ENERGY CONSERVATION: DEMAND-SIDE MANAGEMENT

ENERGY MANAGEMENT INITIATIVES IN INDIA'S INDUSTRIALISED STATES - A STUDY REPORT

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ENERGY CONSERVATION: DEMAND-SIDE MANAGEMENT ENERGY MANAGEMENT INITIATIVES IN INDIA'S INDUSTRIALISED STATES - A STUDY REPORT
1. ELECTRICITY SCENARIO IN INDIA

Since the end of the Tenth Five-Year Plan period, or 2007 onwards, India’s pace has increased significantly in terms of power generation capacity addition as well as in terms of making power available to widely distributed geographical boundaries. However, demand still exceeds supply. To be able to meet the increasing demand for electricity in tandem with high rates of GDP growth, significant augmentations to the installed generating capacity are a must, along with development of the associated transmission and distribution infrastructure. Also, this development has to occur in a manner that simultaneously and adequately addresses sustainable development and environmental concerns.

Average per capita consumption of electricity in India has risen from 15.6 units in 1950 to 800 units in 2012. While only 1500 villages in India were on the grid in 1950, the benefits of electricity had reached around 90.8 per cent of the 593,732 (Census 2001) villages by the turn of the century. However, even though India has come a long way in terms of additions in generation, transmission and distribution capacity since independence, demand has perennially been ahead of supply. Around 223,344 MW of capacity has been added during this period, but peak and normal energy shortages remain at levels of around 8-10 per cent each.

The energy needs of India have grown from 737,052 MU in 2008 to 995,500 MU in 2012-13, indicating a growth of about 6.2 per cent. As of March 2013, energy shortage was at around 9.2 per cent in the northern region, 3.3 per cent in the western region, 15.5 per cent in the southern region, 4.6 per cent in the eastern region and 7.3 per cent in the north-east region. Credibly, with the use of captive power, better grid management and demand-side management, peak shortages have declined over the years, although, normal shortages continue to be higher.
Removal of fundamental, legislative and market-related weaknesses through reforms, bringing in the Electricity Act, 2003, and running several schemes implemented during the Tenth and Eleventh Five-Year Plans – all these measures are aimed at taking electricity to the un-connected areas and generating more power to meet the growing demand. The basic agenda is that lifeline energy needs of all households must be met, and it is critical that industries are also able to access power at competitive tariffs. Agricultural and commercial units must get un-interrupted power supply.

In order to make power available, it is important, not only to plan for additional capacity to meet anticipated demand growth from each of these segments; but also to look at all means of conserving energy. Apart from new capacity addition, transmission capacity augmentation, distribution capacity addition and rural electrification, these means include demand-side management (DSM), energy efficiency, research and development, market development and manpower training.

The report of the Planning Commission’s Working Group on Power Sector has estimated that a capacity addition of about 76,000 MW would be required during the Twelfth Five-Year Plan to meet India’s projected demand. Plans have already been laid out for an inter-regional transmission capacity of 37,800 MW with about 100,000 ckm lines, 13,000 MW HVDC terminal capacity and 270,000 MVA of AC transformation capacity. In an effort to reduce green-house gas (GHG) emissions, the emphasis is on the development of nuclear, hydro and renewable power. The impact of demand-side management and
energy efficiency measures by the Bureau of Energy Efficiency (BEE) has also been taken into account in the plan.

The government has launched a number of schemes aimed at improving the power supply situation. For instance, Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) and Restructured Accelerated Power Development & Reforms Programme (R-APDRP) are aimed at providing last mile connectivity to villages and reducing AT&C losses, respectively. R-APDRP’s mandate also involves the application of IT for energy auditing, accounting, technological up gradation and strengthening of distribution infrastructure.

In short, the government has adopted a two-pronged strategy: a) to augment the supply of electricity including clean and green power and b) to emphasise on the need for demand-side management and energy efficiency measures. In fact, energy efficiency and DSM have assumed far greater significance, led by the need for conservation of depleting energy resources and minimisation of the carbon footprint of the power sector.

This report highlights the results of a study undertaken in Haryana to identify the areas of DSM through various means as per schemes and road maps formulated by the Power Ministry, Government of India.

2. A DSM STUDY – INDUSTRIALISED STATE

An IMaCS study of the domestic, commercial and industrial sectors’ demand pattern in Haryana indicates the areas where DSM would be most effective and required in similar industrialised states. In summer, air-conditioning and food preservation are significant contributors to the daily domestic load throughout the day. As expected, lighting load is significant post afternoon. Washing and cleaning load, although not very high, exists during the morning to mid-day period; indicating the use of washing machines. During winters, the heating load increases in the early morning period, while food preservation load is constant.

![Figure 3.1](image-url)
While ceiling fans contribute to the load throughout the day and night, the load from window air-conditioners and coolers increases during night, mid-morning and early evening. Also, window air-conditioner load outstrips that of other equipment during these periods. Ceiling fans and CFL lamps constitute 78 per cent and 75 per cent of the total cooling and lighting equipment, respectively. In the evening, CFLs and regular tube lights contribute significantly to lighting load. This indicates greater use of CFLs and hence, energy savings.
Figure 4.2
Domestic appliances load
Share of lighting equipment

- CFL lamps: 75%
- Regular tube lights: 19%
- Bulbs: 6%

Source: IMaCS Haryana survey

Figure 4.3
Domestic appliances load
Share of conditioning equipment

- Ceiling fan: 78%
- Air cooler: 14%
- Window AC: 4%
- Split AC: 1%
- Pedestal fan: 3%

Source: IMaCS Haryana survey
Commercial demand pattern

In the commercial sector, the tube light load is constant through the day and night, while halogen and sodium vapour lighting load is high during post evening and at night. Tube lights and ceiling fans constitute a significant share of lighting and cooling equipment, respectively.
Figure 5.2
Haryana load pattern and appliances load – Commercial
Share of lighting equipment

- Regular tube lights: 46%
- Tube light without starter: 10%
- CFL lamps: 39%
- Bulbs: 1%
- Halogen lamps: 3%
- Sodium vapour lamps: 1%

Source: IMaCS Haryana survey

Figure 5.3
Haryana load pattern and appliances load – Commercial
Share of conditioning equipment

- Ceiling fan: 66%
- Split AC: 17%
- Window AC: 8%
- Table fan: 4%
- Air cooler: 3%
- Room heater: 2%

Source: IMaCS Haryana survey
Industrial demand pattern

Industrial lighting load is predominantly because of tube lights and CFL lamps. The cooling load is because of fans, air-conditioners and chillers.
Figure 6.2
Haryana load pattern and appliances load – Industrial
Share of lighting equipment

- CFL lamps 25%
- Regular tube lights 64%
- Tube lights without starter 9%
- Bulbs 1%
- Halogen lamps 1%

Source: IMaCS Haryana survey

Figure 6.3
Haryana load pattern and appliances load – Industrial
Share of conditioning equipment

- Ceiling fan 80%
- Central AC, 1%
- Pedestal fan 6%
- Window AC 4%
- Split AC 6%
- Air cooler 2%
- Chiller 1%

Source: IMaCS Haryana survey
Further, the IMaCS study found that on an average, a commercial consumer spends US$ 5,000 per annum on diesel and US$ 3,400 per annum on electricity bills. An industrial consumer spends, annually, about US$ 26,000 on diesel and US$ 20,000 on electricity bills.

IMaCS estimated that by entering into a tri-partite agreement with solar power developers and selected commercial/industrial consumers, DISCOMS could tap into this revenue opportunity by arranging power from these plants for consumers during peak time. Also, 59 per cent of agricultural consumers surveyed were willing to replace existing pump-sets with energy efficiency pump-sets and 56 per cent were willing to pay for electricity; provided it is supplied at a time desirable to these consumers. IMaCS recommended the implementation of agri-DSM on seven feeders, which would result in demand saving of around 2 MW and energy savings of 68 MU for the life of appliances, assuming a total load replacement of around 13 MW by energy efficient pump-sets.

The key findings of the study were as follows:

**Domestic sector:** Lighting, conditioning, food preservation and water heating equipment contribute significantly to the domestic load. Hence DSM initiatives are identified for these appliances.

**Commercial and industrial sectors:** The major conclusions made under the study for these sectors are as follows:

- DSM initiatives for replacement of lighting and conditioning equipment are identified for these categories
- Regular tube-lights contribute significantly to the total lighting load
- Ceiling fans, split-ACs and window ACs are significant contributors to the conditioning load
- Commercial and industrial consumers spend around 1.5 to 1.8 times their electricity bill on diesel to run diesel generators during hours of power-cut
Agricultural sectors: Agri-DSM is necessary for selected target feeders through an Energy Service Company (ESCO).

Based on these findings, IMaCS recommended the following DSM programme:

<table>
<thead>
<tr>
<th>S no</th>
<th>Old appliance</th>
<th>New appliance</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tube light</td>
<td>T5 FTL</td>
<td>Residential</td>
</tr>
<tr>
<td>2</td>
<td>Old ceiling fan</td>
<td>5 Star rated ceiling fan</td>
<td>Residential</td>
</tr>
<tr>
<td>3</td>
<td>Old window AC</td>
<td>5 Star rated AC</td>
<td>Residential</td>
</tr>
<tr>
<td>4</td>
<td>Old DC refrigerator</td>
<td>5 Star rated DC refrigerator</td>
<td>Residential</td>
</tr>
<tr>
<td>5</td>
<td>Old FF refrigerator</td>
<td>5 Star rated FF refrigerator</td>
<td>Residential</td>
</tr>
<tr>
<td>6</td>
<td>Regular TV</td>
<td>5 Star rated TV</td>
<td>Residential</td>
</tr>
<tr>
<td>7</td>
<td>Electric geyser</td>
<td>5 Star geyser</td>
<td>Residential</td>
</tr>
<tr>
<td>8</td>
<td>Tube light</td>
<td>T5 FTL</td>
<td>Commercial</td>
</tr>
<tr>
<td>9</td>
<td>Old ceiling fan</td>
<td>5 Star rated ceiling fan</td>
<td>Commercial</td>
</tr>
<tr>
<td>10</td>
<td>Old window AC</td>
<td>5 Star split AC</td>
<td>Commercial</td>
</tr>
<tr>
<td>11</td>
<td>Old split AC</td>
<td>5 Star Split AC</td>
<td>Commercial</td>
</tr>
<tr>
<td>12</td>
<td>Tube light</td>
<td>T5 FTL</td>
<td>Industrial</td>
</tr>
<tr>
<td>13</td>
<td>Old ceiling fan</td>
<td>5 Star rated ceiling fan</td>
<td>Industrial</td>
</tr>
<tr>
<td>14</td>
<td>Old window AC</td>
<td>5 Star split AC</td>
<td>Industrial</td>
</tr>
<tr>
<td>15</td>
<td>Old split AC</td>
<td>5 Star split AC</td>
<td>Industrial</td>
</tr>
</tbody>
</table>

Source: IMaCS DSM Study

For the selected DSM programs, the total demand savings and energy savings for the life of the appliances were estimated at 62 MW and 1,987 MU respectively.

3. DSM, ENERGY EFFICIENCY AND CONSERVATION: FOCUS AREAS IN 12TH FIVE-YEAR PLAN PERIOD

Under the Eleventh Five-Year Plan (2007-12), it was proposed by the government to achieve energy savings accounting for 5 per cent of the anticipated energy consumption levels at the beginning of the plan period. A number of initiatives that have been undertaken as part of the different schemes of BEE and the Ministry of Power have led to an estimated 10,000 MW of savings at the end of the plan period through improved efficiencies.

In the Twelfth Plan period, it is proposed that BEE will provide the technical assistance for establishment of DSM cells in the distribution companies of the states (DISCOMs) and capacity building therein. The DSM cells will be trained to undertake the following: a) Load surveys b) Load strategies such as demand response, load management programmes, dynamic/real time pricing, time-of-use rates, automated/smart metering, and web-based/communication system c) Demonstration studies d) Advanced metering e) DSM financing.

As a consequence of DSM and energy conservation and efficiency measures that have been proposed, the target of energy saving, which is expected to be achieved in the terminal year 2016-17 of the Twelfth
Energy Conservation: Demand–Side Management

Five-Year Plan period, is 44.85 BU (on the consumer side), which is equivalent to 60.17 BU at the Bus-bar side.

### Table 2

**DSM tools**

#### Key provisions: Government schemes to promote DSM

**Strengthening state designated agencies (SDAs)**
- Strengthen 32 SDAs in order to enable them to implement various programs and activities
- BEE support for SDAs by way of technical and financial assistance
- SDA to develop/implement five-year energy conservation action plan
- Proposed activities for 12th Five-Year Plan period: Municipality (drinking water and sewage treatment), agriculture sector (pumping), street lighting, commercial buildings, government buildings and waste-heat recovery in small and medium enterprises (SME) including demonstration projects

**State Energy Conservation Funds (SECF)**
- SECFs constituted in 22 states and funds released to 20 states during the 11th Five-Year Plan period to operationalise various energy efficiency initiatives
- The governments of Andhra Pradesh, Rajasthan, Chhattisgarh, Karnataka, Haryana, Gujarat and Mizoram have contributed a matching grant
- In the 12th Five-Year Plan period, it is proposed to set up SECFs in all the states
- SDAs to pursue for SECF constitution and attracting matching contribution by the state governments
- SDAs to implement various energy conservation activities using SECF fund

#### Industrial sector
- National Energy Conservation Award
- Notification of energy intensive sectors as designated consumers
- Enhanced capacity building of energy management professionals
- Implementation of Perform, Achieve & Trade (PAT) scheme

The proposed schemes/activities for the micro, small and medium enterprises (MSMEs) sector are as follows:
- Sector-specific approach for energy efficiency and technology upgrading through facilitation of implementation of DPRs
- Energy mapping of the targeted SME sector on an all-India basis
- Undertaking of innovative financial schemes for adoption of EE technologies in the SMEs
- Technical assistance and capacity building
- SME product labelling promotion scheme

#### Equipment and appliances

The proposed activities under the Standard & Labelling (S&L) Programme for equipment and appliances include the following:
- Including five new equipment and appliances for labelling
- Ensuring awareness creation among all the stakeholders
- Undertaking of check testing, monitoring and market impact assessment of appliances/equipment covered under S&L
- Up-grading energy performance standards for equipment/appliances covered during the Five-Year Plan period

#### Transport sector
- Introduction of fuel economy norms in the Twelfth plan period
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Key provisions: Government schemes to promote DSM

- Technical study for two and three wheelers and commercial vehicles to finalise S&L programme
- **Super-efficient Equipment Programme**
  - Super-efficient Equipment Programme (SEEP) under Market Transformation for Energy Efficiency (MTEE) initiative
  - Enable shifting under MTEE to energy efficient appliances through innovative measures
  - Make energy efficient appliances more affordable
  - Achieve annual savings of 19,598 MW of power and 23 million tonnes of fuel and greenhouse gas emissions reduction of 98.55 million tonnes

**Sector-wise focus**

- Commercial sector: Energy conservation building code & energy efficiency in existing buildings (proposed 12th Five-Year Plan savings of 10.77 BU)
- Residential sector: Bachat Lamp Yojana (proposed savings of about 10 BU)
- Agriculture sector: Agriculture DSM (projected electricity saving is about 0.7 BU)
- Municipal and public utility sector – Municipal DSM (Mu DSM): Energy efficiency in ULBs and energy efficiency in water pumping. The projected electricity saving is about 0.47 BU

**Source:** Working Group on Power Report, Twelfth Five-Year Plan

### 4. CONCLUSION

In conclusion, there are two scenarios of meeting energy demand: a) by adding generation capacity, which is an on-going process and b) by conserving energy and managing demand for energy better. This would not only optimise energy use, but also provide some surplus to meet India’s growing demand. It also advances the cause of precious resource conservation and energy conservation. However, it is also essential to keep the focus on meeting energy needs through demand side management rather than simply curbing them.

The IMaCS study in Haryana indicates that by merely replacing low-efficiency appliances and adopting energy efficient equipment, homes, commercial and industrial units can save up to 2,000 MUs per year; resulting in avoided power purchase costs of about US$ 320 million, taking into account transmission and distribution losses.

The emerging scenario for the Twelfth Five-Year Plan periods indicates that the government is keen to incorporate DSM and energy conservation and efficiency into the projections arithmetic in order to save energy through several measures as applicable to consumer appliances, buildings, transport and industry.

In order to incorporate DSM as an inherent part of the power economics, the government has provided mechanisms for energy savings at the demand side from sectors that contribute most to energy demand. These mechanisms relate to: effective institutional framework such as state designated agencies (SDAs) for implementation; State Energy Conservation Fund for funding; Perform, Achieve and Trade scheme for industries; Super-Efficient Equipment Programme; and use of energy efficient appliances at different levels.
The results of a study undertaken in Haryana to identify the areas of DSM through various means indicate the importance of such exercise in precise determination of areas where energy efficiency or energy conversation measures may help reduce electricity wastage on the demand side.
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