relation to the DSM program implementation was assessed based on the GAT criteria. The data and information required and its accessing method in this research are identified through the set of sub-research question, as displayed in the following Table.

Table : Data and Information Required for the Research and Accessing Method

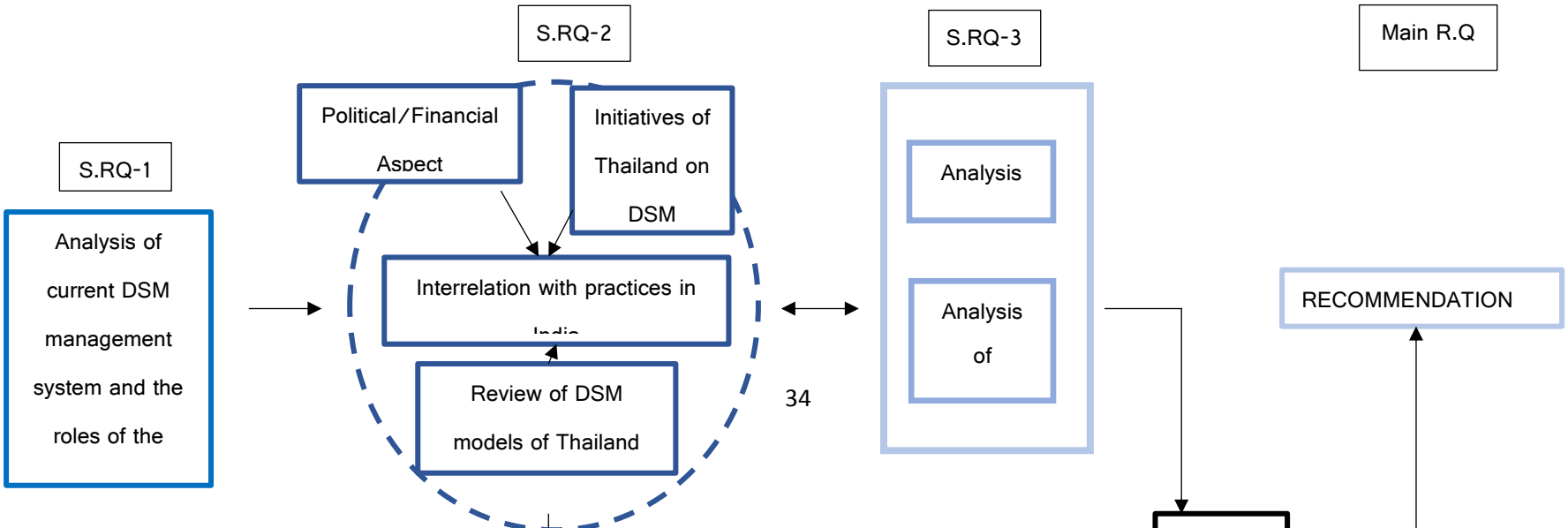
Student Name: Aniket Sarode

Research Question	Data/Information Required to Answer the Question	Sources of Data	Accessing Data
What are the current DSM programmes and implementation practices in the states chosen for the research?	DSM programmes in Gujarat and Andhra Pradesh	Secondary Data Documents	Content Analysis by making valid inferences from the data available
		Secondary Data: Media: Official websites	Content Analysis using GAT matrix
	Current management of DSM practices	Primary Data: Documents	Content Analysis/GAT Matrix
What are the lessons to be learnt from the DSM models employed in Thailand?	Review of Thailand's programs and initiatives related to DSM.	Secondary Data Desk Research	• Programmes undertaken. • Successful measures and initiatives • Evaluation by GAT Matrix
Who are the main actors and what are their roles related to DSM implementation?	The actors and stakeholders in DSM implementation practices	Secondary Data Literature and desk research	Data Analysis using GAT matrix
		Primary Data Media: Official Websites	Content Analysis by making valid inferences from the data available using GAT matrix

Student Name: Aniket Sarode
Student Number: S1888218

3.5 ANALYTICAL FRAMEWORK:

schematic presentation of analytical framework is shown in Figure 3.5.1



The data analysis will be carried out with following sequence:

a. The first step of data analysis is making a review of the DSM activities, literature and document study of DSM practices. Analysis will be done by studying the initiatives undertaken related to DSM and the actors and their roles in DSM management and evaluating the initiatives undertaken by using Governance Assessment Tool Matrix. This step will additionally examine current management of DSM, general practices in the DSM management that influence the DSM conditions. This step will answer sub research question 1.
b. The next analysis is about review of DSM models in Thailand which will answer the sub research question 2. This step will characterize how each aspect can be changed in large scale of actors for successful interrelation.
c. . This step will review the tariff mechanisms, regulations and directives set by DISCOMs and SERC's. This step will find key participants in DSM and will answer sub research question 3.
d. This step will draw out the result of analysis of part b and part c.
e. The result of part d will be then used to build proposition of recommendation to further develop the current DSM and EE practices in India.

3.6 Governance Assessment Tool

The Governance Assessment Tool can be used to methodically assess a governance setting in a particular area concerning a particular issue. In the tool a broad distinction is made between descriptive dimensions and quality criteria. These quality criteria are not normative in a sense, yet relate to the conditions for effective management. Specifically, the tool draws attention to the management conditions that can hinder or encourage the usage of programmes under complex and dynamic conditions. (Bressers et al. 2013).

Figure 3.6.1 describes the five interrelated dimensions of Governance.

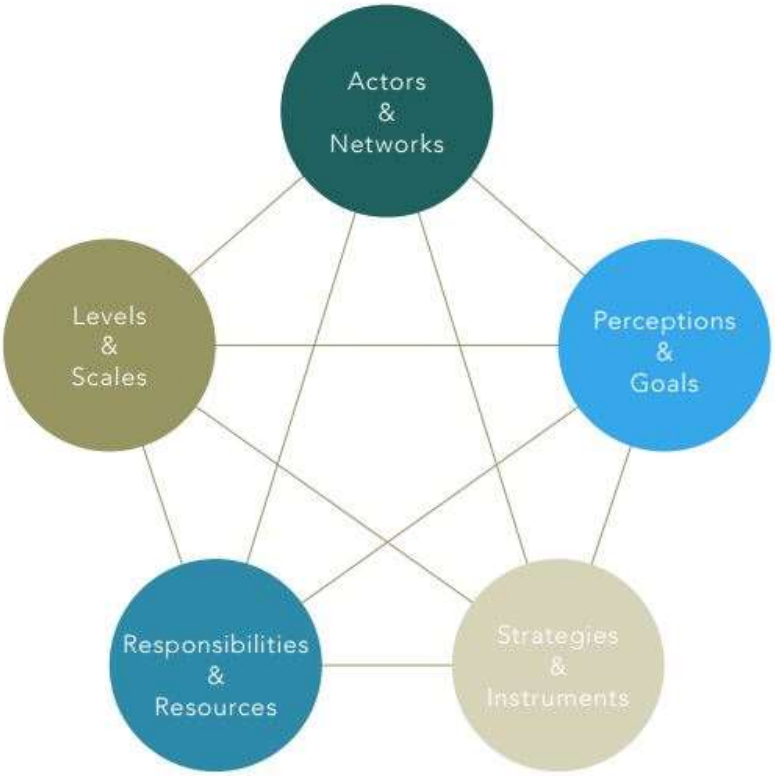


Figure 3.6.1: Five interrelated dimensions of governance. (Bressers et al. 2013).

Advantages of Governance Assessment Tool:

- Effectively combines qualitative and quantitative analysis.
- Can be used as a model for indexing information availability in various sectors.
- Can be interactively applied by both researchers and practitioners.
- Provides insights for actors and create more effective action perspectives 'on the ground'.

Disadvantages of Governance Assessment Tool:

- Comparison across sites can be challenging where there is substantial local adaptation.
- Not fully tested.
- Limited range of governance criteria used.

The assessment of the DSM measures taken by the actors is based on the questions mentioned in the figure 3.6.2.

Governance dimension	Quality criteria of the governance regime			
	Extent	Coherence	Flexibility	Intensity
Levels and scales	How many levels involved?	Do these levels work together?	Is it possible to move up and down levels given the issue at stake?	Is there a strong impact to change behaviour?
Actors and networks	Are all relevant stakeholders involved?	What is the strength of interactions between stakeholders?	Is it practised that the lead shifts from one actor to another?	Is there a strong impact from an actor or actor coalition?
Problem perspectives / goal ambitions	Are the various problem perspectives taken care off?	Do the various goals support each other, or in competition?	Are there opportunities to re-assess goals?	How different are the goal ambitions from the status quo?
Strategies and instruments	What types of instruments are included?	Is the resulting incentive system based on synergy?	Are there opportunities to combine or make use of different types of instruments?	What is the implied behavioural deviation from current practice?
Responsibilities and resources	Are responsibilities clearly assigned and facilitated with resources?	Do the assigned responsibilities create competence struggles or cooperation?	What is the flexibility within the assigned responsibility?	Is the amount of applied resources sufficient?

Figure 3.6.2: The governance assessment tool matrix with its main evaluative questions (Bressers et al. 2013)

Scoring of criteria in GAT matrix

Figure 3.6.2 explains the five dimensions of the governance context and the four criteria that impact to what degree they encourage satisfactory and adaptive action by the stakeholders involved. It should be noted that some level of " judgment" is inevitable while evaluating the status of the four criteria. Therefore, it will be important to make these judgments "inter-subjective", to prevent that the assessment neglects important aspects, has a debatable weighting of observations or uses the concepts in a less than consistent way. This is the same for all cells of the matrix. Consequently, any assessment with respect to the 20 cells that tries to standardize more than an elaborate situation, may not be "precise". That is the reason in assessment of GAT, just three "values" are visualized: Satisfactory/high, moderate/good, unsatisfactory/low (green, yellow and red).

Chapter 4: State wise overview of the DSM Scenario

This chapter discusses the overview of the two states Andhra Pradesh and Gujarat and the DSM activities undertaken in those states.

4.1. Andhra Pradesh

Background:

Andhra Pradesh is one of the 29 states in India located on the south eastern coast. Andhra Pradesh is the seventh largest state in India covering more than 160,000 sq.km. It is also India's 10th largest populated state with nearly 50 million inhabitants. Andhra Pradesh is made out of two regions: Coastal Andhra situated along the Bay of Bengal and Rayalaseema on the south. These two regions include 13 districts, with 9 in Coastal Andhra and 4 in Rayalaseema. (Shankarlal C. Bhatt,2006).

On 2 June 2014, the north-western part of the state was separated to shape another state of Telangana. Andhra Pradesh's long-term capital, Hyderabad, was moved to Telangana as a part of the division. However, as per the Andhra Pradesh Reorganization Act, 2014, Hyderabad will remain the by law capital of both Andhra Pradesh and Telangana states for a timeframe not more than 10 years.

4.1.1 Power Scenario

AP consumed around 70 Billion Units (BUs) of power in 2012-13. There was an energy shortage of 17% and peak shortage of 20% during 2012-13. (Central Electricity Authority, 2014). The approved normal power purchase price for AP DISCOMs is Rs. 3.74[16] (0.06 USD) as per the tariff order for the year 2013-14. (AP Retail Supply Tariffs, 2013). Figure 4.1.1 demonstrates the power purchase prices against the total number of units purchased by AP DISCOMs from various sources. It is clearly visible that around 17% of the power was purchased at a range of Rs. 4.00 (USD 0.06) to Rs. 10.00 (USD 0.16) for each unit, of which around 10 Bus [17] was acquired through market and different sources.

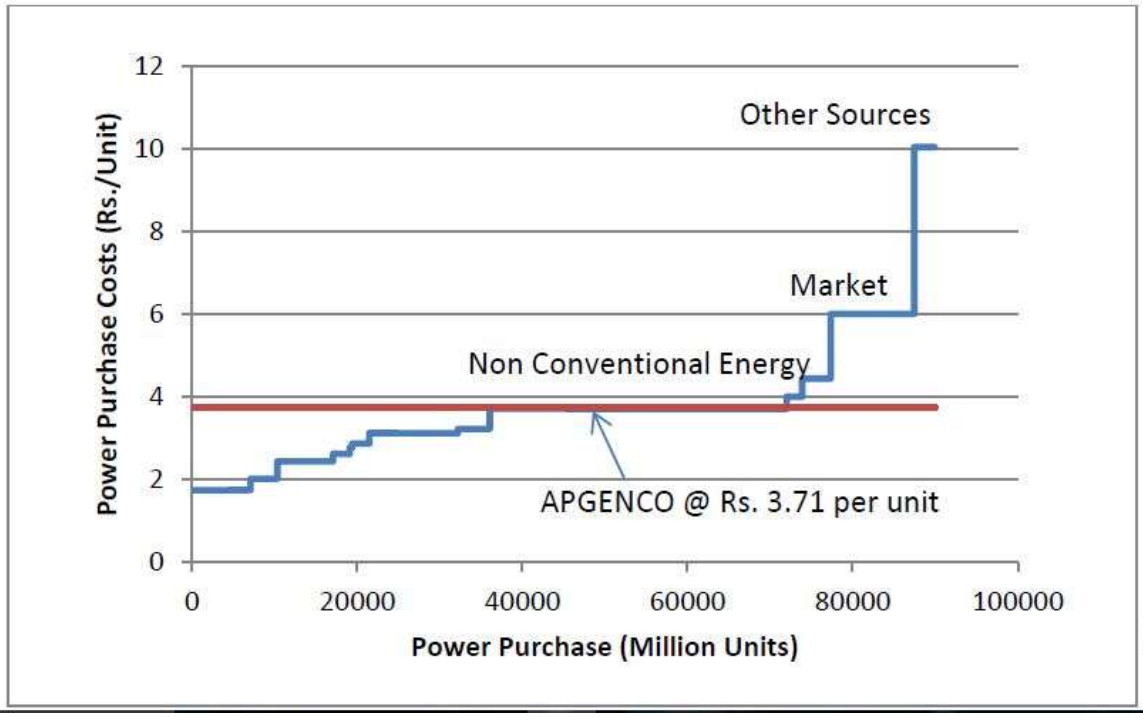


Figure 4.1.1: Approved power purchase costs for AP DISCOMs 2013-14

The average cost of supply for AP DISCOMs was Rs. 5.61[18] (USD 0.09) for each unit. Figure 4.1.2 demonstrates the approved revenue realization from the significant consumer categories for

[16] As mentioned in AP tariff order 2013-14, page 66

[17] In electricity distribution, a bus bar (also bussbar) is a metallic strip or bar, typically inserted inside switchgear, panel boards, and busway enclosures for local high current power distribution.

[18] Pg 156 of tariff order 2013-2014

AP DISCOMs for the year 2013-14. (AP Retail Supply Tariffs, 2013). It can be observed that the revenue realization from residential and agricultural categories is lower than the average cost of supply. These two categories represent over half of the total power consumption in Andhra Pradesh.

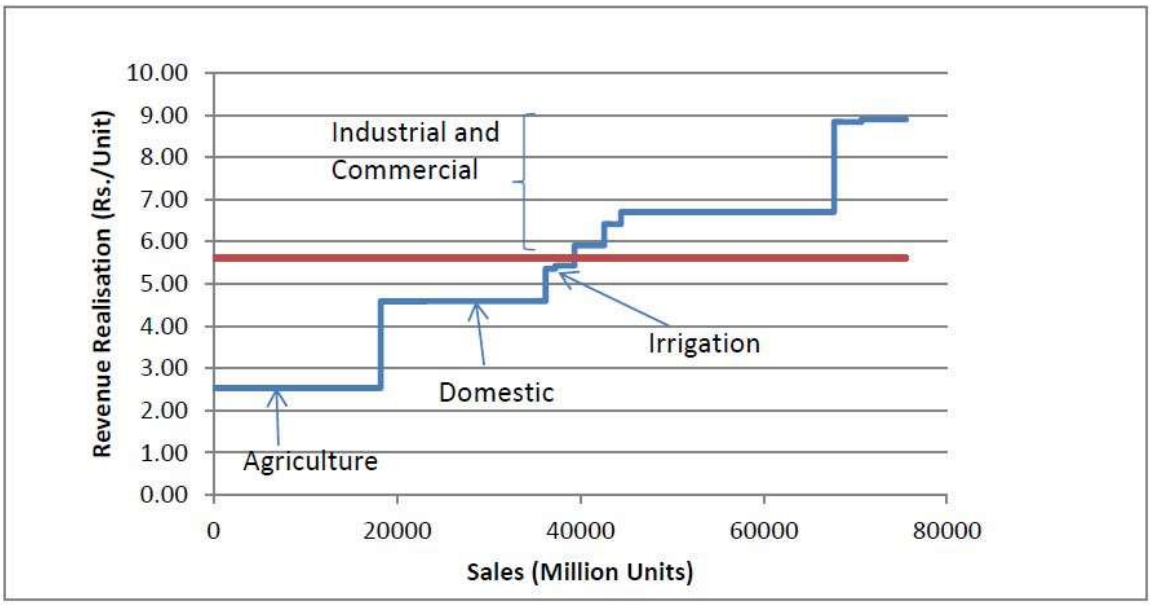


Fig 4.1.2: Average revenue realization for AP DISCOMs 2013-14

As per Central Electricity Authority, it was estimated that there would be a peak shortage of 12.4 % during 2013-14. Andhra Pradesh had an accessible limit of around 17,500 MW as on December 2013. The Andhra Pradesh Power Generation Corporation Limited (APGENCO) had planned a capacity expansion to the tune of 15,000 MW needing an investment of around Rs. 85,000 crores. (1325 million USD) which incorporated thermal and renewable projects. These projects are expected to be commissioned by 2016-17. (APGENCO, 2013).

Sector	Electricity	Savings

There was a huge saving potential estimated from DSM measures in AP. According to a study directed by NPC, estimated savings potential of Andhra Pradesh was around 7 BU in 2008 for four vital sectors (National Productivity Council,2009). (See Table 4.1.3).

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

Table 4.1.3: Saving potential in Andhra Pradesh.

4.1.2 EE/DSM activities in the state

This section presents an overview of EE/DSM measures taken by various actors in the state. The actors and their functions is mentioned in the table 4.1.2.1 followed by their measures undertaken in detail.

Actors	Functions
APERC	study of load curves and consumption patterns
AP DISCOMs	Awareness program, capacitor instalments, efficient lighting programs
NEDCAP	Energy Efficiency auditing

Table 4.1.2.1: Actors and their functions in Andhra Pradesh

4.1.2.1 Andhra Pradesh Electricity Regulatory Commission (APERC)

In AP, the Regulatory Commission has not notified DSM regulations. Since 2005-06, the commission has been accentuating the study of load curve studies and consumption patterns to consolidate DSM measures to reduce the peak. (APERC,2004). In 2009, the APERC, sensing the requirement for price signals to lessen peak demands, again directed the DISCOMs to set up an approach paper for presenting ToD tariff. In the wake of getting remarks from public, it was later chosen to present ToD during time frame (6.00 pm 10.00 pm) and the rate would be Re.

1.00/kWh (USD 0.02) more than the energy charges. The APERC currently has ToD just for the night peak hours. Nonetheless, there is no incentive for consumption amid off-peak hours as is the case in numerous different states like Gujarat and Delhi.

A committee was shaped under the chairmanship of the Chairman and Managing Director, APEPDCL, which recommended some measures for energy conservation. The DISCOMs were directed to present a report about the implementation of these recommendations and the resultant savings, and post this report details on their websites. However, DISCOMs did not present any of such reports on their websites. The commission likewise directed the licensees to raise awareness among consumers through campaigns at least possible costs, which the DISCOMs have complied to.

AP is the main state where its electricity regulatory commission, the APERC, enabled free supply to dry and wet land farmers who implement DSM measures. It had ordered the DISCOMs to give new connections just with meters, and ones which have DSM measures implemented. Nonetheless, it was important to assess whether such tariffs had truly prompted consumers to implement DSM measures. For this reason, there were a series of complaints raised by consumer groups, and the commission had directed the DISCOMs to prepare and submit a report about energy efficiency measures adopted for rural pump-sets and savings achieved after taking these measures. The report details were also posted on their websites, however there was no response from the DISCOMs. Only the APNPDCL had posted a quarterly report on directives on its sites. Some consumer members and the commission had likewise pointed out the claim by DISCOMs that around 95% pump-sets which were given capacitors were faulty, and none or not many of the pump sets had capacitors fixed.

In 2014, APERC issued a consultative document to the Government of Telangana which raised two vital points:

a) There should to be prepaid metering for government organizations as their utilization is unrestricted. The aggregate bill due to the DISCOMs by the government is Rs. 742 crores, (11 Billion USD) and

b) DSM ought to be executed aggressively in the agricultural sector. The commission observed that there was a saving potential of 1,500 MU in this sector, and DISCOMs would spare Rs. 760 crores (USD 11.85 million) every year if appropriate DSM measures were adopted.

4.1.2.2 AP DISCOMs

The four DISCOMs in AP – the Telangana State Southern Power Distribution Company Limited (TSSPDCL), once called Andhra Pradesh Central Power Distribution Company Limited (APCPDCL); the Northern Power Distribution Company of Telangana Limited (TGNPDCL), once called Northern Power Distribution Company of A.P. Constrained (APNPDCL); the Andhra Pradesh Eastern Power Distribution Company Limited (APEPDCL) and the Andhra Pradesh Southern Power Distribution Company Limited (APSPDCL) – take into account around 58 million consumers. The DSM programs by the DISCOMs in AP can be classified into:

a) awareness programs

b) capacitor instalment on agricultural pump-sets for power factor improvement, and

c) efficient lighting programs.

It was observed that all DISCOMs had made substantial efforts in creating awareness through meetings and distribution of brochures. They requested consumers to utilize less energy by turning off appliances, avoiding unnecessary utilization, and utilizing more natural sunlight and air. They made intermittent appeals through TV and public press statements.

The capacitor instalment on pump-sets was another program that was being executed by the DISCOMs. All the DISCOMs asserted that they had installed capacitors on over 95% of the agricultural pumps except for APCPDCL. In the tariff order of 2013-14, the APEPDCL noticed that it presented a proposition to the APERC for presenting an incentive scheme for rural consumers who adopt legitimate metering, DSM measures, EE pump sets and grow irrigated dry crops. The APEPDCL had additionally executed a few energy efficiency and conservation measures in its own particular premises, such as LED based lighting in its corporate setup, and the adoption of 5-star rated distribution transformers DTRs.

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

The NEDCAP was designated as the SDA by the Government of Andhra Pradesh (GoAP) in 2007 according to the EC act. Their website has an exclusive selection on energy efficiency, with generic data on energy efficiency, energy auditing, efficiency in various sectors like agriculture, industry, municipalities, and so on. There is no data on the site about the activities directed by the organization or its financial plan. A booklet by the NEDCAP gives a list of little experimental pilot run programs led by it like replacing bulbs and T12 tube lights with energy saving lights like LEDs, CFLs and T5 tube lights. These pilots had been executed in gram panchayats, government buildings, towns and city corporations bringing about savings of 13 Mus. (NREDCAP- Energy Conservation programs, 2010)

In December 2012, the GoAP established the State Energy Conservation Mission (SECM) to improve consumer awareness of energy efficiency, build up an extensive communication strategy, and also evaluate tangible and intangible benefits from energy conservation. The actors and their area of work is mentioned in the table 4.1.2.3

Actor	Area of work
Chief Secretary of the GoAP	Energy and agriculture
Chairman and Managing Director (CMD)	Transmission Corporation of Andhra Pradesh Limited (APTRANSCO)
CMD	DISCOM
Vice Chairman and Managing Director	New and Renewable Energy Development Corporation of Andhra Pradesh Limited (NREDCAP),
Chief Executive Officer	Energy conservation

Table 4.1.2.3: Actors and their area of work

A corpus[19] fund was made for exercises recommended by the mission, and the expenses for these exercises were arranged by pooling funds from DISCOMs and the NREDCAP. Likewise, in

[19]A corpus fund is a permanently closed fund with no strings or conditions for future application attached.

February 2014, the energy department of the GoAP sanctioned 1.5 crores (USD 20 Million) to APTRANSCO for leading energy efficiency programmes. The chief secretary discussed an arrangement being formulated to strengthen Andhra Pradesh's State Energy Conservation Mission (SECM). He stated that around 15,000 MU of energy can be saved prompting a financial benefit of Rs. 9,500 crores (USD 148 million). He guided every key department to set up energy conservation cells and come up with plans to help Andhra Pradesh turn into an energy effective state. The SECM was enlisted as a society under the Societies Act. Likewise, the GoAP assigned it as the SDA. (Government of AP-Constitution of State Energy Conservation Mission,2012).

The GoAP constituted a specialized panel to set up a draft Energy Conservation Building Code (ECBC). The board of trustees after meetings with different partners prepared a draft and submitted it to the GoAP. The code was applicable to commercial buildings that had a plot area of more than 1000 sq mtr, or built up area of more than 2000 sq.mtr. Some classes of buildings like multiplexes, hospitals, lodgings and convention centres were included regardless of their built up area. The code is obligatory for all new buildings to comply with the AP one-star rating. The ECBC was implemented from 1st August 2014. (Adoption of ECBC,2014).

4.1.3 Specific DSM measures by APERC

4.1.3.1 Low Power Factor Surcharge

For HT consumers, there is an additional charge if the power factor falls below 0.95. The extra charge is 0.5% to at least 10% of the energy charges for the power factor (pf) of 0.94 to 0.75. It was made active in 2009. In the event that the power factor stays below 0.75 for two consecutive months, then the consumer needs to get it to 0.95 in 6 months or else the supply gets discontinued.

Consumers from LT non-domestic, business and industry categories provided with meters fit for measuring active and reactive power would also pay this additional charge. It is also applicable to government water irrigation plans.

In 2010-11, the APEPDCL urged to settle the responsive power tariff at Re. 0.25/kVARh (0.003 USD) for 0.95 to 1.0, and at 0.50/kVARh (USD 0.01) for a power factor under 0.95. Until now, the power factor surcharge is still effective. The commission believed that a kVAh-based duty is the way to go. It asked that all DISCOMs explore enforcing it from 2011.

The kVAh-based charging would encourage consumers to a unity power factor. In 2011-12, it was applicable to all HT and LT consumers fitted with tri-vector meters. The power factor additional charge was then discontinued. LT consumers without kVAh charging were required to set up shunt capacitors of the ratings provided by the licensees. In case of no capacitor found during inspection or the capacitor is discovered as having been tampered with, the consumer is charged 25% of his monthly bill. The commission guided the licensees to install tri-vector meters equipped for recording kVAh consumption for every industrial service with a rating of 20 HP or more, and for all LT II services with a rating of 10 kW or more.

The necessity of pf not being under 0.75 was changed to 0.95. It must be back to 0.95 in three months, or the service would be discontinued. Consumers had asked for incentives for a pf value higher than 0.95. Yet, DISCOMs had denied them any incentive with the basis that a higher pf value is at any rate profitable to consumers and need not be incentivized.

4.1.3.2 Time of Day (ToD) tariff

In 2009-10, with a specific goal to compensate the DISCOMs for high power purchase costs during peak periods, the APERC requested them to prepare an approach paper on the Time of Day (ToD) tariff. It further directed the DISCOMs to file for ToD in the 2010-11 retail supply tariff. Therefore, the DISCOMs proposed the ToD tariff as an extra charge over the typical tariff for all HT-1(A) industrial consumers (at all supply voltages - 11kV/33kV/132kV) in Table 4.1.3.2

Time of day	Charge
1000 hrs to 1400	Rs.0.75 (USD 0.01)

hrs	
1800 hrs to 2200 hrs	Rs.1 (USD 0.016)

Table 4.1.3.2: Additional charge over normal tariff.

There were complaints raised against the ToD tariff, particularly that the ToD rates being too high, there were two peak time periods, they ought to be applied just during peak seasons like the summers, and that there was no incentive as refunds for moving to off-peak. The commission approved the ToD tariff with just the evening peak time period. The extra charge was around 22-35% of the energy charges over all HT consumers.

In 2011-12, the DISCOMs recommended an incentive of Rs. 0.5/kWh (USD 0.07) for the HT-1(A) consumers to move to off-peak hours (12 am to 3 am) in the period June to January (off-season). They had to pay Re. 1/kWh (USD 0.016) additional for the time period 6 pm to 10 pm each day. However, the APERC dismissed the incentive with the argument that the difference between the normal tariff and the ToD tariff itself was an incentive for the consumers to move to off-peak demand. The DISCOMs also recommended a Time of Season (ToS) tariff where the HT and LT-II consumers would pay an extra charge of Re. 0.75/unit (USD 0.01) and Re. 0.5/unit (USD 0.007) in the months of February to May, the high season time frame. However, the APERC rejected the proposition after a thoughtful consideration. There are no details on what this careful consideration involved.

In 2012-13, the DISCOMs proposed to stretch out the ToD duty to HT-II consumers. The commission approved the expansion with the justification that there is a requirement for consumers to embrace extensive energy conservation measures including the arranging of loads to shift to off-peak periods. Given the differing qualities of loads in this category, it was expected that in any event part of the load be moved to off-peak periods.

4.1.3.3 Agriculture Tariff

The APERC ordered that new connections be issued just with DSM measures implemented. DSM measures incorporate a frictionless foot-valve, a capacitor of satisfactory rating, high-density polyethylene (HDPE) or R Polyvinyl Chloride piping at suction or delivery, and ISI marked mono-block or submersible pump-sets. However, all agricultural consumption was not being metered. There was no account of even the metered connections to see whether the differential tariff had

any effects. For this reason, the consumption information over every category was needed. Since not all agricultural consumers were metered, the commission was additionally approaching DISCOMs to provide meters to all agricultural consumers.

4.1.4 Specific DSM activities by AP DISCOMs[20]

4.1.4.1 APEPDCL

a. Efficient Lighting

Consumers in the APEPDCL service zone were asked to use CFLs rather than incandescent bulbs. A proposition for distributing 0.38 million CFLs to rural residential consumers in Vizianagaram region under an exclusive purpose vehicle financing mode with help from the GoAP was submitted to the regulator in the fiscal year 2013-14. In its own particular office, the APEPDCL had supplanted HPSV lights with LED lights in 5 sub-stations and a tender had been floated to do so for 600 sub-stations. They had additionally floated a tender for LED-based retrofits in their corporate office.

b Efficient Pumping/Reactive power management

In the agriculture sector, a proposition had been sent to the APERC for offering an incentive scheme to consumers in the agricultural sector who adopt appropriate metering, DSM measures including energy efficiency pump-sets, and grow irrigated dry crops.

A free of cost pilot was executed for the substitution of old existing 5 HP pumps with 5-star marked pump-set in Karada Mandal, Vizianagaram District, which brought about a savings of 31%. Another venture to replace 2,205 pump-sets with EE star marked pump-sets in Rajanagaram Mandal was also investigated. (APNPDCL,2014).

[20] The current status is as per the tariff order of 2013-14/ ARR filings of 2014-15 and other documents available on the official website of APERC http://www.aperc.gov.in/aperc1/index.php/main/index/12

c. Other Programs

The APEPDCL has taken up 5-star rated DTRs and replaced around 10,000 DTRs so far for improved energy efficiency. For all new connections to be released by the APEPDCL in the towns and for the agricultural area, 5-star rated DTRs are being used.

4.1.4.2 APCPDCL

a. Efficient Pumping/Reactive power management

The APCPDCL has installed 1070 capacitor banks of 2 MVAr rating, and 930 capacitor banks of 600 kVA rating on agricultural pump-sets with a power factor of 0.96. The power factors are being checked at 33 kV level frequently. According to calculations in the current tariff petition (2014-15), the payback time is 10 months. It is estimated that an investment of Rs. 34.20 crores (500 million USD) will accomplish a load reduction of 250 MW. Aside from this, frictionless foot-valves, HDPE/PVC pipes and ISI motors have also been installed.1.65 million CFLs were circulated among six areas under the Bachat Lamp Yojana (BLY) (Savings lamp scheme) teaming up with BEE. M/s C-mission Capital Green Ventures Pvt. Ltd. are the implementers. (APERC,2015)

4.1.4.3 APSPDCL

In response to the order of the regulator on energy conservation and DSM, the APSPDCL expressed in its ARR filing of 2014-15 that they had been directing awareness programs in schools, and that the utilization of CFLs rather than incandescent lights were being publicized through pamphlets.

Some other DSM measures that were carried out by the APSPDCL was the establishment of capacitors, frictionless foot-valves, HDPE/PVC channels and ISI pump sets. (APSPDCL, 2014).

4.1.4.4 APNPDCL

In response to the order of the regulator on energy conservation and DSM, the APNPDCL had additionally installed capacitors on 91% of agricultural administrations, alongside frictionless foot-valves, HDPE/PVC pipes and ISI pump sets. They have printed energy conservation mottos on the power bills of consumers and in flyers. They likewise put in new capacitor banks and kept up with the current banks. (APNPDCL,2014).

4.2 Gujarat

Background:

Gujarat is one of the 29 states of India located on the western part with an area of more than 196,000 sq. km and has nearly 60 million inhabitants. Over the last few years Gujarat has successfully overcome high transmission and Distribution losses, peak demand and energy shortages, low plant load factors and decreasing availability of best quality fuel to run the power plants and successfully secured its overall energy requirements with installed generation capacity of 24,000 MW and became a power surplus state in India. (Shailesh,2013)

4.2.1 Power Scenario

Gujarat consumed around 93 billion units (BU) in 2012-13. The peak demand for 2012-13 was around 11,000 MW, and the peak achieved was just 0.3% lower than that required. The aggregate power purchase costs agreed by the commission for 2013-14 for all Gujarat DISCOMs were to the tune of Rs. 26,950 crores. (USD 420 million) It can be seen from figure 4.2.1 that the revenue realization from rural and residential areas is below the average revenue realization. Figure 4.2.1 demonstrates the average revenue realization for all DISCOMs. (Central Electricity Authority, 2014)

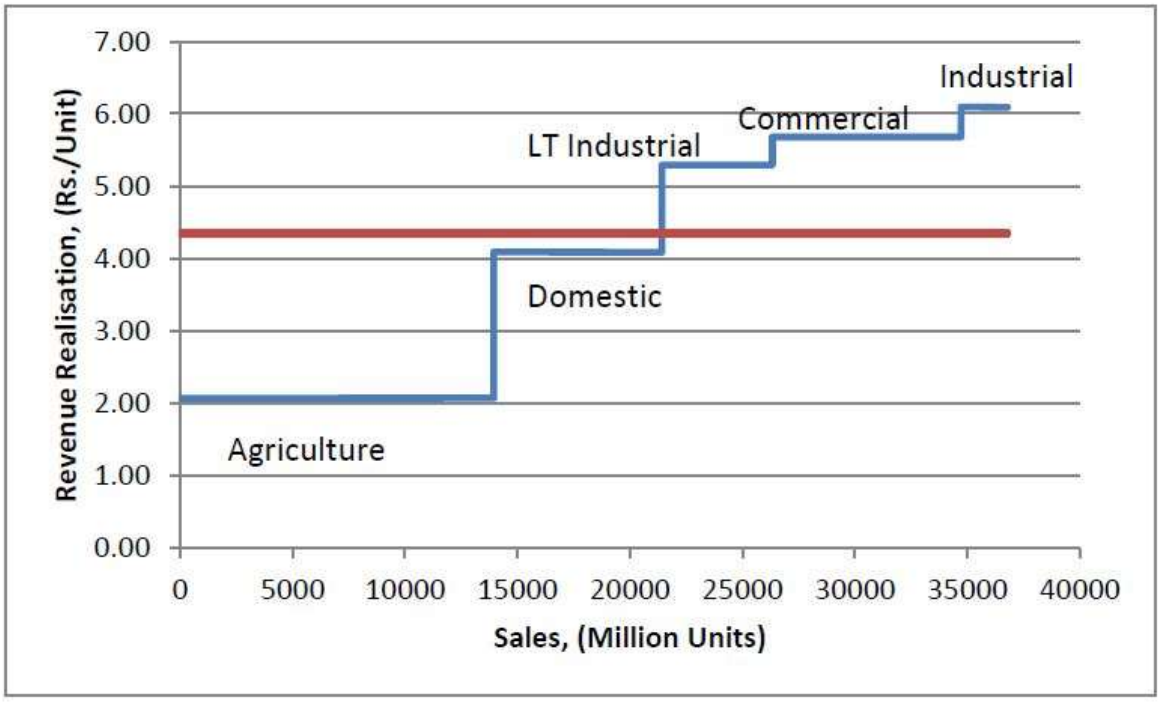


Figure 4.2.1.1: Average Revenue realization for Gujarat DISCOMs 2011-12

Gujarat became a power surplus state in 2013-14 having around 6% surplus energy accessible than needed, however it also faced a little peak deficit of about 0.2%. The state generation company Gujarat State Electricity Corporation Limited (GSECL) has planned a capacity expansion of 3300 MW to be finished by 2017-18 (GERC,2012)

There is a huge saving potential of around 12% realised from EE/DSM measures in Gujarat. A study by the National Productivity Council (NPC) has assessed savings of around 20-35% in the domestic and agricultural sector in Gujarat. Considering the sector wise power consumption in 2007-08, it can be seen that there is a capability of saving around 5 BU in the agricultural and domestic sectors. (National Productivity Council,20012). (See table 4.2.1.2)

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

Table 4.2.1.2: Saving potential in Gujarat

4.2.2 EE/DSM activities in Gujarat

4.2.2.1 Gujarat Electricity Regulatory Commission (GERC)

The GERC had distributed a 'Distribution Code' in 2004. The code determines strategies for determining DSM while doing demand projections and load forecasting. In addition to the code, the GERC had notified DSM regulations in May 2012. The technicalities of these regulations were specified in the segment 'Particular DSM measures by GERC'. Different state advisory group meetings were held by GERC since 2004, and in the meeting held in July 2013, DISCOMs revealed that the DISCOMs had delegated TERI[21] as an expert consultant for the identification of technical potential and the establishment of a DSM plan. The GERC additionally indicated that while doing the study of load research, it might incorporate a) consumer load responsible for peak demand b) plausibility of moving the load from peak to off-peak c) Time of use tariff determination d) extent of improvement in end-use energy efficiency. In the meeting held in August 2014, the GERC had coordinated the DISCOMs and Torrent Power Limited (TPL) to present a detailed DSM program report inside two months for which a budgetary arrangement of Rs. 50 crores (USD 70 million) for each DISCOM and Rs. 20 crores (USD 31 million) for the TPL had been distributed. (GERC,2013).

On the tariff front, the GERC permits the DISCOMs in Gujarat to impose time of use charges for consumption during peak hours for a charging demand up to 500 kVA and above. The GERC additionally permitted power factor incentives and fine to consumers.

[21] The Energy and Resources Institute (TERI) is a research institute based in New Delhi that conducts research work in the fields of energy, environment and sustainable development. Established in 1974, it was formerly known as Tata Energy and Resource Institute. As the scope of its activities widened, it was renamed The Energy and Resources Institute in 2003.

4.2.2.2 Distribution Companies (DISCOMs)

There are four state possessed 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, and one private DISCOM – Torrent Power Limited – which serve the electricity needs of Gujarat. An investigation done by GERC on the tariff orders throughout the last five years revealed that around Rs. 60 crores (USD 90 million) were intended to be utilized for energy conservation exercises by the state owned DISCOMs. These were the arrangements made by the DISCOMs in their tariff petitions.

Alternate projects that the DISCOMs had been executing are to create awareness and enhance pump-set efficiency. For instance, the Uttar Gujarat Vij Company Limited (UGVCL) had incurred expenses of around USD 6.2 million in the year 2013 towards energy conservation by awareness programs, an agricultural pump-set efficiency monitoring framework, and the establishment of a DSM plan. (UGVCL 2013)

4.2.2.3 Gujarat Energy Development Agency (GEDA)

The Gujarat Energy Distribution Agency is the SDA in Gujarat. Various energy conservation measures have been undertaken by the GEDA, bringing about a savings of 1.6 BUs with an investment of 200 million USD. Some exercises that were completed by the GEDA since its beginning are walk through energy audits for Micro, Small and Medium Enterprises (MSMEs), a LED town campaign in Amrapura, restoration of inefficient pump-sets with energy efficient pump-sets, and investment grade audits (IGAs) in government offices.

One of the innovative projects started by the GEDA is the mobile energy conservation demonstration van. This portable van drives across the state generating awareness about energy conservation and energy saving measures among different areas of energy consumers – mostly household consumers and educational buildings. The demo van has been furnished with different energy efficient equipment (EE electrical gadgets and apparatus and energy monitoring

instruments) and some learning devices, for example, display boards, instructive slide shows, movies and publications. (GEDA,2013)

4.2.3 Specific DSM measures by GERC

4.2.3.1 DSM Regulations

The Gujarat DSM regulations have been embraced according to the model DSM regulations published by the FoR. They indicate the objectives of DSM guidelines, along with the process of accomplishing the set DSM targets. The GERC developed the DSM targets along these lines in August 2012 which include: usage of appropriate strategies and measures to influence energy demand, changing the power consumption patterns both in terms of timing and level, dodging or delaying costly capacity addition by slowing demand growth, efficient utilization of resources keeping in mind the aim to reduce expenses to the consumers, emission reduction, execution of DSM plans set out by the BEE, increased use of effective innovations, and administrations through structural and behavioural changes.

4.2.3.2 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.

Billing demand up to 500 kVA	35 paise per unit (USD 0.005)
Billing demand above 500 kVA	75 paise per unit (USD 0.011)
Energy consumed in excess of one-third of the total energy consumed	75 paise per unit (USD 0.011)

during the month during off-peak hours	

Table 4.2.3.2: Time of use charges for Gujarat

The discount for water works consumers having connected load of 50 HP or more for energy consumption during off-peak hours – 1100 hrs. to 1800 hrs. – is 30 paise (USD 0.04) per unit, and for the time period 2200 hrs. to 0600 hrs. it is 75 paise per unit.9USD 0.011)

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

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

Table 4.2.3.2: Power factor adjustment charges

4.2.4 Specific DSM activities by Gujarat DISCOMs[22]

4.2.4.1 MGVCL Madhya Gujarat Vij Company Limited

The MGVCL had led a feasibility study on an agricultural DSM pilot in the city of Anand. The fundamental goal of this pilot project was to empower and encourage the execution of the project all through the state of Gujarat. The project covered 530 agricultural pump-sets connected with four feeders in Anand circle under the MGVCL. After the underlying study, the MGVCL chose to implement the project by utilizing its own funds. The benchmark energy consumption was 13.20 MUs, and the energy saving potential was 3.2 MU at the pump end on a stable side. The aggregate project cost was estimated at 25.7 million USD. Detailed cash flow study indicated a

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

payback time of 4 years and a project rate of return(IRR) of 11.35%. The DPR was set up in 2012, however the project is yet to be implemented.

4.2.4.2 UGVCL Uttar Gujarat Vij Company Limited

The strategy plans for the UGVCL for the fiscal year 2012 to the fiscal year 2016 records the following DSM measures that are supposed to be/have been adopted by them.

Under the action plan for energy conservation by the Gujarat Urja Vikas Nigam Limited (GUVNL), the UGVCL acquired an aggregate of 6,200 CFLs and 4500 electronic stabilizers. These were given to the premises of the UGVCL offices. On the BLY front, expressions of interest were mentioned on their web sites.

The Government of Gujarat had presented a plan for substitution of inefficient pump-sets by energy efficient pump-sets. The plan was introduced with an aim to decrease the power consumption and peak demand in the agricultural sector, and was applicable to unmetered consumers only. The cost of the effective pump-set is to be shared by the consumer, the UGVCL and the Government of Gujarat equally. The GEDA had endorsed 29 manufacturers from which the customer can choose a pump-set. In one year (2009-10), the UGVCL had fixed 13000 old pump-sets of agricultural fixed tariff consumers by energy efficient pump-sets through a pilot program in nine jurisdictions under its ward. The plan brought about savings of 10% for roughly 11,060 pumps, but less than 10% for balance pump sets, hence it was on hold in 2010-11. They again reintroduced the plan in 2014.

4.2.4.3 PGVCL and DGVCL Paschim Gujarat Vij Company Limited and Dakshin Gujarat Vij Company Limited

Load estimation along with load management is implemented by the DSM cell of DGVCL. No other DSM projects or costs towards these projects have been recorded in the business plan of both of these two DISCOMs.

4.2.5 Specific DSM programmes by GEDA

- In the walk through energy audit plan of the GEDA for MSMEs, it had proposed to complete 500 energy audits in 2013-14. The cost of these audits was to be covered by the GEDA. The clusters that were chosen are metal-processing, re-rolling and foundry industries. The plan was in force up to March 2014.
- LED town Amrapura, Gandhinagar: The project was jointly funded by BEE. All lights, indoor and outdoor, were replaced by LEDs in this town. An aggregate of 1,400 LED bulbs, tube-lights and street lights had been distributed. The project cost was 25 million USD and the estimated yearly power savings was around 0.12 million USD, with a payback time of 3 years.
- Investment Grade Energy Audit in government buildings: The broad target was to review the present energy consumption, and after examination, set up a thorough recommendation report for enhancing energy efficiency. 25 government buildings were audited in stages I and II.
- Replacement of incandescent bulbs with T5 tube lights in government buildings was successfully done.

Various effort exercises like Bal Urja Rakshak Dal, capacity building programs, open air and on-air publicity, presentations and sponsorship of events had been led by the GEDA. (UGVCL Business Plan, 2016).

4.3 STATE ACTORS IN DSM in Gujarat and Andhra Pradesh

This section discusses the main actors and their roles related to DSM implementation in the chosen states. The SERCs mainly look after increasing the energy efficiency and tariff rates and also helps in defining energy policies. The DISCOMs act as a link between consumers and SERCs. The detailed initiatives taken by these actors are analysed in chapter 5. The responsibilities of these actors is mentioned below.

4.3.1 STATE ELECTRICITY REGULATORY COMMISSION:

The SERCs are in charge of deciding tariff for electricity and managing power purchase. The 'Time of Day' tariff system is an essential DSM tool that can be used by regulators to shift peak load. Their other duty is to promote efficiency in power sector, and issue licenses and prepare plans and schemes in a joint effort with others for generation, transmission, distribution, supply and use of energy. Through this procedure, regulators can acquire licenses to develop DSM plans and coordinate these plans every day with their power purchase requirement. Another function of the regulator is to help and urge the state government to define the state power policy. When Telangana [23]state was formed, the regulator in Andhra Pradesh requested the state government to incorporate agriculture DSM and issue prepaid meters to government workplaces to enhance power use.One more function is to gather and publish information on forecast on the demand for power use in the state, and to require licensees to gather and publish such information. These data help the DISCOMs and licensees to develop DSM activities and load research exercises in the state. (State Commission,2010)

4.3.2 DISCOMs

DISCOMs are the interface amongst consumers and regulators and therefore hold a vital position in the success of any state DSM activity. They remain to benefit from DSM programmes along with the consumers. India had electricity boards which generated, transmitted and distributed power for a long time. But in 2000, the re-organizing of the power sector brought about various organizations being dismantled. Except for a few private sector DISCOMs, most of them are owned by government. The majority of them are facing financial crunch, reeling as they are being held down by poor operating efficiencies and cross subsidies. For all projects formed centrally, like BEE[24] and executed by an Energy Service Company (ESCO), the DISCOMs can assume a critical part of a facilitator and receive rewards of reduced consumption. (Press Information Bureau Government of India Cabinet, NOV 2015)

[23] Telangana is the youngest state in India which got separated from the north western part of Andhra Pradesh and got an individual identity as a new state on 2 June 2014.

[24] The Bureau of Energy Efficiency was formed in 2002 under the Ministry of Power to create programs related to energy efficiency in India. Since January 2010, it is mandatory for certain appliances to have them rated by BEE.

4.3.3 SDAs

SDAs are legal bodies set up by the states to implement the EC act 2001 and DSM measures at state level. The states were deemed to assign one of the existing organizations as SDA in the state. Nearly all states have their Renewable Energy Development Agency as their SDA, trailed by the Electrical Inspectorate and DISCOM. Since major part of these SDAs are focused around renewable energy, energy efficiency has been neglected because of the limited experience. Out of the two states selected for the research, only Gujarat has very dynamic SDAs, and Govt. of Gujarat has been achieving these exercises commendably. In Andhra Pradesh, the SDAs suffer from either a lack of manpower or resources.

Conclusion

The above mentioned section (section 4.3) answers the third sub research question i.e. Who are the main actors and what are their roles related to DSM implementation? Section 4.3 discusses all the key actors and their respective roles in DSM implementation.

Chapter 5 Review of DSM activities

This section summarises the DSM activities of SERCs, DISCOMs and SDAs in the selected states for the research.

5.1 State Electricity Regulatory Commissions (SERCs)

SERCs have generally depended on tariff mechanisms, for example, the Time of Day (ToD) tariff, incentives and extra charges in view of the power factor and load factor, and kVAh billing. The SERC in Gujarat has issued DSM controls, while Andhra Pradesh has put out draft DSM directions which are yet to be advised. Gujarat also has regulations on the system to decide the cost-effectiveness of DSM programs. Various SERCs have issued general and additionally particular mandates to the DISCOMs with respect to DSM in their periodic tariff orders. Additionally, many SERCs have permitted the DSM costs to be incorporated into the ARR to be recovered from the consumers. Table 5.1 demonstrates the different DSM measures embraced by SERCs of Gujarat and Andhra Pradesh as reported in a research by Prayas (Energy Group).

Type of measure	AP	GJ
ToD tariff	✓	✓
DSM based tariff	✓	-
PF surcharge	✓	✓
PF incentive	-	✓
kVAh billing	✓	✓
Load factor incentive	-	-
DSM regulations	-	✓
Cost effectiveness regulations	-	-

Table5.1: DSM measures undertaken by SERCs in Andhra Pradesh and Gujarat (Chunekar et al,2014)

5.1.1 Tariff Mechanisms

The Time of Day (ToD tariff is the most well-known tariff component adopted by SERCs. Under this tariff, peak hours are determined upon the system peak. The peak hours could be morning peak hours, evening peak hours, or both. There is an extra charge on the energy consumption if

the energy use is in the predetermined peak hours. Excepting Andhra Pradesh, all the other SERCs offer a refund on the energy charges for the utilization in determined off-peak hours. The ToD is compulsory in a few states, normally for High Tension (HT) consumers, and a few classes of Low Tension (LT) consumers too.

Table 5.1.1 describes the ToD tariff in Gujarat and Andhra Pradesh. The two basic hindrances for the ToD tariff execution in these states have been resistance from consumers who express their failure to move loads (peak and off peak), and delays by DISCOMs in their efforts to introduce ToD meters. A large portion of these two states appear to have defeated this barrier and the ToD tariff is set up.

Almost all the states in India have additional charges for low power factor. These are for the most part directed towards the HT consumers, but on the other hand are pertinent to some LT classifications of consumers. There is a base value determined for the power factor, and the extra charge goes up as the power factor goes down. The extra charge ranges from 7% to 20%. Some SERCs have additionally approved incentives for consumers with power factors over a specific limit. Likewise, some SERCs receive the lead + lag logic[25] in calculating the power factor, while some overlook the lead control factor. Various states have also presented kVAh billing which incorporated the power factor, thus wiping out the requirement for levying the extra charge additionally. However, the SERCs have proceeded with the power factor extra charge and the kVAh billing. Likewise, some SERCs have commanded LT consumers to introduce measures like capacitors, or ISI marked motors. This won't have any tariff impact, yet in the event that the DISCOMs observes that these measures are not being complied with, then they can levy additional fines and also cut power supply.

Andhra Pradesh has a one of a kind differential tariff for agricultural consumers in view of the usage 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. Every new connection is supposed to be provided with DSM measures. However, there is no data about whether this is being taken after, and about the effect of the

[25] For power factor calculations, Loads are classified as leading or lagging and the power factor indicates the degree. It is generally used to bring the PF back to 1 by adding capacitors.

differential tariff. Table 5.1.1 gives the ToD tariffs and rates in Gujarat and Andhra Pradesh. (GERC,2013).

Table 5.1.1: ToD tariffs and rates in Gujarat and Andhra Pradesh

	Andhra Pradesh	Gujarat
ToD tariff	✓	✓
Applicable consumers	HT-I-General, HT-II- Others, HT-III- Airports, Railway stations and bus stations	All HT consumers and water works consumers with connected load above 50 HP
Morning peak	-	0700 hrs to 1100 hrs
Evening peak	1800 hrs to 2200 hrs	1800 hrs to 2200 hrs
Morning peak C	-	Up to 500 kVA - 35 paise (USD 0.005) Above 500 kVA – 75 paise (USD 0.01)
Evening peak C	Re. 1/kWh (USD 0.016)	Up to 500 kVA - 35 paise (USD 0.005) Above 500 kVA – 75 paise (USD 0.01)
Off peak time discount or incentive	-	USD 0.01 if the energy consumed is in excess of one third of total energy consumed during the month

5.1.2 Regulations

The Forum of Regulators (FoR) issued demo DSM regulations in 2009. Almost all the states including Gujarat and Andhra Pradesh have adopted these regulations with very little changes. These regulations give monitoring principles for different aspects of DSM measures, for example, core goals, research exercises, planning, funding sources, program endorsement, monitoring, assessment, and sharing of data. The controller is required to build up DSM targets for each DISCOM, and the DISCOM thus is required to make DSM an integral part of their daily activities, and plan, outline, and implement different projects. SERC from Gujarat has notified DSM regulations in the state, while Andhra Pradesh has distributed draft DSM controls. The SERC in Andhra Pradesh and Gujarat have additionally settled a DSM Consultative Committee (DSM-CC) at the commission. The objective of the DSM-CC is

(a) to help the commission in evaluating, reviewing, and monitoring the DSM measures by DISCOMs;

(b) to suggest the DISCOMs on directing different studies like load research, consumer conduct, and so forth and

(c) to go about as a stage to empower the DISCOMs to share their encounters, and interact with the commission on DSM. The members from the board of committee are from the commission, DISCOMs, SDAs, academic institutes, and consumer associations.

5.2 Discoms

DISCOMs in some of the states have been altogether dynamic in undertaking DSM exercises like awareness campaigns, load research, and energy audits, and furthermore innovative DSM programs like appliance exchange, thermal energy storage, and demand response (DR). Table 5.2 demonstrates the diverse DSM exercises and projects embraced by DISCOMs in Gujarat and Andhra Pradesh as mentioned in a study by Prayas (Energy Group).

	AP	GJ
DSM cell	✓	✓
Awareness programmes	✓	✓
Lighting	✓	✓
Ag DSM[26]	✓	✓
Appliance exchange/replacement	-	-
Thermal energy storage	-	-
Demand response	-	-

Table5.2: DSM activities by DISCOMs. (Chunekar et. al,2014)

5.2.1 DSM Planning

[26] 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.

The initial step by the vast majority of the DISCOMs towards DSM has been to set up DSM cells. In states with DSM regulations, it is generally ordered that the cell is headed by a chief engineer or his or her superior. The cell is in charge of all the DSM exercises directed by the DISCOM, for example, load research, multi-year work plans, program design, and usage and monitoring.

The following rationale has been to conduct load research for various consumer classes and build up an action plan for DSM in view of the outcome. Various DISCOMs have guaranteed to direct load research studies however not many are in the public domain. Some DISCOMs have come up with a consistent action plan based on the results of load research. A large portion of the DSM exercises led by the DISCOMs have been ad hoc. Some DISCOMs have done detailed load research and followed an action plan but there is no data on whether these plans have been carried out effectively. The Gujarat DISCOM is a decent illustration of the load research programme. It got a DSM activity design created in view of a detailed load research study done by TERI, however there is little data accessible about its execution. More details can be seen in the box 5.2.1

Box 5.2.1: Load research and action plan for Gujarat

In the interest of Shakti Sustainable Energy Foundation, The Energy and Resources Institute (TERI) attempted a study to set up a detailed action plan for Gujarat. Gujarat had started DSM exercises like time of day tariff, power factor penalties, replacing inefficient pump-sets with efficient pump-sets, and efficient lighting including the BLY program. In the study, transcendent feeders were chosen as tests, and month-wise hourly averages were calculated and standardized on a scale of 100 to better understand the load patterns over various seasons for every consumer category. The study was then used to make a DSM activity plan for that incorporated measures like:

- Promoting energy efficient appliances and energy efficiency in new buildings.
- Training and awareness campaigns.

- Changes in all the programs and operational efficiency in the industries.
- Public purchase of energy efficient appliances
- Feeder isolation.
- key use of energy conservation funds, administrative measures to promote DSM, and bolstering the SDA. This arrangement was set up in 2013, however very little or no data is accessible about the execution of this plan.

5.2.2 Awareness generation and energy audits

Creating awareness is the most widely recognized DSM action directed by DISCOMs. The basic channels of correspondence have been handouts, emails, power bills, celebrating the energy conservation day and week, and so on. Various DISCOMs have power consumption calculating tools on their website. These tools help the residential consumers to assess the aggregate power consumption from various appliances, and additionally probable savings from switching to energy efficient appliances. Tata Power (Mumbai) runs an innovative campaign named Club Enerji[27], by way of which an unofficial energy conservation club framed in 2010 generates awareness about energy conservation in public with more focus on kids. Its exercises include distributing energy conservation booklets, arranging essay competitions and tests, and workshops and events. The second most common DSM activity led by the DISCOMs is the energy audits for industrial consumers. Certified BEE energy auditors direct these audits and determine areas of efficiency improvement.

5.2.3 Lighting Programs

Almost all the state DISCOMs including Gujarat and Andhra Pradesh have embraced energy efficient lighting programs in some way or the other. The most widely recognized program was the Bachat Lamp Program (BLY) by the BEE. It was an ambitious program

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

to replace 450 million incandescent bulbs with Compact Fluorescent Lamps (CFLs). The program was especially appealing for DISCOMs as it didn't require financial investment. Aggregator or manufacturers invested the funds to cover the cost difference of the CFL, and afterward recovered it via the Clean Development Mechanism (CDM)[28]. The program got a decent response at first, however it has since been slowed down because of the fall in carbon markets. The manufacturers are not taking part in the program because of the lack of a cost recovery system.

Taking a hint from BLY, some DISCOMs have started executing their own particular lighting exchange programs, where they give CFLs or LEDs at a lower rate to consumers. They made an arrangement with the manufacturers since they buy in bulk, and the costs are for the most part claimed in the ARR to be recovered from the consumers. There has been a unique pilot program that the GEDC directed to promote CFLs in Gujarat. The CFLs were sold to consumers with a financing plan through the company billing collection centres, retail outlets, and some self-help groups. The consumers paid a little amount (comparable to the cost of the incandescent bulb), and remaining money was recovered through month to month bills. See Box a below for information.

Some DISCOMs have been replacing the current High Pressure Sodium Vapour (HPSV) lamps and other non-efficient lights with LED lighting. DISCOMs have additionally introduced timer switches in a few regions to naturally control the turning on and off of lights on streets. In spite of the fact that various DISCOMs have embraced road lighting ventures, they have reported problems in coordinating with the nearby municipal bodies for the implementation of the project.

Box 5.2.3: CFL financing program in Gujarat.

The Gujarat Energy Distribution Company (GEDC) executed an experimental pilot program of selling 300,000 CFLs resulting in savings of around 12 MW annually? The GEDC did not give any financial incentive on the purchase of CFLs, yet just

[28] The Clean Development Mechanism of the Kyoto Protocol enables developing nations to profit from climate friendly projects, and India is second only to China in utilizing the mechanism to help reduce its carbon emissions.

went about as a facilitator. The consumers had the choice of either purchasing a CFL by making a one-off payment, or via instalments which would be recovered by the GEDC from the monthly bills. Three vendors were chosen through a bidding procedure, and the CFLs were accessible at the bill collection centres, retail shops and through women self-help groups. The program was extensively marketed by the GEDC. Prayas (Energy Group) led an assessment of the program. It was discovered that the program was fruitful in accomplishing a high level of penetration of CFLs and brought about a more noteworthy awareness. However, the savings were not exactly the same as estimated savings since consumers used CFLs to replace FTLs and bulbs in regions with less use. There were a few problems with the qualities of the CFLs. The power factor was seen to be low and there were huge failure rates too. Yet the project proved to be much more beneficial. (Chunekar et. al,2014)

5.2.4 Agricultural DSM programmes

Agricultural consumers across India are largely sponsored by the state government and pay either nothing or a tariff much lower than the normal cost of supply. Since there is no financial incentive for the consumers to invest into efficiency, inefficient agricultural pump-sets, a number of DISCOMs have focused on agricultural consumers for DSM programs. The most widely recognized program has been replacement of inefficient pump-sets with 5-star pumps. Various DISCOMs have additionally introduced capacitors on the pump-sets to enhance the power factor. One genuine worry of these projects has been the performance of energy efficient pumps and the capacitors in the field, given the low quality of energy supply to most agricultural consumers. The GEDC took care of this issue by giving a 5-year guarantee/free-maintenance contract. Another worry has been the estimation of savings from these projects. Number of connections are unmetered with consumer resistance to its installations.

5.2.5 Appliance exchange programmes

DISCOMs in Gujarat and Andhra Pradesh have started appliance exchange programs for their consumers and have managed to receive a decent response. Under these programs, the DISCOMs give a considerable discount to the consumers (to the tune of 40-45%) to replace their old inefficient appliances with new 5-star rated ones. The old appliances are shred in an eco-friendly way. Some DISCOMs are additionally stretching out the plan to new purchases. In some cases, an extra guarantee is offered. These programs have been offered for ceiling fans, fridges and air conditioners. For the last two, only models not more than a specific size is incentivized.

The primary reason why these programs have gotten a decent response is the significant discounts given for the purchase of appliances, which are appealing for consumers. However, the projects could not create a wider impact. Scaling up these projects will require noteworthy budget outlays and can have a considerable tariff impact particularly for the non-participating consumers who can't get the advantages from energy efficient appliances. Additionally, the DISCOMs have experienced difficulties in getting the manufacturers to take an interest in the program. One reason is the absence of accessibility of a 5-star products which comply with latest standards. Another reason is that the dealers are side-lined in light of the fact that under the vast majority of these projects, the DISCOMs deal directly with the manufacturers and reduce the business mark-up by the dealers. Manufacturers are not enthusiastic about disappointing the dealers since they need to rely upon them to sell other different models. On the consumer end, there have been a few issues too. A few consumers have raised doubts whether there is a noticeable effect on their electricity bills. The bills might not have decreased because of various different reasons, for example, the hot summer, new appliances, and so on. However the consumer's view of an absence of bill reduction in spite of investment in the programme persists. Additionally, where the appliances have faced poor quality issues, consumers have held DISCOMs responsible for the poor quality appliances.

5.2.6 Solar water heater programmes

Various DISCOMs have provided incentives to residential consumers to move to the solar water heater since electric water heaters account greatly to morning peak hour power consumption. In a few states, there are subsidies given by the state government. The Bangalore Electricity Supply Company (BESCOM) has made it obligatory to introduce solar water heating systems in order to get another new connection. Furthermore, a refund of 0.50/kWh (USD 0.007) or up to Rs. 50 (USD 0.78), whichever is less, is given to the consumer. Central government help is likewise accessible for those who install solar water heaters. Table 5.2.6 describes the financial help available.

Device	Central financial assistance	Benchmark cost
Solar water heater (ETC)	USD 40 per m^2 or 30% of the cost, whichever is less USD 37 per m^2 or 30% of the cost, whichever is less	USD 132 per m^2 for domestic USD 124 per m^2 for commercial
Solar water heater (FPC)	USD 51 per m^2 or 30% of the cost, whichever is less USD 46 per m^2 or 30% of the cost, whichever is less	USD 171 per m^2 for domestic USD 155 per m^2 for commercial

Table 5.2.6: Financial assistance for solar water heaters (KREDL,2016)

5.2.7 Thermal energy storage

Tata Power launched India's first Thermal Energy Storage (TES) program for commercial and industrial consumers in Gujarat. The thought behind the TES is to run the central AC plants of buildings during the night and convert water to ice which can be stored in ice tanks. During day time, the AC plants are turned off and the building is cooled with the energy stored in ice. The TES has benefits for consumers and the DISCOM. The consumers can likewise benefit of the ToD tariff incentives. The TES framework also

enhances the load factor and the power factor and consumers can profit from the incentives based on them. With the reduction in overall load, the investment in transformer capacity goes down as well. The backup power Diesel Generation (DG) capacity can be decreased. For the utility, it brings about a flatter load curve and saves money on high power purchase costs. Under this program, the TPC enlightens the consumers by introducing TES framework and gives an online measurement and testing framework for the consumer's chillers. It gives an extra discount of USD 0.016/kWh on consumption during night. As of February 2015, the TPC had connected 16000 tons of refrigeration (TR) capacity in the program and accomplished a load shift of 3.7 million Units. (MU). (Tata Power, 2015).

5.2.8 Demand Response

Demand Response (DR) is the consumer's capacity to reduce power consumption at their locations when wholesale prices are high or the reliability of the grid is at stake. There are two sorts of possible mediations in a DR program, automatic and manual. The manual DR program is most fundamental, where the system administrator sends a manual signal to the customer through the phone to reduce his load. The Automated Demand Response comprises of completely computerized motioning from a utility to give automated network connectivity to consumer end-use control systems and procedures. The Tata Power Company – Distribution (TPC-D) in Gujarat has introduced a Demand Response program which is manual. TPC-D in Andhra Pradesh has introduced an automatic DR program.

TPC-D has a manual DR program where commercial and industrial consumers with a connected load over 500 kW offer voluntary load reduction to manage peak demand. The customers enlist in the program and a Memorandum of Understanding (MoU) is formed. In case of events, the TPC-D calls the aggregator who then calls consumers and requests that they reduce their load. The consumption information during the period is studied and compared with the baseline estimation using the load profile of 5-6 consecutive days. The event lasts up to 3 hours each and there can be 50 maximum

events in a year. The TPC-D offers an incentive of USD 0.04/kWh for each unit reduced. The incentive is paid to the aggregator who then pays the consumers. The aggregator likewise helps the consumers with energy audits to recognize the reducible load at a short notice. In 2013, the contracted limit was around 13 MW and they were intending to reach 25 MW. (Tata Power,2014)

5.3 State Governments/ State Designated Agencies (SDA)

SDAs have been least active of all the three actors. In most of the states, the renewable energy development agency is the SDA due to which their emphasis is generally on RE. All of them began with about USD 200 million from BEE and equivalent amount from the state government for their projects. However, all things considered there has been no activity on this front. The most widely recognized projects by SDAs have been awareness programmes and street lighting programs. One case of this program is the Belaku program under which USD 200 million were given to the Karnataka Renewable Energy Development Limited (KREDL) during 2013-14 by the Government of Karnataka (GoK). The principle goal of the plan was to replace roughly 2 million incandescent bulbs of recipients with CFL lights in select towns and towns in all areas in the state. The KREDL site demonstrates no data on the progress of the scheme. Similarly, various state governments have come up with orders, for example, the Maharashtra government provided Government Resolution (GR) to buy only 4-star and 5-star rated appliances in all administration/semi-government/local bodies, and so on. 3-star appliances can be bought only if the higher rated appliances are not available. (KREDL, 2014)

There have been various projects and policies announced by SDAs like the Karnataka Renewable Energy Policy that guaranteed savings of around 7,000 MU each year. Andhra Pradesh has the Energy Conservation Mission that claims savings near 15,000 MU. The states have constituted a few committees to create and execute the state energy policy.

On the industrial front, the SDAs are also in charge of executing the Perform, Achieve and Trade (PAT) program, which is a market based component to upgrade cost effectiveness of enhancements in energy efficiency by assigned consumers. These consumers will be supplied with energy savings certificates that could be traded. The studies have already been directed, and the plan is in the implementation stage.

It is crucial to examine the implementation of these plans executed by the SDAs. For this reason, the BEE came up with a yearly savings report which specifies the energy saved by the SDAs, and there are three such reports accessible in the public domain. These savings are said to be checked by the National Productivity Council (NPC). For the states that have been mentioned in this study, the most recent accessible report estimates energy savings of a hundred MUs by SDAs of Gujarat and Andhra Pradesh, while the evaluated potential or purposeful targets was near ten to fifteen thousand MUs.

5.4 Assessment of DSM activities in India.

	criteria			
Dimensions	Extent	Coherence	Flexibility	Intensity
Levels and scales				
Actors and Networks				
Problem perspectives and goal ambitions				
strategies and instruments				
Responsibilities and resources				
high				
moderate				
low				

Assessment of DSM activities by Regulators, DISCOMs and SDAs in Gujarat.

Table5.4.1: Assessment of DSM measures and initiatives by evaluating the criteria in GAT matrix.

ANALYSIS: EXTENT

- All relevant stakeholders are involved (Residential, industrial, commercial consumers along with GERC, GEDA etc.) to contribute to Energy Efficiency improvement and DSM program implementation.
- Clear defining of objectives with proper assigning of responsibilities to all the actors involved. (GERC, GEDA, DISCOM, SDA, TERI etc.)
- Energy Efficiency awareness generated by promoting publicity campaigns such as demo van to educate household consumers about energy saving measures.
- Satisfactory complex institutional framework with effective implementation capacity reflected in programmes such as agricultural DSM programmes.
- significant record to confirm the savings of all the programme outcomes resulting in willingness of consumers to participate in DSM programmes.

ANALYSIS: COHERENCE

- Excellent coherence between relevant stake holders and subsequent learning from individual experiences because of availability of data on public domain (official web sites of DISCOMs, SEDCs)
- Experienced support organizations working together for a common goal achieved by hiring consultants like TERI to evaluate DSM programmes and conduct Energy Efficiency research.
- Reasonably Successful adaptation to deal with the problem at hand.

ANALYSIS: FLEXIBILITY

- Enables the actors for effective communication between themselves and make shifts in the functioning.
- Robust administrative structure resulting in effective management.
- Phased implementation of programs to gain experience for subsequent projects.

ANALYSIS: INTENSITY

- Both SERC and DISCOM well equipped thus resulting in ease in enforcement and sufficient savings achieved.
- Having experienced professional consultants on board resulting in stronger institutional capacity.
- Sufficient resources to implement DSM measures effectively including data on use of resources.
- DISCOMs and Regulators taking up DSM measures voluntarily in their work plans resulting in significant progress in DSM front.

Assessment of DSM activities by Regulators, DISCOMs and SDAs in Andhra Pradesh.

	criteria			
Dimensions	Extent	Coherence	Flexibility	Intensity
Levels and scales				
Actors and Networks				
Problem perspectives and goal ambitions				
strategies and instruments				
Responsibilities and resources				
high				

ANALYSIS: EXTENT

- All relevant stakeholders are involved (Residential, industrial, commercial consumers along with SERC, DISCOM and SDA) to contribute to Energy Efficiency improvement and DSM program implementation.
- Clear defining of objectives but no proper assigning of responsibilities to all the actors involved. (APERC, NEDCAP, APGENCO etc.)
- Energy Efficiency awareness generated by promoting publicity campaigns such as TV commercials and meetings to educate agricultural consumers (farmers) about energy saving measures but not on a wider scale.
- Satisfactory complex institutional framework but implementation capacity still ineffective reflected in manufacturer unwillingness to participate in Bachat Lamp Yojana because of falling carbon prices.
- No significant record to confirm the savings of all the programme outcomes resulting in lack of belief and thus reluctance of DISCOMs to incorporate the future investment funds from DSM programs in their tariff petitions.

ANALYSIS: COHERENCE

- Moderate coherence between relevant stake holders but less subsequent learning from individual experiences because of absence of data on public domain (official web sites of DISCOMs, SEDCs)
- Experienced support organizations such as NEDCAP to evaluate DSM programmes and conduct Energy Efficient auditing.

- Reasonably Successful adaptation to deal with the problem at hand.

ANALYSIS: FLEXIBILITY

- Enables the actors for effective communication between themselves and make shifts in the functioning.
- Moderately weak administrative structure resulting in ineffective management.
- No sign of phased implementation of programs to gain experience for subsequent projects.

ANALYSIS: INTENSITY

- Both SERC and DISCOM well equipped thus resulting in ease in enforcement but extent of Energy conservation programmes still low compared to evaluated savings potential.
- No professional consultant hired for resolving internal issues resulting in weaker institutional capacity.
- Lack of Sufficient resources to implement DSM measures also no data available whether the resources are implemented effectively.
- No pressure on DISCOMs to undertake DSM measures mandatorily resulting in lack of ownership thus in turn no progress in DSM front.

Conclusion: The aforementioned summary of DSM implementation practices in chapter 5 discusses all the initiatives undertaken by Gujarat and Andhra Pradesh and answers the first sub research question i.e. What are the current DSM programmes and implementation

practices in the two states chosen for the research? In conclusion, Andhra Pradesh can learn a lot from Gujarat on effective implementation of programmes on state levels such as:

- Awareness generation on a wider scale by coming up with innovative and consumer engaging ideas such as demo van.
- DISCOMs should take up responsibilities voluntarily to enhance progress in DSM measures.
- Hiring consultants such as TERI for conducting load research programmes and using the experience gained from Gujarat thereby making institutional capacity stronger.
- Phased implementation of programmes to learn from previous pilot projects.
- Entering records about savings achieved in the DSM programmes on official website and making it accessible for general public.

Chapter 6: Assessment of DSM in Thailand

The table below represents the assessment of DSM measures and initiatives by evaluating the criteria in GAT matrix.

	criteria			
Dimensions	**Extent**	**Coherence**	**Flexibility**	**Intensity**
Levels and scales				
Actors and Networks				
Problem perspectives and goal ambitions				
strategies and instruments				
Responsibilities and resources				
high				
moderate				

ANALYSIS: EXTENT

- All relevant stakeholders are involved (Residential, industrial, commercial consumers along with EGAT and DSMO) to contribute to Energy Efficiency improvement in Thailand.
- Clear defining of objectives and assigning of responsibilities to all the actors involved. (EGAT, DSMO, IMEA)
- Energy Efficiency awareness generated by promoting publicity campaigns to instruct consumers about energy labels in refrigeration programmes etc.
- Strong complex institutional framework with effective implementation capacity reflected in 'Expansion of programmes'.
- Continuous monitoring by IMEA to confirm validity of EGAT's programme outcomes.

ANALYSIS: COHERENCE

- Very high coherence between relevant stake holders often in cross levels too.
- Experienced support organizations working together for a common goal achieved by hiring consultants to evaluate EGAT's programmes.
- Reasonably Successful adaptation to deal with the problem at hand. Experience gained from US in manufacturer and consumer discounts and later shifting to a Thai approach by focussing more on voluntary manufacturer negotiations for marketing and procuring high efficiency 5 star labelled products.

ANALYSIS: FLEXIBILITY

- Designing the program based on local context provided flexibility to collaborate with different stakeholders.

- Enables the actors for effective communication between themselves and make shifts in the functioning.
- Robust administrative structure for effective management.
- Phased implementation of programs to gain experience for subsequent projects.

ANALYSIS: INTENSITY

- Both EGAT and DSMO well equipped thus resulting in ease of enforcement.
- Having experienced professional consultants on board resulting in stronger institutional capacity.
- Adequate staffing of temporary and permanent staff in DSMO resulting into effective functioning and strong support to EGAT.

  Sufficient resources to implement DSM measures.

Lessons Learned:

Based on the general DSM Program outcomes and evaluations, various lessons emerged and were taken in consideration by EGAT as it planned its future exercises. These lessons could also be useful for India in considering DSM programs of their own. However, India should clearly define objectives related to environmental protection and commitment to energy efficiency before implementing any initiative similar to Thailand. The lessons include:

Designing the Programs Based on Local Context:

EGAT's best activities were executed using a Thai approach of mixing manufacturer collaboration and public promotions. Local social perspectives too are essential to guarantee high customer acceptance and participation in such measures. However, it does not necessarily imply that it would work in India too. It might be more valuable to limit outside expertise to discrete assignments and training exercises, leaving the local utility staff to plan the projects based on market research and in-house strategies developed.

Identify DSM Champions:

Without the strong proactive approach taken by the second DSMO executive, it was unlikely that EGAT's program would have created an impact and grown over the years. DSM programs require

strong management and marketing, both to utility management and to the public, to guarantee that projects get the support required to meet their targets. Programs such as Bachat Lamp Yojana in India gained significant impact at first however it has since been slowed down because of the fall in carbon markets. The manufacturers were not taking part in the program because of the lack of a cost recovery system. It would be ideal for the chief Engineer of DISCOM to take strong constructive decisions to involve flexibility in the future plans to overcome such hindrances.

Define Clear DSM Program Objectives:

EGAT persistently faced competing goals such as public or commercial purpose, and EGAT management commitment towards DSM faltered, especially in the events of capacity surpluses after the 1997 financial emergency. A critical lesson for India is that DSM targets need to be clearly defined up front and have long term along with short term goals, to help keep up progression in operations. These goals should address such issues as: public or commercial purpose, load management or energy conservation; financial/environmental advantages or financial benefits; sectoral needs; and so on.

Establish DSM Programs in Context of Reforms:

EGAT's privatization was most certainly not considered when the DSM Program was first established. Potential privatization and rebuilding, tariff changes, etc. should be taken into consideration at the time DSM programs are considered, and a proper structure should be planned. Program financing is a key part of this structure, and should have the capacity to contain pricing reforms and incorporate proper regulations, oversight, institutional and incentive plans, e.g., DSM operational costs and lost income cost recovery plans.

Systemic Planning and Evaluation:

Proper program prioritization and screening played an important part in planning and executing successful DSM programs in Thailand. Evaluation plans should be developed simultaneously in India with program needs to recognize clear goals and performance indicators that will be used to make assessment of program execution. Program plans should also incorporate appropriate development of end-use consumption patterns, market research and standard information.

Phased Implementation:

EGAT's experience exhibits the significance of implementing programs using a phased approach, despite the fact that this could have been additionally strengthened by timely evaluation and program redesign. For India it is ideal to implement pilot initiatives, and then evaluate and refine them before extending and scaling-up execution efforts. A second benefit of this approach in nations/utilities new to DSM is that it enables staff to slowly build their competency and enhance their program design and skills.

Financing Facilities:

EGAT's success in its commercial and industrial sector programs was to a great extent because of suitable financing sources. The DSM efforts and programs implemented in India should address this effectively by organizing complementary financing projects to help industrial and commercial audit programs and non-residential end-use programs. Where reasonable financing and other programs for energy efficiency exist, for example, the framework of the ENCON Act in Thailand, clear connections should be built up between utility DSM programs and other government efforts to guarantee satisfactory coordination and complementarity between initiatives.

Voluntary VS mandatory Labelling:

Voluntary labels are not effective as rating mechanism, since they offer no incentives to manufacturers to label low efficiency models. In India where voluntary labels are the preferred choice, a simple quality brand label would be a desirable option instead of 5 star ratings.

Conclusion

Section 6 answers the second sub research question i.e. What are the lessons to be learnt from the DSM models employed in Thailand? Notably, the summary of different initiatives and programs implemented by Thailand briefly answers the same question. India has lot to learn from Thailand regardless of the fact that DSM is a continuous intervention mechanism and its implementation largely depends on the objectives set for the respective nation.

Chapter 7: Conclusion

Key Findings

The research draws out some key discoveries about the activities at the state level. The regulatory commissions have been active by either notifying DSM regulations or issuing directives to DISCOMs to attempt DSM programs. They have requested that DISCOMs

consider DSM while planning power purchase, and recover the expenses from the ARR. The DISCOMs have likewise led various inventive DSM programs. State governments have set up energy conservation boards and specific goals to direct energy conservation but the extent of the exercises has been low when compared with the savings potential. The SERCs have not been guaranteeing that the DISCOMs comply with the regulations. The DISCOM programs have been actualized on a pilot scale. No data is accessible on how the various government targets have fared up so far.

Based on the assessment by GAT matrix, the current DSM measures by the SERCs and DISCOMs in various categories and the recommendations are mentioned below.

Table 7: Recommendations

Category	Recommendations
Lack of belief	increased awareness and cross learning
lack of ownership	Formation of State Energy Conservation Committees
lack of implementation framework	setting an implementation framework

There are three main reasons for the current state of DSM activities:

Lack of Belief: It is not clear whether the DSM projects have produced substantial savings since the evidence is not mentioned on the web sites of DISCOMs or SERCs. Even the DISCOMs undertaking the DSM programs have been reluctant to incorporate the future investment funds from DSM programs in their tariff petitions. An essential explanation behind this lack of conviction is the absence of definite savings accomplished by the pilot cases. There have been various pilot DSM programs but there have not been many situations where the savings were observed, and the program was assessed and

scaled-up by including the learnings from the pilot program. There is additionally ambiguity about the scale of savings that could be accomplished.

Lack of ownership: There is no ownership for DSM at the state level. As per the Energy conservation act, some SDAs are required to push for DSM exercises in their respective states. DISCOMs are troubled with their own particular issues and don't view DSM as an answer. Moreover, there is no certain mandate for any actor to embrace DSM programs. This lack of ownership also originates from the lack of belief discussed above. However, it also comes from the absence of political visibility for the cause of DSM. The absence of political visibility is the essential reason behind the disregard of DSM by state governments. This is additionally intensified by the fact that there is low CSO awareness about DSM, which brings about an absence of public pressure and in turn no progress on the DSM front.

Lack of implementation framework: As of now, the responsibility of outlining, checking, and implementing the framework is imposed to DISCOMs. Regardless of the event that the DISCOM is eager about actualizing DSM measures, it lacks the resources to execute these. Companies like private ESCO organizations are developing, but they are still not operating on a larger scale. This lack of implementation framework does not encourage DISCOMs to implement large scale programs.

Description of Recommendations

In view of the above conclusions and lessons learnt from Thailand's analysis of DSM initiatives by GAT matrix, a multi-pronged approach is recommended: create awareness and public pressure, and set up an implementation framework. These recommendations are mentioned below:

Increased awareness and cross learning: More data about DSM projects has to be made accessible to people in general. DISCOMs are often requested by the SERCs to

submit yearly reports, yet none of these reports are accessible in public domain. Making the information accessible in public can substantially help the learning procedure. Various regulations require DISCOMs to put this data in the public domain, however this has not happened yet. Likewise, even the tariff mechanism such as Time of Day (ToD) has to be assessed for their viability and modified if needed.

DSM authorities should meet on more than one occasion a year for learning from each other's experiences. A forum for discussion of activities and programmes on a huge scale should be formed, with participation from the DSM cells of the DISCOM.

Formation of State Energy Conservation Committees: Absence of ownership of energy efficiency measures has been expressed before in this research. The most essential beneficiary of DSM exercises is the state government, since it pays a critical amount to subsidise agricultural and low income residential consumption. Henceforth, it should take responsibility for projects and EE measures in the state. A conservation committee should be formed at the state level to audit the DSM and EE exercises. The committee can have individuals from the state government, SERCs, DISCOMs, and other stakeholders.

Setting an implementation framework: The BEE must create programs which can be executed at the state level. The BEE as of now has programs like Bachat Lamp Yojana (BLY), and the present ones for rural pumps need to be scaled up. Basically, the DSM cell of the DISCOMs must not be burdened with the operational part of the projects, for example, design, execution and monitoring. These projects may also need some investment from the DISCOMs as they are constantly hard pressed for cash.

Closing Remark

In addition to the answers of the three sub-research questions, the above-mentioned description of recommendations particularly answers the main research question i.e. How can the regulators and DISCOMs learn from DSM activities in India and Thailand to adopt and implement better EE and DSM measures? In short, the research concludes that DSM

and EE can be efficiently implemented in the future if India makes efforts in generating awareness in public, forming a committee that looks after energy conservation and setting an implementation framework.

The research contributes to finding incentives to improving present DSM conditions by providing recommendations on how it can be adopted for DSM programmes in future. However, the researcher would also like bring to notice that Despite his best efforts to make this research as comprehensive as possible, it was very difficult to find all the relevant documents because of absence of records on the official web sites of the actors and analyse them. This resulted in only partial or limited findings due to difficulty in accessing the data.

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