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Demand Side Management in Punjab

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Table of contents

1 Introduction 5
2 Institutional framework 5
3 Power Sector Profile 6
3.1 Installed capacity and Generation mix 6
3.2 Demand requirement 6
3.3 Demand Pattern 7
3.4 Energy and Peak Deficit 9
3.5 Energy Sales and Consumption mix 9
3.6 Power Purchase 10
3.7 Energy Conservation Action Plan 10
3.8 DSM Initiatives 11
3.8.1 Lighting scheme 11
3.8.2 Energy Efficient Pumps 12
3.8.3 Appliance Replacement program 12
3.8.4 Differential Tariff Schemes 13
3.8.5 Energy Conservation Building Code (ECBC) 13
3.8.6 State Energy Conservation Fund (SECF) 14
3.8.7 Awareness campaigns 14
4 Roadmap for DSM and green growth in Punjab 15
5 Bibliography for Punjab 17

List of Figures

Figure 1: Snapshot of institutional framework in Punjab Power Sector 5

Figure 2: Restricted versus Un-restricted Demand Pattern for the year 2012-13 7

Figure 3: Forecasted Energy Requirement and Peak Load for Punjab 7

Figure 4: Peak demand in the state of Punjab 8

Figure 5: Average Demand Profile for the year 2012 8

Figure 6: Monthly trend of Energy and Peak deficit in Punjab for FY 2013-14 9

1 Introduction

The state of Punjab located in north western part of India is an agrarian state where nearly 60% of the population lives in rural areas. Being a pioneer of green revolution, the state has a major role in making the country self-sufficient in food grain production. Major crops grown in the state include wheat, paddy and sugarcane.

With a rich agricultural base and policies for industrial development, Punjab has become a frontier state in exporting ready-made garments and hosiery, engineering goods, sports goods and yarn and textile, machine tools and hand tools. Agriculture and industry sectors have thus become high power consuming sectors in this state. Strategic energy efficiency and DSM efforts in these sectors could result in significant energy savings.

2 Institutional framework

Punjab State Electricity Regulatory Commission (PSERC), constituted by the Government of Punjab, is the governing body to regulate the functioning of the utilities. Punjab State Power Corporation Ltd. (PSPCL) is the single entity responsible for both generation and distribution while Punjab State Transmission Corporation Ltd. (PSTCL) is a sole entity responsible for transmission. Previously, the Punjab State Electricity Board (PSEB) was responsible for generation, transmission and distribution activities in the state. On April 16, 2010, the erstwhile PSEB was reorganized into two successor companies, PSPCL and PSTCL.

Figure 1 illustrates various entities that play a critical role in the power sector profile of Punjab.

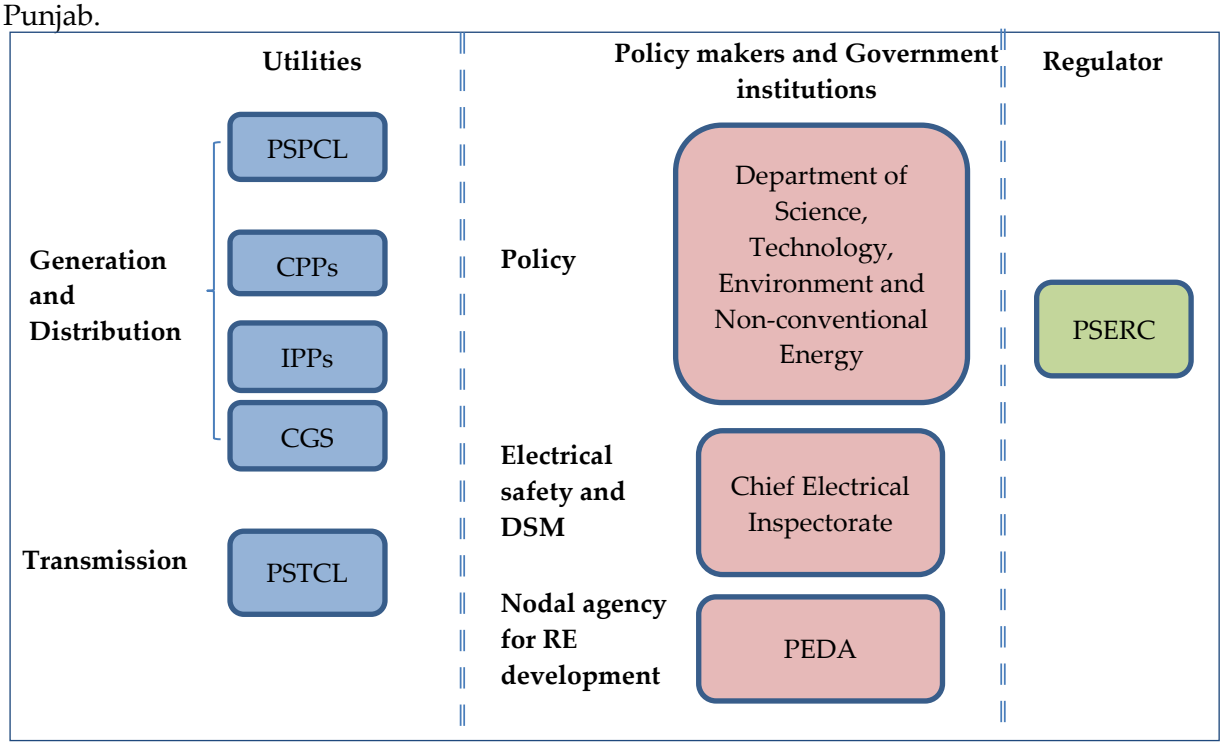

Figure 1: Snapshot of institutional framework in Punjab Power Sector

Acronyms

PSPCL	Punjab State Power Corporation Ltd.	**CPP**	Captive Power Plants
IPP	Independent Power Producers	**CGS**	Central Generating Stations
PSTCL	Punjab State Transmission Corporation Ltd.	**PEDA**	Punjab Energy Development Agency
PSERC	Punjab State Electricity Regulatory Commission		

3 Power Sector Profile

3.1 Installed capacity and Generation mix

The total installed capacity of the state of Punjab was 8,353 MW as on 31st March, 2014. Out of which, state-owned power plants alone constituted 5,040 MW, private-owned plants constituted 1,343 MW, and central-owned plants constituted 1,970 MW. Coal and hydro serve as primary sources of energy in Punjab with more than 80% of the share in the installed capacity. Renewable capacity has a small fraction in the total installed capacity of the state of Punjab (3.5%). (CEA Installed Capacity, 2014)

The total generation in the state of Punjab in the FY 2013-14 was 20,731.49 GWh. Out of which, thermal generation contributed to 81.1% of the share. (CEA Generation Overview, 2014)

3.2 Demand requirement

The maximum restricted demand[1] met has increased from 8,834 MW in 2010- 11 to 9,074 MW in year 2012-13 while the unrestricted demand has increased from 9,399 MW in 2010-11 to 11,520 MW in 2012-13. (SLDC, 2012-13)

Figure 2 shows that the months of June, July and August experienced high restricted demand (in the range of 8,751-9,055 MW) as well as unrestricted demand (in the range of 10,488-10,745 MW) due to increased irrigation load in the year 2012-13. Month-wise restricted and unrestricted demand pattern for the year 2012-13 is given in the Figure 2. (SLDC, 2012-13, pp. 4-5)

[1] Restricted demand refers to demand that is restricted due to power cuts, load shedding etc.

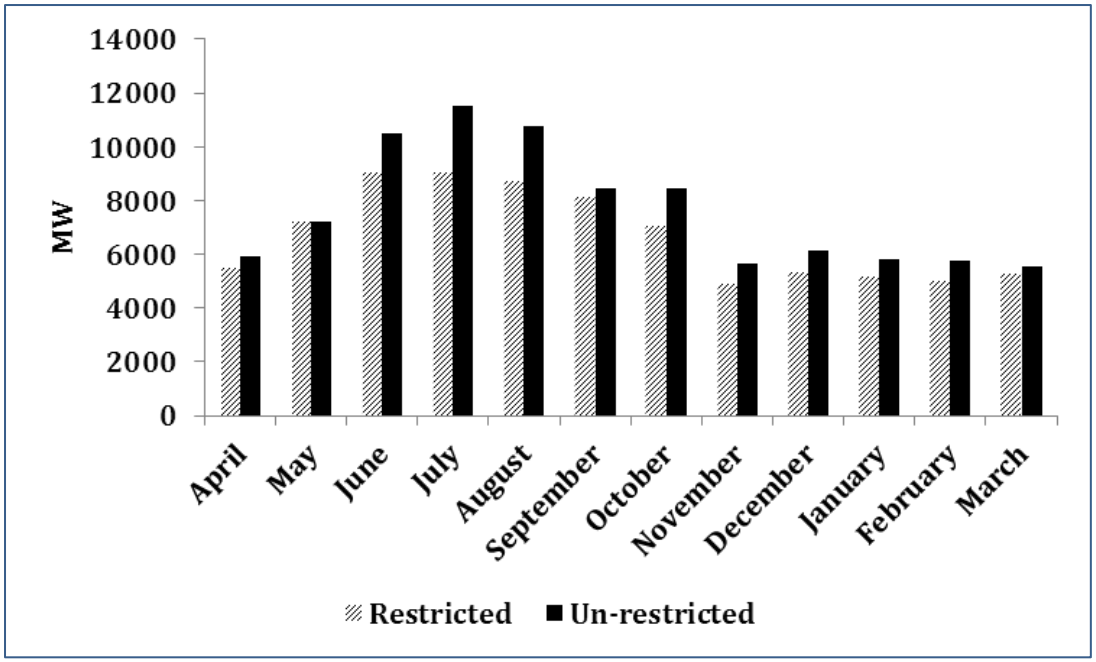

Figure 2: Restricted versus Un-restricted Demand Pattern for the year 2012-13

Source: (SLDC, 2012-13)

It has been forecasted that the demand and energy requirements are expected to double in the next 15 years. (CEA 18th EPS, 2011) Figure 3 depicts the forecasted energy and peak requirements from 2015-2016 to 2021-2022.

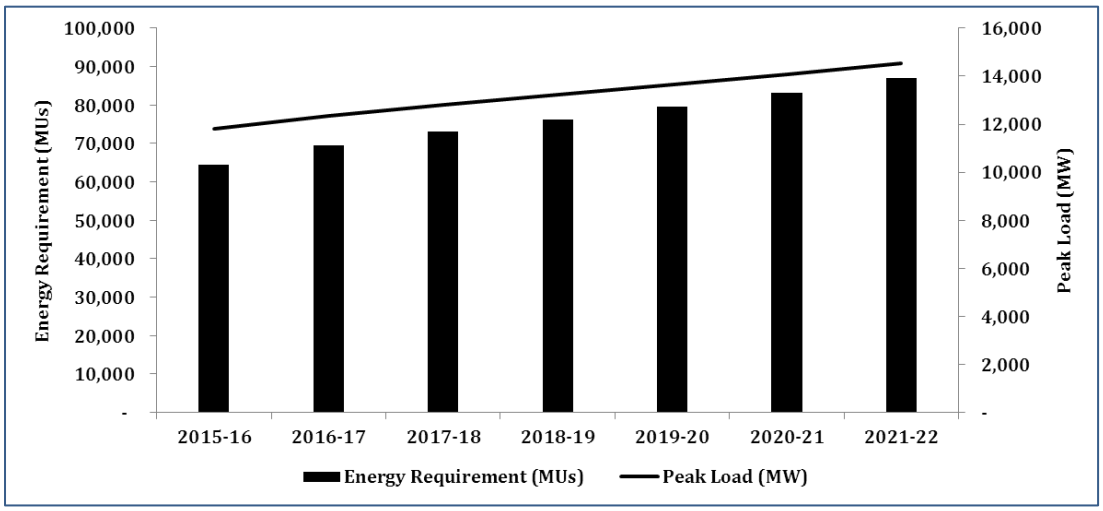

Figure 3: Forecasted Energy Requirement and Peak Load for Punjab

Source: (CEA 18th EPS, 2011)

3.3 Demand Pattern

The utility generally experiences higher demand in summer months - June, July and August due to increased irrigation load as illustrated in Figure 4 .

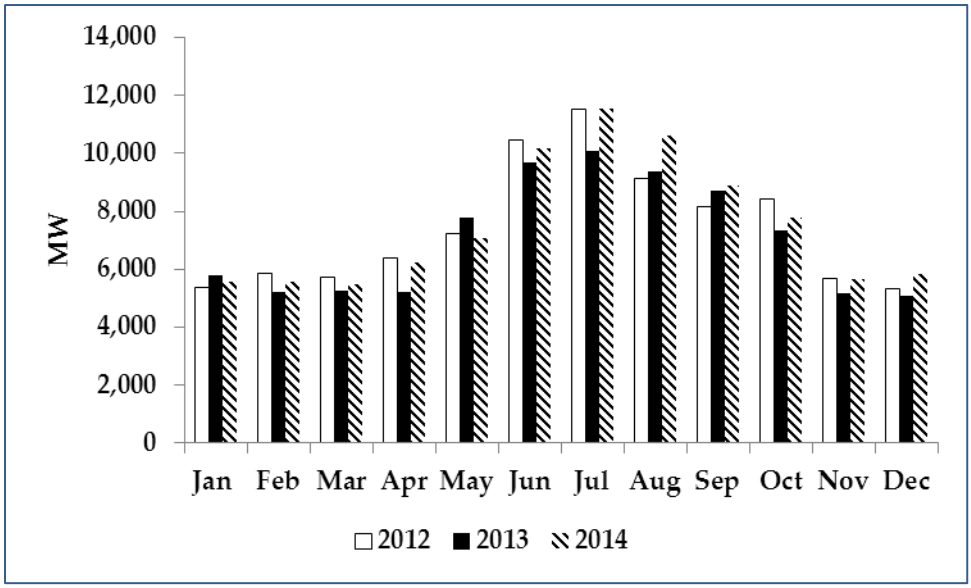

Figure 4: Peak demand in the state of Punjab

Source: (CEA Power Supply Position, 2014)

In 2012, month of July was recorded as the peak demand month of the utility. Figure 5 depicts the ratio of hourly average load pattern to the peak demand met for that month in the year 2012. It can be seen that the there is rise in load in the afternoon which may be contributed by the industry and commercial load, and significant rise in the evenings which may be due to the domestic appliances.

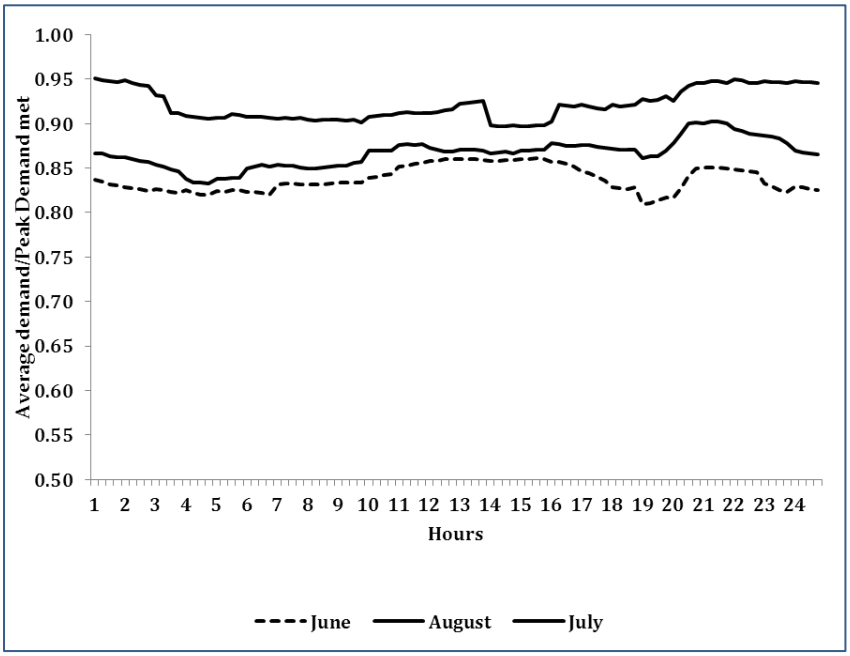

Figure 5: Average Demand Profile for the year 2012

Source: Data obtained from SLDC, Patiala and TERI Analysis

3.4 Energy and Peak Deficit

The energy deficit has decreased from 5.3% to 1.5% in the past 3 years whereas the peak deficit has decreased from 16.9% to only 13.4%. It can be observed that months of June, July and August experienced high peak as well as energy deficits as compared to rest of the months as depicted in Figure 6.

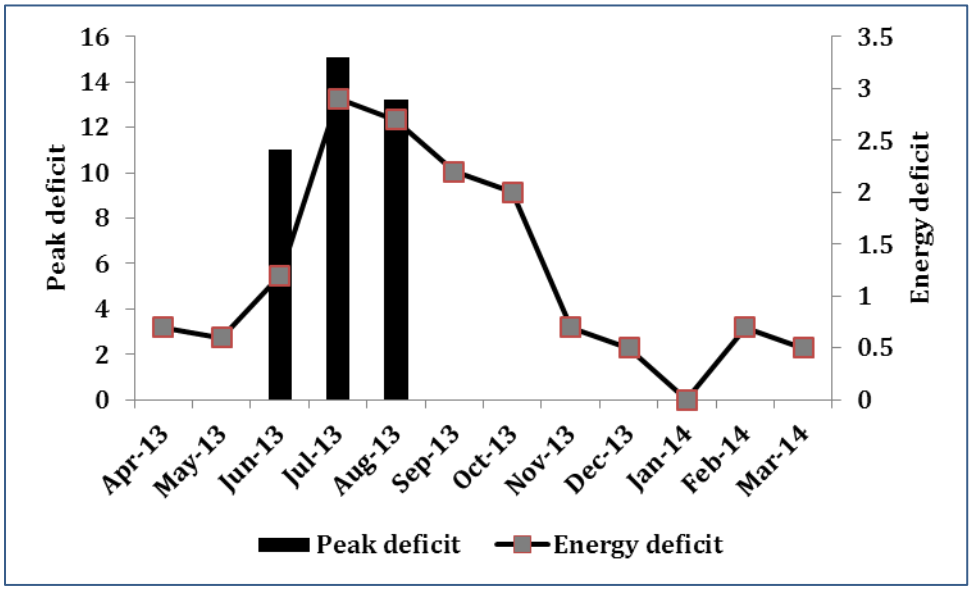

Figure 6: Monthly trend of Energy and Peak deficit in Punjab for FY 2013-14

Source: (CEA Installed Capacity, 2014), (TERI Analysis)

3.5 Energy Sales and Consumption mix

The top three consumer segments having a major share in the electricity consumption in Punjab are industry, agriculture and domestic categories. The total energy sales to different consumer categories within the state for the FY 2013-14 were recorded at 38,682 MU. Out of which, 27,461 MU was provided to metered categories while the rest (11,221 MU) was supplied to the agriculture category. Under the metered category of consumers, domestic and industrial consumers are supplied the maximum share of electricity, 38% and 36% respectively. (PSPCL, 2013-14)

In Punjab, the industrial sector has a diverse portfolio of industries - textile based industries including yarn, readymade garments and hosiery, food/grain processing, manufacture of machines and hand tools, printing and paper machinery, auto parts and electrical switchgears, manufacturing of bicycle and bicycle parts, sewing machines, and sports goods, mainly dominated by Small Scale Enterprises (SMEs) or Micro-Small Scale Enterprise (MSME). (Department of Industries and Commerce)

It has been projected that the industry and agriculture categories will continue to have a major share (70%) in the electricity consumption until 2021-22. (CEA 18th EPS, 2011) The State Action Plan also envisages that industry, agriculture and domestic sectors will have a large scope of reducing electricity consumption through enhancement in energy efficiency. (Govt. of Punjab, 2014)

3.6 Power Purchase

For Punjab, total amount of net short term transactions of electricity were 193 MUs in the month of March 2014. Punjab sold 245 MUs through bilateral transactions and 47 MUs through power exchanges while purchased 2 MUs via bilateral exchanges and 94 MUs through power exchanges in March 2014. (CERC, 2014)

3.7 Energy Conservation Action Plan

In view of designing energy efficiency programs at the national and state level, US AID initiated Energy Conservation and Commercial Program (ECO III) in 2007 for enhancing the institutional capacity of Gujarat Energy Development Agency (GEDA) and Punjab Energy Development Agency (PEDA) to initiate and deliver energy efficiency program and raise the profile of energy conservation activities in the two respective states. This project also aided in developing Energy Conservation Action Plan (ECAP) with an aim to intensify the efforts to promote energy efficiency in different consumer segments by

- Reducing energy consumption in generation, transmission, distribution through end use DSM programs and large scale end use energy efficiency improvements, rational and judicious use, and
- Addressing the concerns of utilities such as demand shortage as well as power shortages through focused DSM initiatives.
- Promote use of energy efficient technologies, equipment, processes, and appliances
- Promote awareness in respect of EC Act, energy efficiency, standards, best practices
- Promote energy efficiency in buildings and Standards & Labeling to promote manufacture and use of energy-efficient appliances

The Mission on Enhanced Energy Efficiency of the state targets to achieve 3-7% energy efficiency improvement in large energy consumers designated by BEE and 15-20% in SME sector.

Budget of around Rs. Rs 3,744.75 Cr (Rs 1,877.25 Cr in 12th plan and Rs 1,867.50 Cr in 13th plan) was allocated for implementation of the activities under this mission. (Govt. of Punjab, 2014)

DSM regulations were notified by PSERC in 2012. In compliance with the provision 8.1 in DSM regulations and notification dated 04.01.2013, Demand Side Management Consultation Committee (DSM-CC) has been constituted to perform the following functions. (PSERC, 2013)

- *Advise the Licensee(s) on conducting continuous consumer surveys and load research to seek information on end-use technologies, usage patterns, willingness to pay, sensitivity studies, market research etc. to assess DSM potential;*

- *Advise awareness activities/campaigns/exhibitions, consumer interaction sessions developed by the Licensee(s) & to supervise the same thereafter;*
- *Promote cross-learning among the Licensee(s) and other stakeholders so as to design appropriate DSM Programme(s)/Plan;*
- *Develop innovative tariff offerings to promote DSM;*
- *Review DSM Programme(s)/Plan submitted by the Licensee and to assist the Commission in assessment;*
- *Evaluate the terms set by the financers/ bankers for funding DSM Plan;*
- *Provide support to the Commission for instituting DSM Programme(s)/Plan monitoring, review and Evaluation Measurement & Verification (EM&V) as and when required;*
- *Study the impacts of already implemented DSM Programme(s);*
- *Apprise the Commission about all DSM related activities on quarterly basis.*

Punjab Energy Development Agency (PEDA) has been designated as the State Designated Agency (SDA) in Punjab for spearheading energy efficiency efforts and implementing energy conservation programs, including those mandated by BEE. PEDA has been conferred with National Energy Conservation Award in appreciation of their efforts in energy conservation in the SDA sector for the year 2008.

Although there have been some energy conservation programs in the state, the involvement of the utility in implementation of electricity-savings measures has been very minimal. In September 2014, PSERC imposed a disallowance of Rs 72.27 crores on PSPCL for non-implementation of DSM regulations.[2]

DSM regulations requires the utility to come up with DSM plan which would in turn require a detailed load research analysis to be conducted for different consumer categories. Load research analysis (funded by EESL) is currently underway by TERI in the state.

3.8 DSM Initiatives

3.8.1 Lighting scheme

PEDA in association with PSEB initiated the implementation process of Bajat Lamp Yojana (BLY) scheme in 2009 in seven circles, Gurdaspur, Hoshiarpur, Nawanshahr, Ludhiana Suburban, Khanna, Sangrur and Faridkot. In 2007, the Punjab State Government issued directives to replace incandescent bulbs with CFLs in all government buildings and offices. With effect from 15.4.2008, use of CFLs (20 W maximum) on agriculture pump set sites was also mandated. (Govt. of Punjab, 2012)

[2] News article from Tribune dated 08.09.2014 http:/ / www.tribuneindia.com/ 2014/ 20140823/ punjab.htm

Punjab's mission on enhanced energy efficiency targets achieving energy efficiency in street lighting sector by replacement of conventional street lights with LeDs. (Govt. of Punjab, 2014). Almost eight thousand street lights have been changed with energy-efficient lights in Amritsar Municipal Corporation and 170 LED street lights (30 watt & 40 watt) have been installed at Municipal Council, Majitha, having annual energy savings of 0.79 lacs units. Additionally, solar rooftop projects and solar street lighting continue to be promoted in all sectors in order to enhance the share of solar power in the state. Until now, around 1,107 MW of solar rooftop have been installed by PEDA and 5300 number of solar street lights has been commissioned. (Govt. of Punjab, 2014)

The state has the objective of ramping up capacity of grid-connected solar power generation to 4,000 MW by 2017 through the mandatory use of the renewable purchase obligation by utilities backed with a preferential tariff. (Govt. of Punjab, 2014) Specifically, increase coverage of solar lighting by putting 1,000 solar lighting systems during 12th and 13thfive year plan.

3.8.2 Energy Efficient Pumps

Energizing pump sets contribute to a major share in the consumption of electricity in the agriculture sector. Thus, replacement of pumps with energy efficient pumps, adoption of solar pumps and adopting best irrigation practices would have a positive impact on energy savings. A pilot agricultural demand side management project was conducted by agencies (that were hired by BEE) which involved survey of 2,186 agriculture pump-sets in the districts of Mukatsar and Tarn-Taran. An annual energy saving potential of 7.38 MU was estimated with a payback period of 2 to 3 years. State government issued a mandatory directive on 07.10.2011 for use of BIS marked motor pump sets, power capacitor, foot/reflex valves. (BEE)

Punjab's Mission on Strategic Knowledge for Climate Change envisages research & development of new and innovative technologies in agriculture and water management. (Govt. of Punjab, 2014)

3.8.3 Appliance Replacement program

The State government has decided to procure only energy efficient electrical appliances in the government offices while making new purchases, as suggested by BEE regarding installation of threshold star rating appliances on the basis of life cycle cost analysis.[3]

Punjab's Mission on Enhanced Energy Efficiency aims to "create demand for energy efficient appliances, technologies and programs by educating the public and private sector on their options." (Govt. of Punjab, 2014)

[3] http:/ / www.dailypioneer.com/ state-editions/ chandigarh/ punjab-asks-officers-to-install-energy-efficient-appliances.html

3.8.4 Differential Tariff Schemes

Industry category contributes highest to the consumption sales data, with a share of around 36% of metered sales (PSPCL, 2013-14). The larger industries segment are covered under PAT scheme as designated consumers, while SME sector is being targetted by underaking energy efficiency initiatives in clusters identified by BEE. Based on several studies & energy audits, the electrical energy saving potential in industry sector varies from 7-10%. (Govt. of Punjab, 2012)

Two types of differential tariff rates were imposed for managing the peak demand of the utility incentivize consumers for reducing their load during the peak periods.

- Peak Load Exemption Charges (PLEC): Penalty that was introduced more than two decades back to restrict the load of the industrial sector during peak demand period[4] of the utility, and
- Time of Day Tariff (ToD): Introduced in 2013 for 6 months (October to March) of the year from FY 2013-14 onwards, during off peak hours from 22:00 hrs. to
- 06:00 hrs. for large supply industrial category

"The Commission in its Tariff Order for FY 2013-14 directed PSPCL to examine the issues raised by the Consumers/Consumer Organizations and conduct mock trial/parallel run of the proposed Two Part Tariff System at least in 5 selected divisions of PSPCL for 6 months and submit a detailed report along with a more refined proposal for introduction of Two Part Tariff, addressing the concerns of the consumers/Consumers Organizations expressed during the processing of ARR for FY 2013-14 and also the observations made by PSPCL during the mock trial/parallel run." (CEA, 2014)

As a result, PSPCL expressed in a staff paper that the introduction of rebate under the ToD tariff has not added any activity during off peak hours. Specifically, stating that *"the consumption during off peak hours from 10.00 PM to 06.00 AM has not increased with the introduction of ToD tariff and is almost the same as for previous year before the introduction of ToD tariff.* PSPCL also observed that *"it is essential to relook at the ToD tariff model and redesign it so as to increase the consumption in the industrial category"*. (PSPCL, 2014)PSPCL is considering removal of PLEC and revision of ToD tariff.

3.8.5 Energy Conservation Building Code (ECBC)

The Punjab State Mission for Enhanced Energy Efficiency envisages achieving energy efficiency of the order of 15-35% in buildings (Commercial & Institutional buildings such as hotel, malls and govt. buildings based on Energy Conservation Building Code (ECBC)/Green Rating for Integrated Habitat Assessment (GRIHA) norms. The Punjab ECBC-2013 has been developed by amending ECBC for the composite climate zone applicable to the state of Punjab. As of 2013, use of Punjab ECBC in building byelaws has been mandated vide notification issued by Dept. of Housing & Urban Development Govt. of Punjab. (Govt. of Punjab, 2014)

[4]Peak period is defined as 6 pm to 10 pm in Punjab

In the building sector, PEDA has conducted energy audits in 24 Govt. and public buildings for implementation of energy efficiency projects and conducted survey of several commercial buildings.

PEDA's Solar Passive Complex, a BEE 5 star rated building, has been regarded as the center of excellence. This solar building exhibits a unique combination both in terms of energy efficiency and environment friendliness. The building integrates natural light and air with built in light vaults, solar photovoltaic power plant, water bodies and environment friendly landscaping.

3.8.6 State Energy Conservation Fund (SECF)

Pursuant to the Section 16 of EC Act 2001, Governor of Punjab constituted a fund on 22.02.2010 called as the "Punjab State Energy Conservation Fund" for the purposes of promotion of efficient use of energy and its conservation within the state. The rules for applicability of these funds were notified in 2009 to be utilized for the following activities (PEDA, 2009) :

- Awareness programmes disseminating information to individual consumers, industries, commercial organizations, etc. regarding energy conservation and efficient use of energy
- Training of personnel and specialists for efficient use of energy and its conservation
- Promotion of R&D in the field of energy conservation
- Develop creation of testing and certification procedure
- Develop and execute demonstration projects
- Promote energy efficient processes for equipment, devices and systems, etc.

On 05.07.2010, the State government required formation of a State Level Steering Committee (SLSC) to provide guidance and support for the operation of PSECF and monitor and review the progress of activities that have been carried out through utilization of PSECF. (BEE)

3.8.7 Awareness campaigns

PEDA has conducted several awareness campaigns amongst different consumer segments through press advertisement, school lectures through field staff, display of Mobile Exhibition Van, bus panels and radio jingles about the benefits of energy conservation. Some of their efforts were:

- Celebration of "State Level Conservation Day" in 2009 in coordination with PSEB,
- Painting and debate competitions for school children under the National Energy Conservation Campaign,

- Publishing of Annual Year Book on Energy Conservation Measures, and
- State level conference on energy conservation to discuss joint progress with certified energy managers, certified energy auditors and designated consumers

The State's Mission on Energy Efficiency promotes education and training of key stake holders on implementation of energy conservation measures, e-filing on annual reporting energy data, e-learning in consonance with BEE's mission on the Energy Conservation Act, 2001 and for adoption of monitoring and evaluation mechanisms. (Govt. of Punjab, 2014)

4 Roadmap for DSM and green growth in Punjab

Although Punjab has come up with DSM regulations as discussed in the earlier sections, the progress has been relatively slow paced. Some initiatives, such as promotion of energy efficient lighting and pumping, use of building codes to make the buildings more efficient, replacement of street lights with efficient ones, awareness programs have been initiated in pilot scale. A multi-pronged approach looking at technical, financial, social as well as economic aspects needs to be looked into for the programs to be implemented in an accelerated and sustained fashion. For large scale implementation, PSPCL, state government, PSERC, PEDA, Agriculture department, ESCOs, financial institutions, consumer groups will have a major role in propelling DSM efforts. Further, there is also a need for regular monitoring and verification of the proposed initiatives to analyze the impact of the programmes and understand the ground level realities. Learning from implementation of DSM programs in Punjab would not only serve as a model for other states but also help in scaling up of such projects at the national level.

There is a potential for energy saving up to 20-25% in different sectors of the economy in the state of Punjab (Govt. of Punjab, 2014). Roadmap has been carved out outlining targets that need to be envisaged and steps that need to be taken in a phased manner for achieving these targets for strengthening energy efficiency and DSM efforts.

Short-term

- Develop suitable business models, tariff structures and institutional structures for effective implementation of DSM programs
- 100% metering connecting all consumers of the state to the grid
- Special focus on promotion of EE appliances in domestic households, street lighting, government & private establishments, and water pumping needs in agriculture sector
- Implement cluster-specific energy efficient/DSM solutions targeting Medium and Small Scale Enterprises
- Enroll smart grid pilot projects in 1-2 cities
- Impact analysis of DSM programs that have already been implemented
- Investment in research and development, training and capacity building programs

- Creation of adequate resource pools, Energy Service Companies (ESCOs) and business models for implementing DSM programs
- Formulation of effective customer outreach and communication programs for active involvement of consumers in DSM and Energy Efficiency
- Develop Centre for Excellence to address R&D and demonstration issues related to DSM and energy efficiency
- Build alliances and partnerships through global collaboration in research & technology development on DSM, Energy Efficiency and Smart Grid technologies

Mid-term

- Improve the reliability, security and quality of supply along with evolving pricing structures
- Impact analysis of the DSM regulations and incorporate modifications to make it effective
- Regulatory impact studies on tariff based interventions
- Impact analysis of business models developed for implementation of DSM programs
- Increase the State Energy Conservation Fund and monitor its utilization
- Continued research and development, training and capacity building programs
- Full rollout of smart grids in urban areas based on learning from pilot studies

Long-term

- Integrate RE, off grids, demand response options and storage solutions with advanced information and communication technology (ICT) infrastructure
- Improve the reliability, security and quality of supply along with evolving pricing structures
- Continued research and development, training and capacity building programs

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About TERI

A unique developing country institution, TERI is deeply committed to every aspect of sustainable development. From providing environment-friendly solutions to rural energy problems to helping shape the development of the Indian oil and gas sector; from tackling global climate change issues across many continents to enhancing forest conservation efforts among local communities; from advancing solutions to growing urban transport and air pollution problems to promoting energy efficiency in the Indian industry, the emphasis has always been on finding innovative solutions to make the world a better place to live in. However, while TERI's vision is global, its roots are firmly entrenched in Indian soil. All activities in TERI move from formulating local- and national-level strategies to suggesting global solutions to critical energy and environment-related issues. TERI has grown to establish a presence in not only different corners and regions of India, but is perhaps the only developing country institution to have established a presence in North America and Europe and on the Asian continent in Japan, Malaysia, and the Gulf.

TERI possesses rich and varied experience in the electricity/energy sector in India and abroad, and has been providing assistance on a range of activities to public, private, and international clients. It offers invaluable expertise in the fields of power, coal and hydrocarbons and has extensive experience on regulatory and tariff issues, policy and institutional issues. TERI has been at the forefront in providing expertise and professional services to national and international clients. TERI has been closely working with utilities, regulatory commissions, government, bilateral and multilateral organizations (The World Bank, ADB, JBIC, DFID, and USAID, among many others) in the past. This has been possible since TERI has multidisciplinary expertise comprising of economist, technical, social, environmental, and management.

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