Draft for discussion purposes only

Electric utility load research and DSM programme design

Utility CEO Forum on Demand Side Management

August 2013

Abstract

This paper is the third among the series of background papers developed for the participants of meetings held by the Utility CEO Forum on Demand Side Management.

Load research marks the beginning of the process of acquiring cost-effective demand side resources by electric utilities. Demand side resources constitute energy and demand savings resulting from the actions of a utility, beyond the customer's meter. Load research helps electric utilities to identify strategic demand side management (DSM) measures and also quantify the resource potential for those measures. In the recent past, many state electricity regulatory commissions have directed electric utilities to undertake load research in order to estimate the potential of demand side resources available with the utilities. The Bureau of Energy Efficiency also recognizes load research as a critical component in the overall DSM process cycle driven by utilities. This is evident as BEE seeks to provide technical assistance for the DSM cells, established within the electric utilities, to undertake load research studies during the 12th Five Year Plan (FYP).

Similarly, DSM programme design is an integral part of the overall DSM resource acquisition process. After a decision has been made to proceed with a DSM measure, the utility should design a programme in order to reach the target customers and motivate them through incentive payments and information campaigns. This is essential to replicate the impact of individual DSM measures on a larger (megawatt) scale. The program design phase constitutes assessment of incentives, program goals, program budget, selection of appropriate delivery mechanisms, marketing platforms, monitoring and verification protocols.

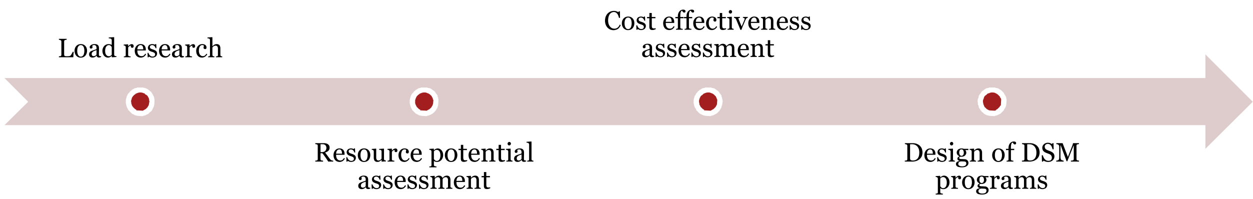
Many State-owned electric utilities within the country are still unaware of the commonly adopted methods for load research and successful programme designs for rolling out DSM measures. Therefore, this paper provides an illustration of conducting load research through a case study in one of the states (Himachal Pradesh) of India. The paper also describes some of the most successful DSM program designs, summarizes their key features and provides examples of adoption in India as well as in other parts of the world.

Table of contents

1. Introduction to load research

In the framework of utility driven Demand Side Management, load research is an important function to understand, classify as well as quantify the behaviour of the end user's electricity consumption pattern. Load research is also the starting point in the overall DSM planning process by electric utilities (see fig below).

Illustrative steps in DSM Planning process



Load research is a set of activities focused to identify strategic demand side measures and also quantify resource potential for those measures. The *load profile (also referred as load curve or load shape in literature)* is the variation in electrical load of a facility/customer/end use or sector as whole versus time. An hourly variation of the unrestricted load in a 24 hour window is generally termed as the '*daily load profile*' and this is the most preferred tool by analysts to study electricity consumption behaviour of end users. The analysis of the load profiles of different consumer categories can identify strategic load management interventions required to flatten the overall load curve of the utility. The load research activities also involve surveys, which aim to take stock of the installed electrical equipment, their capacity, make, technology and time of usage. The analysis of these outcomes along with some secondary research can quantify the market size of electrical appliances/equipment, assess the penetration of energy efficient technologies, and also identify relevant load reduction measures targeting specific end use applications for energy efficiency enhancements. Finally the load profiles and survey outcomes also allow analysts to quantify the technical potential for energy savings resulting from the acquisition of identified demand side resources.

Summary of outcomes resulting from load research exercise

Direct Outcomes	Derived Outcomes
• Load profile/curve/shape of individual consumer facilities in different consumer categories • Stock of the installed electrical equipment, their capacity, make, technology and time of usage	• Overall load profile of different consumer categories and their contribution to the systemic load curve • Strategic load management interventions to flatten the load curve • Market size of electrical appliances/equipment in different consumer categories • Penetration of energy efficient technologies among electrical appliances/equipment in different consumer categories • Load reduction measures targeting specific end use applications for energy efficiency enhancements • Technical potential of energy and demand savings resulting from the acquisition of identified demand side resources

Cost effectiveness assessment of demand side resources usually follows load research activities and aims to assess the economic potential, which is the technical potential of those resources that are cost-effective when compared to supply-side alternatives. The economic potential should provide an indicative proxy to set the goals and targets for acquiring DSM resources in a given timeframe. There are standard tests defined in some of the DSM regulations, notified in India, to assess the cost effectiveness of demand side resources. However this is not the focus of this paper.

1.1. Load research activities

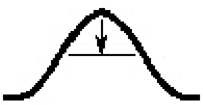
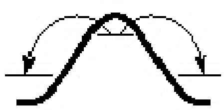
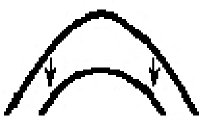
Load research is usually carried out in two different groups of activities.

Recording hourly load data

Majority of the electricity connections in domestic, commercial, agriculture and LT industry categories in India are provided with a basic electricity recording meter that can only record units of energy consumption in a cumulative pattern. Therefore, recording hourly load data for consumers in these categories requires physical monitoring and recording of the cumulative readings of energy consumption. The physical monitoring should be done for a statistically determined sample of consumers in a 24 hour window to capture any single day's load profile. The monitoring should also be done during different time zones in a year characterised by seasons and holidays to capture all the variations.

Automatic metre reading (AMR) is the technology of automatically recording real-time load and energy consumption data of an entire facility. The main advantage of this technology is that the electricity pricing can be based on near real-time consumption. This timely information, coupled with a detailed analysis, can help utilities as well as customers better control the use and supply of electrical energy. AMR data can be very useful to derive accurate load profiles, on a daily basis, for all kinds of consumer categories. In India, the meters with AMR technology are installed for most of the feeders supplying electricity to the individual consumers. AMR meters are also installed for high tension consumers in some states to implement real time pricing policies. Therefore hourly load recording using AMR meters is effective only for HT consumers and certain other groups of consumers with dedicated feeders. For majority of consumers, the utilities in India must resort to physical monitoring of electricity meters to record the hourly load data.

The hourly load profile recorded for a sample of consumers can be averaged to determine the sample mean (that is, the average hourly load profile) within each homogenous group of consumers. Subsequently, the total number of consumers or the total connected load, within each of these groups may form the basis for the extrapolation of the sample mean to the entire population. The analysis of load shapes of different consumer categories along with the systemic load shape of the overall utility should allow analysts to make informed judgments to identify relevant load management strategies (see table below). Time of day (TOD) tariffs, load factor/power factor improvement incentives and demand response initiatives are some of most commonly adopted interventions to achieve the load management strategies identified by the utilities.

Load Management strategies adopted worldwide	
	**Peak clipping** (reduction in peak demand) is reduction of peak load through Utility's direct control on equipment/appliance used by the consumer or through tariff adjustments whereby consumers curtail load at certain peak hours of the day.
	**Valley Filling** (increased demand at off peak) involves increasing the load during off-peak hours. Valley filling consists of building off-peak loads. This may be particularly desirable where the long-run incremental cost is less than the average price of electricity.
	**Load Shifting** (demand shifting to non peak) involves shifting peak loads to off peak hours. Popular applications include use of storage water heating, storage space heating, and coolness storage. In this case, the load shifting associated with thermal storage involves load shifting related to conventional electricity applications e.g. building heating by electric convectors.
	**Strategic Conservation** (the reduction of utility load, more or less equally, during all or most hours of the day) is one of the non traditional approaches to load management and results from utility-stimulated conservation. Not normally considered load management, it also involves a decrease in sale as well as modifications in the way electricity is used.

Load and market surveys

This activity mainly involves primary surveys through questionnaires, administered to capture the customer's connected load, stock of electrical appliances, wattage, make, technology and time of usage in different time zones in a year characterised by seasons and holidays. Primary surveys may be conducted by personally interviewing representatives from consumer facilities or getting questionnaires administered through web based tools (popularly known as e-surveys). Qualified engineers, certified energy auditors or specially trained personnel need to undertake such surveys in order to effectively understand the customer's facilities as well as provide assistance to the customer in gauging certain quantitative responses. Appendix 1 provides sample questionnaire designs for conducting load and market surveys in certain consumer categories. Effective stratification and sampling is the key to generate accurate results that are representative of the sample population.

The analysis of the survey responses along with some secondary research should allow the analysts to quantify the market size of electrical appliances/equipment, assess the penetration of energy efficient technologies, and also identify relevant load reduction measures, which specify energy efficient retrofits and replacements for existing stock (see table below).

Load reduction measures (Illustrative)	
Residential and Commercial	
Refrigeration	Incentives for purchasing BEE star rated (>3) refrigerator
Space conditioning	Incentives for purchasing BEE star rated (>3) air conditioners, installing direct load control devices on air conditioners, thermal energy storage systems, or home insulation systems
Lighting and ceiling fans	Incentives to purchase BEE star rated (>3) CFL; T5 lamps with electronic ballasts; LED based lighting systems; BEE star rated (>3) ceiling fans
Water heating	Rebates/incentives to install solar water heaters, jackets and low-flow, shower heads or high efficiency water heaters, Direct load control of water heaters, Water heating storage for load shifting
Others	Incentives for captive power generation using rooftop solar PV panels
Industry (Manufacturing)	
Motors	Incentives for installing high efficiency fans, blowers, compressed air systems, variable speed drives
Lighting	Incentives (rebates) to upgrade existing fluorescent bulbs and fixtures with high efficiency lights and electronic ballast
Heating	Incentives for solar water heaters
Agriculture pumping	
Pumping system	Incentives for installing high efficiency pumping systems that include motors, pumps, high efficiency foot valves, replacing GI pipes to PV pipes, impeller retrofits, variable speed drives, etc.
Municipal water pumping	
Pumping system	Incentives for installing high efficiency pumping systems that include motors, pumps, impeller retrofits, variable speed drives, changing pumping schedules to off peak periods etc.
Municipal street lighting	
Street lighting	Incentives for installing high efficiency street lighting systems, smart controls, etc.

These outcomes should further allow analysts to create an analytical model to assess the technical potential of energy and demand savings resulting from the load reduction measures identified through surveys. Technical potential is a theoretical construct of the technical upper bound of the energy and demand savings resulting with complete market penetration of energy-efficient appliances, deemed technically feasible from an engineering perspective. Technical potential does not consider cost or acceptability factors of the customer. This potential can be estimated using a bottom-up approach by evaluating the entire umbrella of energy efficiency measures.

$$\text{Technical potential} = \sum \text{Energy savings per measure} * \text{market size} * \text{penetration factor}$$

The market size is an estimate of the overall connected load of the specific end-use appliance or technology in a predefined consumer group. The penetration factor is an estimate of the current market penetration of energy efficiency technology in the overall market size.

As discussed earlier, sampling is a critical step in load research activities as the target population representing the electricity demand is usually very large. The sample size and selection must be statistically significant and representative of the target population to derive reasonably accurate results. The following section describes the commonly adopted methods for sampling the target population while conducting load research studies.

1.2. Sampling methodology for load research activities

The theory of statistical random sampling may be adopted to determine the sample size of consumers for conducting load research. The statistical formula for estimating the sample size using this theory is as given below:

$$n = \frac{z^2 \cdot (C_v)^2}{(P)^2}$$

In the above mentioned formula:
n = sample size of the target population
Cv = Coefficient of variation. Cv of 0.5 has been historically recommended, and numerous projects have shown this to be a reasonable guess for most applications.
Z = Z-statistic, 1.645 for 90% confidence, 1.282 for 80% confidence.
P = Precision required, typically 10% or 20%

For small population groups, the sample size has to be modified using the finite population correction shown in the equation below. Typically, this correction is required when the population size is less than 500.

$$n^* = \frac{Nn}{n + N}$$

In the above mentioned formula:
n* = sample size corrected for population size
n = sample size for infinite population
N = population size

Tips for reducing sampling error are as follows:

- Use sample sizes that meet a confidence of at least 80%, and a precision of 20%.
- Use a conservative approach while selecting original sample sizes, by using a high Cv, typically greater than 0.5, especially for population groups known to contain variations. This will increase the initial sample size, but reduce the risk of under-sampling.

The underlying assumption of the random sampling theory is that the target population is *homogenous*, without significant variations. Therefore, the target population needs to be stratified and filtered in order to identify *reasonably homogeneous groups of population*, based on similarities in function, geography, technology and other energy performance indicators.

Sample size table for homogenous groups of population (where Cv = 0.5)			
Precision	20%	20%	10%
Confidence	80%	90%	90%
Z-statistic	1.282	1.645	1.645
Population size N		Sample size n*	
200	11	16	51
300	11	17	56
400	11	17	59
500	11	17	60
>500	11	17	68

Source: Random Sampling Theory, M&V Guidelines: Measurement and Verification for Federal Energy Projects; US DoE, , 2008

Stratification of the target population

Most of the utilities in India have categorised the electricity consumers within their areas into domestic (residential), commercial (services), industry (manufacturing), agriculture, municipal water supply and street lighting. Within some of these categories, the utilities have further created different slabs of connected load, electricity consumption and supply voltage. This framework can form the basis to stratify and filter the target population into different groups that are reasonably homogenous. The following table provides an illustrative stratification framework that can be used for sampling the population of consumers in any utility service area.

Stratification framework for sampling (Illustrative)

First level of stratification				
Domestic (residential)	Commercial (services)	Low tension Industry (manufacturing)	High tension Industry (manufacturing)	Agriculture pumping
		Further levels of stratification		
Based on urban, rural and connected load	Based on connected load and function of buildings	Based on connected load and function of facilities	Based on connected load and function of facilities	Based on connected load and technology of pump sets
< 2 kW	Hotels and restaurants, shops, private hospitals, banks, coaching institutes, private offices etc.	Food processing, spinning mills, electrical goods, brewery, rubber engineering, polymer, stone crushers, liquor, poultry farms, and IT parks	Steel, cement, chemical, textile, pharmaceutical, plastic, paper, glass etc	Monobloc pump sets, submersible pump sets
2-5 kW	< 10 kW	< 10 kW	500-1000 kW	<5 HP
>5 kW	10-100 kW	10-100 kW	>1000 kW	5-10 HP
	>100 kW	100-500 kW		>10 HP

Source: PwC analysis

The final sample size for conducting load surveys depends on the number of stratified homogenous groups within the target population. The samples in each stratified group need to be drawn at random, so that each member has an equal probability of being selected. In practice, the degree of stratification usually depends on cost and time constraints, and the sample size thus determined is further distributed uniformly across the remaining stratification parameters. Sample size distribution is usually done across geographical localities in order to capture any remaining variability arising out of the respective geographical location.

In the following section, a case study of load research, conducted in the state of Himachal Pradesh, is discussed to illustrate the application of the concepts and methods discussed so far.

2. Case study: Load research in Himachal Pradesh

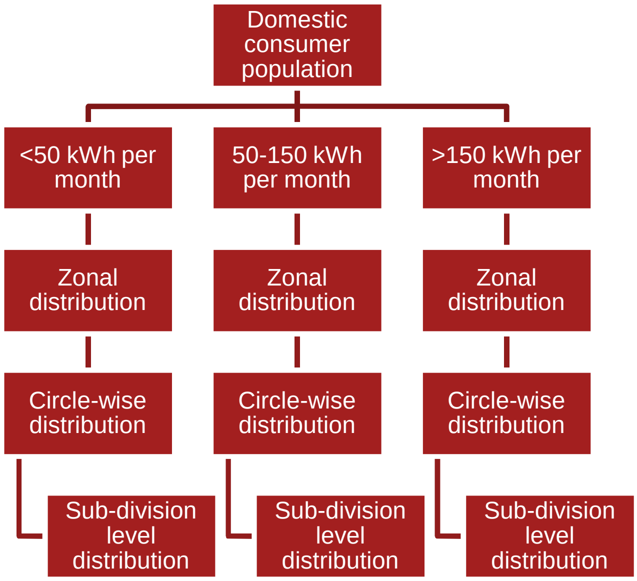
In 2009, the Himachal Pradesh Electricity Regulatory Commission (HPERC) initiated and sponsored a study to develop Energy Efficiency and Demand Side Management (EE and DSM) plan for the power sector in the state of Himachal Pradesh. Load research was an integral part of this study in order to identify and evaluate demand-side resources available with the Himachal Pradesh State Electricity Board (HPSEB). The load research study was conducted during the summer (May 2010 to June2010) and the winter (December 2010 to February2011) seasons, in order to understand the effect of seasonal variations on the electricity consumption patterns of consumers. Load surveys, hourly recording of electricity meters and AMR data analysis were carried out in order to develop the load profiles of different consumer categories.

2.1. Sampling process

The HPSEB has following category of consumers as per its tariff petitions: Domestic, commercial, non-domestic non-commercial (NDNC), water and irrigation power supply (WIPS), low tension (LT) industrial, high tension (HT) industry, agriculture, street lighting, and bulk supply. These consumer categories defined by HPSEB has formed the first level of stratification for the entire consumer population in the state.

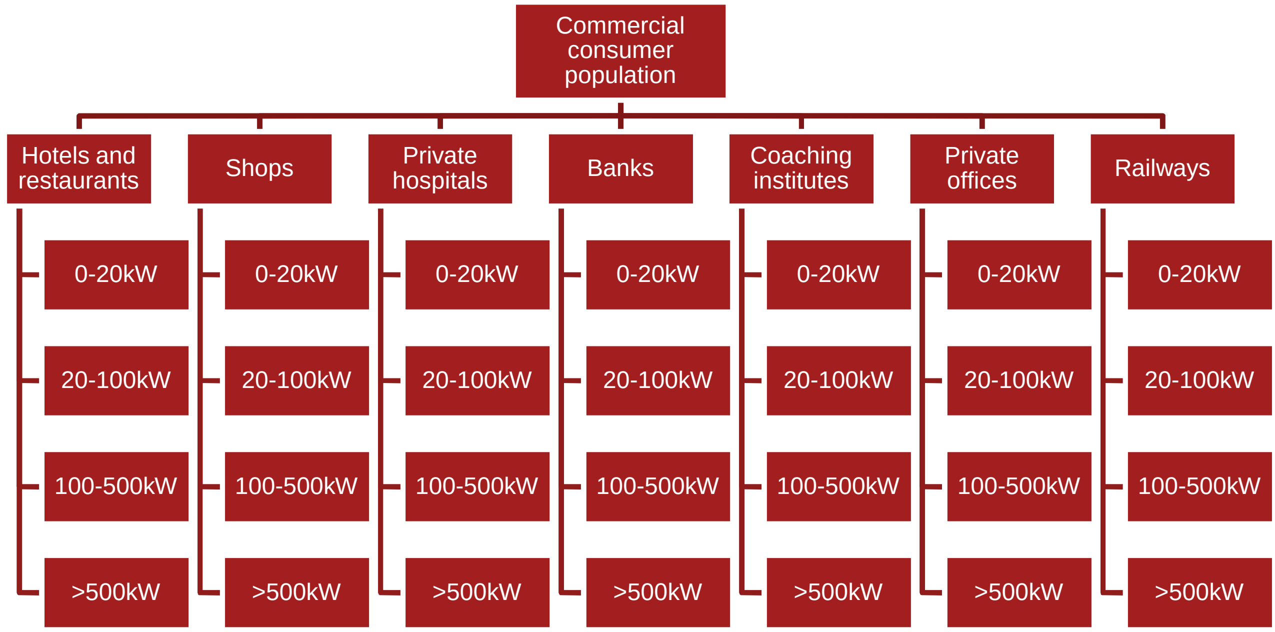
In the domestic category**,** tariff petitions have classified consumers into three distinct categories, on the basis of monthly energy consumption (that is, less than 50 kWh per month, between 50 to 150 kWh per month and more than 150 kWh per month). This classification forms the basis for first level of stratification. Consumer population data within these stratified groups was collected from the division level offices of the HPSEB, and the sample sizes were determined using the random sampling theory. The commercial category comprised seven sub-categories such as hotels and restaurants, shops, private hospitals, banks, coaching institutes, private offices and others. This categorisation formed the basis for the first level of stratification. The consumer population data in each of these seven sub-categories was further stratified into different groups of connected load in the range of 0-20 kW, 20-100 kW, 100-500 kW, and above 500 kW. The population data in each of these stratified groups was collected from the sub-division level offices of the HPSEB and the sample sizes were determined using the random sampling theory.

Stratification framework for domestic consumers



Subsequently, the sample sizes determined for each of the stratified groups in both the domestic as well as commercial categories were distributed (in the ratio of the number of consumers) among the various zones and circles defined in the administrative structure of the HPSEB. The circle-level samples were further divided between electrical divisions within that particular circle, in the ratio of the number of consumers in those electrical divisions. This distribution had ensured the geographical coverage of the sample in order to minimise any sampling errors resulting from geographical variations in the population.

Stratification framework for commercial consumers



The non-domestic non-commercial (NDNC) category comprised of nine sub-categories such as government offices, government hospitals, educational institutes, and religious places (having connected load > 5 kW), village community centres, charity hospitals, municipal committees, panchayats, and other major consumers. This categorisation formed the basis for the first level of stratification. The further process of sampling was similar to the commercial category.

The water and irrigation power supply (WIPS) category comprised of three sub-categories based on connected load (less than 100 kW, between 100 - 500 kW and more than 500 kW). These sub-categories formed the basis for the first level of stratification. The further process of sampling was similar to that of the domestic category.

The low tension industry category comprised of industries having a connected load of less than 100kW. The type of industries within the LT category were sectors such as iron and steel, textile, pharmaceuticals, chemicals, food processing, engineering, polymer, stone crushers, liquor, poultry farms, and IT parks. This categorisation formed the basis for the first level of stratification. The consumer population data in each of these sub-categories was further stratified into different groups of connected load in the range of 0-20 kW, 20-50 kW and 50-100 kW. The further process of sampling was similar to that of the commercial category. The sample size estimated for low tension industry was 100.

The high tension industry category comprised of industries having a connected load of more than 100 kW. The type of industries within this category were iron & steel, cement, chemical, pharmaceuticals, plastic, food processing, paper, glass, gas, spinning mills, electrical goods, brewery, rubber and general sectors. These categories formed the basis for the stratification, and the sample sizes were determined using the random sampling theory. The sample size estimated for high tension industry was 59.

In the street lighting and agriculture categories, no sampling was done since the nature of the load was constant, and there were dedicated feeders serving these consumers. Hence, there was no requirement for load surveys and walk-through audits to capture the load profile in these categories.

2.2. Load research activities in Himachal Pradesh

The sampling process was followed by load surveys, walk-through audits (market surveys), AMR data analysis and feeder data analysis for the collection of information pertaining to connected load, energy consumption, stock of electrical appliances, time of use, and other electrical parameters required to derive the load profile of consumers within different categories.

For domestic, commercial, non-domestic non-commercial, water and irrigation power supply, and the LT industrial categories, load curves were derived from the data of the load survey. The load surveyor monitored the energy consumption readings every hour (from 6am to 10pm) on electricity metres installed at within the premises of the consumers, and estimated the hourly electricity consumption for a single day, during both summer as well as winter seasons. The estimated hourly consumption profile was then used to derive hourly load curves for the sample consumers. The load surveys also captured the time of use of major end-use applications within these consumer categories.

AMR half-hourly consumption data was used in order to derive the load curves for HT industries (above 100 kW). Walk-through audits were conducted within the HT industries for capturing the time of use of specific end-use applications.

For the street lighting category, monthly energy consumption data from a sample of dedicated feeders at the sub-division level was collected for last one year. Further, these consumption values were converted into daily consumption. Thereby, by dividing the daily consumption by the average hours of daily operation, the hourly load profile was derived for a single day. A similar method was adopted for the agriculture category as well in order to derive the hourly load curves.

The sample mean (that is, the average hourly load) within each of these stratified groups, in all the consumer categories, was then multiplied with the total population of the respective group, in order to derive the overall load curve for all the stratified groups. The summation of the load profiles derived for the individual stratified groups formed the overall load profile for each consumer category.

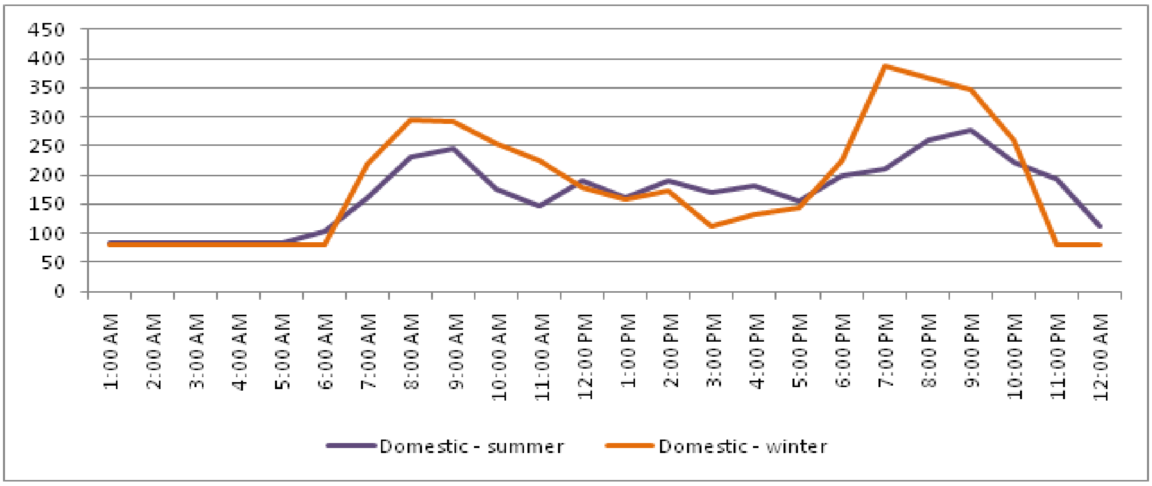
Summary of load research activities in Himachal Pradesh

Consumer category	Load research technique	Output
Domestic, commercial, non-domestic non-commercial, water and irrigation power supply and LT industrial	Questionnaire- based load and market survey and hourly recording of electricity metre readings	Hourly load curve, time of use of specific end -use applications
HT Industry	AMR data analysis, Load and market surveys	Hourly load curve time of use of specific end- use applications
Agriculture and street lighting	Feeder-level energy data analysis	Hourly load curve

2.3. Findings of the load research study in Himachal Pradesh

The domestic category, which formed 85% of the consumer base and 20% of energy sales, had a unique load shape with two distinct peaks. This included morning peak hours between 7 to 9 am and evening peak hours between 7 to 9 pm.

Load curve for the domestic category during the summer and winter season

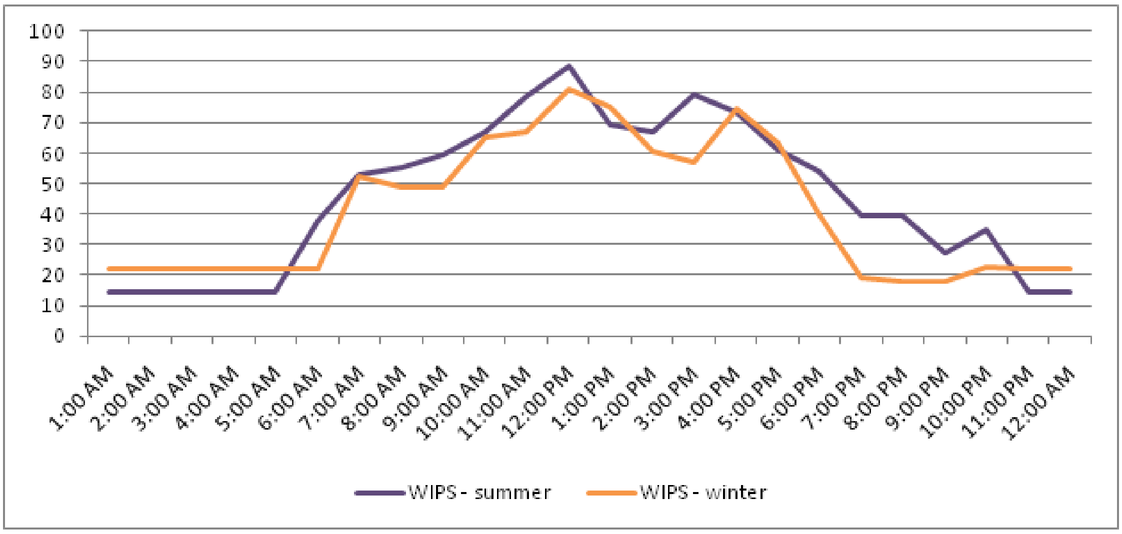


Contribution of specific end-use applications in the domestic category (%)

	0000-0500		0500-0900		0900-1800		1800-0000	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Conditioning	45.82	58.45	13.81	17.04	49.99	54.06	41.17	40.51
Cooking	0.00	0.00	5.92	4.34	11.99	10.97	7.98	5.55
Illumination	8.58	2.45	6.58	5.82	4.71	5.05	30.65	25.34
Water heating	4.68	2.32	26.30	38.23	0.00	2.32	2.16	18.25
Laundry	2.22	1.55	20.55	12.45	16.08	16.85	0.54	0.25
Refrigerator	38.70	35.23	26.84	22.12	17.22	10.75	17.50	10.12

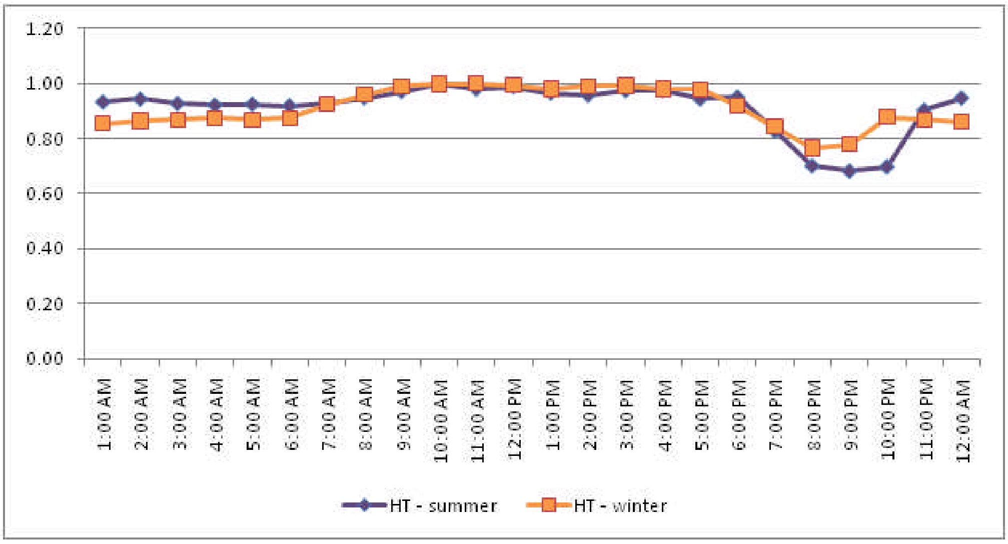
The water and irrigation power supply sector (WIPS) sector formed only 0.20% of the consumers, but contributed 7.13% of the energy sales.

Load curve for the WIPS category during the summer and winter season

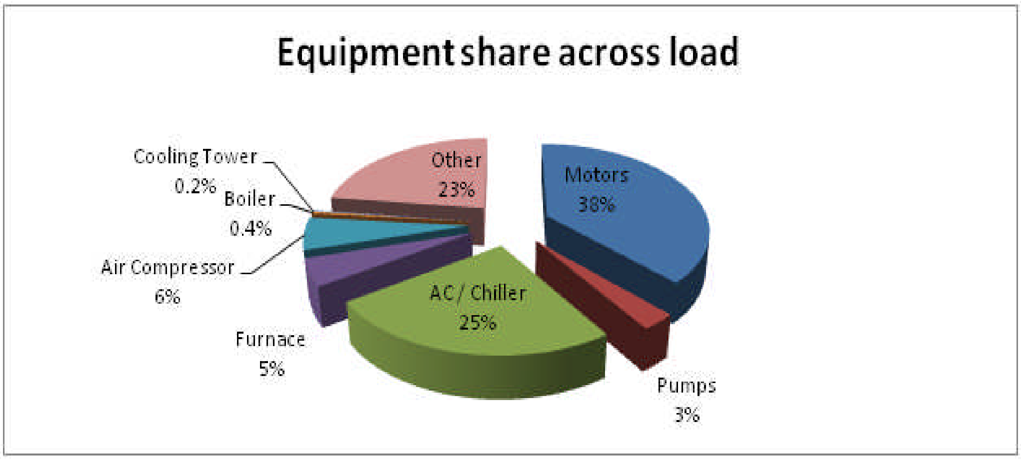


High-tension industries represent 0.07% of consumers, but contribute more than 58.5% of energy sales. The figure below shows the variation of peak factor of the HT industry derived from the ratio of load curve to the peak load. One can observe that the peak factor is relatively flat except for a marginal drop during the evening time driven by the peak load restriction imposed by the state.

Peak analysis of the HT industries



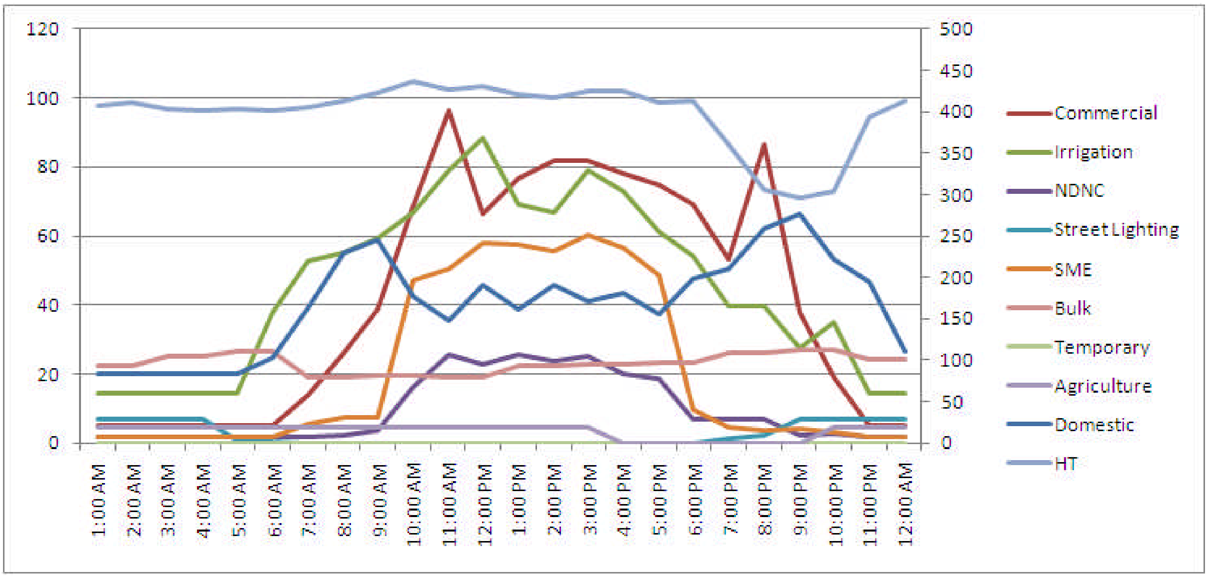
The figure below shows the overall distribution of electrical equipment load installed in HT industry category. The predominant load is contributed by motors. This is augmented by the fact that air compressors and pumps are also predominantly motor loads.



Consolidated load curve

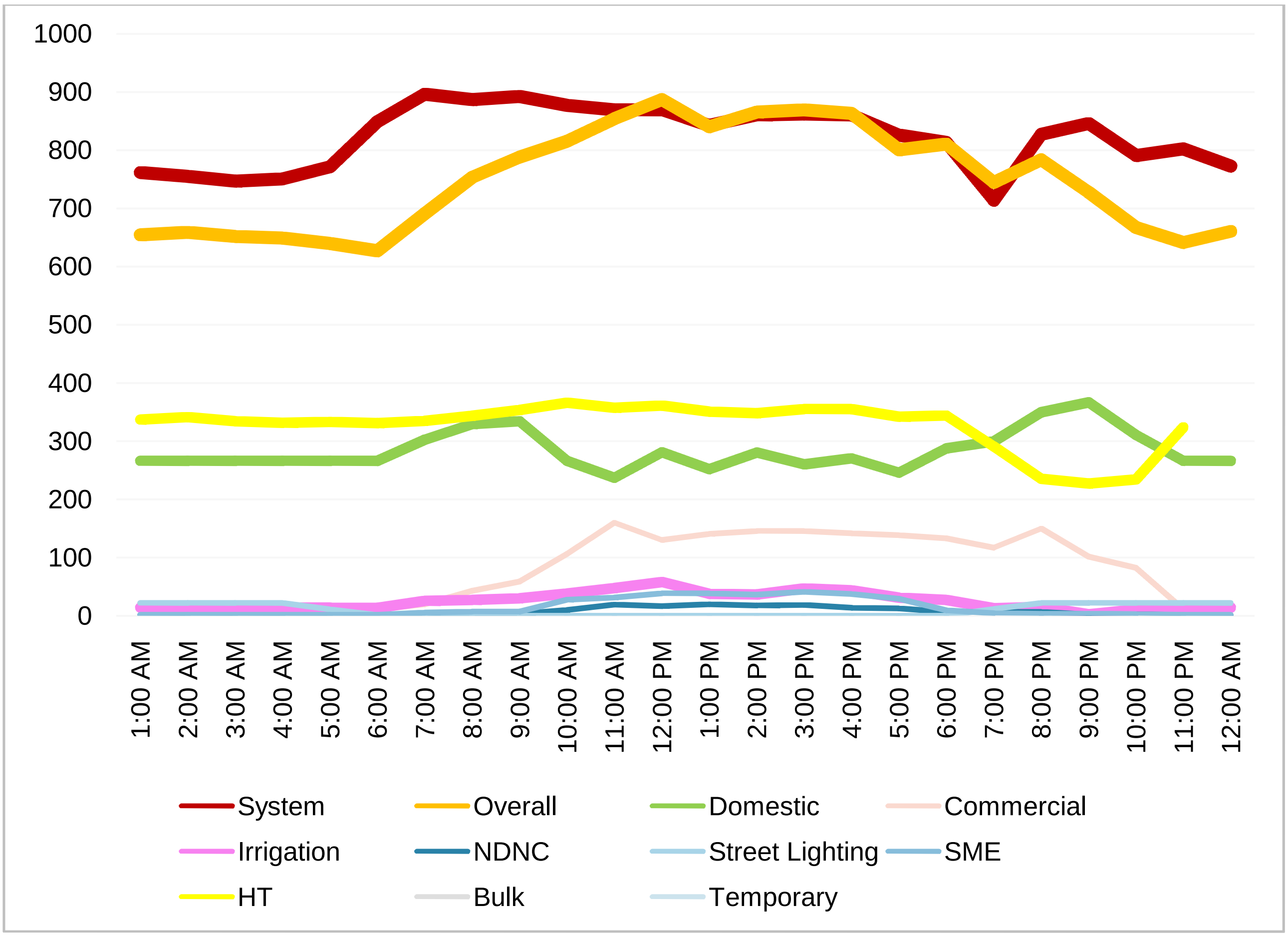
The consolidated load curve derived from the load curves of individual consumer categories indicates that the HT industry and the domestic categories are the major contributors to the morning and evening peaks. Other categories such as commercial, NDNC, irrigation (WIPS) and the SME (LT) industry peak mostly during the day time between 9am and 6pm.

Consumer category wise load curves in Himachal Pradesh



Note: Domestic and HT graphs are plotted on the right hand vertical axis and other categories are plotted on the left hand vertical axis.

Consolidated load curve



Peak contribution of various categories

	7:00 AM		12:00 PM		9:00 PM	
	Summer	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**
Domestic	24.45%	28.08%	21.72%	19.37%	40.78%	43.33%
Commercial	2.75%	0.74%	9.61%	7.07%	9.40%	5.87%
WIPS	10.83%	6.73%	14.18%	8.85%	7.49%	2.23%
NDNC	0.38%	0.70%	4.27%	2.56%	0.69%	0.80%
Street lighting	0.01%	0.46%	0.00%	0.00%	1.04%	0.73%
SME	0.84%	1.34%	7.66%	6.39%	0.56%	0.75%
HT	57.27%	58.05%	55.38%	53.31%	40.37%	43.67%
Bulk	6.21%	3.34%	5.18%	1.99%	6.08%	2.62%
Temporary	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Agriculture	1.54%	0.56%	1.13%	0.47%	0.00%	0.00%

DSM strategies and interventions identified from a load research study: Himachal Pradesh

The load curves and contribution assessment of the specific end-use applications have indicated several opportunities for enhanced penetration of energy efficient technologies. Besides technology interventions, a few load management strategies were being identified to reduce the peak demand burden of the state.

- Power factor improvement from 0.9 to 0.95
- Partial shifting of WIPS load from day time to night time

The annual energy savings potential estimated from power factor improvement was 12 Million units (see table below).

Annual savings in each category due of power factor improvement

Category	Annual energy savings (including T&D losses)	Annual savings (Rs. crores)
HT industries	4.27 Million units	1.34
Small & medium industries	1.7 Million units	0.54
WIPS category	6 Million units	1.94

The partial shifting of WIPS load could shift up to 50 MW of peak loads occurring during the day time between 7AM to 7PM. For illustration purposes, the impact of shifting 10 MW of peak WIPS load was analysed as follows.

Impact of shifting 10 MW of peak WIPS load

- *Annual Energy savings - 2161031.57 kWh*
- *Monetary benefits accrued by the HPSEBL - INR 75 lakhs*

The load surveys conducted in a sample of consumers in all categories has identified some load reduction measures, specifying the replacement of certain end use electrical appliances/equipment. The table below shows the proposed load reduction measures and the technical potential of energy savings resulting from the acquisition of these demand side resources.

Technical potential of DSM measures

S.No.	Old technology	Proposed technology	Sector	Technical potential (MU)
1	Standard efficiency motor	Energy Efficient Motor	Industry HT	111.45
2	Standard efficiency pumps	Energy Efficient Pumping system	Industry HT	7.35
3	Reciprocating compressor	Screw Compressor	Industry HT	6.69
4	SS blades in cooling tower	FRP for cooling tower	Industry HT	2.09
5	Standard efficiency fans/blowers	Energy Efficient fans/blower	Industry HT	108.29
6	Incandescent bulb	CFL	Industry HT	0.16
7	Incandescent bulb	CFL	Domestic	1.11
8	Standard efficiency pumps	Energy Efficient Pumping system	Irrigation	72.27

3. Introduction to the DSM programme designs

The DSM programme design is an integral part of the DSM resource acquisition process by utilities. As discussed earlier, load research marks the beginning of this process that allows utilities to identify relevant demand side measures and quantify the technical potential for energy savings from those measures. The cost effectiveness assessment that follows this step allows the utilities to further streamline these measures by identifying and prioritising them on the grounds of cost effectiveness. Subsequently DSM goals and targets are set by appropriate authorities to plan for the acquisition of cost effective DSM resources.

After deciding to proceed with a demand side measure, the utility will design a programme to reach the target customers and motivate them usually with incentive payments and information campaigns. This phase is generally perceived as *program design* in the DSM planning process by utilities. It constitutes evaluation and selection of appropriate delivery mechanisms to roll out the identified measures at megawatt scale. The DSM programme design process should address many considerations, including target market, programme goals, programme budget, incentives, monitoring and verification protocols. This phase should also define the eligibility criteria for customer participation in the program and further detail the steps involved from customer application and utility appraisal to realisation of incentives by explaining the roles and responsibilities of programme administrators and other stakeholders.

The following sections introduce some of the most successful program designs, summarize their key features and provide examples of adoption in India and other parts of the world.

Rebate programmes offer capital rebates to offset the differential cost involved in purchase of high efficiency electric appliances. The rebate is usually paid directly to the purchaser, who submits a proof-of-purchase receipt. In this case, the customer may self install the unit, provided that they supply the paid sales invoice along with the rebate application form.Wholesalers and distribution centres, can also be reimbursed, typically requiring a proof-of-sale to a retail customer. In this case the customer can claim the rebate at the time of purchase. Utility can make customers aware of the product through a variety of sources including bill inserts, direct mail pieces, utility website, appliance contractors, builders, and retailers. To participate, eligible customers can submit a completed application with a copy of their invoice or receipt. At this time, customers may self-install the units, provided that they supply the paid sales invoice along with the rebate application form. When a customer submits the form with an invoice, it is reviewed for accuracy and qualifications prior to mailing a rebate check.

Case studies of rebate programmes in India

Tata power Delhi launched an appliance replacement programme *(pilot scale) in association with LG, Voltas and Godrej. This scheme was available from 1st August 2011 to 31st October 2011. The scheme offered an exchange mechanism under which existing old refrigerators and air conditioners can be replaced with new energy efficient BEE star rated refrigerators and ACs. The consumers were offered special discounts on market prices and good salvage value for the old appliances. They could also claim the cash rebate directly at the time of purchase. Over 4000 star rated appliances were sold under the scheme.*

Bachat Lamp Yojana*, initiated by the BEE through various Discoms in the country, distributed CFL lamps to households at discounted price by the CFL suppliers and retailers. The consumers could claim the cash rebate directly at the time of purchase.*

International case study of rebate programme[1] - Eskom's Standard Product programme

Eskom is a public utility that has been entrusted with the business of generation, transmission and distribution of electricity in South Africa. Its standard product programme is currently active and designed to provide product specific cash rebates for efficiency improvements derived from the implementation of approved technologies. The rebate amount capped at a maximum of R500 000 per project site and for a project to qualify for a rebate, the demand reduction achieved must be greater than 1kW and the energy savings must be greater than 2MWh/annum. Standard products are solutions designed to act as replacements for less energy efficient technologies. Technologies that have been approved by Eskom will be considered to be standard products. The Eskom has compiled a database of application specific standard products (heat pumps, solar geyser, energy saving shower heads, CFL, and LED lighting systems) which are energy efficient technologies, and can be purchased by the customers to receive up to 85% of capital costs as rebate from the electricity supplier. Customers must ensure that new installations and technologies confirm to all applicable laws, specifications and regulations. The following diagram describes the standard product program cycle, which present the steps involved from application for rebates to realising the rebates by customers.

Standard product programme cycle

Step 1: The customer submits a project proposal with all the required documentation to the Eskom for approval. On receipt of the submission, the Eskom communicates (in writing), the details of the measurement and verification (M&V) process that will apply as well as the project obligations (e.g. de-commissioning, disposal requirements for existing technologies, sustainability commitment, pledge, etc).

Step 2: The customer signs a predefined scope and sustainability commitment. This includes an indemnity clause, to prevent the customer from double claiming energy savings through other initiatives and encourages sustainability of the solution (e.g. necessary maintenance and continued, optimal operation) for a period of three years.

Step 3: The customer self finances the proposed intervention. Less energy efficient technologies is replaced with energy efficient standard product solutions.

Step 4: The customer decommissions and resposibly disposes the less energy efficient equipment to ensure the desired energy savings benefits materialise. Where appropriate, the customer submits proof of the disposal or decommissioning to the Eskom.

Step 5: The customer notifies the Eskom about the completion of installation. Eskom, at its own expense, performs a technical and disposal audit which may take the form of a phone call, a site visit or full measurement and verification (depending on the agreed project specifics in step 1). Eskom confirms and signs off on the implementation based on which a project completion certificate is issued.

Step 6: The customer submits all the actual cost invoices reflecting final rebate (as agreed between Eskom and Customer) to process the rebate payments by the Eskom.

[1] http://www.eskomidm.co.za/

Direct install programmes use utility or contractors to directly install low-cost, quick pay-back energy efficiency measures in customer facilities. These programmes will deploy teams of technicians in factories and facilities to identify and install low-cost, low risk measures. In exchange the DSM programme is able to achieve reliable and highly cost-effective energy savings. This type programme is not yet tested in India and is mostly prevalent in developed countries.

International case study on the direct-install programme[2]

San Diego Gas and Electric Company (SDG&E) is a regulated public utility that provides energy services to about 3.4 million people in San Diego, USA. The direct install programme of SDG&E, which is currently active, provides a number of free energy- and money-saving services for qualifying small- and medium-sized businesses. Qualifying businesses include commercial rate customers who do not have monthly electrical demand over 100kW for three consecutive months during a twelve month period. After the initial screening process, one of the approved contractors by SDG&E evaluates the customer's facility, identifies energy-saving opportunities and subsequently installs energy-efficient upgrades and retrofits at no cost to the customer. Free upgrades include fluorescent lighting, occupancy sensors and vending misers.

Bid programmes solicit private contractors to submit proposals and improve energy efficiency levels within a targeted group of customers. These set broad goals such as location and measure and facility types, relying on bidders to propose projects. Such proposals include a thorough cost benefit analysis.

International case study on the bid programme[3]

Eskom registered Energy Services Companies (ESCO) are experts who identify energy efficiency opportunities, scope and execute projects in specific target markets to. ESCOs utilise their in house knowledge of efficient technologies and specialise in determining the best and most suitable way of obtaining electricity savings at a business. Eskom's ESCO funding process offers funding for projects with electricity demand reduction of 200 kW or more that enables the switch to energy-efficient technologies and processes. These funding programmes usually involve a four-way partnership via legal contracts between Eskom, the customer, the ESCO, and an independent, measurement and verification expert. To participate in the funding programme, the ESCO submits a proposal, which the Eskom reviews on its technical and financial merits. Once a contract has been signed, the ESCO is given the go-ahead to implement the project. Eskom supports ESCO projects by funding up to 100% of the financial benchmark value for viable energy efficiency projects.

In order to ensure that ESCO projects deliver the promised savings, there are penalty clauses in place which ensure that when ESCO scopes the project, they do so accurately to ensure that projected savings are realistic in nature. The complete process cycle of the Eskom's ESCO funding model is described in the following section.

Eskom's ESCO funding process cycle

Step 1: The customer signs a letter of intent with the Eskom registered ESCO stating the customer's intent to partner with the ESCO, starting with conducting an energy audit to identify possible energy efficient interventions.

Step 2: The ESCO conducts a detailed energy audit, which informs the development of a project proposal. The project proposal details the possible and recommended interventions for electricity demand reduction and optimization of electricity consumption.

[2] http://www.sdge.com/direct-savings-direct-install
[3] http://www.eskomidm.co.za/

Step 3: The ESCO presents the project proposal to the customer for review and acceptance.

Step 4: The customer signs off on the project proposal and signs the Eskom project application form.

Step 5: The ESCO submits the project proposal to Eskom for consideration. Subsequently the project is registered on the Eskom database, after which undergoes an evaluation phase. The first level of evaluation revolves around the technical aspects of the project, as well as its overall feasibility. This is followed by a financial evaluation, which takes into consideration the savings that will be made and therefore the funding contribution that Eskom can contribute towards the proposed project. Following the evaluation procedures, Eskom makes a commitment to the customer in respect of the funding contribution they can expect. In order to ensure that the anticipated savings can be accurately measured, measurement and verification (M&V) site visits and audit processes performed at Eskom's cost. The goal of this process is to establish a baseline from which to measure future savings.

Step 6: The customer and the ESCO agree with and sign off on the M&V baseline established by Eskom.

Step 7: The customer signs the Eskom agreement that takes into account the savings as measured against the signed off baseline, as well as highlighting the penalties imposed for the non-achievement of expected savings. The standard duration for these agreements is five years.

Step 8: The ESCO and Eskom negotiate and sign a New Engineering Contract (NEC) around the implementation of the new technologies. This part of the process, from submission of customer application to the signing of the NEC agreement and the procurement of the necessary technologies can be expected to take somewhere between three and six months.

Step 9: The customer facilitates the project implementation by providing access to facilities. This marks the beginning of project implementation. At this point, the ESCO will be expected to implement the project in a timely and professional manner. Project implementation may take up to 12 months, depending on the customer and the technologies being installed. A series of progress payments is made to the ESCO during this period.

Step 10: Upon completion of the project installation, an immediate post-implementation M&V is undertaken, to ensure the project meets all requirements laid out in the signed contracts.

Step 11: Further M&V is undertaken for a period of three months, during the project's acceptance period, at the end of which a completion certificate is signed by the ESCO.

Step 12: The customer and the ESCO jointly sign the Measurement Acceptance Date (MAD) certificate to mark the official hand over of the newly created asset to the customer. At this time the full funding contribution has been received by the ESCO.

Over the following five years, Eskom undertakes regular M&V monitoring to ensure the project continues to go according to plan and meets the accepted baselines, while the customer sustains the project over this period and also facilitates and/or submits, as applicable, regular M&V reports.

Standard offer programme is a mechanism to acquire demand-side resources (energy and demand savings) based on a predetermined rate (e.g. USD/kWh). These rates are reflective of the feed-in-tariffs for energy efficient technologies. Standard offer rates can be determined by the long run marginal cost of supply or estimated subsidies necessary to attract commercial bids. ESCOs, equipment suppliers or other organisations that can deliver energy and demand savings at the agreed rate are eligible to submit projects. They are paid once the projects have been implemented and savings certified by an authorised monitoring and verification organisation. Purchase rates can vary by measure type, region, size of the project, or any other parameter that helps improve the programme's potential to succeed. Standard offer programmes can also accept custom measures not on the pre-approved list; project developers submit a description of the measure with estimated savings and costs, and the programme manager calculates an offer price unique to the proposal.

The standard offer design is adopted by utilities worldwide but is yet to be tested in India.

International case study on Standard offer programme[5]

Eskom's standard offer programme is a mechanism for which the Eskom pays for verified energy savings using a pre-determined and published rate for the purchase and use of an approved energy efficient technology by the end user. Any energy user (customer)or a project developer or an energy service company (ESCO) that can deliver verifiable energy savings, from 50kW to 5MW, can propose projects, and is paid the fixed amount per kWh (see table below) over a period of three years, if successfully selected.

Energy savings demonstrated by the participants is verified by an authorised, independent measurement and verification (M&V) organisation. The following technologies are included in Eskom's standard offer:

- Small-scale renewable energy, off-grid solutions such as photo voltaic, biomass waste, wind energy, geothermal, solar, thermal gradient and ground source heat; municipal solid waste
- Energy efficient lighting systems (CFL, T8, and T5)
- Building management systems (HVAC control systems, heat pumps, variable speed drives, sensors, and thermostats)
- Hot water systems (heat pumps and solar water heaters)
- Process optimisation (efficient motors, fans, variable frequency drives and others)
- LED down lighters

Published standard offer rates in South African Rand/kWh

Target technologies	R/kWh
Energy efficient lighting systems	0.42
LED lighting technologies	0.55
Building management systems	0.42
Hot water systems	0.42
Process optimisation	0.42
Industrial and commercial solar water systems	0.70
Renewable energy	1.20

The complete process cycle of the Eskom's standard offer program is described in the following section

Eskom's Standard offer programme cycle

Step 1: The customer submits the standard offer application by completely filling the project and technical information templates, published by Eskom. The customer also proposes a preliminary M&V plan along with the standard offer application.

Where a customer opts to partner with an ESCO and requires the ESCO to act on his behalf, the customer signs a letter of intent to confirm this agreement for the entire contract period, including the three year sustainability portion. The standard offer project contract is thus placed between Eskom and the ESCO in such cases.

Step 2: Evaluation of the standard offer application by the Eskom. If the evaluation committee approves the application, Eskom provides the ESCO/ customer with a letter confirming the project evaluation committee's (PEC) approval.

Step 3: The M&V process begins. The Eskom appointed independent M&V team provides the ESCO/customer with the detailed metering specifications to purchase and install the metering equipment for the development of the project's baseline.

[5] http://www.eskomidm.co.za/

Step 4: Upon receipt of metering specifications, the ESCO/customer purchases and installs the necessary M&V equipment. Purchasing, installation and maintenance of the M&V equipment is managed by the project ESCO/customer.

Step 5: The ESCO/customer and the M&V team jointly sign off the baseline established using the M&V meters installed as per the specifications.

Step 6: The ESCO/customer and the Eskom sign the final standard offer contract after negotiating on some key terms and conditions.

Step 7: Eskom gives the ESCO/customer permission to start the installation process. This marks the beginning of project implementation.

Step 8: The previously installed, inefficient technologies are disposed of safely. Where appropriate a crushing or disposal certificate is submitted to Eskom in order to complete the implementation process.

Step 9: Eskom confirms and signs off on the implementation based on which a project completion certificate is issued.

Step 10: The project impact assessment is done by the appointed M&V team to confirm the electricity savings that resulted from the efficiency upgrade. On conclusion the M&V team's assessment of savings are communicated and agreed by the parties.

Step 11: The ESCO/customer submits the application for the first progress installment (70% of the verified savings at the published rate).

Over the next three years, annual payment requests are submitted together with M&V reports. Each year, a further 10% of the total project value is paid out, commensurate with the savings achieved.

References

1. Report of the Working Group on Power for XII Plan Period, Ministry of Power, Government of India, January 2012
2. DSM and Energy Efficiency Plan for the state of Himachal Pradesh, PwC, July, 2010
3. M&V Guidelines: Measurement and Verification for Federal Energy Projects; US Department of Energy, 2008
4. DSM Program Procedures Manual Volume I – Industrial Energy Efficiency Program; Natural Resources Defence Council; China-US Energy Efficiency Alliance; State Grid National DSM Instruction Centre (China); April 2011
5. http://www.ndpl.com:84/DSM/dsm_initiatives.jsp
6. http://www.sdge.com/direct-savings-direct-install
7. http://www.eskomidm.co.za/

Appendix 1 A - Sample questionnaires for load and market survey

Electricity Consumption Pattern of Domestic Consumers

1. House address ____

____

2. Energy Meter No.

____

Name of the respondent

____

3. Floor area (m^2) ______________________

4. Accommodation (Nos.) Rooms ____________, Kitchen _____________, Bathrooms _____________

Describe the Stock of electrical appliances in your house

End use application	Type of appliance	No. of appliances	Total wattage	Brand	Model	BEE Star Rating (yes/No)	BEE Star rating (1,2,3,4,5)
Conditioning	1-Table Fan						
	2-Ceiling Fan						
	3-Air Conditioner Split						
	3-Air Conditioner Window Mounted						
	4- Air Cooler						
	5- Air Heater						
	6-Others						
Cooking	1-Discoid Heater						
	2-Electric Cooker						
	3-Microwave Oven						
	4-Electric Oven						
	5-Others						
Illumination	1-Tubelights T12						
	T8						
	T5						
	LED						
	2-Bulbs and down lighters Incandescent						
	CFL						
	LED						
	3-Others (specify)						
Water Heating	1-Electric Water Heater (Geysers)						
	2-Discoid Heater (coil type)						
	3-Solar Water heater						
	3- Others (specify)						
Laundry	1-Ordinary W/M						
	2- Semi-auto. W/M						
	3-Fully auto. W/M						
Refrigerator	1- <300 L						
	2- 300 L and above						

What is the time of use of appliances in your house?

End use application	Type of appliance	Number of working hours																											
		Summer														Winter													
		Weekdays							Weekends/Holidays							Weekdays							Weekends/Holidays						
		0.00-5.00	5.00-7.00	7.00-9.00	9.00-13.00	13.00-18.00	18.00-21.00	21.00-24.00	0.00-5.00	5.00-7.00	7.00-9.00	9.00-13.00	13.00-18.00	18.00-21.00	21.00-24.00	0.00-5.00	5.00-7.00	7.00-9.00	9.00-13.00	13.00-18.00	18.00-21.00	21.00-24.00	0.00-5.00	5.00-7.00	7.00-9.00	9.00-13.00	13.00-18.00	18.00-21.00	21.00-24.00
Conditioning	1-Table Fan																												
	2-Ceiling Fan																												
	3-Air Conditioner																												
	4- Air Cooler																												
	5- Air Heater																												
	6-Others																												
Cooking	1-Discoid Heater																												
	2-Electric Cooker																												
	3-Microwave Oven																												
	4-Electric Oven																												
	5-Others																												
Illumination	1-Tubelights																												
	2-Incand. Lamps																												
	3- CFL																												
	4- E+ tubelights																												
	5-Others (specify)																												
Water Heating	1-Electric Water Heater																												

	2-Discoid Heater (coil type)																												
	3- Others (specify)																												
Laundry	1-Ordinary W/M																												
	2- Semi-auto. W/M																												
	3-Fully auto. W/M																												
Refrigerator	1- 165 L																												
	2- 180 L																												
	3- 200 L																												
	4- 230 L																												
	5- 300 L & above																												

11 What are the other electric equipments used in your house?

Kind of equipment used	Stock of appliances	Number of working hours			
		Daily		Monthly	
Normal CRT TV		Summer	Winter	Summer	Winter
LCD TV					
LED TV					
Plasma TV					
DVD Player					
Radio					
Stereo					
Computer (Laptop)					
Computer (Desktop)					
Iron box					
Vacuum Cleaner					
Dish Washer					
Blender					
Hair drier					
Others (specify)					

Water Pump Information:

Pump size:

Operating periods:

Summer AM from __________ to _________ PM from __________ to _________

Winter AM from __________ to _________ PM from __________ to _________

Municipal Water supply Periods:

Summer AM from __________ to _________ PM from __________ to _________

Winter AM from __________ to _________ PM from __________ to _________

HOURLY LOAD DATA

(Readings in kW)

Hour	Date:	Day:
Hours	Meter No.	M.F.:
AM. 6.00		
7.00		
8.00		
9.00		
10.00		
11.00		
12.00		
PM. 1.00		
2.00		
3.00		
4.00		
5.00		
6.00		
7.00		
8.00		
9.00		
10.00		
11.00		
12.00		
AM 01.00		
02.00		
03.00		
04.00		
05.00		
06.00		

Date: **(Signature of Respondent)**

Electricity Consumption Pattern of Commercial Consumers

1. Name of Establishment ____

2. Name of the respondent

____

3. Address of the facility

____

____

4. Which of the following types of organizations best describes your organization?

☐ Hotel & Restaurant ☐ Shop ☐ Private Hospital

☐ Bank ☐ Coaching Institutes ☐ Private Offices

☐ Railways ☐ Others (specify) ____________________

5. How many employees work at your facility? __________

6. Hours of business (hrs./day) _______________

7. How many square meters is your facility buildup area approximately? __________ m²

Of which: Conditioned/heated area _________ m²

8. Connected Load / Contract Demand ______________ kW

9. Fill in the following table related to energy consumption for last year:

S.No.	Energy Source	Quantity	Unit	Cost/unit (Rs.)
1	Electricity			

Describe the Stock of electrical appliances in your facility

End use application	Type of appliance	No. of appliances	Total wattage	Brand	Model	BEE Star Rating (yes/No)	BEE Star rating (1,2,3,4,5)
Conditioning	1-Table Fan						
	2-Ceiling Fan						
	3-Air Conditioner Split						
	3-Air Conditioner Window Mounted						
	4- Air Cooler						
	5- Air Heater						
	6-Others						
Cooking	1-Discoid Heater						
	2-Electric Cooker						
	3-Microwave Oven						
	4-Electric Oven						
	5-Others						
Illumination	1-Tubelights T12						
	T8						
	T5						
	LED						
	2-Bulbs and down lighters Incandescent						
	CFL						
	LED						
	3-Others (specify)						
Water Heating	1-Electric Water Heater (Geysers)						
	2-Discoid Heater (coil type)						
	3-Solar Water heater						
	3- Others (specify)						
Laundry	1-Ordinary W/M						
	2- Semi-auto. W/M						
	3-Fully auto. W/M						
Refrigerator	1- <300 L						
	2- 300 L and above						

What is the time of use of appliances in your facility?

End use application	Type of appliance	Number of working hours																											
		Summer														Winter													
		Weekdays							Weekends							Weekdays							Weekends						
		0.00-5.00	5.00-7.00	7.00-9.00	9.00-13.00	13.00-18.00	18.00-21.00	21.00-24.00	0.00-5.00	5.00-7.00	7.00-9.00	9.00-13.00	13.00-18.00	18.00-21.00	21.00-24.00	0.00-5.00	5.00-7.00	7.00-9.00	9.00-13.00	13.00-18.00	18.00-21.00	21.00-24.00	0.00-5.00	5.00-7.00	7.00-9.00	9.00-13.00	13.00-18.00	18.00-21.00	21.00-24.00
Conditioning	1-Table Fan																												
	2-Ceiling Fan																												
	3-Air Conditioner																												
	4- Air Cooler																												
	5- Air Heater																												
	6-Others																												
Cooking	1-Discoid Heater																												
	2-Electric Cooker																												
	3-Microwave Oven																												
	4-Electric Oven																												
	5-Others																												
Illumination	1-Tubelights																												
	2-Incand. Lamps																												
	3- CFL																												
	4- E+ tubelights																												
	5-Others (specify)																												

Water Heating	1-Electric Water Heater																												
	2-Discoid Heater (coil type)																												
	3- Others (specify)																												
Laundry	1-Ordinary W/M																												
	2- Semi-auto. W/M																												
	3-Fully auto. W/M																												
Refrigerator	1- 165 L																												
	2- 180 L																												
	3- 200 L																												
	4- 230 L																												
	5- 300 L & above																												

11. Fill in the following with regard to self – generation in the facility?

Sl No.	Equipment No.	Nominal Capacity (KVA)	Actual Capacity (KVA)	Power	Efficiency	Type
1						
2						
3						
4						
5						

Water Pump Information:

Pump size:

Operating periods:

Summer AM from __________ to _________ PM from __________ to _________

Winter AM from __________ to _________ PM from __________ to _________

Municipal Water supply Periods:

Summer AM from __________ to _________ PM from __________ to _________

Winter AM from __________ to _________ PM from __________ to _________

HOURLY LOAD DATA

(Readings in kW)

Hour	Date:	Day:
Hours	Meter No.	M.F.:
AM. 6.00		
7.00		
8.00		
9.00		
10.00		
11.00		
12.00		
PM. 1.00		
2.00		
3.00		
4.00		
5.00		
6.00		
7.00		
8.00		
9.00		
10.00		
11.00		
12.00		
AM 01.00		
02.00		
03.00		
04.00		
05.00		
06.00		

Date: **(Signature of Respondent)**

Electricity Consumption Pattern of Industrial Consumers

1.	Name and address of the unit	
2.	Telephone/Fax No.	
3.	Co-ordinating officers: (Name and Email ID)	
4.	Year of commissioning	
5.	Annual Turnover for 2007-2008 (Rs crores):	
6.	Type of operation (Continuous/Batch)	
7.	No. of Shifts/ day	
	Shift Timing Shift 1	From .... to ....
	Shift 2	From .... to ....
	Shift 3	From .... to ....
	Working days/year	
8.	Brief description of process	

9. Is there a scope to change one of the shift timing to night shift (if working for 2 shift in a day)?

10. Which of the following products does your industry manufacture?

- ☐ Steel
- ☐ Cement
- ☐ Pharma
- ☐ Brewery
- ☐ Plastic
- ☐ General
- ☐ Chemical
- ☐ Electrical Goods
- ☐ Food Processing
- ☐ Gases
- ☐ Glass
- ☐ Paper
- ☐ Spinning Mills
- ☐ Rubber
- ☐ Others

11. Utility Account Number:

12. Connected Load (kW)

Total Connected Load: ....
Lighting load: ....
Non-lighting load: ....

	No. of units	Total kVA ratings of all units	KVA rating of min. size unit	KVA rating of max. size unit	No. of units typically in operation during		
					Shift 1	Shift 2	Shift 3
Motors							
Furnaces							
Heating							
Electrolysis							
Process							
Others (Specify)							

HOURLY LOAD DATA

(Readings in kW)

Hour	Date:	Day:
Hours	Meter No.	M.F.:
AM. 6.00		
7.00		
8.00		
9.00		
10.00		
11.00		
12.00		
PM. 1.00		
2.00		
3.00		
4.00		
5.00		
6.00		
7.00		
8.00		
9.00		
10.00		
11.00		
12.00		
AM 01.00		
02.00		
03.00		
04.00		
05.00		
06.00		

Date: **(Signature of Industry Representative)**