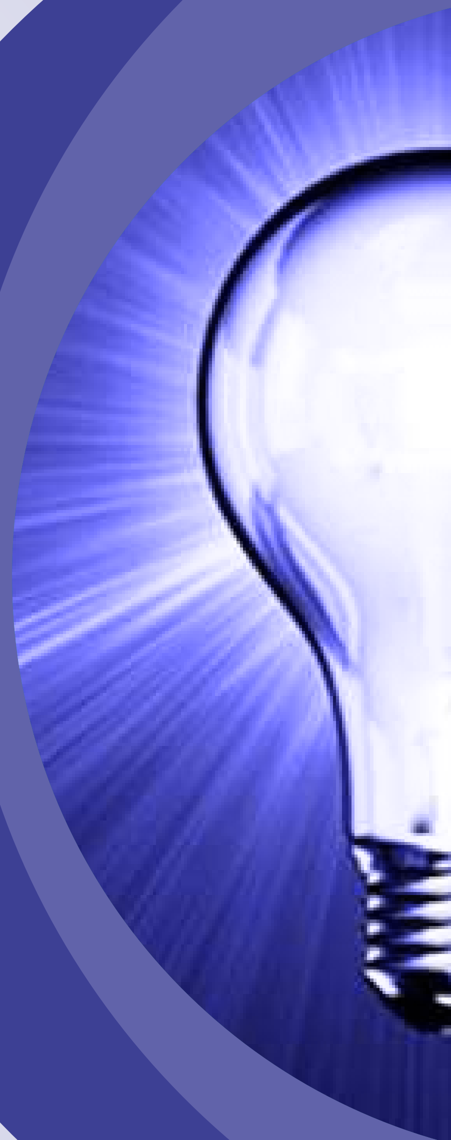
STANDARD OFFER PROGRAM

HANDBOOK
SEPTEMBER 2015

SOP HANDBOOK



SHAKTI SUSTAINABLE ENERGY FOUNDATION

MP ENSYSTEMS™ Advisory Pvt. Ltd.

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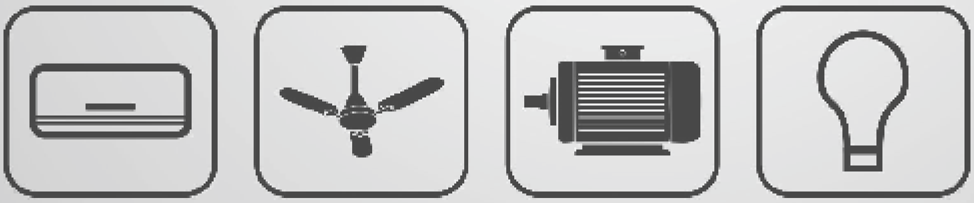

SHAKTI SUSTAINABLE ENERGY FOUNDATION

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CERC

Gireesh B. Pradhan
Chairperson

Foreword

In the Indian scenario of rapidly rising demand for energy and paucity in the supply of power, energy savings by efficient use of electricity in various fields is a key resource to meet the gap between demand and supply. The Central Electricity Regulatory Commission (CERC) has provided a regulatory mandate for Demand Side Management (DSM) to manage the deficit. Additionally, the Forum of Regulators, which is responsible for harmonizing, coordinating, and ensuring uniformity of approach amongst the Electricity Regulatory Commissions across the country, has conducted studies and drafted model regulations in the field of Energy Efficiency and Demand Side Management, spurring the State Electricity Regulatory Commission to also issue State specific DSM Regulations.

Standard Offer Programs or SOPs are well established international tools involving partnership between the consumers, utilities and other stakeholders to ramp up DSM measures at a standard rate agreed upon. The funding of such programs could flow from National/State level funds, appropriate charges in electricity bills, budget allocations in tariff etc. Thus, successful implementation of SOPs would benefit the entire system in terms of cost reduction and energy savings.

The **'Standard Offer Program Handbook'** outlines, for the stakeholders, financing mechanisms and the framework for designing and implementing a SOP which can be used as a ready reckoner in order to successfully adopt energy efficiency on a large scale. I congratulate Shakti Sustainable Energy Foundation and MP Ensystems Advisory Pvt. Ltd. for their efforts in developing this Handbook and hope all concerned stakeholders take advantage of the same so as to contribute in enhancing energy efficiency in the power

(Gireesh B. Pradhan)

ऊर्जा दक्षता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)

BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

अजय माथुर, पीएच. डी
महानिदेशक

Ajay Mathur, Ph.D.
Director General

Message

Managing demand is now becoming as important a role for electricity distribution companies as is the management of supply. Indeed, with generating capacity in the country far exceeding the economic demand, the pressure on distribution companies is to balance demand and supply at least cost to consumers; dropping of loads is fast becoming an unacceptable solution. The first task in this direction is the development of an approach towards tariff setting that encourages end-use efficiency (such as time-of-day tariffs) while enabling financial viability of the distribution company as well. In parallel, the second task is to encourage consumers to meet their electricity-driven needs (for lighting, space conditioning, office productivity, recreation, etc.) with lower electricity supply. These Demand-Side Management (DSM) methods have the potential to reduce both the peak demand, as well as total energy demand, thus providing a win-win situation to both the distribution company and to its consumers.

The Bureau of Energy Efficiency has undertaken and promoted a number of utility DSM activities to stimulate market transformation with participation of all stakeholders. At the same time, the Bureau, through Energy Efficiency Services Limited (EESL) is also supporting 35 distribution companies in creating DSM Cells, training DISCOM officials in DSM design and implementation, and preparing DSM projects. DISCOMS can scale up energy efficiency efforts through simplified and implementable Standard Offer Programs (SOP).

The "Standard Offer Program Handbook" is a comprehensive how-to guide on designing and implementing SOPs. It discusses in detail all the aspects involved in design, approval and implementation of an SOP. This handbook will help program DISCOMs right from designing the SOP and seeking the necessary approvals, to determining the savings achieved from the program and incentivizing consumers.

We hope that it would be a useful knowledge product for utilities, Electricity Regulatory Commissions and consultants to understand nuances of SOP and implement them successfully.

(Ajay Mathur)

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Preface

India's electricity sector has a lead role in enabling the efficient use of power in order to meet the country's development needs. Recognising the need for concerted action on bridging the demand/supply gap, several distribution utilities in India have implemented various Demand Side Management (DSM) programmes.Unfortunately, these have had limited reach and scope due to barriers that are technical, financial and institutional in nature. The Standard Offer Program, a well-tested international concept, is a Demand Side Management implementation option that will allow significant scale-up opportunities in India's power sector.

This handbook on the Standard Offer Program, a first of its kind, is a how-to-guide for designing and implementing Standard Offer Programs in India. It addresses critical aspects related to design, approval, implementation and the Measurement and Verification of a Standard Offer Program. The handbook has been developed in consultation with key stakeholders from India's energy efficiency fraternity including electricity distribution utilities and State Electricity Regulatory Commissions (SERCs), and sector experts.

Shakti Sustainable Energy Foundation works towards aiding the design and implementation of policies that encourage energy efficiency, renewable energy and sustainable urban transportation. We are very pleased to support the development of this manual, which will aid the upscaling of DSM implementation in India.

I am extremely grateful to all the contributors and reviewers of the handbook for providing their inputs and guidance through the process. I extend special thanks to MP Ensystems Advisory Private Limited, our partner, in developing this handbook.

(Krishan Dhawan)

About the SOP Handbook

The Standard Offer Program (SOP) Handbook is an important and comprehensive how-to guide for regulators and policy makers, Central and State Government entities, electricity distribution utilities and project implementers. This Handbook has been developed with the objective of guiding these stakeholders through the process of conceptualization and roll-out of the SOP. The Handbook discusses in detail all the aspects involved in design, approval and implementation of an SOP and provides necessary guidance on all stages right from conceptualizing and designing the SOP and seeking the necessary approvals to determining the savings achieved from the program and incentivizing consumers.

Acknowledgements

The MP Ensystems Advisory Private Limited team would like to extend our sincere gratitude to the Shakti Sustainable Energy Foundation (SSEF) for entrusting us with this assignment and supporting us throughout the process of developing this Handbook. SOP works to strengthen the energy security of the country by aiding the design and implementation of policies that encourage energy efficiency as well as renewable energy. Our special thanks to Mr. Gireesh Pradhan, Chairman, Central Electricity Regulatory Commission, Dr. Ajay Mathur, Director General & Ms. Pravatanalini Samal, Assistant Energy Economist, Bureau of Energy Efficiency, Mr. Saurabh Kumar, Managing Director, Energy Efficiency Services Limited, Mr. U. N. Panjiar, Chairman, Bihar Electricity Regulatory Commission, experts at the Haryana and Uttar Pradesh Electricity Regulatory Commission, Mr. V. L. Sonavane, ex-Member, Maharashtra Electricity Regulatory Commission, Dr. Nitin Pandit, Managing Director World Resources Institute – India and Prof. Suryanarayana Doolla, Indian Institute of Technology – Bombay for their critical review and valuable and timely inputs to enrich this document. We are indebted to the team at SSEF, especially Mr. Deepak Gupta, Ms. Natasha Bhan and Ms. Vrinda Sarda, for their active involvement and support in this project. Our sincere thanks to Mr. Chinmaya Acharya, Chief of Programs at the SSEF for being available to our larger team to discuss key aspects covered under this program. We also thank Convener, DSM Consultation Committee at MERC and DSM cell members of BEST, Tata Power, and Reliance Infra for their inputs. The project team has also benefited from the interactions with several colleagues from the State Electricity Regulatory Commissions, Distribution Licensees, Forum of Regulators, Energy Sector Consultants and Equipment/Appliance Suppliers for sharing data wherever possible. We thank all of them for their inputs & insights while preparing this document, and hope that the Handbook will prove to be of immense use to them in their DSM endeavors.

Project Team

The Project team that put together this SOP Handbook comprises Deepak Gupta, Natasha Bhan and Vrinda Sarda of the SSEF, Mahesh Patankar, Sonia Shukla, Parag Kulkarni, Rahul Yenumula, Sudhanshu Mishra, Harman Singh, Ishan Paliwal and Priya Bhargava, of MP Ensystems Advisory Private Limited, Arijit Maitra, Legal Expert and Professor Suryanarayana Doolla of IIT Bombay. Other team members, Archana Patankar, Ira Prem and Sravanthi Rallabandi, provided support towards finalization of this Handbook.

Annexures

Demand Side Management(DSM)program implementation in India has evolved from bilateral/ multilateral/ donor-funded implementation to more recent advent of **Indian-utilities-sponsored initiatives** post the enactment of Electricity Act 2003. **Over 14 State Electricity Regulatory Commissions have notified DSM regulations** and few utilities have successfully implemented DSM measures such as retrofit programs for fans, unitary ACs, tube lights, refrigerators, demand response and agriculture DSM. Given the legal structure and technological advancements in the end-use segments, it is now important to push the market towards innovative implementation options at scale. **Standard Offer Program** (SOP) is one such key conduit that has been successfully implemented in electricity markets in other continents. Primary structure of a SOP program includes consumers implementing **energy efficiency measures producing negawatts** (saved energy/ demand or both), which can be purchased by utility by way of monetization of savings. In simpler terms, an **SOP can be construed as a Feed-in-Tariff for efficiency similar to the ones applicable to renewable energy sources.** One of the key benefits of a SOP is the programs' ability to be **technology-agnostic** more than being prescriptive solutions getting locked-in in certain technologies. As such, the SOP has been known for setting out a larger consumer engagement either directly or through the energy service providers.

In the Indian context, energy conservation and demand reduction, both are important contributing factors for the grid management. **Indian power sector experienced an interesting variant of the SOP structure in the mass-market lighting efficiency initiatives.** As such, the Indian power sector stakeholders now recognize the need for and benefits of SOP structure. **SOP provides the scaling-up opportunity** by offering simplified and implementable solutions. These solutions can help tide-over inherent challenges associated with how DSM program are currently implemented. In congruence with the DSM Regulations in India, the incentives/rebates offered to the consumers in the SOP would reflect benefits accrued from reduced power procurement costs over the cost of energy efficiency measures. SOP provides many benefits to Utility and Consumers. **Utility gets benefitted by reduced power purchase cost, increased consumer participation, reduced time of program roll out and simplified contract with consumers or aggregators.** Whereas, **consumers have benefits of reduced energy bills, increased ROI, scientific measurements of savings through M&V.** Proposed SOP implementation structure involves multiple stakeholders resulting in essential market creation opportunities as well.

Primarily, consumers and/or aggregators (super ESCO as an example) are the implementation partners with program ownership vested with utilities or in the proposed structure with the Bureau of Energy Efficiency (BEE). Measurement and verification processes in the Indian DSM space are still evolving. **M&V measures can range from simpler, non-complex methods to more complex methods.** Within the context of the notified DSM regulations, SOP implementation can be driven through the following funding sources:

- National level funding through the National Clean Energy Fund (NCEF)
- State Energy Conservation Funds created through Public Benefit Charges applied on the electricity bills
- Budget allocation in the tariff recovery approved through the Aggregate Revenue Requirements (ARR)
- State government budget allocation through energy departments

One key barrier to the implementation of DSM initiatives in India has been the fear of loss of revenue from the paying consumers. **SOP price that falls below the Average Power Purchase Cost would bring immediate benefit to the power system.**

Savings from efficient use of electricity are a key resource for any electricity system, especially in a country like India, which faces electricity shortage and access issues. The Indian regulatory framework supports design and implementation of Demand Side Management (DSM) measures by utilities, for their consumers. The preamble to The Electricity Act, 2003 sets out in broader terms what the Act is expected to achieve. The Preamble mentions "promotion of efficient and environmentally benign policies" as an important objective. Further, Section 23 of the Electricity Act, 2003 empowers the Electricity Regulatory Commissions to take steps and measures for *inter alia* maintaining the efficient supply of electricity[1]. Several State Electricity Regulatory Commissions (SERCs) in India have issued Regulations to this effect[2]. A small number of utilities have successfully implemented DSM measures, such as, retrofit programs for fans, unitary air-conditioners, tube lights, refrigerators and proven their benefits. Given these successful examples, it is now opportune to scale up implementation of DSM measures.

Distribution utilities in India have tried out specific DSM measures that include on-bill financing, rebates, incentives and limited design assistance. A Standard Offer Program (SOP) is a construct where the consumers are encouraged to actively participate in the utility DSM programs. Consumer participation has been proven to be effective when the spectrum of the technologies deployed has been broadened. Reduced tariffs and reduced first-costs of the technologies deployed have also made the necessary impact over the utility systems. Essentially, the consumers acting as the producers of negawatts that benefit them as well as the utilities have been at the epicenter of successful DSM initiatives. Most importantly, the consumers by adoption of efficient technologies become an integral part of resource acquisition, in reduction of overall cost structure and measurement of savings.

A SOP provides opportunities for scaling-up by offering simplified and implementable solutions. These solutions can help tide-over inherent challenges associated with the way DSM program are currently implemented. SOP can even be termed as an acquisition at par with the feed-in tariff provision applicable for renewable energy sources.

Classical definition of SOP: *SOP is the purchase of energy and/or demand savings by a distribution company from consumers for energy and/or demand savings from key end-uses, at a standard rate (Rs/kW and/or Rs/kWh) agreed upon at the start of the program.*

[1] *Section 23 of The Electricity Act, 2003 states "Directions to licensees. - If the Appropriate Commission is of the opinion that it is necessary or expedient so to do for maintaining the efficient supply, securing the equitable distribution of electricity and promoting competition, it may, by order, provide for regulating supply, distribution, consumption or use thereof."*

[2] *As on 28th February, 2015, 16 final notified and 2 draft DSM Regulations have been issued by various ERCs. Additionally, some more States have included specific directives in the utility tariff orders, directing the utilities to undertake activities such as load research and identification of DSM potential.*

SOP has proven to be a simple tool for distribution utilities across the world (e.g. United States of America, South Africa and Portugal)[3], and more recently in India where Energy Efficiency Services Limited (EESL) launched a successful lighting SOP initiative in Puducherry to intervene on the consumer side of the meter and facilitate efficient operations at a large scale. One of the Mumbai based utilities, Tata Power, has launched an SOP for their commercial and industrial (C&I) consumers recently.

The SOP program of Tata Power, Mumbai *supports energy efficiency initiatives undertaken by commercial and industrial consumers on their own. Eligible interventions under this program are any EE/EC measures such as HVAC, Lighting, motive power, control systems, etc. The savings from these interventions should be measurable through the M&V procedure laid down by Tata Power. M&V is carried out by a third party appointed by Tata Power. SOP price finalized for the program is Rs 1 / kWh for verified savings between 8am and 8pm excluding Sundays and holidays. The program is under implementation and results are awaited.*

An SOP meets two objectives from the utilities' perspective:

(a) Load Management
(b) Strategic Conservation

SOP can be designed for various consumer categories and end-uses based on their contribution to the system load, as seen in accompanying Figure 1 (e.g. lighting end-use for residential consumers, air-conditioning for commercial consumers, etc.). Under an SOP, the Program Owner 'purchases' proven energy and/or demand savings at a pre-determined price from consumers.

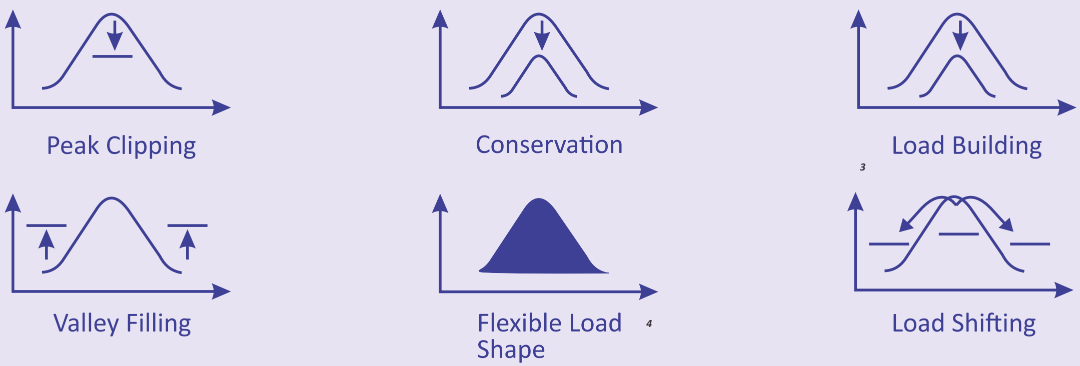


Figure 1: DSM Load Shape Objectives

[3]*Further details in Annex III*

The price is based on the 'value' of the savings to the Program Owner, which differs based on the time of use. A variation of the Standard Offer Program, is the Standard Product Offer (SPO) in which a standardized product is offered by utilities to their consumers – similar to appliance-level DSM measures currently implemented by a few utilities. In case of SPO, utilities provide consumers an incentive on the initial cost of a standard model of an efficient appliance[4].

SOP provides many benefits to the program owners and consumers, as given in Table 1 below:

Table 1: SOP Benefits

Benefits to Utility	Benefits to Consumers
Reduced time for program rollout as approval is taken for multiple end-uses or technologies	Reduction in electricity bills
Simplified and standardized contracts between the program Owner and consumers/aggregators[5]	Technology agnostic program hence consumers can use various technologies or operational changes
Achievable economies of scale - options available to go beyond utility territory"	Reduction in payback period for technology adoption
Higher transparency and reduced risks as payments are linked to proven savings[6]	Can modify the energy conservation measure adopted based on the feedback from M&V agency
Reduction in power purchase cost	

[4]The discounted payments to be made by the consumers may collected from the consumers in the following manner: (i) upfront, at the time of technology installation, or, (ii) through on-bill financing, in which the utility may charge the consumer equated monthly instalments in their electricity bills (corresponding to their share of the efficient technology cost), over a period of 6 months to one year.

[5]This is the entity implementing the SOP on behalf of multiple consumers and aggregating the savings achieved. The Aggregator will coordinate with consumers in the implementation of the SOP.

[6]Proven savings is verified savings based on agreed M&V protocol.

In the typical summer residential load curve as seen in Figure 2, the price of electricity purchased by the distribution utility at time T_1 is lower than that at time T_1 and any savings achieved in time T_2 will have higher 'value' to the distribution utility. Thus, the utility is more likely to pay higher incentives for savings achieved through end-uses contributing to the load during time T_2 (air-conditioning in this example). The SOP Price, i.e. the incentive offered to the consumer, can be different in different time periods (i.e. higher incentive in T_2 than in T_1), or it can be a weighted average of the incentives in different time periods.

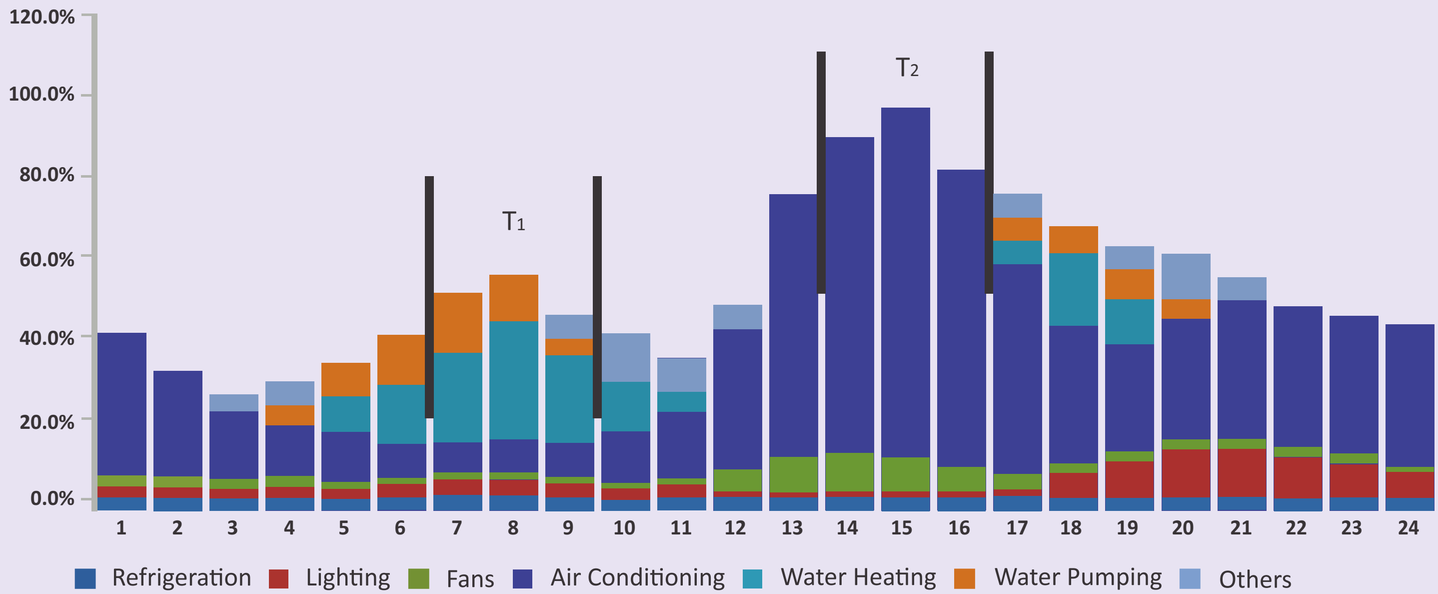


Figure 2: Typical Residential Load Curve (e.g. during summer in Delhi)

OUTLINE OF THE HANDBOOK

This SOP Handbook has been designed to serve as an important and comprehensive "how-to" guide for various stakeholders and is structured as below (Table 2):

Table 2: Description of Sections in the SOP Handbook

S. No.	Section	Description
1	SOP Implementation Framework	The Implementation Framework that can be adopted for an SOP to be offered at the national level, or, at the utility level.
2	Implementation process	Step-by-step process for the design and rollout of an SOP
3	Design of an SOP	Detailed guidelines on designing an SOP, including, guidelines to select which SOP to offer, guidelines to perform benefit-cost analysis, guidelines on determining the SOP price and contents of a typical Program Design Document
4	Measurement and Verification (M&V) options	Possible M&V options for an SOP
5	Roles and responsibilities of various stakeholders	Identification of stakeholders and defining specific responsibilities at various stages in an SOP design and rollout
6	Proposed structure of an 'SOP Rollout Manual'	Table of contents of a typical Program Rollout Manual that would be released by the Program Owner when announcing an SOP

In addition, several annexures to the Handbook are included to serve as easy reference to the stakeholders while designing their own SOP. The key annexures included in this Handbook are given in Table 3:

Table 3: Description of Annexures

S. No.	Section	Description
I	Abbreviations	List of abbreviations used in the Handbook
II	Glossary	Definitions of key terms
III	International Examples of Successful SOPs	Examples of SOP Implementation in other countries, including programs offered, eligible consumers, incentives given, etc.
IV	Typical Terms of Reference for Load Research Activities	Draft Terms of Reference (ToR) for appointing an agency to perform the load research activity for the distribution utility
V	Sample Questions for Consumer Survey – Residential and Commercial Categories	List of questions for residential and commercial ategories for generating load curves and analysing the willingness to pay for energy efficient technologies
VI	Sample Questions for Vendor Survey	List of questions to be administered to vendors for capacity evaluation
VII	Representative Load Curves	Illustrations of load curves for various end-uses and/or categories
VIII	Template for Regulatory Filing (Program Design Document (PDD)) – with Aggregator	Template for distribution utilities to prepare a PDD for submission to the regulatory commission when they intend to engage an Aggregator
IX	Template for Regulatory Filing (Program Design Document (PDD)) – without Aggregator	Template for distribution utilities to prepare a PDD for submission to the regulatory commission when they do not intend to engage an Aggregator
X	Types of Meters, Available Models, M&V Applicability, Indicative Costs	Different types of meters available, the major supplies for each of the meters, applicability of such meters in Standardized and/or Comprehensive M&V and the range of indicative costs.
XI	Brief Description of Energy Efficient Technologies	Brief description of technologies discussed in this handbook

S. No.	Section	Description
XII	Details of Energy Efficient Technologies	A comprehensive list of various technologies for specific end-uses, their technical specifications and ratings, the price range and the major suppliers
XIII	Annual Energy Savings from Energy Efficient Technologies	Figures to present annual savings that can be achieved from using energy efficient technologies for various end-uses
XIV	Average Power Procurement Cost (APPC), Highest Marginal Cost (HMC) and Units Purchased	APPC, HMC and Units Purchased for distribution utilities from across the country
XV	Capital Recovery Factor	CRF for various discounts rates and life of technology
XVI	Table of Contents of Program Rollout Manual	Possible coverage of the Program Rollout Manual that may be published by a Program Owner when rolling out an SOP
XVII	Summary of Agreements and Contractual Documents	List of elements of the model agreements and contracts that need to be signed by various stakeholders
XVIII	Consumer Outreach Material	Illustrative formats for program announcement, flyer and registration form
XIX	Communication and Marketing Approaches	List of approaches that can be used by the program owners for creating awareness and information dissemination
XX	DSM Initiatives Undertaken by Utilities in India	List of utility DSM initiatives implemented/ under implementation in India

This chapter presents various options for implementation of an SOP in India and discusses the following important aspects to be considered in the implementation process:

- The Regulatory backing for an SOP and the current status of DSM Regulations across different states in India
- Roles of key stakeholders in implementation
- Implementation options
- Funding options
- Methodology for determining the SOP price
- Potential end-uses and technologies
- M&V options

2.1 The Regulatory Backing For A Standard Offer Program

A Standard Offer Program is well-backed by the Indian regulatory framework, which supports design and implementation of DSM measures by utilities for their consumers. Several State Electricity Regulatory Commissions (SERCs) have issued DSM Regulations to this effect. As of July 2015, 17 SERCs have notified DSM regulations and one has issued draft regulations as seen in Figure 3. Additionally, some states have included specific directives in the utility tariff orders, directing the utilities to undertake activities, such as, load research and assessment of DSM potential.

Figure 3: Status of DSM Regulations in India[7]

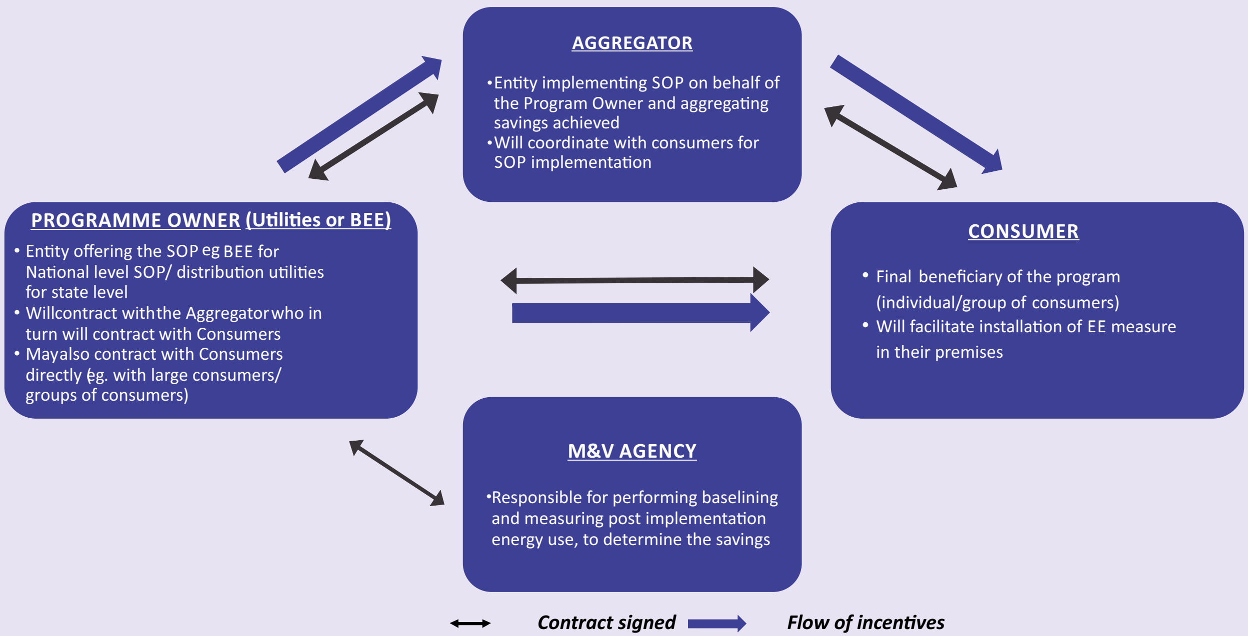
[7]Notified Regulations: Maharashtra-Apr'10, Tripura-Jul'10, Jharkhand-Sep'10, Orissa-Jun'11, Jammu & Kashmir-Aug'11, Himachal Pradesh-Sep'11, Delhi Feb'12, Punjab-Mar'12, Assam-Apr'12, Gujarat-May'12, Manipur & Mizoram-Aug'12, Tamil Nadu-Feb'13, Uttar Pradesh-Mar'14, Bihar-Aug'14, Goa and Union Territories-2014, Haryana-Nov'14, Karnataka-Jul'15
Draft Regulations: Kerala-May'11

Important provisions in the current DSM Regulations are:

- DSM programs are to **be driven by distribution utilities** for their consumers
- DSM programs and plans are **to be prepared by utilities** and approved by the respective commissions
- **Incentives** can be offered by utilities to their consumers
- Program investments **to be "cost-effective"** to both the licensee and the consumers
- DSM **expenses may be passed through in the tariff,** while simultaneously aiming for reduction in the overall tariff
- **M&V to be undertaken** for ascertaining demand and energy savings

2.2 The Key Stakeholders

The key stakeholders in the implementation of an SOP are the Program Owner, the Aggregator, the Consumer and the M&V Agency. The flow of incentives and contractual agreements among these stakeholders is depicted in Figure 4 below.



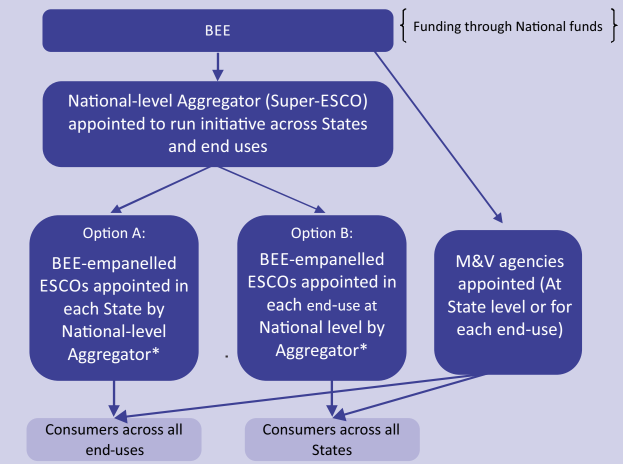
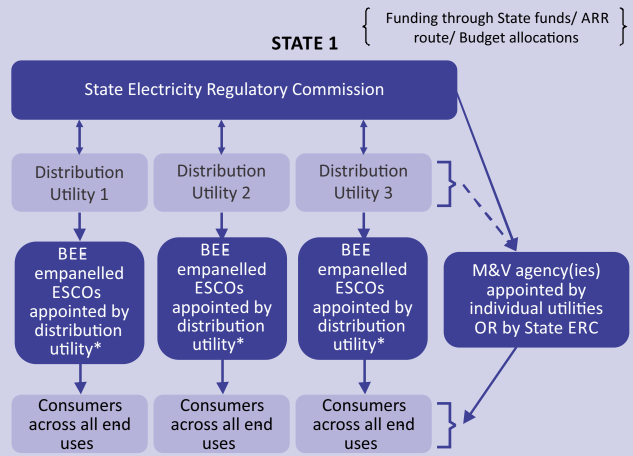
SOP Incentives can flow to the consumers from the Program Owner via the Aggregator (wherever involved) or directly

Figure 4: Key Stakeholders in Implementation of SOP

2.3 Implementation Options

The implementation structure of the SOP will depend on the entity offering the SOP. Two possible implementation options - program offered by the BEE at the national level and program offered by distribution utilities in their service areas - are depicted in Table 4 below:

Table 4: Proposed Options for Implementation of SOP

	Option 1: Program offered by the BEE at the National Level	Option 2: Program offered by distribution utilities in their area of jurisdiction
	 * National level super-ESCO can run this program through subcontracted entities, if needed	 * *National level Super ESCO can play this role through subcontracted ESCOs. Also, they may be appointed for allend uses OR forspecific end uses*
Program offered by	BEE or any entity BEE chooses to appoint	Individual distribution utilities
Program approval by	Any Central Ministry that approves budgets	Respective SERCs, based on one-time approval sought for the program by the utilities

	Option 1: Program offered by the BEE at the National Level	Option 2: Program offered by distribution utilities in their area of jurisdiction
Program impleme-nted by	National-level Aggregators (e.g. super ESCO like EESL) appointed by BEE to run the initiative.The national-level Aggregator may in turn appoint BEE empanelled sub-contracted service providers, (i) for each state, across all end-uses, or, (ii) for each end-use, across all states	Energy service providers appointed by utility as program implementers. A national level aggregator can also be appointed and play this role through other service providers. The program implementers can be appointed by the distribution utilities for all end-uses or for specific end-uses
M&V done by	Third party M&V agencies appointed by BEE, categorizing or classifying the program on (a) geography or, (b) end-use	Third party M&V agencies appointed by SERCs or distribution utilities, categorizing or classifying the program on (a) geography or, (b) end-use
Funding avenues	National-level funds	State funds/ ARR route/ specific budget allocation

2.4 Funding Sources

The possible funding options for implementation of an SOP are as follows (Table 5):

Table 5: Possible Funding Options

Funding option		Applicability	
		Option 1	Option 2
National Level Funds, for example: National Clean Energy Fund (NCEF) or budget allocations **Preferred**	• If BEE is the Program Owner, requests may be sent from the BEE to the NCEF for funding the national level SOP. • If distribution utilities are the Program Owners, BEE may serve as the conduit for routing funds the NCEF to the respective utilities. • A pre-determined amount may be tapped into each year (in excess of INR 1,000 Crore per year or a budget that can fetch up to 1,000 MW of annual savings).	✓	✓
State Level Funds **Preferred**	• The program may be funded through a State Energy Conservation Fund set up as a revolving fund at the State or utility level. The fund is generated through a Public Benefit Charge (PBC) approved by the Regulator and levied on all consumers. • The PBC may be levied every month, for a duration approved by the Regulator.		✓
ARR route	• The program may be funded through regulatory provisions that allow DSM-related expenses to pass through in the tariff setting process.		✓
Budget Allocation	• The program may be funded through specific budget allocations made by State Electricity Regulatory Commissions (recovered through ARR) or State Governments for implementing DSM programs.		✓

Regulators may also allow return on equity placed in efficient equipment installed on the customer side of the meter. A specific reference on possible return on investment to be offered to the distribution licensees is made in Clause 3.2 of MERC regulations, DSM Implementation framework, April 2010.

2.5 Determination of SOP Price

SOP Price, a key element, can influence the scale of the program. SOP Price, the amount paid to the consumers to incentivise them to implement the SOP initiatives, is the savings of the distribution utility that will be shared with the consumers (further details provided in Section 4.3). It may differ based on the type of intervention and technologies. For strategic conservation, which leads to savings throughout the day and not particularly during the peak of the system, the incentive will be determined on the basis of the energy (kWh) saved. For load management interventions, leading to savings during the peak time, the incentive may be based on (i) energy (kWh) saved, (ii) load (kW) curtailed or (iii) a combination of (i) and (ii). Also, the incentive payout may be made as (i) capacity payments (based on kVA) and (ii) payments based on kWh/ kW savings. The kVA based incentives may be determined based on the reliability charge that the utility pays, and the per kVA charge paid by consumers. The methodology that may be used for computation of the incentives is presented in Figure 5.

***SOP Price:** This is the incentive in Rs/kWh or Rs./kVA which is paid by the distribution utility on the savings achieved by the consumer as a result of (a) retrofitting with energy efficient technology, b) purchasing a new energy efficient technology, c) measurable operational improvements or d) any other measurable load curtailment*

The SOP price should be determined based on the Benefit-Cost analysis[8] of the program. The SOP price is typically offered to consumers if the benefit-cost analysis is positive. **However, even if the benefit-cost analysis is negative, the utility may still offer an SOP price to encourage the consumers to implement energy efficient measures in view of improving system readiness for constraints or emergencies.** The parameters considered for computing the SOP price are the Cost of Conserved Energy (CCE)[9], the tariff of the target consumer and the power purchase costs of the distribution utility (the Average Power Purchase Cost (APPC)[10,11] and the Highest Marginal Cost (HMC)[12]).

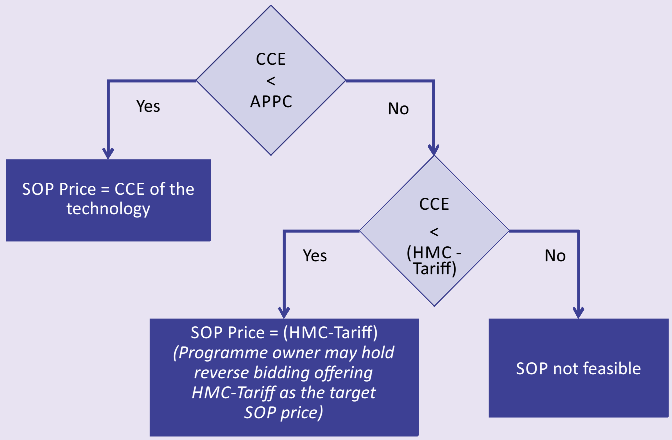


Figure 5: Computation of SOP Price

[8] *Societal cost benefit analysis can also be carried out for an SOP program using the societal cost test that attempts to quantify the change in the total resource costs to society as a whole rather than to only the service territory (the licensee and its consumers). The test uses "social cost of power" which could be considered as the consumers' willingness to pay for power. In the Indian context, cost of diesel generation can be used as a proxy for consumers' willingness to pay for power.*

[9] *Cost of Conserved Energy (CCE) is the cost incurred to save 1 kWh of energy. CCE is specific to a technology and usage pattern and the lower the CCE the more attractive the program. The methodology for computation of CCE is given in section 4.3.*

[10] *The APPC is the ratio of total power purchase cost (Rs. Cr) and the total power purchase (MU) of the utility and is expressed in Rs/kWh.*

[11] *Some of the utilities get exposed to Unscheduled Interchanges (UI) penalty or rebates which changes their APPC approved by regulatory commission. As UI penalty and rebates are uncertain APPC is recommended value to compare cost of savings vs. cost of generation*

[12] *HMC is the cost incurred to procure the top 10% costliest power (excluding must-run plants).*

The following scenarios can be considered:

(i) When the CCE is less than the APPC, the cost incurred to save 1 kWh is less than the average cost incurred to purchase 1 kWh. This makes the program economically viable. In this case, the incentive offered to the consumer, i.e. the SOP price, may be equal to the CCE.

(ii) When the CCE is more than the APPC (i.e. the cost incurred to save 1 kWh is higher than the average cost incurred to purchase 1 kWh), the tariff of the targeted consumer needs to be compared with the highest marginal cost of power purchase, to ascertain whether the distribution utility would lose more by means of lost revenue (tariff not paid by consumer due to kWh saving) or gain more by not buying costly power. The following two scenarios may be considered:

   a. If the tariff of the target consumer is less than the HMC, the loss of revenue for the distribution utility is less than the savings of the costly power purchased. This results in a net positive benefit to the distribution utility, computed as the difference between the tariff of the target consumer and the HMC.

   b. If the tariff of the target consumer is more than the HMC, the loss of revenue for the distribution utility is greater than the savings of costly power purchased. This results in a net negative benefit to the distribution utility and the program is not feasible. However, the utility may support such programs to promote energy efficiency by providing low levels of incentives.

Further details on determination of the SOP Price are given in Section 4.3.

The schedule of incentive payment maybe decided based on the end-use being targeted, the first costs of the energy efficient technology and the consumer type. The options for schedule of payment for savings from various types of end-uses can be as follows:

- Option 1: The entire incentive is paid to the consumer as a first cost rebate at the start of the program. The incentive to be paid is based on the expected savings for a specified period (e.g. 6 months or 1 year).
- Option 2: The incentive is paid to the consumer partly at the start of the program and partly based on proven savings.
- Option 3: The incentive is paid based on proven savings. First-cost rebates are optional in this case.

The proposed schedule of payment for various end-uses is given in Table 6.

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Table 6: Proposed Schedule of Payment for various End-uses

End-use	Applicability for type of consumer						Options for schedule of payment		
	Residential	Small commercial	Large commercial	Large industrial	Housing colonies	Municipal consumers	Option 1	Option 2	Option 3
Space cooling/ lighting	✓	✓					✓		
Space cooling/ lighting				✓				✓	✓
Motive power (motors and pumps)					✓			✓	✓
Water heating/ water pumping						✓	✓	✓	
Water pumping							✓	✓	✓

2.6 Potential End-uses and Technologies

The indicative list of potential end-uses and technologies targeted under an SOP is given in Table 7 below.

Table 7: Proposed Technologies for Intervention under various End-uses

End-Use	Technology
Lighting	LED bulbs/ tube lights/ CFL
Space Cooling	Fans – 5 star fans, super-efficient fans
	Unitary ACs – 5 star rated window ACs, 5 star rated split ACs, Inverter ACs
	Chillers – Water/ air cooled scroll/ screw chillers
	Thermal Storage
Water Heating	Unitary Geysers – 5 star rated storage type geysers
Refrigeration	Heat Pumps
	Direct Cool/ Frost Free refrigerators – 5 star rated refrigerators
Water Pumping	Pumps – 5 star rated pumps
Industrial Applications	Motors and pumps – 5 star rated motors and pumps, Chillers – Energy Efficient chillers

2.7 Measurement and Verification (M&V)

Measurement and Verification (M&V) plays a critical role in the implementation of an SOP. The M&V methodology must be finalised before the program is rolled out. The approach may be defined for each end-use targeted, as some interventions may require a comprehensive M&V and for others, a standardized savings approach may be sufficient (further details are given in Section 5). Table 8 shows the possible approaches that may be adopted for effective M&V.

Table 8: Possible M&V Methodologies

Approach	Applicability	Description
Standardized M&V	Non-complex projects – e.g. lighting retrofits and unitary AC retrofits	Savings can be estimated at the program design stage and verified at the implementation stage. Savings can be computed as a combination of (i) sampling of savings through actual measurements of baseline and post-implementation energy usage at a certain pre-defined confidence interval and pre-defined margin of error (using statistically significant sample), and, (ii) extrapolating the savings to the population
Comprehensive M&V	Complex projects – e.g. chiller replacements, heat pump installations, etc.	Savings computed through actual measurements of baseline and post-implementation energy usage

Appointment of M&V Agency (MVA): The entity who will appoint the independent M&V Agency will be determined by the Program Owner. The following options may be considered:

(i) **Option 1 -** BEE as the Program Owner: The independent MVA will be appointed by BEE at the State level or at the end-use level. For example, the MVA may be appointed for unitary ACs across India or for all the end-uses for the individual state(s).

(ii) **Option 2** - Distribution utilities as the Program Owners: The MVA will be appointed by either the distribution utility or the ERCs, from an empanelled list of MVAs at State/ Central/ utility level.

The implementation of an SOP may broadly be undertaken in the following three phases:

1. **Pre-implementation Phase:**
   This is the preparatory phase where target consumers and target energy efficiency measures are identified based on utility load profiles and benefit-cost assessment. The program documents are prepared and approvals are sought from the Central Ministry (in case of a national level program) or the State Regulatory Commission (in case of a utility-level program). M&V requirements for the program are identified at this stage.

2. **Implementation Phase:**
   After program approval, implementation is undertaken in this phase, by appointing an aggregator at national or utility level (if applicable). Consumer outreach and enrolment, vendor tie-ups and baseline energy estimation is undertaken as part of the M&V process and field installations are undertaken in this phase.

3. **Post-implementation Phase:**
   In this phase, post-installation energy use calculations are undertaken as part of the M&V process, savings are determined and incentive payouts to consumers are processed.

Elements of the implementation process are detailed in the following sub-sections.

3.1 Pre-implementation Phase

This is the preparatory phase in which the Program Owner identifies and shortlists target end-uses and/or technologies for implementation of the SOP, performs benefit-cost analysis for each option, prepares PDDs and seeks approval from the State Regulatory Commission or the respective Ministry/ Department. The specific steps to be undertaken are as shown in Figure 6:

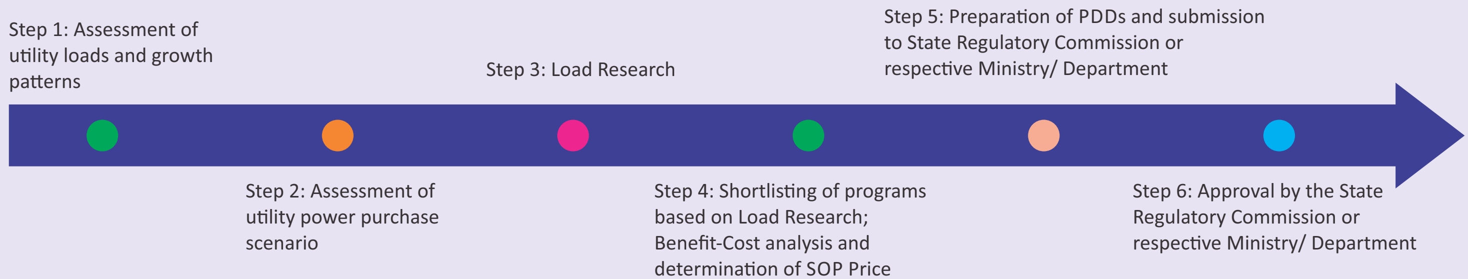


Figure 6: Pre-Roll-Out Phase

Table 9: Pre-Roll-Out Phase

Step No.		Details
Step 1	Assessment of utility loads and growth patterns	The first step is the assessment of utility-level and consumer category-wise (e.g. residential, small commercial, large commercial etc.) load growth, based on compounded annual growth rate (CAGR) over the past 5 years
Step 2	Assessment of utility power purchase scenario	The objective of this step is to examine the utility power purchase scenario, specifically, (i) power purchase agreements and short term power purchase (quantum and cost), including cost of power purchased in various time periods, and, (ii) energy and peak shortages
Step 3	Load Research	This is an extremely important step in designing appropriate and high impact SOPs. It involves understanding of consumer load patterns that vary from utility to utility and are based on parameters, such as, share of loads of urban/rural consumers, types of consumers, climatic zones, etc. Load Research is used to establish aspects, such as, contribution of various end-uses to the utility load curves (base and peak loads), contribution of appliances therein, comparison with utility power procurement costs to establish peak coincidence and consumer willingness to pay for efficient technologies. The Load Research activity should be undertaken at regular intervals (say, every 3-4 years) as the consumer mix, electricity usage patterns etc., will change over time. Typically, Load Research involves: (a) Consumer Survey: This is a survey of a representative sample of consumers to understand parameters, such as, appliance usage patterns (and peak coincidence therein), awareness about EE technologies and willingness to pay. Sample questionnaires that can be used for a consumer survey are given as Annex V.

Step No.	Step	Details
		(b) Market Survey: This is the assessment of the vendor side and involves preparing a list of vendors for various energy efficient technologies under consideration, technical specifications of the technologies, price range, supply chain characteristics and readiness of the market to respond to specific requests for the EE technologies. Sample questionnaires that can be used for the market survey are given as Annex VI. (c) Load Analysis: This is the analysis of the AMR and other meter data of the consumers, to understand their energy usage patterns (applicable if the required data are available). (d) Energy Audits: This involves walk-through audits of the consumers' premises and a detailed audit if required. A detailed list of activities involved in performing Load Research is included under Annex IV. Sample load curves that may be generated from a Load Research activity are given as Annex VII.
Step 4	Short listing of programs based on Load Research; Benefit-Costanalysis and determination of SOP Price	The results of the Load Research will help identify specific initiatives that will bring the highest value to the utility and to the consumers. In this step, the benefit-cost analysis for identified end-uses and specific technologies is undertaken to shortlist specific technologies for implementation. The benefit-cost assessment will help ascertain the SOP price to be offered. The guidelines for performing benefit-cost analysis are discussed in Section 4.

Step No.	Step	Details
Step 5	Preparation of PDDs and submission to State Regulatory Commission or respective Ministry[13]	Once the technologies are identified, the distribution company will prepare PDDs for submission to the Regulatory Commission for approval. The PDD template is given as Annex VIII (with Aggregator) and Annex IX (without Aggregator). The PDD will discuss the identified technologies, benefits and costs from implementation of the SOP, SOP price that will be offered, methodology for M&V and implementation of the program along with roles and responsibilities of various stakeholders.
Step 6	Approval by the Regulatory Commission or respective Ministry	The Regulatory Commission will study the PDD submitted by the distribution company and approve the program for implementation or suggest modifications if any.

3.2 Implementation Phase

The implementation phase will begin once regulatory approval is obtained and the Program Owner (BEE or utility) appoints an Aggregator to implement the program. During the implementation, the Aggregator will reach out to enrol consumers, appoint vendor(s) and facilitate installation of the technologies at consumer's premises. The specific steps to be undertaken by program owner are as follows (Figure 7):

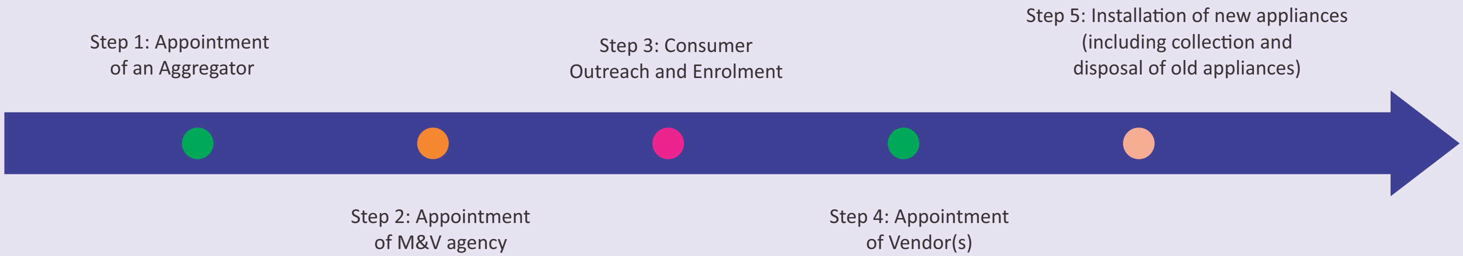


Figure 7: Roll-out Phase

[13] *PDD template included as Annex VIII*

Table 10: Roll-out Phase

Step No.	Step	Details
Step 1	Appointment of an Aggregator	The Program Owner may issue a Request for Proposal (RfP) to appoint an Aggregator who will implement the program on behalf of the Program Owner. 1. BEE, in case of a national level program, may appoint a national-level Aggregator who in turn will approach the distribution utilities with specific programs for implementation and thus aggregate the savings. 2. In case of implementation at utility level, the utility may appoint the aggregator The appointed Aggregator may further appoint energy service providers to support consumer enrolment and implementation of DSM programs.
Step 2	Appointment of M&V agency (MVA)	The M&V for the program will be performed by an M&V agency appointed for this purpose. The MVA will prepare M&V plan and determine the baseline energy consumption prior to installation of energy efficiency measure, which will be considered to compute the savings. If the program is implemented at national level, then BEE will appoint the MVA and the utility will appoint the MVA in case of a utility-level program
Step 3	Consumer Outreach & Enrolment	The Aggregator, along with appointed service providers, will approach consumers, explain the details of the program and convince them to enrol in the program.
Step 4	Appointment of Vendor(s)	The Aggregator (or sub-contracted service providers), can shortlist vendors to undertake the EE measures at the consumer's premises (e.g. supply and installation of EE appliances and safe disposal of inefficient appliances).

Step No.	Step	Details
Step 5	Installation of Energy saving measure	The vendor will be responsible for installing the appliances (and other required peripherals) at the consumer's premises and the removal and safe disposal of the old appliances. For technologies like heat pumps and large chillers, data from consumer premises may be collected at this stage and feasibility of technology installation may be analysed. Data collection will include revenue meter data/ end-use-specific data/ data from existing building management systems, log books maintained at consumer premises, etc. For retrieving and analysing this data, aspects such as the communication protocols, internet connection, facility for modem based data acquisition etc. need to be in place at the consumer's premises. Details of various energy efficient technologies and the expected annual energy savings from these technologies are given in Annex XI and Annex XII.

3.3 Post-implementation Phase

Once the implementation of the EE initiative(s) is carried out and consolidation of the savings is achieved, the M&V agency appointed by the program owner undertakes the measurement and verification process to verify the savings achieved. The specific steps in the post-implementation stage are as follows:

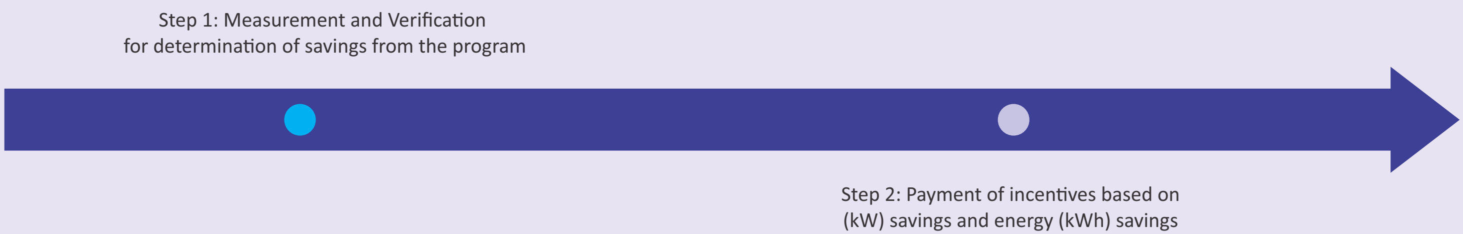


Figure 8: Post Roll-out Phase

Table 11: Post Roll-out Phase

Step No.	Step	Details
Step 1	Measurement and Verification for determination of savings from the program	The energy and peak savings may be determined either by using the standardized or the comprehensive M&V methodology. For standardized M&V, meters[14] need to be installed on the appliances for a sample of consumers and the results then applied to the population (suitable for small to medium sized non-complex interventions, such as, retrofits for lighting technologies, fans, unitary ACs). Under comprehensive M&V, meters will be installed on all the appliances (applicable to larger complex measures like chillers and heat pumps).
Step 2	Payment of incentives based on demand (kW) savings and energy (kWh) savings	The incentives will flow from the Program Owner to the consumer via the Aggregator and sub-contracted service providers (if any). The Aggregator will aggregate the savings from multiple consumers and send the details to the Program Owner. The Program Owner will pay the Aggregator at the pre-determined SOP price on the demonstrated energy savings (kWh) annually or as per the terms of the agreement. The demonstrated savings will be determined based on the M&V exercise to be performed by the appointed M&V agency as per the M&V plan. The Aggregator will, in turn, pay the consumers the pre-determined SOP price on the demonstrated energy savings (kWh) annually or as per the terms of the agreement[15].

[14] *Details of available meters in Annex VII*
[15] *Alternately, payments may also be made at the time of installation of the appliance, based on the expected savings*

This chapter presents the guidelines for selecting appropriate end-uses and technologies for rolling out an SOP, conducting a benefit-cost analysis and finalizing the methodology for determining the SOP price.

4.1 Guidelines to select which SOP to offer

The selection of technology/ end-use for an SOP will depend on the objective of the program. If the aim is to reduce peak load, then the technologies or end-uses contributing to the peak of the system will be targeted (e.g. ACs). If, however, the aim is to conserve energy, then appliances like refrigerators maybe targeted. The SOP price will be higher for end-uses that contribute to the peak as the power purchase price is higher during peak periods.

As an initial step, a supply side analysis involving hourly load of the system and cost of power purchase from various sources to meet this load needs to be carried out. The objective of this exercise is to identify the peak hours for which the power purchase price and load shedding is high. The utilities can then accordingly design SOPs to tackle these issues.

To identify what appliances contribute to the peak load or energy consumption,Load Research needs to be undertaken by the utility. Load Research will involve conducting a questionnaire-based survey, analysis of Automated Meter Reading (AMR) data (if available) and analysis of billing data of the consumers. Based on this analysis, appliance ownership and usage pattern can be determined which will further help in developing the system, category and appliance curves. These curves can then be superimposed on the system level curve to identify end-uses/ technologies that contribute to the peak.

4.2 Guidelines to perform Benefit-Cost Analysis

The benefit-cost analysis considers all the costs to be incurred by both participants and distribution utilities and the benefits accruing to them from the SOP. Benefit-cost analysis helps determine whether the program is economically viable for both the parties. The tests that may be performed on the suggested programs are the Total Resource Cost (TRC) test, the Rate Payer Impact Measure (RIM) test and the Tariff Impact test. This section outlines the elements of benefits and costs to be computed, approach for performing the benefit-cost analysis and some illustrations of the same using this approach.

4.2.1 Elements of Benefits and Costs

The benefits are computed as the peak power purchase cost plus the off-peak power purchase cost. These benefits remain the same across all the tests. However, the tests differ as per the cost elements to be computed. In case of the TRC test, the total cost of the program is taken into consideration, whereas in the RIM test the cost to the utility, including the revenue loss is taken into consideration to determine the tariff impact of the programs. The cost and benefit elements of the TRC, RIM and Tariff Impact tests are given in Table 12. These components are further explained in this section.

Table 12: Benefits and costs in the three tests

Benefits (same for all three tests)	Costs – TRC Test	Costs – RIM and Tariff Impact Tests
• Reduced power purchase cost for the utility as a result of reduced consumption by the participants	• Cost of the efficient technology • Operational and Maintenance costs of the technology • Marketing, M&V costs and other • administrative costs towards the program	• Cost of the technology borne by the utility • Loss in revenue to the utility due to • reduced consumption by the participants • Operational and Maintenance costs of he technology • Marketing, M&V costs and other administrative costs towards the program

Benefits:

Reduced power purchase cost for the utility

Based on the kW ratings of the efficient and inefficient appliances and the hours of use of the equipment, the savings can be computed using the following formula:

Annual Savings (kWh)	=	(kW of old equipment – kW of new equipment)	X	Number of hours of use per day	X	Number of days of use per year

As the price of electricity purchased by utilities changes with time, the monetary savings (Rs. Cr) should be calculated based on peak time energy savings (kWh) and non-peak time[16] energy savings (kWh). The suggested methodology uses HMC[17] for computing monetary savings (Rs. Cr) during peak hours and the Average Power Procurement Price (APPC) for computing the monetary savings (Rs. Cr) during non-peak hours.

16Peak Time: The period during which the load on the system is at its maximum and so is the power purchase price. Non-Peak time: Time other than the peak time is referred to as non-peak time

17Highest Marginal Cost (HMC), computed as the cost incurred by the utilities to purchase top 10% of its power (by cost), excluding the power purchased from hydro, renewables and nuclear based power plants.

Costs:

Cost of the efficient technology

This cost includes (i) the cost of the efficient equipment, (ii) installation cost, (iii) cost of removal and safe disposal of the old equipment, and (iv) salvage value of the old equipment (to be deducted from the total cost). Utilities across India typically invite quotations from equipment manufacturers for supply of efficient equipment. Manufacturer(s), who quote the lowest price for the given equipment, are empaneled for the supply of the equipment. Although the consumer pays for the equipment, the tendering process by the utility reduces the costs of the equipment (due to increased consumption and large volumes) and increases uptake. For example, the case of the Demand Side Management (DSM) based Efficient Lighting Program (DELP) implemented by EESL in Puducherry helped reduce the price of LED bulbs significantly. The case details are given below:

> ***In the Puducherry DELP program*** *implemented by EESL in 2014-2015, the cost of 7 Watt LED bulb was Rs. 320 (which further reduced to Rs. 204 in subsequent bidding undertaken in Guntur and Anantapur, Andhra Pradesh, and to Rs. 104 in the bidding undertaken in Delhi in February 2015) whereas the Maximum Retail Price (MRP) of a 7 Watt LED bulb was more than Rs. 450. The total initial cost towards the program was Rs. 22.8 crore and the annual maintenance cost was 3% of the initial cost. Of the initial cost, Electricity Department-Puducherry (ED-P) contributed equity of 30% and the remaining 70% was taken as debt from EESL. For repayment of the debt portion, ED-P will pay an annual amount of Rs. 46.4 Crore (at an interest rate of 12.5%), over a 10 year period. On the equity[18] portion, the JERC has approved a Return on Equity (RoE) of 15.5%.*
>
> **Key success factors of DELP: Aggregator model, price reduction enabled due to bulk procurement, on-bill financing**

[18]*Joint Electricity Regulatory Commission's (JERC's) order approving the DELP program of ED-P, (http://jercuts.gov.in/writereaddata/Files/Order12825414.pdf)*

Operations and Maintenance (O&M) Costs

This includes the costs incurred for operating the appliance such as repairs and cleaning. Typically, annual costs towards O&M are in the range of 0.5-1% of the initial cost of the equipment for the first year. O&M is a recurring cost and needs to be escalated each year to account for cost inflation.

Marketing and Administrative costs

This includes costs incurred towards promoting the program, utility manpower costs, appointing an Aggregator and sub-contracted energy service providers and other administrative expenses. Typically, the marketing and administrative costs are about 1-2% of the initial cost of the efficient equipment.

Measurement and Verification (M&V) costs

The M&V costs are typically about 1-3% of the initial cost of the equipment. The M&V cost will vary based on the methodology used. For example, in case of standardized M&V, meters are only installed at sample locations (either hourly or kWh) and hence the cost is lower than that of adopting a comprehensive M&V approach where meters are installed at all the participants' locations and possibly on all the technologies.

Loss in revenue for the utility due to reduced consumption

Energy consumption of consumers is likely to reduce from the use of EE appliances. The reduced consumption implies reduced sales for the utility and hence reduced revenue. However, if the cost of power purchased by the utility at the time of energy saved is more than the tariff of that particular consumer category, then the benefit to the utility will be **the difference in power procurement price and tariff of the consumer**. For example, the tariff for commercial and industrial consumers would be typically higher than the cost of power procured for the quantum of energy saved. Hence, the utility will face a loss in revenue by implementing the SOP. In such cases, however, SOP can be justified in view of power system constraints and other suitable cost-effectiveness tests or guidelines.

4.2.2 Approach for performing the benefit-cost analysis

The overall approach to be followed for performing the benefit-cost analysis using the Total Resource Cost test, the Rate Payer Impact Measure test and the Tariff Impact test, is illustrated in Figure 9.

Briefly, the NPV of benefits and the NPV of costs for the TRC test are computed. If the NPV of benefits minus the NPV of costs for the TRC test is negative, the program is not recommended for implementation and the RIM test is not performed. But if the TRC test is positive, further assessment is undertaken.

The NPV of costs under the RIM test is then computed. If the NPV of benefits minus the NPV of costs for the RIM test is positive, the program is recommended for implementation, and if not, the Tariff Impact test is performed. The objective of the Tariff Impact test is to assess the tariff impact on the consumers as a result of the implementation of the program. SERCs may allow certain tariff impact within which DSM programs may still be implemented – for example, the DSM Regulations of Maharashtra allow a tariff impact of 'not... more than Rs. 0.01/kWh or over 0.1% of existing tariff'.

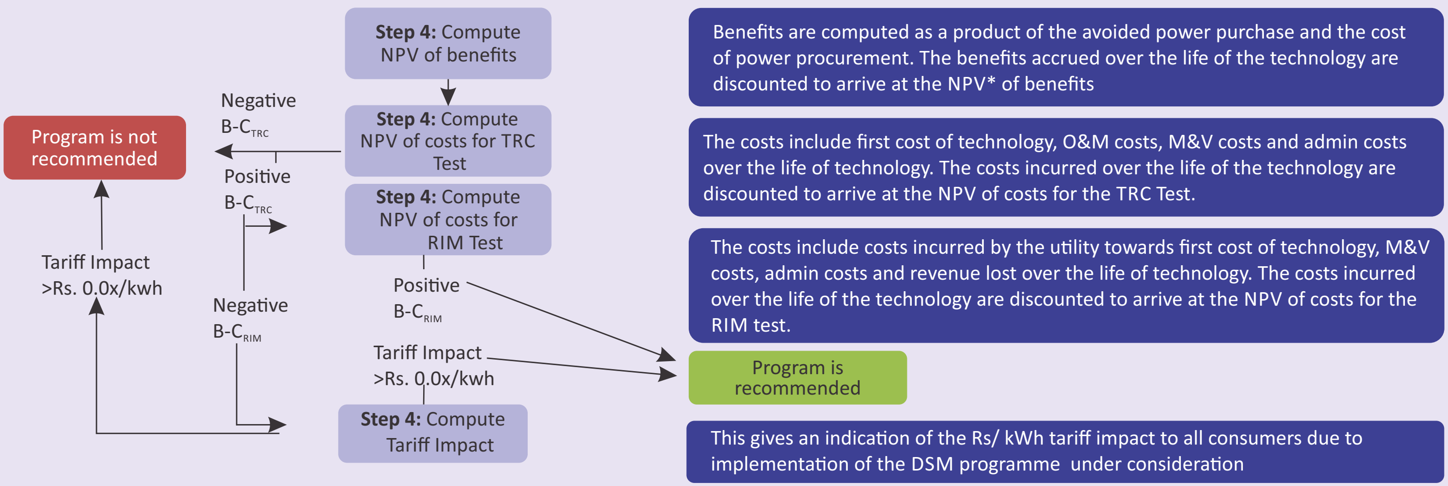


Figure 9: Flow-Chart for Benefit-Cost Analysis

4.2.3 Illustrative programs

The benefit-cost analysis is explained though two illustrative programs, the details of which are given in Table 13:

Table 13: Illustrative Programs – Details

Program Details	Illustrative Program – 1	Illustrative Program – 2
Target End-use	Air-conditioning	Air-conditioning
Target consumer category	Commercial	Residential
Old Technology	1.5 ton inefficient unitary ACs	Inefficient unitary geysers
New Technology	1.5 ton 5-star rated unitary ACs	Heat Pumps

Illustrative Program 1: Replacement of inefficient unitary AC with 5-star rated unitary AC

Table 14 lists the inputs required for conducting benefit-cost analysis and the source of the assumptions. The assumptions shown here are only for illustrative purposes.

Table 14: Assumptions for Benefit-Cost Analysis for Illustrative Program 1 (1.5 ton unitary ACs)

S No.	Parameter	Source	Assumption
Technology Specific Assumptions			
1	Cost of new technology (Rs) Including cost of installation, salvage value and disposal of old technology	Discounted price expected to be offered for bulk quantity	25,000
2	Rating of the new technology (kW)	Standard ratings available in the market	1.540
3	Rating of the old technology (kW)		1.975
4	Life of the new technology (years)	As given by the equipment supplier	8

S No.	Parameter	Source	Assumption
5	Operations and Maintenance (O&M) cost (% of initial cost of the technology)	Typically 1-2% of the initial cost of the equipment	1
6	Escalation for O&M cost (%)	Thumb rule	5
Utility Specific Assumptions			
7	HMC (Rs /kWh)	Utility tariff order	5
8	Average Power Purchase Cost (Rs / kWh)	Thumb rule	3
9	Escalation rates for power purchase cost (%)		5
10	Distribution losses (%)	Utility tariff order	15
11	Transmission losses (%)		5
12	Commercial Energy Charge (Rs / kWh)		8
Program Specific Assumptions			
13	Number of replacements	To be decided by the utility	1
14	Utility contribution to the initial cost of the technology (% of initial cost)		0
15	Marketing and Administrative costs (% of initial cost)	Typically 0-2% of the initial cost of the technology	2
16	M&V costs (% of initial cost)	Typically 1-3% of the initial cost of technology	2
17	Hours of use of technology – peak-time	From load research studies	6

S No.	Parameter	Source	Assumption
18	Hours of use of technology – peak-time	From load research studies	5
19	Days of use per year		300
20	Discount rate[19]	Thumb rule	10.5

Based on these assumptions, the step-by-step approach for undertaking the benefit-cost analysis is as follows:

Step-1: Compute Savings (without considering losses)

As discussed earlier, the savings from the program have to be computed during peak as well as non-peak hours. The savings computed in this step are the savings per equipment at the consumer's end. The transmission and distribution losses additionally need to be taken into consideration in further steps to arrive at the savings per equipment at the bus-bar.

The formula used for computation of savings is as follows:

Peak Annual Savings (kWh)	=	(kW of old equipment – kW of new equipment)	X	Number of hours of use during peak time	X	Number of days of use per year
Non-Peak time Annual Savings (kWh)	=	(kW of old equipment – kW of new equipment)	X	Number of hours of use during peak time	X	Number of days of use per year

In the illustrative program considered, the savings computed based on the assumptions in Table 14, are as follows:

Peak time Annual Savings (kWh)	=	(1.98-1.54)/1000	X	6	X	300	=	783 kWh
Non-Peak time Annual Savings (kWh)	=	(1.98-1.54)/1000	X	5	X	300	=	653 kWh

[19] *Discount rate is used to calculate annualized cost of power procurement, benefits, and investments.*

These are the annual kWh savings as a result of replacing one inefficient AC with one 5-star rated AC. The old technology does not have a star rating and / or is being used beyond the life of the technology.

Step-2: Compute Savings (after considering losses)

The savings computed in Step 1 are at the consumer end of the meter. To arrive at the savings at the periphery of the distribution utility the savings have to be grossed up by distribution and transmission losses using the following formula:

$$\text{Savings (including losses)} = \frac{\text{(Savings (excluding losses)}}{\text{([(1-Distribution losses)*(1-Transmission losses)])}}$$

The savings (including losses) will be as follows:

$$\text{Peak time annual savings (kWh)} = \frac{783}{[(1-15\%)*(1-5\%)]} = 970\text{kWh}$$

$$\text{Non-Peak time annual savings (kWh)} = \frac{653}{[(1-15\%)*(1-5\%)])} = 808 \text{ kWh}$$

The total annual savings (peak and non-peak) from the program are 970 kWh + 808 kWh = 1778 kWh.

Step-3: Compute Annual Monetary Savings (Rs)

To compute the monetary savings (Rs), we need to determine the highest marginal price of power purchase and average power purchase price for the life of the technology. The formula for escalating the power purchase price will be as follows:

Power Purchase Price (Rs / kWh) for x^{th} year = Power Purchase Price (Rs / kWh) for base year X (1+escalation factor)^(x)

The HMC (Rs / kWh) and APPC (Rs/kWh) computed for each year of the life of the technology using an annual escalation rate of 5% (see assumptions table) is shown in Table 15:

Table 15 : Projected Power Purchase Price (Rs/kWh)

Year		0	1	2	3	4	5	6	7	8
HMC	Rs./kWh	5	5.25	5.5	5.8	6.1	6.4	6.7	7.0	7.4
Average Power Purchase Cost	Rs./kWh	3	3.15	3.3	3.5	3.6	3.8	4.0	4.2	4.4

HMC varies based on the "Time of the Day" depending on the demand and supply situation. Referring to Figure 15, the HMC in time T_2 is greater than the HMC in time T_1. HMC for a year is computed by preparing a Merit Order Dispatch (MOD). The MOD is prepared by sorting the generating stations from which power is being procured by the distribution utility, in decreasing order of their energy charge. The HMC is then computed as the average cost for procuring the costliest 10% of the power.

Based on the projected power purchase prices and annual peak and non-peak savings, the monetary savings can be computed as shown in Table 16:

Table 16: Savings (Rs.) from the Program

Year		0	1	2	3	4	5	6	7	8
Peak Savings (A) (from step-1)	kWh		970	970	970	970	970	970	970	970
HMC (B)	Rs./kWh	5	5.25	5.5	5.8	6.1	6.4	6.7	7	7.4
Peak Savings (C = A * B)	Rs.		5,093	5,335	5,626	5,917	6,208	6,499	6,790	7,178
Non-Peak Savings (D) (from step-1)	kWh		808	808	808	808	808	808	808	808
Average Power Purchase Cost E)	Rs./kWh	3	3.15	3.3	3.5	3.6	3.8	4	4.2	4.4
Non-Peak Savings (F = D * E)	Rs.		2,545	2,666	2,828	2,909	3,070	3,232	3,394	3,555
Total Savings (G = C + F)	Rs.		7,638	8,001	8,454	8,826	9,278	9,731	10,184	10,733

Step-4: Compute Net Present Value (NPV) of the Savings (Rs)

To compute the NPV of the savings, the savings have to be accounted for the discount rate. Since, the discount rate has been assumed at 10.5%, discount factor for each of the years can be computed using the following formula:

$$\text{Discount Factor - for xth year} = \frac{1}{(1+\text{Discount Rate})^{(x)}}$$

Using this formula, the discount factors for the life of the technology and the discounted savings (Rs) can be computed as follows:

Table 17: NPV of Benefits (Rs)

Year		0	1	2	3	4	5	6	7	8
Discount Factor (A)		1.00	0.90	0.82	0.74	0.67	0.61	0.55	0.50	0.45
Total Savings (B)	Rs.		7,638	8,001	8,454	8,826	9,278	9,731	10,184	10,733
Discounted Savings (C = A * B)	Rs.		6,874	6,561	6,256	5,913	5,660	5,352	5,092	4,830
Net Present Value of benefits (addition sum of discounted savings for all the years)	Rs.	46,538								

Step-5: Compute Costs (for TRC Test):

Some cost parameters are one time and incurred only during the first year of the program, such as, the initial cost of the technology, M&V costs and Marketing and Administration costs and some are recurring such as O&M cost and loss in revenue to the utility.

Table 18: First Cost of the Program (Rs) / Consumer

S No.	Parameter	Value
1	Cost of the appliance	Rs. 25,000
2	Number of appliances	1
3	Total cost of the appliance(s) (A)	Rs. 25,000
4	Marketing and Administrative Cost (2% of the initial cost) (B) (B= 2% * A)	Rs. 500
5	M&V Costs (2% of the initial cost) (C) (C= 2% * A)	Rs. 500
6	Total First Cost (D = A + B + C)	Rs. 26,000

Recurring costs have to be borne by the participant till the end of life of the technology. The O&M cost of the first year in this example, will be Rs. 250 (computed as 1% of the initial cost of the technology). These costs are escalated for the life of the technology, similar to escalation in power purchase costs under step-3. The escalated recurring expenses are shown in Table 19:

Table 19: Recurring Cost of the Program (Rs)

Year		0	1	2	3	4	5	6	7	8
O&M Cost (Rs) (A)	Rs		250	263	276	289	304	319	335	352
Total Cost (One time + Recurring)	Rs	26,000	250	263	276	289	304	319	335	352
Net Present Value of costs	Rs.	27,525								

Step-6: Compute NPV of Benefit-Costs-TRC Test:

NPV of costs will be computed similar to the NPV of benefits computed under step - 3. The NPV of costs will be Rs. 27,525. Hence the NPV of benefits minus costs will be Rs. 46,538 - Rs. 27,525 = Rs. 19,013. Since, the TRC test is positive, the program is considered for RIM test.

Step-7: Compute Costs-RIM Test:

Similar to computation of costs in TRC test, some cost parameters are applicable only for the first year such as the initial cost of the technology, M&V costs and Marketing and Administrative costs and some are recurring such as O&M cost and loss in revenue to the utility.

Table 20: First Cost of the Program (Rs.)

S No.	Parameter	Value
1	Cost of the appliance – Utility's share	Rs. 0
2	Number of appliances	1
3	Total cost of the appliance(s) (A)	Rs. 0
4	Marketing and Administrative cost (2% of the initial cost) (B) (B= 2% * A)	Rs. 500
5	M&V costs(2% of the initial cost(C) (C= 2% * A)	Rs. 500
5	Total First Cost (D = A + B)	Rs. 1,000

Since, the O&M costs are borne by the participant, the utility does not have recurring cost in the program. However, the utility will incur loss in revenue due to reduced consumption to the participants. This is computed as the product of reduced consumption (excluding losses) and the consumer tariff, which is Rs. 8 / kWh for the first year and is estimated for the life of the technology. The estimated costs are shown in Table 21:

Table 21: Recurring Cost of the Program (Rs.)

Year		0	1	2	3	4	5	6	7	8
Consumer Tariff – Commercial Consumer (A)	Rs. / kWh	8.0	8.4	8.8	9.3	9.7	10.2	10.7	11.3	11.8
Reduced Sales / Annum (B)	kWh		1,436	1,436	1,436	1,436	1,436	1,436	1,436	1,436
Loss in revenue due to reduced consumption (C = A * B)	Rs.		12,062	12,666	13,299	13,964	14,662	15,395	16,165	16,973
Total Cost (One time + Recurring)	Rs.	1,000	12,062	12,666	13,299	13,964	14,662	15,395	16,165	16,973

Step-8: Compute NPV of Benefits - Costs-RIM Test:

NPV of costs will be computed similar to the NPV of benefits computed under step-3. The NPV of costs for RIM test is Rs. 74,570. Hence, the NPV of benefits minus costs will be Rs. 46,538 - Rs. 74,570 = (-) Rs. 28,032. Although, the RIM test is negative, the program can still be implemented if the tariff impact is less than Rs. 0.01 / kWh[20].

Step-9: Compute Tariff Impact:

The tariff impact is the ratio of net benefits (from step - 6) to total sales of the distribution utility. Assuming total sales to be 1,000 MU, the tariff impact would be (+) Rs. 0.00003 / kWh (28,032 /,1000 MU). Although the tariff impact is positive, the program can still be implemented since it is less than Rs. 0.01 / kWh and the utility can offer a lower SOP price than CCE to promote use of energy efficient appliances.

[20] *Reference: Hon'ble Maharashtra Electricity Regulatory Commission's DSM Regulations (2010)*

Illustrative Program 2: Use of Heat Pump instead of unitary geysers

In the residential sector, water heating in individual homes is done through geysers installed at each home. Instead, if a heat pump is installed by the builder during the construction stage, it would help reduce the connected load, the residential water heating peak and MUs consumed during use. HPs are also cost-effective and this is illustrated through the benefit-cost analysis. The illustration is for a building where 3 heat pumps can replace 300 unitary geysers resulting in savings in connected load as well as energy consumption. The following table lists the assumptions required for the benefit-cost analysis and the source of the assumptions:

Table 22: Assumptions for Benefit-Cost Analysis for Illustrative Program 2

S No.	Parameter	Heat Pump	Unitary Geysers
Technology Specific Assumptions			
1	Number of units required for the building of 150 apartments	3	300
2	Rating of each unit (kW)	48	3
3	Total Rating of units per building (kW) (A)	144	900
4	Number of hours of use / day (B)	2	1
5	Number of days of operation /year (C)	120	120
6	Energy Consumption per annum (D = A x B x C) (kWh)	34,560	108,000
7	Total savings per annum (kWh)	73,440	
8	Cost per equipment	Rs. 12 Lakh	Rs. 6000
9	Total cost for all the equipment for the building	Rs. 36 Lakh	Rs. 18 Lakh
10	Cost difference	Rs. 18 Lakh	

Hence to save 73,440 kWh per annum, an additional investment of Rs. 36 Lakh has to be made.

[21] A discount of 30% is considered given bulk procurement by the distribution company

Table 23: Other assumptions for Benefit-Cost Analysis for Illustrative Program 2

S No.	Parameter	Source	Assumption
Utility Specific Assumptions			
1	HMC (Rs /kWh)	Utility tariff order	Rs. 5 / kWh
2	Average Power Purchase Cost (Rs / kWh) Excluding cost for peak power procurement cost		Rs. 3 / kWh
3	Escalation rates for Power Purchase Cost (%)	Standard assumption	5%
4	Distribution losses (%)	Utility tariff order	15%
5	Transmission losses (%)		5%
6	Consumer energy charge (Tariff) (Rs / kWh)		Rs. 2.5 / kWh
Program Specific Assumptions			
7	Number of replacements	To be decided by the utility	1
8	Utility contribution to the initial cost of the technology (% of initial cost)		0%
9	Marketing and Administrative costs (% of initial cost)	Typically 0-2% of the initial cost of the technology	2%
10	M&V costs (% of initial cost)	Typically 1-3% of the initial cost of technology	2%
Other Assumptions			
11	Discount rate	Standard assumption	10.5%

It is also assumed that both the heat pump and the unitary geysers are operated only during the peak hours. Based on all the above assumptions, a step-by-step approach for performing the benefit-cost analysis is explained below:

Step-1: Compute Savings (without considering losses)

The formula used for computation of savings is as follows:

Annual Savings (kWh)	=	(kW of old equipment – kW of new equipment)	X	Number of hours of use during peak time	X	Number of days of use per year

In the illustrative program considered, the savings computed based on the assumptions are as follows:

Annual Savings (kWh) = 73,440 kWh

Step-2: Compute Savings (after considering losses)

The savings computed in Step 1 are at the consumer end of the meter. To arrive at the savings at the periphery of the distribution utility the savings have to be grossed up by distribution and transmission losses using the following formula:

$$\text{Savings (including losses)} = \frac{\text{(Savings (excluding losses)}}{\text{([(1-Distribution losses)*(1-Transmission losses)])}}$$

The savings (including losses) will be as follows:

$$\text{Annual savings (kWh)} = \frac{73440}{[(1-15\%)*(1-5\%)])} = 90947 \text{ kWh}$$

Step-3: Compute Annual Monetary Savings (Rs)

To compute the monetary savings (Rs), we will need to arrive at the highest marginal price of power purchase and average power purchase price for the life of the technology. The formula for escalating the power purchase price will be as follows:

Power Purchase Price (Rs / kWh) for x^{th} year	=	Power Purchase Price (Rs / kWh) for base year	x	(1+escalation factor)^(x)

The power purchase price computed for each year of the life of the technology using an annual escalation rate of 5% (see assumptions table) is shown in Table 24:

Table 24: Projected Power Purchase Price (Rs./kWh)

Year		0	1	2	3	4	5	6	7	8
HMC	Rs./kWh	5	5.25	5.5	5.8	6.1	6.4	6.7	7	7.4

Based on the projected power purchase prices and annual savings, the monetary savings can be computed as shown in Table 25:

Table 25: Savings (Rs) from the Program

Year		0	1	2	3	4	5	6	7	8
Savings (A) (from step-2)	kWh		90,947	90,947	90,947	90,947	90,947	90,947	90,947	90,947
HMC (B)	Rs./kWh	5	5.25	5.5	5.8	6.1	6.4	6.7	7	7.4
Savings (C = A * B)	Rs. Lakh		4.77	5.00	5.27	5.55	5.82	6.09	6.37	6.73

Step-4: Compute Net Present Value (NPV)[22] of the Savings (Rs.)

To compute the NPV of the savings, the savings for each of the years needs to be discounted. Since, the discount rate used is 10.5%, discount factor for each of the years can be computed using the following formula:

$$\text{Discount Factor for xth year} = \frac{1}{(1+ \text{Discount Factor })\text{\textasciicircum}(x)}$$

Using this formula, the discount factors for the life of the technology and the discounted savings (Rs) can be computed as follows:

[22] *Present Value is today's value of the future revenues or costs. It is dependent on discount rate and number of years and its value reduces with years i.e. present value of an amount 5 years in the future will be higher than the present value of an amount 10 years in the future. NPV is the difference between present value of revenues and present value of costs.*

Table 26: NPV of Savings (Rs.)

Year		0	1	2	3	4	5	6	7
Discount Factor (A)		1.00	0.90	0.82	0.74	0.67	0.61	0.55	0.50
Total Savings (B)	Rs. Lakh		4.77	5.00	5.27	5.55	5.82	6.09	6.37
Discounted Savings (C = A * B)	Rs. Lakh		4.29	4.10	3.90	3.72	3.55	3.35	3.19
Net Present Value (addition for all the years)	Rs. Lakh	29.12							

Step-5: Compute Costs for TRC Test:

Some cost parameters are one-time and incurred only during the 1st year of the program, such as the initial cost of the technology, M&V costs and Marketing and Administrative costs. O&M cost is a recurring cost.

Table 27: First Cost of the Program (Rs.)

S No.	Parameter	Value
1	Initial cost of the program	Rs. 18 Lakh
2	Marketing and Administrative Cost (2% of the initial cost) (B) (B= 2% * A)	Rs. 0.36 Lakh
3	M&V Costs (2% of the initial cost) (C) (C= 2% * A)	Rs. 0.36 Lakh
4	Total First Cost (D = A + B + C)	Rs. 18.72 Lakh

Recurring costs have to be borne by the participant till the end of life of the technology. The O&M cost of the first year will be Rs. 0.18 Lakh (0.5% of the initial cost of the technology). These costs are escalated for the life of the technology, similar to escalation in power purchase expense under step-3. The escalated recurring expenses are shown in Table 28:

Table 28: Recurring Cost of the Program (Rs.)

Year		0	1	2	3	4	5	6	7	8
O&M Cost (Rs) (A)	Rs. Lakh		0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25
Total Cost (One time + Recurring)	Rs. Lakh	18.72	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25

Step-6: Compute NPV of Benefits - Costs-TRC Test:

NPV of costs will be computed similar to the NPV of benefits computed under step-3. The NPV of costs will be Rs. 19.82 Lakh. Hence, the NPV of benefits minus costs will be Rs. 29.12 Lakh – Rs. 19.82 Lakh = Rs. 9.30 Lakh. Since, the TRC test is positive, the program is considered for RIM test.

Step-7: Compute Costs-RIM Test:

Similar to computation of costs in TRC test, some cost parameters are applicable only for the first year such as the initial cost of the technology, M&V costs and Marketing and Administrative costs. Other costs are recurring such as O&M cost and loss in revenue to the utility.

Table29: First Cost of the Program (Rs.)

S No.	Parameter	Value
1	Cost of the appliance – Utility's share	Rs. 0
2	Marketing and Administrative Cost (2% of the initial cost) (B) (B= 2% * A)	Rs. 0.36 Lakh
3	M&V Costs(2% of the initial cost) (C) (C= 2% * A)	Rs. 0.36 Lakh
4	Total First Cost (D = A + B)	Rs. 0.72 Lakh

Since, the O&M costs are borne by the participant, the utility does not have recurring cost in the program. However, the utility will incur loss in revenue due to reduced consumption to the participants. This is computed as the product of reduced consumption (excluding losses) and the consumer tariff, which is Rs. 2.5 / kWh for the first and is escalated for the life of the technology. The escalated costs are shown in Table 30:

Table 30: Recurring Cost of the Program (Rs.)

Year		0	1	2	3	4	5	6	7	8
Consumer Tariff – Residential (A)	Rs / kWh	2.5	2.6	2.8	2.9	3.0	3.2	3.4	3.5	2.6
Reduced Sales / annum (B)	kWh		73,440	73,440	73,440	73,440	73,440	73,440	73,440	73,440
Loss in revenue due to reduced consumption © = A * B)	Rs. Lakh		1.84	1.93	2.02	2.13	2.23	2.34	2.46	2.58
Total Cost (One time + Recurring)	Rs.	0.72	1.84	1.93	2.02	2.13	2.23	2.34	2.46	2.58

Step-8: Compute NPV of Benefits - Costs-RIM Test:

NPV of costs will be computed similar to the NPV of benefits computed under step-3. The NPV of costs for RIM test will be Rs. 11.92 Lakh. Hence, the NPV of benefits minus costs will be Rs. 29.12 Lakh – Rs. 11.92 Lakh = Rs. 17.20 Lakh. The program has cleared both TRC and RIM and hence is suggested for implementation.

Step-9: Compute Tariff Impact:

The tariff impact is the ratio of net benefits (from step - 8) to total sales of the distribution utility. Assuming total sales to be 1,000 MU, the tariff impact would be (-) Rs. 0.00172 / kWh (Rs. 17.20 Lakh / 1,000 MU). Since the NPV of benefits minus costs of the RIM test is positive, the program is expected to result in a reduction in tariff.

4.3 Guidelines on determining the SOP price

The SOP price is determined based on the CCE of the echnology, APPC, HMC and the tariff of the consumer. The following figure shows their inter-relationship for various categories:

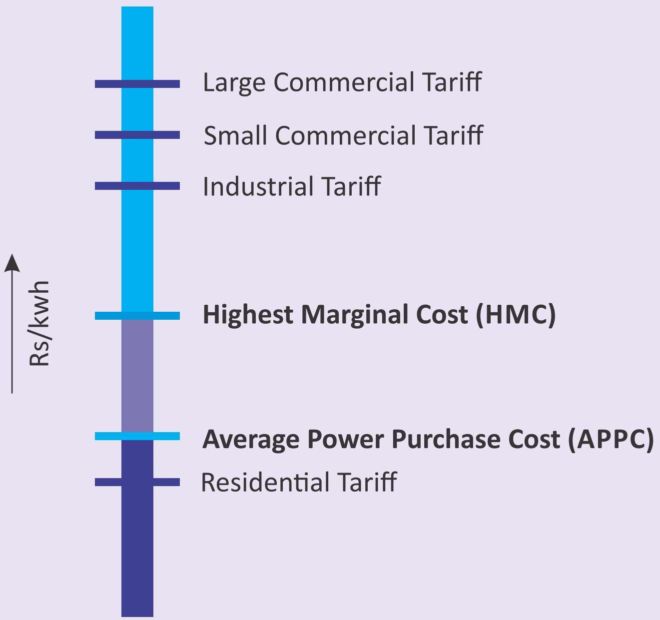


Figure 10: Typical APPC and HMC in relation to Consumer Tariffs

The residential tariff may be lower than the APPC or between the APPC and the HMC. The tariffs for small commercial, industrial and commercial consumers are typically higher than the HMC. In some cases, the tariff for small commercial category may be less than the HMC.

The price that can be offered for the SOP will depend on what the CCE is for the technology for the type of consumer under consideration, APPC, HMC and the tariff of the consumer.

A step-by-step approach to arrive at the SOP price is given below:

Step-1: Compute CCE for the technology:

CCE is the cost incurred to save 1 kWh of electricity. CCE is a function of initial cost of the technology and Capital Recovery Factor (CRF). CCE and CRF are explained in the glossary section. CRF is a factor of discount rate and the life of the technology and computed using the following formula:

CRF=[D x (1 + D)^(L)]÷[(1 + D)^(L)-1]

Where D is discount rate and L is life of the technology
Annex XV gives the CRF for various values of discount rate and life of technologies.

In case of Illustrative Program 1, where discount rate is assumed to be 10.5% and life of technology as 8 years, the CRF will be 0.1909.

The formula for computing CCE is as follows:

CCE	**=**	**First Cost of technology X CRF ÷**		**Annual Savings (kWh)**	
CCE	**=**	**Rs. 25000 X 0.1909**	**÷**	**1778**	**= Rs. 2.68 / kWh**

Hence, Rs. 2.68 will have to be spent to save 1 kWh of electricity from this technology. The process for determination of the SOP price is depicted in Figure 11 below:

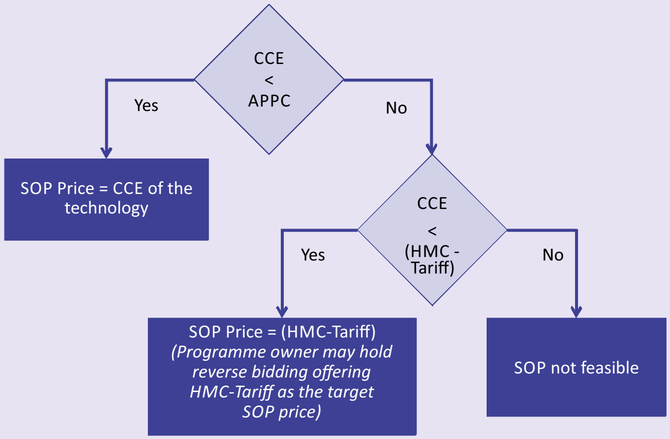


Figure 11: Determination of SOP Price

Wt. average power purchase cost is the weighted average cost of power purchase for the utility with the weight being the energy consumption for peak and off-peak hours. The formula for computing the wt. average power purchase cost is given below:

Step-2: Compute the APPC:

The APPC should be computed as the ratio of the total power purchase cost (Rs. Cr) and the total power purchase units (MU) of the utility and is expressed in Rs / kWh.

Step-3: Compute the HMC:

HMC is the cost incurred to procure the top 10% costliest power. HMC can be computed using the following steps:

- Prepare a list of all the power plants from which power is sourced by the distribution utility excluding renewable sources .
- Sort the remaining plants in descending order of their energy charges (Rs/kWh).
- Select the power plants that provide up to 10% of the total power purchase of the utility.
- HMC would be the weighted average power purchase cost (capacity charge and energy charge) with weight being the power purchase quantum (MU)

Step-4: Compare CCE with APPC for the utility:

If the CCE of the technology is less than the APPC, then the SOP price will be equal to the CCE. As computed in Step 1, the CCE is Rs. 2.68/kWh and the APPC is Rs. 3/kWh (more than the CCE), the SOP price will be equal to Rs. 2.68/kWh i.e. the utility will offer Rs. 2.68/kWh saved to the consumers for replacing inefficient AC with efficient AC under the SOP.

$$\text{Wt. Average Power Purchase Cost} = \frac{\text{APPC} * \text{Off Peak Electricity Consumption} + \text{HMC} * \text{Peak Electricity Consumption}}{\text{Total Electricity Consumption}}$$

Step-5: Compare Tariff of the consumer with HMC:

If the CCE > APPC, then to arrive at an SOP price, the consumer tariff needs to be compared with the HMC. If the tariff is less than the HMC, then the SOP price will be the difference between HMC and Consumer Tariff. If the tariff is higher than the HMC, then the difference between HMC and Consumer Tariff would be a negative benefit to the distribution utility and the program is not feasible. However, the utility may support such programs to promote energy efficiency by providing low levels of incentives.

The indicative SOP price range (along with indicative APPC, HMC and consumer tariffs) for various technologies is shown in Figure 12[23]:

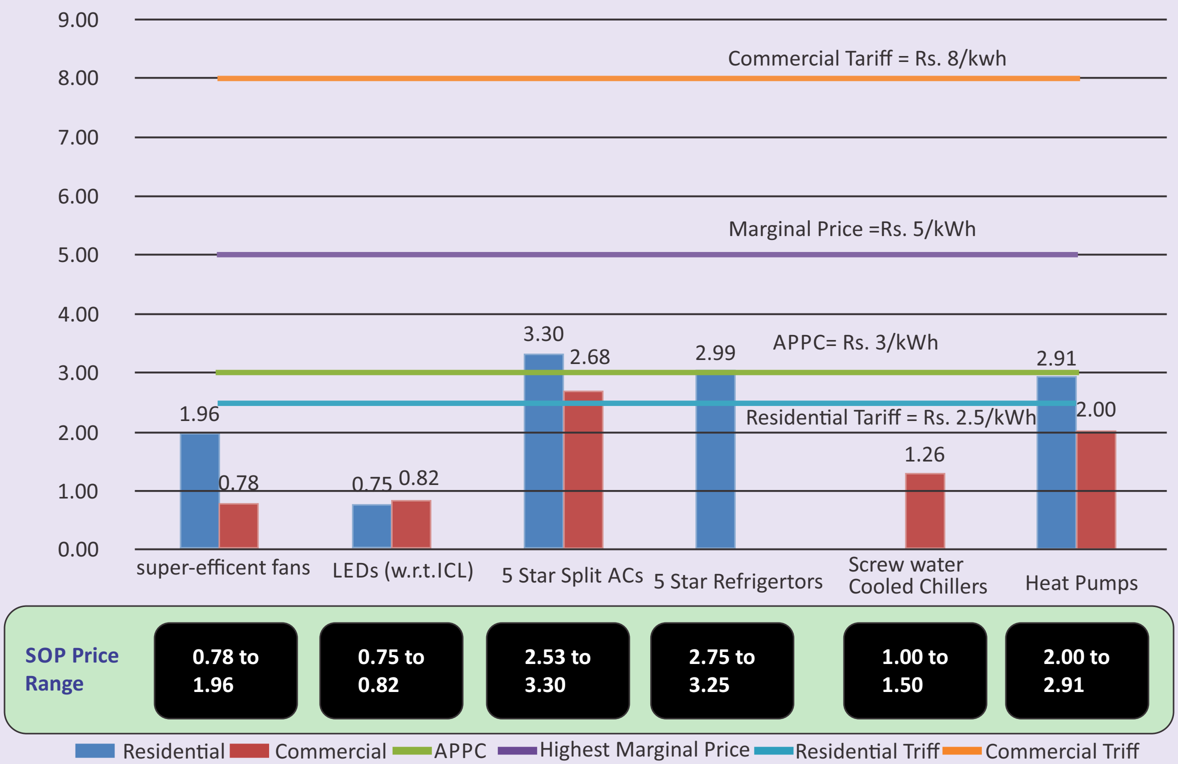


Figure 12: Indicative SOP Price Range for Various Technologies

[23] *The APPCs in the States are typically higher than the indicative values shown here.*

4.4 Guidelines on payment of incentives (SOP Price)

The first step is to decide the duration of payment of incentives to the consumer. This is typically 1 or 2 years and would depend on the end-use and/or technology. There are two options in which a utility can pay the consumer the incentives:

- Estimate the savings from the DSM measure for the duration of the SOP (1 or 2 years). Pay the consumer an amount at a price slightly less than the SOP price on the estimated savings at the start of the program. At the end of the program, post-M&V, the difference in savings can be settled. For example, if the estimated savings is 100 kWh and the SOP price is Rs. 1/kWh, then at the start of the program, the utility can pay an amount of Rs. 0.8/kWh on the estimated savings i.e. Rs. 80.
- Pay monthly incentive based on the savings achieved. For example, if the monthly savings is 10 kWh and the SOP price is Rs. 1/kWh then the consumer would receive an amount of Rs. 10 per month.

This section describes in detail the importance of the Measurement and Verification (M&V) for an SOP, possible M&V approaches, M&V process and the standardized and comprehensive M&V for a typical SOP.

5.1 The Importance of M&V for an SOP

Measurement and Verification (M&V) plays a critical role in an SOP as it forms the basis of determining the savings realised from an efficiency measure and accordingly providing incentives to the consumers. The Program Owner may choose to incentivize consumers based on the savings achieved / to be achieved or roll-out such expected savings converted into a first-cost incentive. It is important for the specific M&V approach to be designed at the outset for each program under consideration and agreed upon by all the stakeholders involved.

Worldwide a number of protocols for M&V have been developed. Using these guidelines, some Indian entities have developed India-specific M&V approaches which have been described in the next sub-section. An independent M&V agency (MVA) needs to be appointed for undertaking the M&V by the Program Owner. With BEE as the Program Owner, the independent MVA may be appointed by BEE for each State or for each end-use (e.g. for unitary ACs for all over India or for all the end-uses for the state of Gujarat). With distribution utilities as the program owner, the independent MVA may be appointed by either the distribution utility or the ERCs, from an empanelled list of MVAs at the Central, State or utility level.

5.2 Possible M&V Approaches

M&V measures can range from simple to more complex methods. The possible India-specific M&V approaches that may be adopted for an SOP are as follows:

Table31: M&V Approach

Approach	Applicability	Description
Standardized M&V	Non-complex projects – e.g. lighting retrofits, unitary AC retrofits, etc.	Savings can be estimated at program design stage and verified at implementation stage. Savings can be computed for a statistically significant sample of appliances through actual measurements of baseline and post-implementation energy usage at a certain pre-defined confidence interval and pre-defined margin of error. A kWh savings per appliance value may be computed based on these actual measurements and this figure may be applied to the population to determine the total savings from the measure.
Comprehensive M&V	Complex projects – e.g. chiller replacements, heat pump installations, etc.	Savings computed through actual measurements of baseline and post-implementation energy usage

5.3 The Measurement & Verification Process

The M&V methodology needs to be decided before the launch and implementation of the SOP and will differ for each end-use/ technology under consideration. Some programs may require comprehensive M&V and for some other programs a standardized savings approach may be sufficient. The process that may be followed for undertaking M&V for an SOP is as follows:

Appointment of MVA by (i) BEE in case of a national level SOP, and, (ii) by the utility or SERC in case of a utility or state level SOP

Preparation of M&V Plan by MVA at program outset, for each technology under consideration

Agreement of Program Owner, Aggregator and Consumer[24] on the M&V plan prepared by the MVA

Installation of meters and baseline measurements on sampling basis, as e required under the M&V plan

Installation of EE technology and issuance of installation certificate by Aggregator. At this stage, quality checks may be done by Program Owner/ MVA on sampling basis

Payment of installation-based incentive, if required under the agreement (payment to be made by Program Owner or Aggregator)

Post installation, the M&VA would perform sample checks to assess successful running of EE equipment. The checks would be done after a predefined period (e.g. 6 months or 1 year)

Assessment of energy and peak savings as per the M&V plan

Reporting of savings by MVA to utility for release of payment to participating consumers(this will also serve as an input to future SOP design)

[24] In case of large consumers

5.4 Standardized M&V

Under standardized M&V, the savings are estimated based on actual measurement of a sample of equipment. The process for performing standardized M&V is given below:

- **Applicable technologies/end-uses:** Lighting equipment, Fans, Air-Conditioning, Refrigerators, Geysers / Water-Heaters, Water Pumps etc.
- **Sample measurement of wattage or energy consumption of old technology and new technology:** Wattages or energy consumption of old and new technologies may be measured using a watt meter or a kWh meter on a sample basis for both old and new technology. The sample size for such measurement may be computed by using a confidence level and relative precision of 90% and 10% respectively.
- **Measurement of hours of operation:** Hours of operation for a sample of equipment may be measured using an "hour meter" before and after the installation of the new equipment. This is because once the efficient product is in place, there is a possibility that it is operated for longer times than before. Post-installation hours of operation may however, also be assumed same as the pre-installation hours of operation. The sample size for such measurement may be computed by using assumptions for confidence level and relative precision.
- **Estimation of savings:** Based on the number of hours and wattage, the standardized savings will be computed and used for processing the payments to the participating consumers in the SOP program

5.5 Comprehensive M&V

Under comprehensive M&V, savings are estimated based on the actual measurement of energy consumption for all the equipment installed. The process for performing comprehensive M&V is given below:

- **Applicable technologies/end-uses:** Chillers, Heat Pumps, Thermal Storage etc.
- **Estimation of baseline parameters:** The hours of operation at various load conditions, wattage of the equipment and other parameters like power input and chiller output in case of chillers will be measured before the installation of the new equipment. The baseline curve will be generated based on the data captured.
- **Post-Installation parameters:** Similar readings for hours of operation at various load conditions, wattage of the equipment and other parameters will be measured after installation of new equipment. Based on the data captured on the new equipment, post-implementation equipment curve will be generated.
- **Estimation of savings:** The savings will be the difference in the computed baseline curve and the post-implementation curve.

The types of end-uses/ technologies that are most amenable for comprehensive M&V and the measurements that may be taken before and after installation are as listed here. In case of comprehensive M&V, the measurements need to be taken for parameters other than energy consumption, wattage of the equipment and hours of operation for creating the baseline curve. The parameters to be measured for various technologies / end-uses are listed in Table 32:

Table 32: Comprehensive M&V - Technologies and Parameters to be Measured

Technology	Parameters to be measured
Chiller	kW before and after installation, hours of use before and after installation, relative humidity, ambient temperature, air exchange rate **Evaporator coil** - Chilled water flow rate (kg/hr), Chilled water inlet & outlet temperatures (°C), Net Refrigeration Capacity (TR) **Water cooled condenser** – Cooling water mass flow rate (kg/hr), cooling water condenser inlet & outlet temperatures (°C), Heat rejected at condenser (TR) **Air cooled condenser** – Cooling air mass flow rate (kg/hr), cooling air condenser inlet & outlet temperatures (°C), Heat rejected at condenser (TR)
Thermal Storage	kW before and after installation, hours of use before and after installation, volume, charging & discharging rate (TRH/hr), ambient temperature (°C)
Heat Pump	kW before and after installation, hours of use before and after installation, thermostat temperature (°C), ambient temperature (°C), inlet water temperature (°C)

As covered in Section 2.3, the roll-out and implementation of an SOP may either be at the national level, in which case the Program Owner will be the Bureau of Energy Efficiency (BEE), or at a utility level, in which case the Program Owner will be the distribution utility. In either case, Aggregators / sub-contracted energy service providers will implement the SOP on behalf of the Program Owner and an independent M&V Agency will be appointed to undertake the M&V for the program. The roles and responsibilities of various stakeholders are discussed below.

6.1 Program Owner

- Identify end-uses and/or technologies that can be targeted for SOP based on load research, assessment of energy and peak deficits, technology availability and benefit-cost analysis
- Determine SOP price to be offered for each of the end-uses and/or technologies
- Obtain required approvals from central ministry or SERC
- Tie in funding for the program through various funding options (discussed in Section 2.4)
- Draft RfP for selecting Aggregator
- Appoint Aggregator for program implementation based on pre-defined qualification criteria
- Sign agreement with Aggregator
- Draft RfP and appoint MVA
- Ensure necessary data are provided to MVA
- Ensure adherence to the accepted M&V plan and verify savings reported by Aggregator
- Pay Aggregator the pre-determined SOP price based on the demonstrated savings from the implemented DSM programs as per the terms of the agreement signed with the Aggregator. If Program Owner has directly enrolled consumers (e.g. large commercial establishments), directly pay the SOP price on the demonstrated savings to the consumer.

6.2 Aggregator and/or Energy Service Provider (ESP)

- Contract with Program Owner
- Further sub-contract required work to ESPs based on end-use (when at national/utility level) or state (when at national level) and sign agreement(s) with sub-contracted ESPs
- Prepare program outreach material
- Reach out to consumers and enroll them into the program
- Oversee and regularly update Program Owner on status of enrolment of consumers
- Appoint vendor(s) through a bidding process and sign contracts with selected vendors
- Ensure installation of efficient technologies at consumer's premises and/or provide assistance to consumers for undertaking operational efficiency improvements (independently or through vendors)
- Ensure safe disposal of old equipment
- Oversee and regularly inform Program Owner on status of implementation and incentives to be paid as per the SOP
- On receipt of the payment from Program Owner, pass on incentives to the consumers as per terms of agreement
- Provide required support to MVA for determining savings

- Make payments to sub-contracted ESPs as per terms of agreement
- Provide regular updates to Program Owner on status of implementation work
- Provide necessary O&M support during the SOP tenure

6.3 M&V Agency

- Contract with Program Owner for M&V of the SOP
- Adopt appropriate methodology to determine consumer baseline consumption for various end-uses before implementation of efficiency measure; seek support from Aggregator/sub-contracted ESPs, as required
- Discuss with concerned stake holders and get sign-off on M&V plan from Program Owner
- Ascertain savings from efficiency measure as per M& V plan
- Provide regular updates to Program Owner on status of M&V

6.4 Participating Consumers

- Enroll in the program
- Support Aggregator and sub-contracted ESPs in implementing the efficiency measure and undertaking safe disposal of old equipment, where applicable
- Support MVA in determining the savings achieved from implementation of the program

ANNEX I: ABBREVIATIONS

AC	:	Air-Conditioner
AC	:	Alternating Current
ARR	:	Aggregate Revenue Requirement
BEE	:	Bureau of Energy Efficiency
CCE	:	Cost of Conserved Energy
CEA	:	Central Electricity Authority
CFL	:	Compact Fluorescent Lamp
COP	:	Coefficient of Performance
CRF	:	Capital Recovery Factor
DC	:	Direct Current
DSM	:	Demand Side Management
EE	:	Energy Efficiency
EESL	:	Energy Efficiency Services Limited
EMS	:	Energy Management System
ERC	:	Electricity Regulatory Commission
ERSE	:	Energy Services Regulatory Authority
ESP	:	Energy Service Provider
FTL	:	Fluorescent Tube Light
HPWHS	:	Heat Pump Water Heating System
HVAC	:	Heating, Ventilation and Air-Conditioning
IIM-A	:	Indian Institute of Management - Ahmedabad
IPLV	:	Integrated Part Load Value
IPMVP	:	International Performance Measurement and Verification Protocol
LED	:	Light Emitting Diode
LR	:	Load Research
M&V	:	Measurement and Verification
MVA	:	Measurement and Verification Agency
NCEF	:	National Clean Energy Fund
NDPL	:	North Delhi Power Limited
PSE&G	:	Public Service Electric and Gas Company
SCE	:	Southern California Edison
SDA	:	State Designated Agency
SDC&E	:	San Diego Gas & Electric
SOP	:	Standard Offer Program
SPO	:	Standard Product Offer
TES	:	Thermal Energy Storage
VSD	:	Variable Speed Drive

Table 33: Glossary of Terms

S.No.	Glossary	Definition
1	Aggregate Revenue Requirement (ARR)	ARR is the amount to be recovered by the distribution company through the tariff route from consumers towards the cost incurred for supplying the electricity. This is computed by taking into consideration all the cost parameters such as power purchase cost, O&M expenses and revenue such as subsidies from State Government.
2	Aggregator	This is the entity implementing the SOP on behalf of multiple consumers and aggregating the savings achieved. The Aggregator will coordinate with consumers in the implementation of the SOP.
3	Average Cost of Power Purchase (APPC)	This is the average cost of power purchase for the utility which is simply the ratio of total power purchase cost to the total power purchase quantum and is expressed in Rs. / kWh
4	Capital Recovery Factor (CRF)	The capital recovery factor can be interpreted as the amount of equal (or uniform) payments to be received for n years such that the total present value of all these equal payments is equivalent to a payment of one dollar at present, if interest rate is i. CRF= capital recovery factor = [i(1+i)n]/[(1+i)n-1]
5	Coefficient of Performance (COP)	The coefficient of performance is used to quantify the performance of refrigeration cycles. The COP is a ratio of Cooling or heating provided by electrical energy consumed. Higher COPs equate to lower operating costs. The COP may exceed 1, because it is ratio of output vs loss. COP is highly dependent on operating conditions, especially absolute and relative temperature between sink and system.
6	Compounded Annual Growth Rate (CAGR)	This is the average year-on-year growth rate estimated based on the present value, the future value and the number of years. The formula for computing CAGR is ((f/p)^(1/n)-1) - where f is the future value, p is the present value and n is the number of years.

S.No.	Glossary	Definition
7	Cost of Conserved Energy (CCE)	This is the cost to be incurred to save 1 kWh of electricity is expressed in Rs / kWh.
8	Demand Side Management (DSM)	Demand side Management is used to describe the actions of a utility, beyond the consumer's meters, with the objective of reducing electricity use through activities or programs that promote electric energy efficiency or conservation, or more efficient management of electric energy loads.
9	Energy Management System (EMS)	The Energy management system is a system of computer-aided tools used by operators of electric utility grids to monitor, control, and optimize the performance of the generation and/or transmission system.
11	Highest Marginal ost	Cost incurred by the distribution company to purchase the top 10% of the costliest power.
12	Integrated Part Load Value (IPLV)	Integrated Part Load Value or IPLV is the rating that was developed by the Air-conditioning and Refrigeration Institute. Unlike EER, however, the IPLV measures the efficiency of air conditioners under a variety of conditions - that is, when the unit is operating at 25%, 50%, 75% and 100% of capacity and at different temperatures. IPLV is only calculated for non-residential central air conditioners - if you are purchasing a central air conditioning unit for your home, you should compare efficiency based on the SEER rather than the IPLV.
13	Load Management	It is the process of balancing the demand with supply by adjusting the load at the consumer's end.
14	Measurement and Verification (M&V)	The process for quantifying savings delivered by the implemented energy efficiency measure, as well as the sub-sector of the energy industry involved with this practice.
15	National Clean Energy Fund (NCEF)	Fund, created through collection of clean energy cess on sale of coal, to be utilised for supporting Clean Energy projects.

S.No.	Glossary	Definition
16	Net Present Value (NPV)	Net present value (NPV), also known as net present worth, is an approach to evaluating investments that assesses the difference between all the revenue the investment can be expected to achieve over its whole life and all the costs involved, taking inflation into consideration and discounting both future costs and revenue at an appropriate rate. The discount rate used may be the rate at which banks and financial institutions would lend to consumers, and adjusting for risks or other factors. The DSM Regulations of Maharashtra Tests suggest that a discount rate of 10.5% be used for the benefit-cost assessment of DSM programs.
17	Operations and Maintenance (O&M)	A monthly/annually recurring cost incurred towards maintenance of the equipment.
18	Program Design Document (PDD)	This is the document detailing the DSM programs for implementation including Benefit Cost Analysis to be presented to the Electricity Regulatory Commission for approval.
19	Standard Offer Program (SOP)	SOP is the purchase of energy and/or demand savings by a distribution company from consumers for energy and/or demand savings from key end-uses, at a standard rate (Rs/kW or Rs/kWh) agreed upon at the start of the program.
20	Standard Product Offer (SPO)	In which a standardized product is offered by the utilities to their consumers.
21	State Designated Agency (SDAs)	SDAs are mandated to support in the implementation of DSM programs as per the Energy Conservation Act. These are agencies such as Energy Efficiency and Renewable Energy Management Centre in Delhi.
22	State Energy Conservation Fund (SECF)	This is fund collected through Consumer Benefit Charge from the consumers or any other sources to be made available for implementation of DSM programs.
23	Strategic Conservation	This is the reduction of distribution company's load more or less equally throughout the load curve.

A brief snapshot of some of the international SOPs implemented is presented in this section.

Table 34: Brief Snapshot of International SOPs Implemented

S.No.	Utility - Location	Launc h Year	No. of Projects	Target Sectors	End-Use Targeted	Budget Approved	Eligible Sponsors	Savings (MW)	Savings (GWh)	M&V Methodology
1	Centerp oint - Texas	2011	101	☐ Residential ☑ Commercial ☑ Industrial ☑ Public Buildings ☑ Educational ☐ NGO ☐ Agriculture	☑ HVAC ☑ Lighting ☐ Water heating ☑ Motors ☑ Building Envelope ☑ Industrial processes ☑ EMS ☑ Refrigeration	$ 5.6 M (2011)	☑ ESCO ☑ Customer ☐ NGO ☐ Engineering firms ☑ Technology providers ☐ Educational institute	15	NA	☑ Deemed ☑ Simplified M&V ☑ Detailed M&V
2	ESKOM – South Africa	2010	61	☑ Residential ☑ Commercial ☐ Industrial ☑ Public Buildings ☐ Educational ☐ NGO ☐ Agriculture	☐ HVAC ☑ Lighting ☑ Water heating ☑ Motors ☐ Building Envelope ☐ Industrial processes ☑ EMS ☑ Refrigeration	ZAR 5.4M (2011-2014)	☐ ESCO ☑ Customer ☑ NGO ☑ Engineering firms ☑ Technology providers ☐ Educational institute	31	148	☑ Deemed ☐ Simplified ☐ M&V Detailed M&V

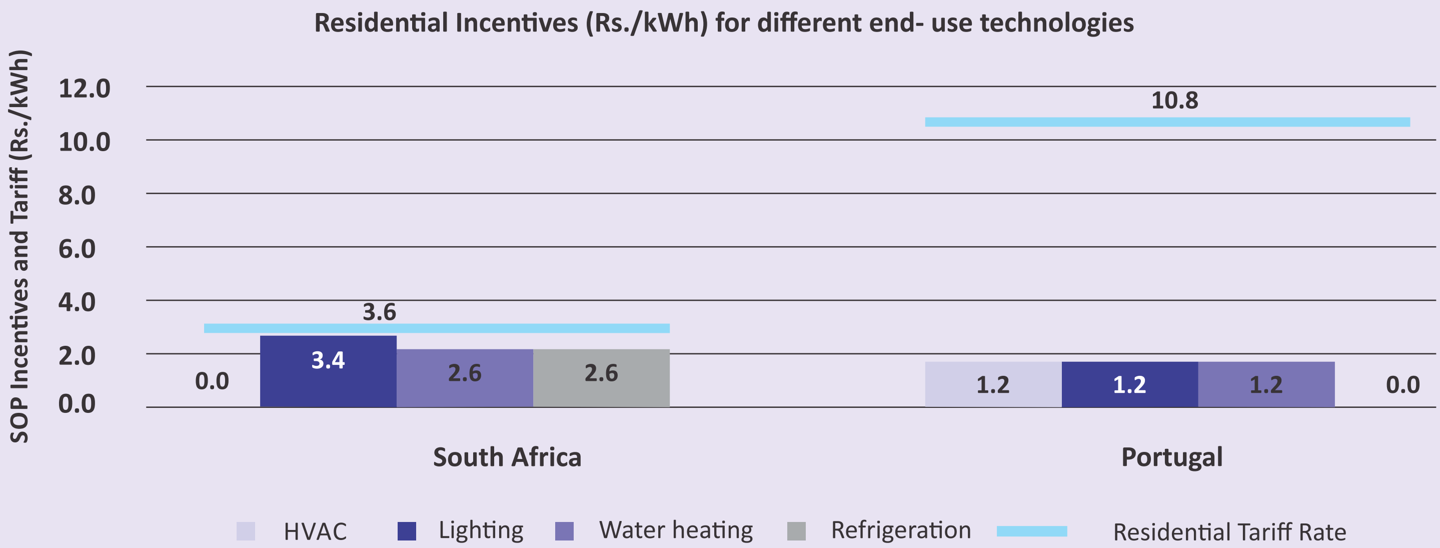
S.No.	Utility - Location	Launch Year	No. of Projects	Target Sectors	End-Use Targeted	Budget Approved	Eligible Sponsors	Savings (MW)	Savings (GWh)	M&V Methodology
3	Southern California Edison - California	2009	75	☐ Residential ☑ Commercial ☐ Industrial ☐ Public Buildings ☐ Educational ☐ NGO ☑ Agriculture	☑ HVAC ☑ Lighting ☐ Water heating Motors ☑ Building Envelope ☑ Industrial processes ☐ EMS ☑ Refrigeration	$ 3.1 B (2009-2012)	☑ ESCO ☐ Customer ☐ NGO ☑ Engineering firms ☑ Technology providers ☐ Educational institute	51	348	☑ Deemed (DEER) ☐ Simplified M&V ☐ Detailed M&V
4	ERSE (Energy Services Regulatory Authority) - Portugal	2007	- -	☑ Residential ☑ Commercial ☑ Industrial ☐ Public Buildings ☐ Educational ☐ NGO ☐ Agriculture	☑ HVAC ☑ Lighting ☑ Water heating ☑ Motors ☐ Building Envelope ☐ Industrial ☑ processes ☐ EMS Refrigeration	€23 M	☑ ESCO ☑ Customer ☐ NGO ☑ Engineering firms ☑ Technology providers ☑ Educational institute	NA	0.5	☐ Deemed ☐ Simplified M&V ☑ M&V
5	Public Service Electric and Gas Company (PSE&G) – New Jersey	1995		☑ Residential ☑ Commercial ☑ Industrial ☐ Public Buildings ☐ Educational ☐ NGO ☐ Agriculture	☑ HVAC ☑ Lighting ☐ Water heating ☐ Motors ☐ Building Envelope ☐ Industrial processes ☑ EMS ☐ Refrigeration	$ 2.2 M (1995)	☑ ESCO ☑ Customer ☐ NGO ☐ Engineering firms ☐ Technology providers ☐ Educational institute	NA	NA	☑ Deemed ☐ Simplified M&V ☑ Detailed M&V

The technologies targeted under various end-uses are listed in Table 35:

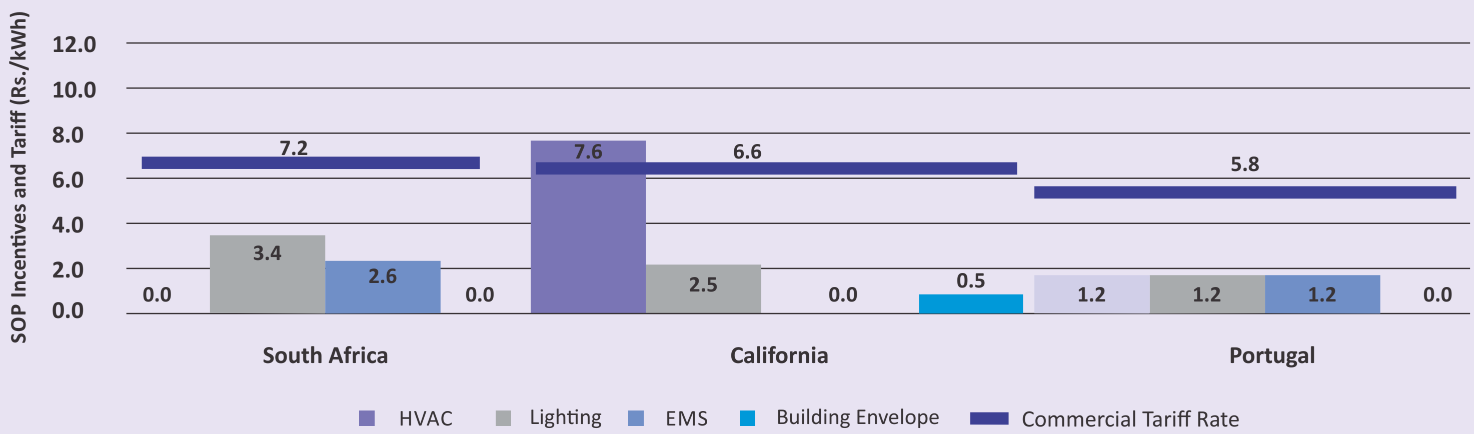
Table 35: Technologies Targeted in International SOP

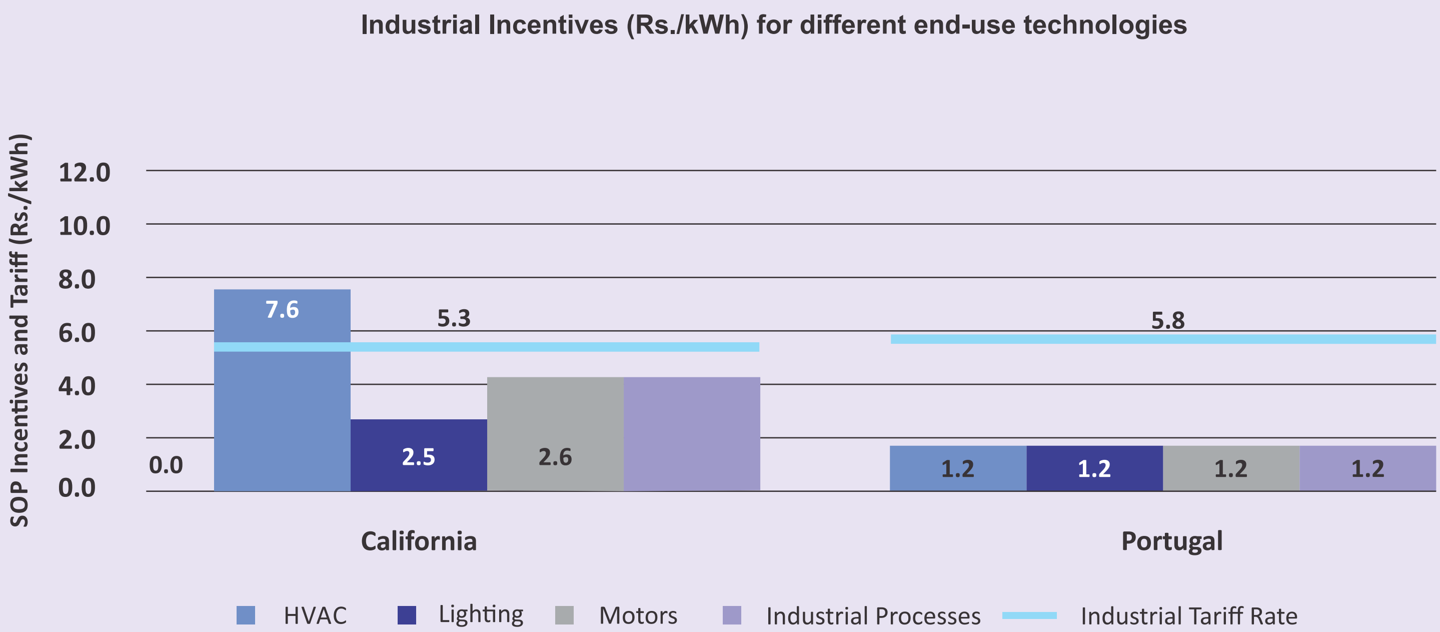
End-Use	Technologies
HVAC	High Efficiency DX/HP, High Efficiency Chillers, High Efficiency Room/Terminal, Economizers, Control Systems, Variable Speed Drives, Occupancy Sensors, Duct Sealing and Balancing, Insulation
Lighting	Compact Fluorescents, Electronic Ballasts, Reflector Systems, Efficient Fluorescent Lamps (T-8, T-5, etc.), Lighting Controls/ Daylight dimming control, Occupancy Sensors, High Intensity Discharge lamp
Water Heating	Load Control (Cycling), High Efficiency, Insulation Blankets, Low-Flow Showerheads, Low-Flow Aerators, Solar Assisted
Motors	High Efficiency, Variable Speed Drives
Building Envelope	Insulation, Infiltration Control, Glazing and Glazing Control, Windows
Industrial Processes	Compressed Air, Motors and Pumps, Heat recovery systems, Installation of capacitors to reduce reactive power , Transformers with low losses, Energy recovery, Cogeneration projects, Fuel switching from electric to gas, Cooling towers upgrades
Refrigeration	High Efficiency, Controls, Variable Speed Compressors, Multi-Stage Compressors

Figure 13: Incentives Offered by Various Utilities in International SOPs



Commercial Incentives (Rs./kWh) for different end-use technologies





EMS: Energy Management Solution

The Terms of Reference (ToR) that may be used for appointing an outsourced entity for conducting Load Research for the utility are as follows:

1. Analysis of utility load data and preparation of System Load Curve:
   - I Collect utility load data at transmission-distribution interface
   - ii. Plot load data and create the load curve
   - iii. Assess base load and peak loads
2. Analysis of utility power procurement data and preparation of System Cost Curve:
   - I. Analyze 15-minute cost of power purchase for a defined period (e.g. one financial year)
   - ii. Plot power purchase cost curve
   - iii. Determine average power procurement cost and highest marginal cost of power purchase
3. Compare System Load Curve with System Cost curve, establish peak coincidence and highlight other inferences
4. Preparation of Category Load Curves:
   - i. Collect and analyze feeder level data from the utility
   - ii. Select predominant feeders for each of the categories (more than 90% load from the selected category) and plot the load curves
   - iii. Compare Category Load Curves with System Load Curve and System Cost Curve and highlight inferences
5. Consumer survey and preparation of system, category and appliance load curves
   - i. Undertake sampling and select sample
     - a. Prepare sampling methodology and plan
     - b. Determine stratified and statistically significant sample size (sample size to be determined for all relevant tariff slabs), using energy consumption data as the variable
     - c. Select random sample
   - ii. Prepare category-wise questionnaires (e.g. residential, small commercial, large commercial, common utilities for housing societies, etc.) for assessing aspects such as appliance ownership, appliance usage patterns, willingness to pay for energy efficient appliances, awareness of energy efficient appliances, etc.
   - iii. Administer the questionnaire to the randomly selected sample and collect verbal inputs
   - iv. Analyze data collected on appliance ownership and usage patterns and create load curves for various appliances
   - v. Compare Appliance Load Curves with Category Load Curves and System Load Curve establish peak coincidence
   - vi. Analyze and present other inputs received from consumers
6. Analysis of vendors:
   - i. Analysis of total sales and the sales of energy efficient technologies
   - ii. Analysis of price of efficient technology with respect to price of energy inefficient technologies
   - iii. Gauge the readiness of the market to cater to energy efficient technologies

The step-by-step approach that may be followed for undertaking the consumer surveys is elaborated as follows:

Step 1. Prepare Sampling Methodology and Sampling Plan for the consumer survey

Step 2. Determine stratified and statistically significant sample size (sample size to be determined for all relevant tariff categories and tariff slabs) using energy consumption data as the variable. An example of how the sample size can be computed for residential consumers is as follows:

Table36: Step-by-step Approach for Undertaking Consumer Surveys

Circle (or other geographic region or any other parameter)	Urban/ Rural (or any other parameter)	Consumer tariff slab	Sample size (no.)
Circle A	Urban	0 – 100 kWh per month	A
		100 – 300 kWh per month	B
		300 – 500 kWh per month	C
		Over 500 kWh per month	D
	Rural	0 – 100 kWh per month	E
		100 – 300 kWh per month	F
		300 – 500 kWh per month	G
		Over 500 kWh per month	H
Circle B	Urban	0 – 100 kWh per month	I
		100 – 300 kWh per month	J
		300 – 500 kWh per month	K
		Over 500 kWh per month	L
	Rural	0 – 100 kWh per month	M
		100 – 300 kWh per month	N

Circle (or other geographic region or any other parameter)	Urban/ Rural (or any other parameter)	Consumer tariff slab	Sample size (no.)
		300 – 500 kWh per month	O
		Over 500 kWh per month	P
Circle C	...	...	...
	...	...	...
TOTAL RESIDENTIAL SAMPLE SIZE = A + B + C + D + E + F + G + H + I + J + K + L + M + N + O + P + ...			

Step 3. Select random samples, i.e. a list of consumers, in each of the strata:

In the above example, the random sample of 'A' number of consumers will be selected among those 'Urban' consumers in 'Zone A' who consume between '0 to 100 kWh per month'.

For the randomly selected consumers, prepare a list with the following details: consumer number, name, address, and phone number, email ID (where available).

It is suggested that the list of consumers so prepared should be in multiples of 3 to 4 of the actual sample size of consumers to be interviewed. For example, if the sample to be interviewed is 30 consumers, the list should contain 100-120 entries. This will help tide over challenges in the field, such as consumer premises being closed or consumers refusing to participate in the survey.

Step 4. Prepare category-wise questionnaires (e.g. residential, small commercial, large commercial, common utilities for housing societies, etc.). Some characteristics of the questionnaires are:

The questionnaires should be simple and self-explanatory. Additional notes may be added where required.

The questionnaires may be translated into the local language and the script to be read by the interviewer may be included.

The questionnaire should be as objective as possible; subjective or open-ended responses are difficult to analyze once the survey is completed.

The data entry formats which will be used to capture the inputs received in the questionnaire, should be prepared at this stage. The questionnaire may be modified, if needed, to enable ease of data entry on completion of the survey.

Step 5. Prepare for administrative requirements of the survey – this includes:

- A generic letter from the utility stating that the survey has been authorized by the utility and the interviewer approaching the consumer is an authorized representative.
- A temporary identity card for the interviewer.

Step 6. Undertake training of interviewers (the field personnel who will conduct the actual interviews). The training should cover:

- The purpose of the Load Research and what is expected to be achieved
- Why the survey is being conducted and how the results will be used
- Explanation of each question in the questionnaire
- How the interviewer should approach the consumer, introduce the subject and request for a response to the questionnaire
- How each question should be asked and how the responses should be captured in the questionnaire – e.g. whether the interviewer should prompt the consumer or not for a response, whether the responses should be circled on the questionnaire/ whether tick marks should be put in boxes on the questionnaire, etc.

Step 7. Communicate to consumers that the Load Research activity is being conducted by the utility. The options that may be used for reaching out to consumers are given in Annex XIX.

Step 8. Administer the questionnaire to the randomly selected sample of consumers and collect verbal inputs. Utility personnel may accompany the surveyor especially for consumers such as the large commercial consumers, large industrial consumers and high-end residential consumers.

Step 9. Undertake data entry of the responses received in the consumer survey. At this stage, any discrepancies noticed in the questionnaire may be rectified by contacting the consumers again.

Step 10. Analyze data and document inputs received in the consumer survey.

The analysis that may be undertaken in a typical Load Research based on (i) the data available with the utility (energy consumption data, power purchase data, feeder data, AMR data, etc.), (ii) the vendor assessment, and, (iii) the consumer survey, is as given in the following Table 37.

Table 37: Load Research Activities, Objectives and Analysis

Load Research Activity	Objective of the Activity	Analysis
Analysis of data available with the utility		
Historical analysis of the monthly energy consumption of consumers	To understand the trend in consumption of various types of consumers and category of consumers contributing most to the energy consumption	Using the data available with the utility, a graph can be plotted by sub-category e.g. LT-I 0-300.
Historical analysis of system load – Generation annual load curve	To determine when the peak occurs for the system	The data from for hourly load registered at the transmission generation periphery can be used for generation of load curve.
Historical analysis of hourly power purchase cost of the utility	To understand the cost incurred for peak power and the average cost of power purchase	Gather information on power purchase cost and system load, superimpose the cost of power purchase on the load curve
Analysis of feeder level data for predominant feeders	To generate category level load curves	Identify predominant feeders such as residential feeder and gather hourly load registered. The category level load curve can be generated from the data.
Vendor Analysis		
Sales of Efficient Technologies	To understand the current market penetration	Contact a few equipment suppliers and understand the sales of efficient technology w.r.t inefficient technology
Analysis of pricing and major players in the sector	To understand the incremental cost to be incurred for efficient technology	The information will be available with the equipment suppliers
Market readiness	Whether the market will be able to cater to the demand that will be created by the SOP	Data on output of the equipment supplier, stock of the supplier etc. needs to the gathered.

Load Research Activity	Objective of the Activity	Analysis
Consumer Survey and Analysis		
Sampling Plan and Methodology for the consumer survey	Selection of sample size for the consumer survey	Appropriate sampling technique such as stratified sampling should be adopted. Sampling plan will include the sample selected from each of the categories
Preparation of questionnaire for consumer survey	To obtain information on appliance usage by the consumers	Will includes questions such as ownership of appliances, hours in which appliances are used, ratings of appliances
Generation of appliance level load curve	To understand the contribution of various appliances to the load curve	The appliance load curves will be plotted from the consumers survey and superimposed on the load curve to understand the appliances that are operated during peak hours

1. General information

Name	
Location	
Contact number	
Email ID	
Area of the house/ apartment/ commercial establishment	
Energy Consumption in the last month (kWh) – From the electricity bill	
Average electricity bill (Rs.)	
Working hours/ time that people are in the house	
Average money spent on communication per month (mobiles/landlines/ Wi-Fi etc.)	

2.Please list the details of appliances available in your house, their year of purchase, and usage timings:

Appliance	Type	No. of appliances	No. of appliances typically used at a time	Year of last purchase	Size	Hours of usage <tick mark where applicable>																								Is there any seasonal variation in usage? If yes, please elaborate.	Are you planning to purchase/ replace in the next 1-2 years
						12am to 1am	1am to 2am	2am to 3am	3am to 4am	4am to 5am	5am to 6am	6am to 7am	7am to 8am	8am to 9am	9am to 10am	10am to 11am	11am to 12noon	12noon to 1pm	1pm to 2pm	2pm to 3pm	3pm to 4pm	4pm to 5pm	5pm to 6pm	6pm to 7pm	7pm to 8pm	8pm to 9pm	9pm to 10pm	10pm to 11pm	11pm to 12am		
Tube light	☐ Regular ☐ T5 ☐ LED																														
Bulb	☐ Regular ☐ LED																														
	☐ LED																														
Lighting controls																															
Ceiling fan	☐ Regular ☐ Small				-																										
Window AC	☐ 1 star ☐ 2 star ☐ 3 star ☐ 4 star ☐ 5 star				*<ton>*																										
Split AC	☐ 1 star ☐ 2 star ☐ 3 star ☐ 4 star ☐ 5 star ☐ Inverter				*<ton>*																										
Chillers	☐ Reciprocating ☐ Screw ☐ Scroll				*ton*																										

Appliance	Type	No. of appliances	No. of appliances typically used at a time	Year of last purchase	Size	**Hours of usage** *<tick mark where applicable>*																								Is there any seasonal variation in usage? If yes, please elaborate.	Are you planning to purchase/ replace in the next 1-2 years
						12am to 1am	1am to 2am	2am to 3am	3am to 4am	4am to 5am	5am to 6am	6am to 7am	7am to 8am	8am to 9am	9am to 10am	10am to 11am	11am to 12noon	12noon to 1pm	1pm to 2pm	2pm to 3pm	3pm to 4pm	4pm to 5pm	5pm to 6pm	6pm to 7pm	7pm to 8pm	8pm to 9pm	9pm to 10pm	10pm to 11pm	11pm to 12am		
Refrigerator	☐ Direct Cool ☐ Frost free				*<lt.>*																										
Washing machine	☐ Semi auto ☐ Fully auto				*<kg.>*																										
Geyser	☐ Storage ☐ Instant				-																										
TV	☐ Regular ☐ LCD ☐ LED				*<inch>*																										
Wireless router/ modem																															
Laptop/ computer																															
Printer																															
Mobile phone charger	-				-																										

3. If you are aware of energy efficient appliances, please rank the most important reason(s) for not replacing the existing inefficient appliances?

- ☐ High initial cost
- ☐ Not sure about the savings
- ☐ Existing appliance is working well
- ☐ Existing appliance is recently bought
- ☐ Time constraints
- ☐ Planning to replace in the near future
- ☐ Energy expenses are a small part of total monthly household expenses

4. Are you aware of energy efficiency programs undertaken by your utility? Yes ☐ No ☐

   i. If yes, have you participated in any of those programs? Yes ☐ No ☐ If no, why so? ____________________

5. If incentivized, are you willing to switch off/ reduce your loads if required by the utility at specific times in the day?

   ☐ Yes ☐ No

   - If yes, at what incentive level (Rs/kWh)? ☐ 0.5 ☐ 1.0 ☐ 1.5 ☐ 2.0 ☐ 2.5 ☐ 3.0
   - What kind of loads are you willing to reduce?

   ☐ Lighting ☐ HVAC ☐ Others ______________________ (please specify)

   c. How will you reduce loads?

   ☐ Switch off ☐ Modulate ☐ Change of operation timings Others __________(please specify)

6. Are you aware of technologies such as heat pumps that reduce electricity consumption for heating requirements of the whole building?

   ☐ Yes ☐ No

7. How much are you willing to pay for efficient appliances, based on the expected savings you will get?

Energy Efficient Appliance	Average price of inefficient appliance (Rs.)*	Average price of efficient appliance (Rs.)*	Price difference between inefficient and efficient appliance (Rs.)	Maximum Expected yearly savings from efficient appliance (Rs.)	Payback period (years)	Willingness to pay (Rs.) *<tick mark where applicable>*
T5 tube light (and ballast)	500 *(T12 tube light)*	600	100	350	1 -2	☐ Up to Rs. 500 ☐ Rs. 500 to Rs. 600 ☐ Rs. 600 to Rs. 800
LED tube light	500 *(T12 tube light)*	1300	800	200	6 -7	☐ Up to Rs. 800 ☐ Rs. 800 to Rs. 1000 ☐ Rs. 1000 to Rs. 1300 ☐ Rs. 1300 to Rs. 1500
LED bulb	30 *(Incandescent bulb)*	600	570	500	1-2	☐ Up to Rs. 50 ☐ Rs. 50 to Rs. 200 ☐ Rs. 200 to Rs. 600 ☐ Rs. 600 to Rs. 800
Ceiling fan	1500 *(Inefficient fan)*	2300	800	400	5-6	☐ Up to Rs. 1500 ☐ Rs. 1500 to Rs. 1800 ☐ Rs. 1800 to Rs. 2000 ☐ Rs. 2000 to Rs. 2300 ☐ Rs. 2300 to Rs. 2600

ANNEX V: SAMPLE QUESTIONS FOR CONSUMER SURVEY – RESIDENTIAL AND COMMERCIAL CATEGORY

Energy Efficient Appliance	Average price of inefficient appliance (Rs.)*	Average price of efficient appliance (Rs.)*	Price difference between inefficient and efficient appliance (Rs.)	Maximum Expected yearly savings from efficient appliance (Rs.)	Payback period (years)	Willingness to pay (Rs.) *<tick mark where applicable>*
Split AC – 1.5 ton	19,000 *(Inefficient window AC)*	42000	23000	7000	5-6	☐ Rs. 26000 to Rs. 28000 ☐ Rs. 28000 to Rs. 35000 ☐ Rs. 35000 to Rs.40000 ☐ Rs. 40000 to Rs.70000
Window AC – 1.5 ton	19,000 *(Inefficient window AC)*	30000	11000	6000	5-6	☐ Up to Rs. 19,000 ☐ Rs.19000 to Rs. 25000 ☐ Rs. 25000 to Rs. 28000 ☐ Rs. 28000 to Rs. 30000
Refrigerator – 250 L frost free	14,000 *(Inefficient refrigerator)*	20000	6000	3500	5-6	☐ Up to Rs. 14000 ☐ Rs. 14000 to Rs. 17000 ☐ Rs. 17000 to Rs. 20000 ☐ Rs. 20000 to Rs. 25000
Geyser	5,000 *(Inefficient geyser)*	8000	3000	7000	1-2	☐ Up to Rs.5000 ☐ Rs. 5000 to Rs.7000 ☐ Rs.7000 to Rs. 8000 ☐ Rs. 8000 to Rs.10000

**Retail prices*

8. How will you fund the replacement of appliances?

   ☐ Own funds ☐ Loan from financial institution ☐ Engage an energy service provider

1. End use technology/products you provide:

☐ Fan ☐ Air Conditioner ☐ Lighting ☐ Water Heating
☐ Water Pump ☐ Thermal Energy Storage ☐ Others (please specify) ____________

2. Are you a manufacturer or distributor of technology: ☐ Manufacturer ☐ Distributor

   a. If manufacturer, how do you get the raw materials/parts for the manufacturing of the product? ____________
   b. If distributor, how do you import the products for distribution? ________________

3. How many manufacturing and distribution units do you have in India?

☐ 1 ☐ less than 5 ☐ 5 to 10 ☐ more than 10

4. Where are they located?

S. No.	Best Technology	Annual Sales (Number of Pieces per annum)	Production/Distribution quantum (Number of Pieces per annum)	Final cost with discount (Rs. per piece)
1				
2				
3				
4				
5				
6				

5. In how much time will you be able to supply the product in case a bulk order is given?

☐ 2 days ☐ 1 week ☐ 2 weeks ☐ more than 2 weeks

6. Cost range of the product:-
    a. Cost of the product ___________
    b. Cost of the peripherals ___________
    c. Cost of installation ___________

7. Do you have any past experience in thermal storage, heat pumps?
    a. How many installations have you done before in India?

☐ Less than 5 ☐ 5 to 10 ☐ more than 10

    b. Where are they located? Specify the sector and city;

☐ Residential Building _______________ ☐ Commercial Building_______________
☐ Industry______________ ☐ Hotel_____________ ☐ Hospital ______________

    c. What were the key issues faced during the installations? ____________________
    d. Any new upcoming projects if you have in Mumbai or other cities? ____________

8. What are the finance options you provide to the customers?

☐ EMI ☐ Finance Institutions ☐ others (specify) _________________

9. How the agreements are made with the financiers? ___________________

10. Have you worked with energy service providers or Discoms?

☐ Yes ☐ No

11. How do you market your products? _____________________________

12. What are the market barriers? ___________________________

13. Do you meet with similar technology providers at any forum?

☐ Yes ☐ No

14. How often you meet and what are the topics discussed during the meet?

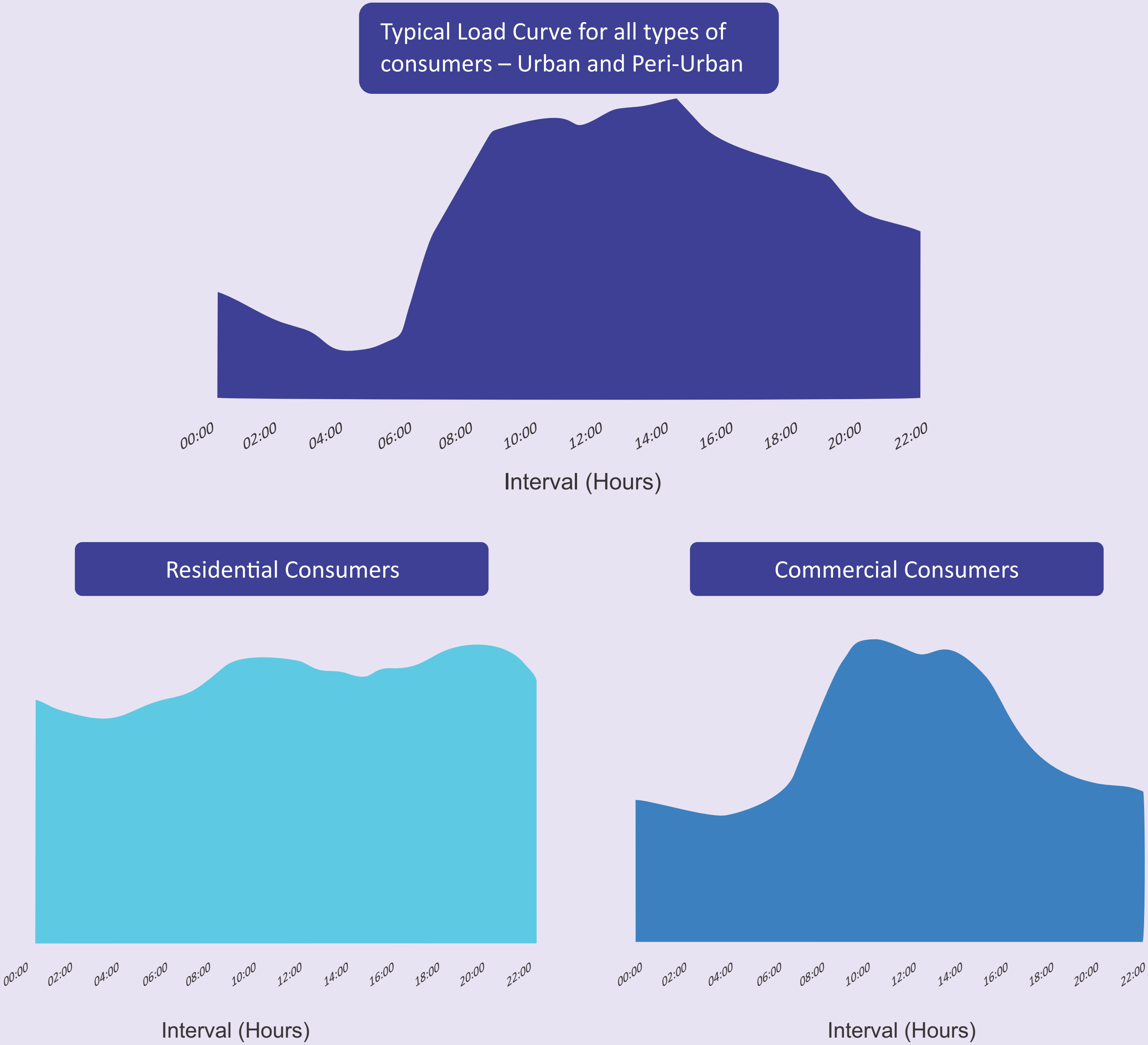
☐ 1 month ☐ 3 months ☐ 6 months ☐ annually

15. Do you have an R&D department in your organization?

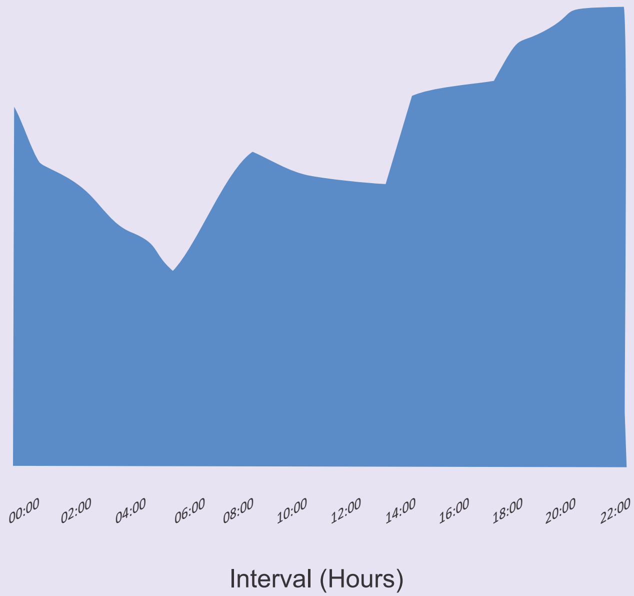
☐ Yes ☐ No

16. How much is invested annually by your organization on R&D? ____________________

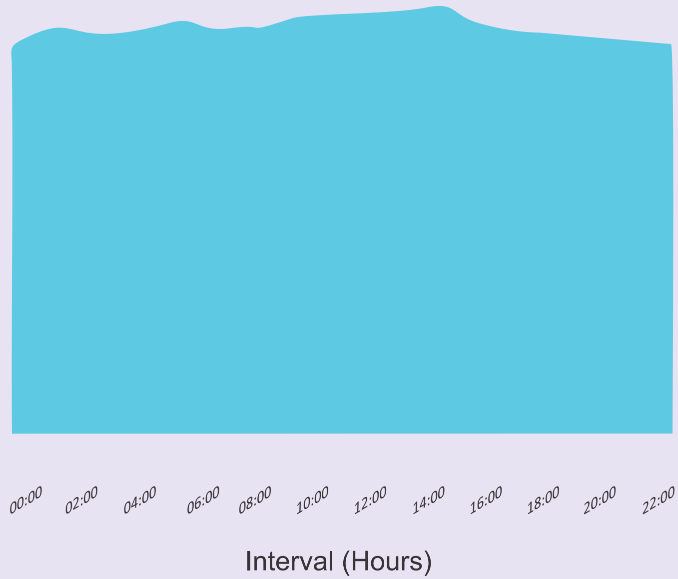
Figure 14: Representative Load Curves



Typical Railways and Metro Load Curve



Typical Curve for Industrial Sector



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1. Summary

This document describes the *<Utility Name>*'s Standard Offer Program (SOP) for scaling up implementation of Demand Side Management (DSM) measures in its area of jurisdiction.

Through the SOP, the *<Utility Name>* will purchase energy and peak-demand savings from its consumers by offering them incentives in return. Implementation of the SOP is expected to result in reduced costly power purchase cost and hence an overall reduced tariff for all consumers.

The *<Utility Name>* aims to implement the SOP for the *<type of consumer>* consumers (e.g. residential and commercial) in its distribution area and has identified certain end-uses for intervention, based on the contribution of these end-uses to the peak-demand and energy consumption of the *<Utility Name>*. These end-uses are *<list of end uses targeted>* (e.g. lighting, air-conditioning, etc.).

The implementation of the SOP will be undertaken by an Aggregator, who in turn may appoint end-use level Aggregator s for program implementation. The Aggregator will be responsible for all activities related to program implementation, such as consumer outreach, enrolment of consumers in the programs, enrolment of vendors/channel partners through a bidding process, facilitation in field implementation through vendor partners (including facilitation for safe disposal of the old equipment), service as the conduit for flow of incentives from <Utility Name> to consumer, desk support, monitoring and program management.

The Aggregator will be appointed through a bidding process or on nomination once regulatory approval is received by <Utility Name>.

The Aggregator will receive incentives from the <Utility Name> for aggregation of the savings from multiple consumers, based on the savings (kWh and kW) achieved from the identified end-uses/technologies. The Aggregator will in turn pass on the incentive to the consumers, based on pre-defined values. The SOP prices (Rs / kWh and/or Rs/kW) that are proposed to be offered by *<Utility Name>*for various end-uses/technologies, the targeted MW and MU savings and the corresponding budget requirement are as follows:

S.No.	End-Use / Technology	Incentive on Demand and/ or Energy Savings (Rs/kW or Rs/kWh)	Savings Target (MU)	Budget requirement (Rs. Cr)	Tariff Impact (Rs./kWh)

- Utility name> may also sign an agreement with consumers, especially large consumers, directly.
- <Utility Name> will also appoint an independent agency to perform Measurement and Verification (M&V) activities for assessing savings from the implemented program. M&V will be undertaken independently and the M&V report(s) will be submitted directly to <Utility Name>.
- <Utility Name> has performed a detailed benefit-cost analysis for each of the end-uses/technologies and determined the SOP Price (incentive values). <Utility Name> now seeks approval from the Hon'ble <Commission's Name> for the implementation of this program.

2. Background and Rationale

Many utilities across the world were successful in scaling up the implementation of DSM measures by way of SOP. South Africa and USA are some of the countries that have demonstrated successful SOP implementation. In India, the DSM based Efficient Lighting Program (DELP) SOP implemented by EESL in Puducherry has been successful in driving economies of scale to achieve savings at reduced costs. Some of the advantages of SOP are:

1. Simpler program roll-out through approval for multiple end-uses or technologies
2. Consumers can choose technologies and/or operational changes – leading to pragmatic program delivery
3. Contracts between the Program Owner and consumers/ Aggregators are simplified and standardized
4. Economies of scale can be achieved – options available to go beyond utility territory; programs can promote operational innovations
5. Payments are made only for proven savings thus achieving higher transparency and reduced risks

The *<Utility Name>* has designed an SOP, determined the SOP price to be offered for various end-uses/technologies and now seeks approval from *<Regulatory Commission's name>* for implementing the program.

3. Target Consumers and Market Segment(s)

The target consumers are the following:

<Target consumer category 1> (e.g. residential)

<Target consumer category1>(e.g. small commercial)

The number of consumers that will be enrolled in the program will depend on savings targets for the particular end-use. Consumers will be enrolled on a first-come-first-served basis.

4. Program Implementation Process

Following the approval from the *<Commission's name>*, the following tasks will be carried out:

1. The *<Utility Name>* will issue a Request for Proposal (RfP) to appoint an Aggregator who will implement the program on behalf of the utility[25].
2. The appointed Aggregator may in turn appoint energy service providers to support in consumer enrolment and program implementation.
3. The Aggregator, along with appointed energy service providers, will shortlist vendors to supply and install the technologies considered under this program at the consumer's premises and safely dispose of the existing technologies as per the required norms[26].

[25] *If the program is implemented at a national level, then BEE will be the Program Owner and BEE will appoint an Aggregator who will approach the distribution utilities with specific programs for implementation.*
[26] *Norms may be formulated by the respective Pollution Control Board*

4. The Aggregator, along with appointed energy service providers, will also approach consumers, explain the details of the program and convince them to enroll in the program. The Aggregator will keep updating *<Utility Name>* on the status of enrolment of consumers to the program.

5. The M&V for the new appliances will be performed by an M&V agency appointed by the distribution utility. The demonstrated savings will be determined based on the M&V undertaken by the appointed M&V agency.

6. The Aggregator will aggregate the savings from multiple consumers and convey the same to *<Utility>* for payment.

7. The *<Utility>* will pay the Aggregator the pre-determined SOP price on the demonstrated energy savings (kWh) annually as per the terms of the agreement.

8. The Aggregator in turn will pay the pre-decided incentive to the energy service providers and the consumers.

9. The Aggregator, with assistance from the M&V agency, will prepare an analysis report on the incentives offered and the savings realized and compare the results with the benefit-cost analysis undertaken at the program design stage.

5. Measurement and Verification

M&V will be done using one of the following methodologies to arrive at the savings achieved by the consumers by implementation of an energy efficiency measure:

1. Standardized M&V: Meters will be installed on the technologies for a sample of consumers and the results will be applied to the population of technologies. This method will be applied for small to medium technologies such as lighting, fans, unitary ACs.
2. Comprehensive M&V: Meters will be installed on all the technologies. This method will be applied for large technologies such as chillers, heat pumps.

6. Key Barriers Addressed

The incentives offered on demand savings (kW) and energy savings (kWh) to the consumers will help reduce high initial costs through economies of scale, increase consumer participation by providing pre-determined SOP price and increase scale-up implementation of DSM activities. It will also help ensure early retirement and safe disposal of old technologies.

7. Technical Specifications

The technical specifications of the technologies under consideration in this program are as follows:

Technology	Size of the appliance	Rating of the old appliance	Rating of the new appliance

8. Expected Energy and Demand Savings and SOP Price

The SOP price, i.e. the incentive to be provided to consumers to motivate them to participate in the program, is determined based on the expected savings from the program, and accordingly the reduced power purchase cost. The following parameters are considered to determine the SOP Price for the various types of consumers: average power procurement cost, highest marginal cost of power purchase, tariff of the consumer, cost of conserved energy (in turn a function of cost of the technology, life of the technology, discount rate and the annual energy savings).

The incentives will be paid to the Aggregator who will in turn pay the incentives to the appointed energy service providers and the participating consumers. In addition, the <Utility> will pay the fee to the M&V agency.

9. Financing Approach

The following options are being considered by <Utility> for financing this program:

1. State Energy Conservation Fund, supplemented through collection of the Public Benefits Charge (PBC) from all consumers <approval for PBC collection will be sought separately)
2. Through the tariff route, under provisions from the *<State>* DSM Regulations
3. Through a proposal put up to the BEE for funding the program by tapping into the National Clean Energy Fund for sourcing funds to implement the program.

End-Use / Technology	Target Number (no.)	Expected Demand (MW) and/ or Energy (MU) Savings	First Cost Incentive) (Rs/ technology)	SOP Price (Rs/kWh)	Budget Requirement (Rs. Cr)	Tariff Impact (Rs./kWh)

Note: Benefit-Cost Analysis is given in Annexure-I & II

10. Implementation Responsibilities – BEE, Distribution Company, Aggregator, M&V Agency, Consumers

<Utility> (Program Owner)

- Be responsible for offering/rolling out the SOP
- Identify end-uses and/or technologies that can be targeted for SOP based on Load Research, assessment of energy and peak deficits, technology availability and benefit-cost analysis
- Determine SOP price to be offered for each of the end-uses and/or technologies
- Obtain required approvals from Hon'ble SERCs (when utility is the Program Owner)
- Program funding:
  - BEE as program owner: Submit proposal to NCEF for funding the national level SOP
  - Distribution utility as the program owner: Seek funds either through the BEE route (BEE can route funds from NCEF to the utility), or, approach Hon'ble SERC for creation and utilization of funds from a State Energy Conservation Fund (SECF)
- Draft RfP for selecting Aggregator
- Appoint Aggregator for program implementation based on pre-defined qualification criteria
- Sign agreement with Aggregator
- Draft RfP and appoint M&V agency
- Oversee savings reported by Aggregator
- Pay Aggregator the pre-determined SOP price based on the demonstrated savings from the implemented DSM programs as per the terms of the agreement signed with the Aggregator
- In some cases, the program owner may directly enroll consumers such as large commercial establishments. Then, the program owner will directly pay the SOP price on the demonstrated savings to the consumer.

- **Aggregator and/or energy service providers:**
- Contract with Program Owner
- Further sub-contract required work to ESPs based on end-use (when at national/utility level) or state (when at national level) and sign agreement(s) with sub-contracted ESPs
- Prepare program outreach material
- Reach out to consumers and enroll them into the program.
- Oversee and regularly update Program Owner on status of enrolment of consumers
- Appoint vendor(s) through a bidding process and sign contracts with selected vendors
- Ensure installation of efficient technologies at consumer's premises and/or provide assistance to consumers for undertaking operational efficiency improvements (independently or through vendors)
- Ensure safe disposal of old equipment
- Oversee and regularly inform Program Owner on status of implementation and incentives towards the demand savings (kW) to be paid as per the SOP
- On receipt of the payment from Program Owner, pass on incentives to the consumers as per terms of agreement
- Provide required support to M&V agency for determining

savings

- Make payments to sub-contracted ESPs as per terms of agreement entered by both the parties
- Provide regular updates to Program Owner on status of implementation work

Measurement and Verification (M&V) Agency:

- Contract with Program Owner or any other entity appointing the M&V agency for M&V of SOP
- Adopt appropriate methodology for determination of consumer baseline consumption for various end-uses before implementation of efficiency measure (Standardized M&V or Comprehensive M&V); seek
- Discuss with and get sign-off on M&V methodology from Program Owner
- Ascertain savings from efficiency measure at regular intervals, such as annually or monthly, as agreed with Program Owner
- Provide regular updates to Program Owner on status of M&V work

Participating consumer(s)

- Enroll in the program
- Support Aggregator and/or sub-contracted ESPs in implementing the efficiency measure and undertake safe disposal of old equipment, where applicable
- Support M&V agency in determining the savings achieved from implementation of the program

The following annexures give the details of benefit-cost analysis for LED program for residential category. Similar annexures can be prepared for other programs and other categories.

Annexure-I: Assumptions for the Benefit-Cost Analysis

1. Consumer Tariff

Category	Peak Energy Charge (Rs / kWh)	Off-Peak Energy Charge (Rs / kWh)
Residential		
Commercial		

2. Other information

Particulars	Value
Highest Marginal Price (Rs/kWh)	
Average Power Procurement Price (Rs/kWh)	
Escalation Rate (%)	
Total Utility Sales	
Distribution Loss (%)	
Transmission Loss (%)	
O&M Cost (% of initial cost)	
Marketing and Administrative Cost (% of initial cost)	
M&V Cost (% of initial cost)	
Escalation in O&M Cost year-on-year	
Discount Rate (%)	

3. Technology Related Assumptions

	Old Technology	End-Use	Category	Cost of Techn-ology (Rs)	Peak Hour Usage	Off-Peak Hour Usage	Diversity Factor (%)	Consump-tion of new tech (kW)	Consump tion of old tech (kW)	Life of new tech	Days of usage per year
LED Bulb	Incandescent Bulb	Lighting	Residential								
LED Bulb	CFL	Lighting	Residential								
LED Bulb	Incandescent Bulb	Lighting	Commercial								
LED Bulb	CFL	Lighting	Commercial								

Annexure-II: Benefit-Cost Analysis Results

Year	Unit	0	1	2	3	4	5	6	7	8	9	10	11	12
Benefits from the program														
Energy savings - peak (w/o losses)	kWh													
Energy savings - off-peak (w/o losses)	kWh													
Power purchase cost savings - peak	Rs													
Power purchase cost savings - off-peak	Rs													
NPV of Benefits	**Rs**													
Towards TRC test														
Cost of technology - total	Rs													
Marketing and administrative expenses	Rs													
M&V Costs	Rs													
O&M costs	Rs													
Total costs	Rs													
NPV of costs - TRC	**Rs**													
TRC - NPV of benefits minus NPV of costs	**Rs**													
Towards RIM Test														
Cost of technology - utility contribution	Rs													
Marketing and administrative expenses	Rs													
M&V Costs	Rs													
O&M costs	Rs													
Loss in revenue	Rs													
Total costs	Rs													
NPV of costs - RIM	Rs													
RIM - NPV of benefits minus NPV of costs	Rs													

Annexure-III: Computation of SOP Price

Tech	Category	Technology Replacement	Cost of Technology (Rs.)	Cost of Conserved Energy (CCE) (Rs./kWh)	APPC (Rs /kWh)	HMC (Rs /kWh)	Tariff (Rs /kWh)	CCE < APPC? (Yes or No)	Where CCE < APPC, Tariff < HMC? (Yes or no)	Decision (Proceed or don't proceed)	SOP Price Cap (Rs./kWh)
<e.g. Fans>	<e.g. Residential>	<e.g. Replacement of inefficient fans with 5 star fans>									
		<e.g. Replacement of inefficient fans with super-efficient fans>									
	<e.g. Small Commercial>										
<e.g. Lighting>											

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The *<Utility Name>* will make incentive payments to the consumers based on the savings (kWh and kW) achieved from the identified end-uses/technologies. The SOP prices (Rs / kWh and/or Rs/kW) that are proposed to be offered by *<Utility Name>* for various end-uses/technologies, the targeted MW and MU savings and the corresponding budget requirement are as follows:

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[26] *Norms may be formulated by the respective Pollution Control Board*

4. The M&V for the new appliances will be performed by an M&V agency appointed by the distribution utility. The demonstrated savings will be determined based on the M&V undertaken by the appointed M&V agency.
5. The *<Utility>* will pay the consumers the pre-determined SOP price on the demonstrated energy savings (kWh) annually or as per the terms of the agreement signed by the both.
6. The M&V agency will prepare an analysis report on the incentives offered and the savings realized and compare the results with the benefit-cost analysis undertaken at the program design stage.

5. Measurement and Verification

M&V will be done using one of the following methodologies to arrive at the savings achieved by the consumers by implementation of an energy efficiency measure:

1. Standardized M&V: Meters will be installed on the technologies for a sample of consumers and the results will be applied to the population of technologies. This method will be applied for small to medium technologies such as lighting, fans, unitary ACs.
2. Comprehensive M&V: Meters will be installed on all the technologies. This method will be applied for large technologies such as chillers, heat pumps.

6. Key Barriers Addressed

The incentives offered on demand savings (kW) and energy savings (kWh) to the consumers will help reduce high initial costs through economies of scale, increase consumer participation by providing pre-determined SOP price and increase scale-up implementation of DSM activities. It will also help ensure early retirement and safe disposal of old technologies.

7. Technical Specifications

The technical specifications of the technologies under consideration in this program are as follows:

Technology	Size of the appliance	Rating of the old appliance	Rating of the new appliance

8. Expected Energy and Demand Savings and SOP Price

The SOP price, i.e. the incentive to be provided to consumers to motivate them to participate in the program, is determined based on the expected savings from the program, and accordingly the reduced power purchase cost. The following parameters are considered to determine the SOP Price for the various types of consumers: average power procurement cost, highest marginal cost of power purchase, tariff of the consumer, cost of conserved energy (in turn a function of cost of the technology, life of the technology, discount rate and the annual energy savings).

In addition, the <Utility> will pay the fee to the M&V agency.

End-Use / Technology	Target Number (no.)	Expected Demand (MW) and/ or Energy (MU) Savings	First Cost Incentive) (Rs/ technology)	SOP Price (Rs/kWh)	Budget Requirement (Rs. Cr)	Tariff Impact (Rs./kWh)

Note: Benefit-Cost Analysis is given in Annexure-I & II

Further, the approach for incentivizing consumers will vary based on the type of consumer, as follows:

- For <consumer type> (e.g. residential and small commercial consumers), the expected demand and energy savings will be translated to incentives on the first cost, and only a one time incentive on the first-cost will be paid.
- For <consumer type> (e.g. large commercial consumers), the initial cost of the equipment will be borne by the consumers and the program owner will pay incentives towards demonstrated demand (kW) savings and energy (kWh) savings.

9. Financing Approach

The following options are being considered by <Utility> for financing this program:

1. State Energy Conservation Fund, supplemented through collection of the Public Benefits Charge (PBC) from all consumers <approval for PBC collection will be sought separately)
2. Through the tariff route, under provisions from the <State> DSM Regulations
3. Through a proposal put up to the BEE for funding the program by tapping into the National Clean Energy Fund for sourcing funds to implement the program.

10. Implementation Responsibilities – BEE, Distribution Company, Aggregator, M&V Agency, Consumers

<Utility> (Program Owner)

- Be responsible for offering/rolling out the SOP
- Identify end-uses and/or technologies that can be targeted for SOP based on Load Research, assessment of energy and peak deficits, technology availability and benefit-cost analysis
- Determine SOP price to be offered for each of the end-uses and/or technologies
- Obtain required approvals from Hon'ble SERCs (when utility is the Program Owner)
- Program funding:
  - i) BEE as program owner: Submit proposal to NCEF for funding the national level SOP
  - ii) Distribution utility as the program owner: Seek funds either through the BEE route (BEE can route funds from NCEF to the utility), or, approach Hon'ble SERC for creation and utilization of funds from a State Energy Conservation Fund (SECF)
- Appoint Energy service providers for program implementation based on pre-defined qualification criteria
- Sign agreement with Energy service providers
- Draft RfP and appoint M&V agency
- Estimate the savings from various programs
- Pay consumers the pre-determined SOP price based on the demonstrated savings from the implemented DSM programs as per the terms of the agreement signed with them.

Energy service providers:

- Contract with Program Owner
- Prepare program outreach material
- Reach out to consumers and enroll them into the program.
- Oversee and regularly update Program Owner on status of enrolment of consumers
- Appoint vendor(s) through a bidding process and sign contracts with selected vendors
- Ensure installation of efficient technologies at consumer's premises and/or provide assistance to consumers for undertaking operational efficiency improvements (independently or through vendors)
- Ensure safe disposal of old equipment
- Oversee and regularly inform Program Owner on status of implementation and incentives towards the demand savings (kW) to be paid as per the SOP
- On receipt of the payment from Program Owner, pass on incentives to the consumers as per terms of agreement
- Provide required support to M&V agency for determining savings
- Make payments to sub-contracted ESPs as per terms of agreement entered by both the parties
- Provide regular updates to Program Owner on status of implementation work

Measurement and Verification (M&V) Agency:

- Contract with Program Owner or any other entity appointing the M&V agency for M&V of SOP
- Adopt appropriate methodology for determination of consumer baseline consumption for various end-uses before implementation of efficiency measure (Standardized M&V OR Comprehensive M&V); seek support from Aggregator/sub-contracted ESPs, as required
- Discuss with and get sign-off on M&V methodology from Program Owner
- Ascertain savings from efficiency measure at regular intervals, such as annually or monthly, as agreed with Program Owner
- Provide regular updates to Program Owner on status of M&V work

Participating consumer(s)

- Enroll in the program
- Support *<Utility Name>* and energy service providers in implementing the efficiency measures and undertake safe disposal of old equipment, where applicable
- Support M&V agency in determining the savings achieved from implementation of the program

The following annexures give the details of benefit-cost analysis for LED program for residential category. Similar annexures can be prepared for other programs and other categories.

Annexure-I: Assumptions for the Benefit-Cost Analysis

1. Consumer Tariff

Category	Peak Energy Charge (Rs / kWh)	Off-Peak Energy Charge (Rs / kWh)
Residential		
Commercial		

2. Other information

Particulars	Value
Highest Marginal Price (Rs/kWh)	
Average Power Procurement Price (Rs/kWh)	
Escalation Rate (%)	
Total Utility Sales	
Distribution Loss (%)	
Transmission Loss (%)	
O&M Cost (% of initial cost)	
Marketing and Administrative Cost (% of initial cost)	
M&V Cost (% of initial cost)	
Escalation in O&M Cost year-on-year	
Discount Rate (%)	

3. Technology Related Assumptions

New Techn-ology	Old Technology	End-Use	Category	Cost of Technology (Rs)	Peak Hour Usage	Off-Peak Hour Usage	Diversity Factor (%)	Consump-tion of new tech (kW)	Consumption of old tech (kW)	Life of new tech	Days of usage per year
LED Bulb	Incandescent Bulb	Lighting	Residential								
LED Bulb	CFL	Lighting	Residential								
LED Bulb	Incandescent Bulb	Lighting	Commercial								
LED Bulb	CFL	Lighting	Commercial								

Annexure-II: Benefit-Cost Analysis Results

Year	Unit	0	1	2	3	4	5	6	7	8	9	10	11	12
Benefits from the program														
Energy savings - peak (w/o losses)	kWh													
Energy savings - off-peak (w/o losses)	kWh													
Power purchase cost savings - peak														
Power purchase cost savings - off-peak	Rs.													
NPV of Benefits	Rs.													
Towards TRC test														
Cost of technology - total	Rs.													
Marketing and administrative expenses	Rs.													
M&V Costs	Rs.													
O&M costs	Rs.													
Total costs	Rs.													
NPV of costs - TRC	Rs.													
TRC - NPV of benefits minus NPV of costs	Rs.													
Towards RIM Test														
Cost of technology - utility contribution	Rs.													
Marketing and administrative expenses	Rs.													
M&V Costs	Rs.													
O&M costs	Rs.													
Loss in revenue	Rs.													
Total costs	Rs.													
NPV of costs - RIM	Rs.													
RIM - NPV of benefits minus NPV of costs	Rs.													

Annexure-III: Computation of SOP Price

Tech	Category	Technology Replacement	Cost of Technology (Rs.)	Cost of Conserved Energy (CCE) (Rs./kWh)	APPC (Rs /kWh)	HMC (Rs /kWh)	Tariff (Rs /kWh)	CCE < APPC? (Yes or No)	Where CCE < APPC, Tariff < HMC? (Yes or no)	Decision (Proceed or don't proceed)	SOP Price Cap (Rs./kWh)
<e.g. Fans>	<e.g. Residential>	<e.g. Replacement of inefficient fans with 5 star fans>									
		<e.g. Replacement of inefficient fans with super-efficient fans>									
	<e.g. Small Commercial>										
<e.g. Lighting>											

Table 38: Types of Meters, Available Makes, M&V Applicability, Indicative Costs

S. No.	Type of meter	Parameters measured	Suppliers in India	Applicability		Indicative Price Range(Rs)
				Standardized M&V	Comprehensive &V	
1	Single Phase Energy Meter	Time duration with load curve, kWh & MD backup for last 12 month, Voltage & Current (optional)	L&T, Siemens, Schneider Electric			3,000 – 4,000
2	Trivector meter	Display 350 parameters PF, per phase RMS voltages and currents, Frequency, kW, kVA, kVAr, KWH, kVAh, kVArh+, kVArh-, tamper details, rising demand with elapsed time, high resolution energies	L&T, Honeywell, ABB, Schneider Electric			80,000 – 90,000
3	BTU Meter	Temperature sensor and net heat computing unit, single source of flowmeter, thermal power & energy consumed through measurement of flow	L&T, E&H, Honeywell, Schneider Electric, Siemens			2,00,000 – 3,00,000
4	Lux Meter	Measuring luminous flux per unit area	Testo India, Sigma nstrum-ents, Rescholar Equipment, HTC Iinstruments			4,000 – 5,000
5	Digital Multimeter	Measure current, voltage and power supply frequency	Motwane, Kusam Electrical,			2,000 – 5,000
6	Multi ratio Current Transformer(CT)	Current	Siemens, ABB			50,000 – 1,00,000

A brief description of various energy efficient technologies is given in this annex:

Unitary AC:

Unitary ACs (window ACs, Split ACs and Split + Inverter ACs) are small air-conditioning systems that typically use vapour compression cycles. The entire system uses a circulating liquid refrigerant which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere. The vapour compression system has four components (i) compressor, (ii) condenser, (iii) expansion valve and (iv) evaporator.

Energy Efficient Chillers:

Chillers are used to remove heat from a liquid. In most of the medium and large air conditioning systems, chilled water is typically circulated through heat exchangers or coils in air handling units or other types of devices close to the load centers. This cools the air in the respective space(s), after which the water is re-circulated back to the chiller to be cooled again. The cooling coils transfer sensible heat and latent heat from the air to the chilled water, thus cooling and usually, dehumidifying the air. A typical chiller for air conditioning applications is rated between 15 and 1,500 tons (180,000 to or 53 to 5,300 kW) in cooling capacity. Chilled water temperatures can range from 35 to 45 degrees Fahrenheit (1.5 to 7 degrees Celsius), depending upon application requirements.

There are three main types of conventional chillers, namely,

i. Reciprocating Chillers: Reciprocating chillers are used as central AC systems for buildings and consist of one or more reciprocating compressor-motor assemblies. The reciprocating compressors are positive displacement compressors and can be found in ranges from fractional to very high horsepower.

ii. Screw Chillers: Screw chillers are used as central systems for buildings and consist of one or more screw compressor-motor assemblies. The screw compressor has a rotary-type positive displacement mechanism and uses two meshing helical screws (rotors), to compress the gas.

iii. Scroll Chillers: Scroll chillers use a scroll compressor in the packaged unit. Scroll compressors are orbital motion, positive-displacement machines that compress air or refrigerant with two inter-fitting, spiral-shaped scroll members. Scroll compressors are quiet, smooth-operating units with high efficiency ratios.

Refrigerators:

A refrigerator transfers heat from the refrigerator to the environment and hence cools the food stored inside the refrigerator. It also has a freezer, which maintains the temperature in the compartment below the freezing point of water to make ice and store frozen food. A refrigerator has (i) evaporator, (ii) compressor, (iii) condenser and an (iv) expansion device. Refrigerator also has a refrigerant, which is vaporized in the evaporator through the heat from inside the refrigerator followed by raise in pressure and temperature of the refrigerant through the compressor. The high pressure vapor is then condensed into high pressure

[28] *Vapor-compression refrigeration" Wikipedia, n.d. Web. 21 June 2013.*

[29] *HVAC Systems." 2009 ASHRAE Handbook: Fundamentals. Atlanta, GA.: ASHRAE, 2009. 158. Print.*

liquid through the condenser and the heat is absorbed by the outside air the flows across the condenser. The resultant high pressure high temperature liquid refrigerant is turned to low pressure low temperature mixture of refrigerant liquid and vapor through the expansion device. The refrigerant goes to the evaporator, and the cooling cycle continues.
Two types of home refrigerators are typically available in market. These are:

Direct Cool Refrigerators: Primary convection is the primary way of cooling of food within the refrigerator. Some refrigerators have a fan to avoid internal condensation of water. In these refrigerators, reduced cooling is observed due to formation of frost/ice in the refrigerator and hence these refrigerators need manual defrosting periodically.

Frost Free Refrigerators: These refrigerators normally have direct cooling system along with door cooling technology. The formation of internal frost/ice is restricted through continuous internal movement of air. This refrigerator has three basic parts: a timer, a heating coil and a temperature sensor. The heating coil is wrapped around the freezer coils and every six hour or so, the timer turns on the heating coil and this melts the ice off the coil. When all the ice is removed, the temperature sensor senses the temperature rising above 0ºC and turns off the heating coil.

Ceiling Fans:
Ceiling fans are the most commonly used electrical appliances for space conditioning in residential, commercial and industrial spaces in India. Several ceiling fans currently in use in various types of buildings are inefficient and there exists large potential to achieve energy efficiency by replacement of these energy inefficient fans with BEE five star rated efficient ones. Development of super-efficient fans is also being undertaken in India and these fans will be even more efficient than the 5 star rated fans.

Heat Pumps:
Heat Pumps use electricity to move heat from one place to another instead of generating heat directly. To move the heat, heat pumps work like a refrigerator in reverse. While a refrigerator pulls heat from inside a box and transfers it into the surrounding room, a HPWH pulls heat from the surrounding and transfers it at a higher temperature into a tank to heat water. Based on their input source, there are three basic types of heat pumps available in the market viz. Air-To-Water System (also referred to as an “air-source” heat pump) and the Water-To-Water System (or “water source” heat pump) and ground-source heat pumps. Heat pumps consist of a refrigerant, reversing valve, coil, evaporator, compressor, condenser, expansion equipment and plenum.
Heat Pumps can be used for centralized water heating, cooling common areas and are also suited well for applications such as in hospitals, hotels and in industries such as the food industry where large volume of constant hot water is required.

Thermal Energy Storage (TES):

The primary principal of a thermal storage unit is to shift the peak demand resulting from an air-conditioning system to the off-peak period by storing thermal energy (cooling in the form of ice) developed during the night-time. Small thermal storage systems have the capability to cater to 4 TR to 40 TR packaged systems by integrating a separate unit coupled with the packaged air-conditioning systems. Two primary technologies are used to store the "cooling", namely, using ice-on-coil units and nodules-based techniques. In both the cases, use of phase change fluids such as glycol solutions is essential to store the "ice" in separate units, which is then thawed during the day-time peak to generate chilled water. In smaller systems the refrigerant can directly be cooled in a small heat transfer unit to generate the required cooling effect.

Unitary Geysers:

There are two types of geysers viz. (i) Instantaneous Geysers and (ii) Storage Geysers

Instantaneous Geysers: Instant electric water heaters heat the volume of water as it passes through the heater and do not have a storage tank to store heated water. As a result, the efficiency of the water heater is improved.

Storage Geysers: In a storage water heater, a tank is available to store the heated water. These type of electric water heaters have electric resistance elements to heat the water in the storage tank using two electric resistance elements located at the bottom and the top of the tank and each of the elements is controlled by an independent thermostat. In two element tanks the lower element provides recovery from standby losses and the upper element provides heating during periods of large hot water use.

LED Bulbs and LED tube lights:

Light Emitting Diode (LED) bulbs are the currently the most efficient lighting equipment available that consumes about 10% of energy consumed by incandescent bulb and about 50% of energy consumed by Compact Fluorescent Lamp (CFL) and produces about the same amount of light. An LED bulb consists of a semi-conductor, which has electrons and when these electrons are charged they release energy in the form of light. A 7 W LED bulb can emit light equivalent to a 60 W incandescent bulb. LED tube lights consist of several individual LEDs and can replace existing inefficient tube lights such as T12 and T8 tube lights.

Induction Motors:

An induction motor is an AC electric motor. In this motor, the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. Energy efficient three phase squirrel cage induction motors are included under BEE's voluntary labeling scheme. Squirrel cage induction motors are widely used in industrial applications due to their ruggedness.

Table 39: Details of Energy Efficient Technologies

S.No.	End-Use	Technology	Type	Corresponding technology it may replace to provide the same output (luminosity, cooling, heating, etc.)	Rating (kW)	Price range (Rs.)	Life Range (years)	Partial list of suppliers in India
1	Lighting	LED lamps	4W	25-35 W incandescent bulb, 6-8 W CFL	0.004	350-450	12-16	Avni ENERGY, Promptec Renewable Energy Solutions Pvt Ltd, Alien Energy Pvt Ltd, OSRAM India Pvt. Ltd.
			6W	35-45 W incandescent bulb, 8-10 W CFL	0.006	450-550	12-16	Promptec Renewable Energy Solution Pvt Ltd, OSRAM India Pvt. Ltd.
			7W	45-55 W incandescent bulb, 10-14W CFL	0.007	500-600	12-16	Avni ENERGY, Alien Energy Pvt Ltd, Laaj Lighting
			8W	50-60W incandescent bulb, 12-15W CFL	0.008	500-700	12-16	Instapower, MIC lectronics, Promptec Renewable Energy Solution Pvt Ltd
			10W	65-75 W incandescent bulb, 15-20W CFL	0.010	600-800	12-16	OSRAM India Pvt. Ltd.
2	Air conditioning	BEE five star rated fan	1200 mm	75-85 W ordinary fan	0.055	2,100-2,400	15-18	Crompton Greaves, Relaxo, Usha, Khaitan, Havells, Orient, Omega, Indigo
3	Air conditioning	BEE five star rated window AC	1 TR	1.8-1.9 kW Window AC	1.0-1.2	30,000-37,000	8-12	Hitachi, LG, Voltas, Whirlpool
			1.5 TR	1.8-2.0 kW Window AC	1.5-1.7	39,000-42,000	8-12	Hitachi, LG, Panasonic, Voltas, Haier, Zamil

S.No.	End-Use	Technology	Type	Corresponding technology it may replace to provide the same output (luminosity, cooling, heating, etc.)	Rating (kW)	Price range (Rs.)	Life Range (years)	Partial list of suppliers in India
4	Air conditioning	BEE five star rated split AC	1 TR	1.3-1.5 kW Split AC	1.00.9-1.2 -1.2	38,000-42,000	8-12	Godrej, LG, Zamil, Hitachi, Samsung, Blue Star, Panasonic, Videocon, Voltas, Haier, Onida, Mitsubishi Electric, Lloyd, Whirlpool, Carrier
			1.5 TR	1.7-1.9 kW Split AC	1.4-1.6	45,000-52,000	8-12	Godrej, LG, Zamil, Hitachi, Samsung, Blue Star, Panasonic, Videocon, Voltas, Haier, Onida, Mitsubishi Electric, Lloyd, Whirlpool, Carrier
			2TR	2.4-2.6 kW Split AC	1.8-2.1	50,000-62,000	8-12	Zamil, Hitachi, Blue Star, Panasonic, Voltas, General, Mitsubishi Electric, Toshiba
5	Air conditioning	Inverter AC	1TR	1.8-1.9 kW Window AC, 1.3-1.5 kW Split AC	0.9-1.1	32,000-52,000	8-12	LG, Samsung
			1.5TR	1.8-2.0 kW Window AC, 1.7-1.9 kW Split AC	1.4-1.6	36,000-68,000	8-12	LG, Samsung, Daikin, Bluestar
			2TR	1.7-1.9 kW Split AC	1.8-2.1	46,000-78,000	8-12	LG, Samsung, Daikin, Bluestar

S.No.	End-Use	Technology	Type	Corresponding technology it may replace to provide the same output (luminosity, cooling, heating, etc.)	Rating (kW)	Price range (Rs.)	Life Range (years)	Partial list of suppliers in India
6	Air conditioning	Energy efficient chiller	50 TR Reciprocating (water cooled)	50 TR, 75 kW, Reciprocating (air cooled)	40-45	750000-850000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			50 TR Screw (water cooled)	50 TR, 75 kW, beciprocating (air cooled), 50 TR, 70 kW, Screw (air cooled)	35-40	800000-1000000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			50 TR Scroll (water cooled)	50 TR, 75 kW, Reciprocating (air cooled), 50 TR, 60 kW, Scroll (air cooled)	38-45	900000-1100000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			100 TR Reciprocating (water ooled)	100 TR, 135 kW, Reciprocating (air cooled)	90-95	1500000-1800000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			100 TR Screw (water cooled)	100 TR, 135 kW, Reciprocating (air cooled), 100 TR, 150 kW, Screw (air cooled)	70-75	1600000-1800000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			100 TR Scroll (water cooled)	100 TR, 135 kW, Reciprocating (air cooled), 100 TR, 120 kW, Scroll (air cooled)	75-85	1800000-2000000	12-18	Carrier, Blue star, Trane, Daikin, Voltas

S.No.	End-Use	Technology	Type	Corresponding technology it may replace to provide the same output (luminosity, cooling, ating, etc.)	Rating (kW)	Price range (Rs.)	Life Range (years)	Partial list of suppliers in India
6	Air conditioning	Energy efficient chiller	150 TR Reciprocating (water ooled)	150 TR, 205 kW, Reciprocating (aircooled)	135-140	2200000-2500000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			150 TR Screw (water cooled)	150 TR, 205 kW, Reciprocating (air cooled), 150 TR, 215 kW, Screw (air cooled)	105-115	1800000-2200000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			150 TR Scroll (water ooled)	150 TR, 205 kW, Reciprocating (air cooled), 150 TR, 185 kW, Scroll (air cooled)	115-125	2600000-2900000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			200 TR Reciprocating (water ooled)	200 TR, 270 kW, Reciprocating (air cooled)	185-190	2800000-3200000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			200 TR Screw (water cooled)	200 TR, 270 kW, Reciprocating (air cooled), 200 TR, 300 kW, Screw (air cooled)	145-150	2500000-2800000	12-18	Carrier, Blue star, Trane, Daikin, Voltas
			200 TR Scroll (water cooled)	200 TR, 270 kW, Reciprocating (air cooled), 200 TR, 240 kW, Scroll (air cooled)	160-165	3300000-3500000	12-18	Carrier, Blue star, Trane, Daikin, Voltas

S.No.	End-Use	Technology	Type	Corresponding technology it may replace to provide the same output (luminosity, cooling, heating, etc.)	Rating (kW)	Price range (Rs.)	Life Range (years)	Partial list of suppliers in India
7	Refrigeration	BEE five star rated refrigerator	150-200 L	0.034-0.038 kW Refrigerator	0.027-0.024	14000-17000	10-12	Godrej, Kelvinator, Haier, LG, Samsung, Videocon, Electrolux
			200-250 L	0.042-0.045 kW Refrigerator	0.023-0.026	16000-23000	10-12	Godrej, Kelvinator, Haier, LG, Samsung, Videocon, Electrolux
			250–300 L	0.054-0.058 kW Refrigerator	0.025-0.0	21000-25000	10-12	Godrej, Haier, LG, Videocon
8	Air conditioning	Thermal storage	50 TRH	30 TRH Chiller system	40-45	175000-200000	20-25	Cristopia Energy Systems
			100 TRH	60 TRH Chiller system	78-82	350000-400000	20-25	Cristopia Energy Systems
			500 TRH	300 TRH Chiller system	400-420	1750000-2000000	20-25	Cristopia Energy Systems
			1000 TRH	600 TRH Chiller system	820-850	3500000-4000000	20-25	Cristopia Energy Systems
			5000 TRH	3000 TRH Chiller system	3800-4200	17500000-20000000	20-25	Cristopia Energy Systems
			15000 TRH	9000 TRH Chiller system	10500-11000	52500000-60000000	20-25	Cristopia Energy Systems

S.No.	End-Use	Technology	Type	Corresponding technology it may replace to provide the same output (luminosity, cooling, heating, etc.)	Rating (kW)	Price range (Rs.)	Life Range (years)	Partial list of suppliers in India
9	Water Heating	Heat pump	40 TR		40-45	1700000-1900000	8-12	National Heat Pumps
10	Water Heating	BEE five star rated unitary geyser	6 L	2.5-3.5 kW Geyser	2-3	6000-8000	15-20	Bajaj, AO Smith, Crompton Greaves, Krissol, Kohinoor, Sutex, Prime Us, Ves-Star, V-Guard, Kent
			10 L	2.5-3.5 kW Geyser	2-3	5000-9000	15-20	Racold, Bajaj, Morphy Richards, AO Smith, Kenstar, Crompton Greaves, Krissol, Prime Us, Ves-Star, V-Guard, Kent
			15 L	2.5-3.5 kW Geyser	2-3	6000-11000	15-20	Racold, Bajaj, AO Smith, Morphy Richards, Kenstar, Crompton Greaves, Krissol, Prime Us, Ves-Star, V-Guard, Kent
			25 L	2.5-3.5 kW Geyser	1.5-3	6000-12000	15-20	Racold, Bajaj, AO Smith, Morphy Richards, Kenstar, Crompton Greaves, Krissol, Prime Us, Ves-Star, V-Guard, Kent
			35 L	2.5-3.5 kW Geyser	1.5-2.5	9000-13000	15-20	Racold, AO Smith, Krissol, Prime Us, Thermoking, MEA, Berlia, Summer-Con, Kent

S.No.	End-Use	Technology	Type	Corresponding technology it may replace to provide the same output (luminosity, cooling, heating, etc.)	Rating (kW)	Price range (Rs.)	Life Range (years)	Partial list of suppliers in India
11	Water Pumping	BEE five star rated water pumps	1.0 HP to 2.0 HP		0.75-1.5	3200 -3500	5-7	Kirloskar, Crompton Greaves
			3 HP to 6.5 HP		2.2-4.8	9000-13000	5-7	Kirloskar, Crompton Greaves, Ansons, Texmo, Shakti
			7.5 HP to 10 HP		5.6-7.5	11000-14000	5-7	Kirloskar, Crompton Greaves, Aquatex
			12.5 HP to 15 HP		9.3-11.2	14000-18000	5-7	Kirloskar

Figure 15: Annual Energy Savings in Lighting

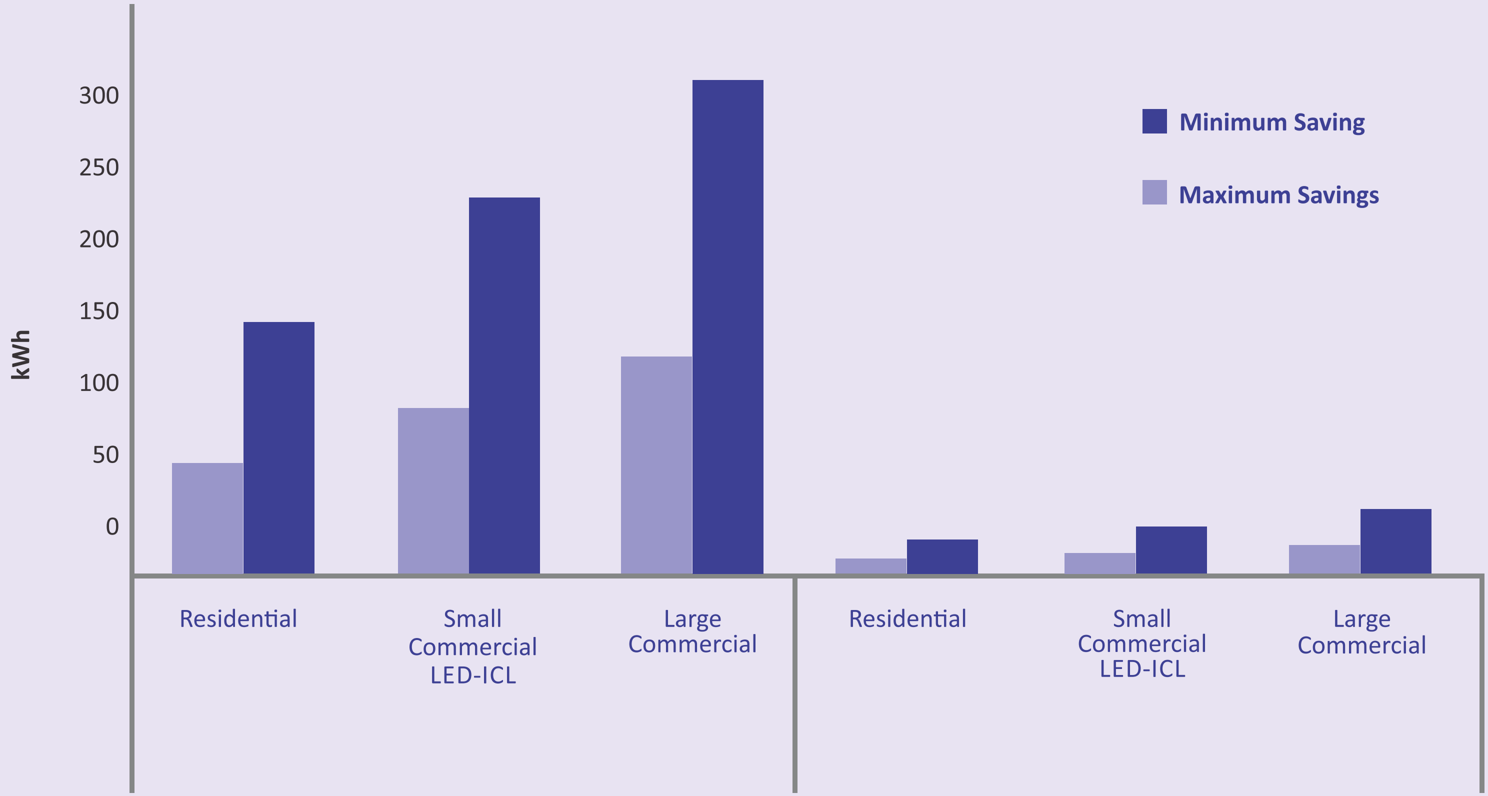


Figure 16: Annual Energy Savings in Air Conditioning

Figure 17: Annual Savings in Chillers

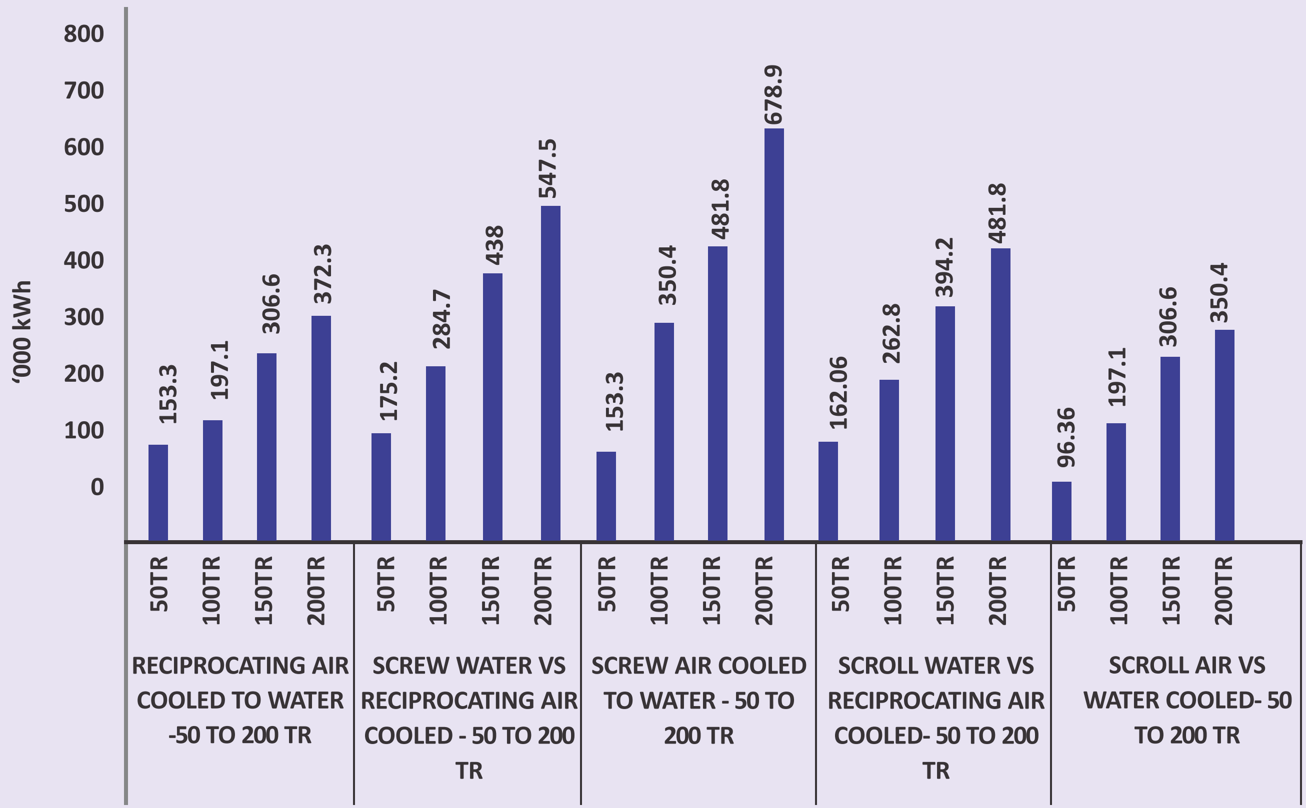


Figure 18: Annual Savings for Refrigerators

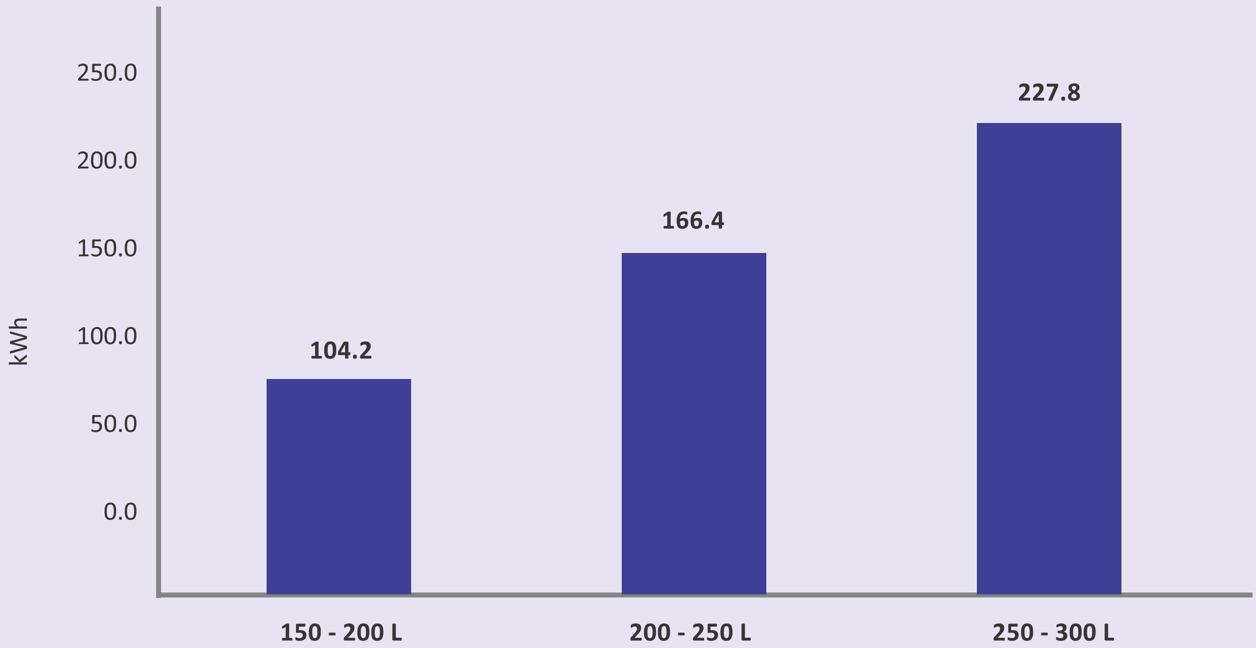


Figure 19: Annual Savings in Water Heating

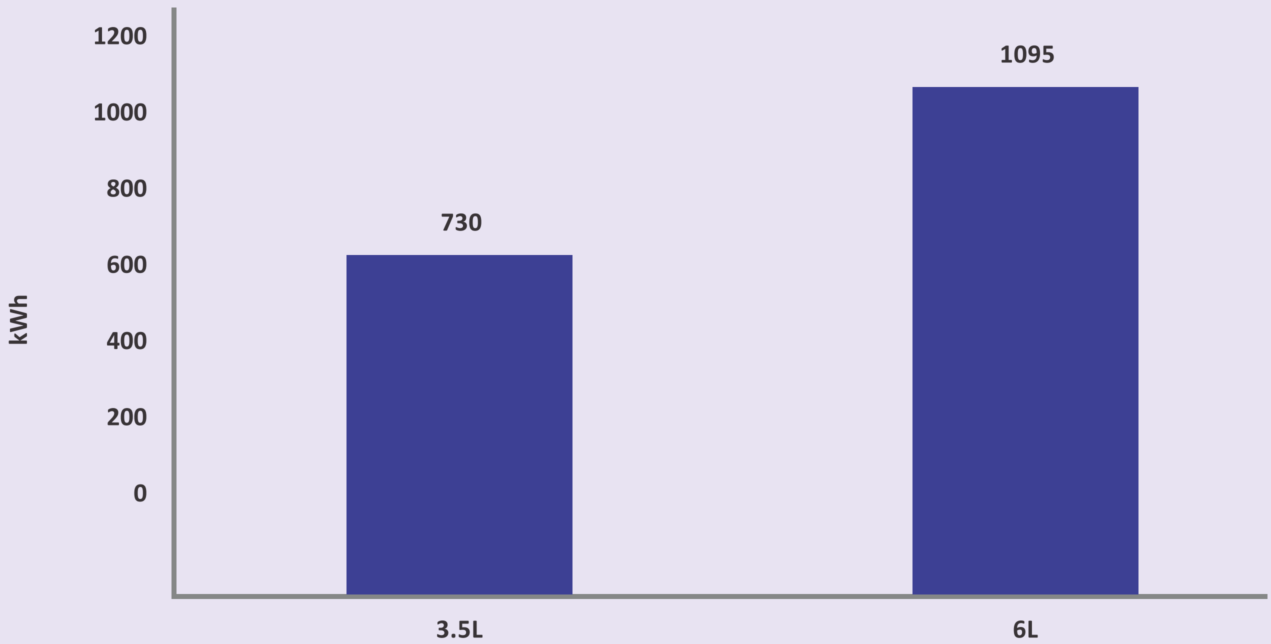
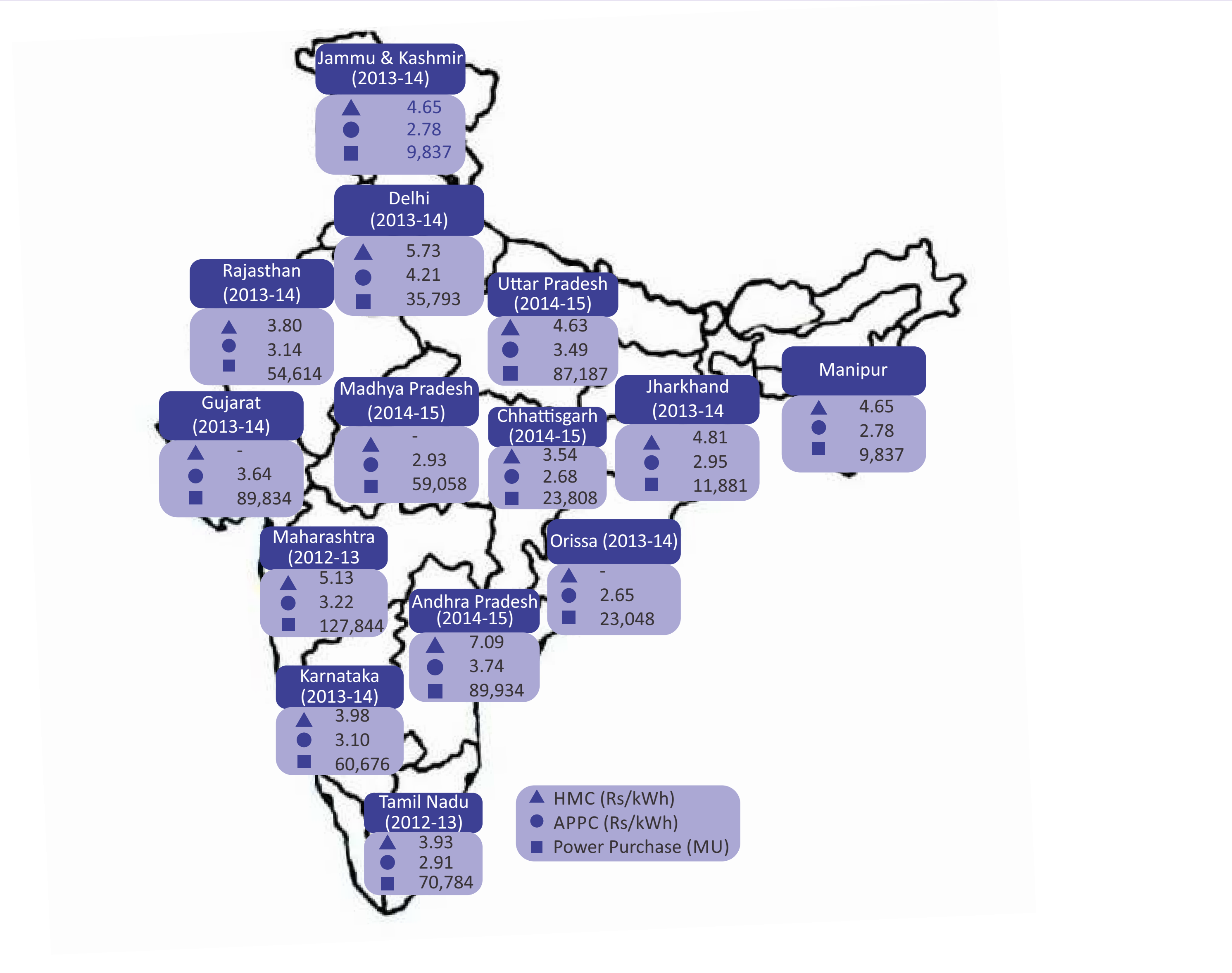


Figure 20: Annual Savings in Water Pumping

Figure 21: APPC and HMC of Indian Utilities



ANNEX XV: CAPITAL RECOVERY FACTOR (CRF)

CRF is used for calculating the CCE and depends on discount factor and life of technology. The following table gives the CRF for various discounts rates and life of technology. For example, if the life of the technology is 10 years and the discount rate is assumed to be 10.5%, then the CRF will be 0.1663(refer: Table 39):

Table 40: Capital Recovery Factor for Various Years and Discount Rates

Years \ Discount Rate	9.0%	9.5%	10.0%	10.5%	11.0%	11.5%	12.0%	12.5%	13.0%	13.5%	14.0%	14.5%	15.0%
1	1.0900	1.0950	1.1000	1.1050	1.1100	1.1150	1.1200	1.1250	1.1300	1.1350	1.1400	1.1450	1.1500
2	0.5685	0.5723	0.5762	0.5801	0.5839	0.5878	0.5917	0.5956	0.5995	0.6034	0.6073	0.6112	0.6151
3	0.3951	0.3986	0.4021	0.4057	0.4092	0.4128	0.4163	0.4199	0.4235	0.4271	0.4307	0.4343	0.4380
4	0.3087	0.3121	0.3155	0.3189	0.3223	0.3258	0.3292	0.3327	0.3362	0.3397	0.3432	0.3467	0.3503
5	0.2571	0.2604	0.2638	0.2672	0.2706	0.2740	0.2774	0.2809	0.2843	0.2878	0.2913	0.2948	0.2983
6	0.2229	0.2263	0.2296	0.2330	0.2364	0.2398	0.2432	0.2467	0.2502	0.2536	0.2572	0.2607	0.2642
7	0.1987	0.2020	0.2054	0.2088	0.2122	0.2157	0.2191	0.2226	0.2261	0.2296	0.2332	0.2368	0.2404
8	0.1807	0.1840	0.1874	0.1909	0.1943	0.1978	0.2013	0.2048	0.2084	0.2120	0.2156	0.2192	0.2229
9	0.1668	0.1702	0.1736	0.1771	0.1806	0.1841	0.1877	0.1913	0.1949	0.1985	0.2022	0.2059	0.2096
10	0.1558	0.1593	0.1627	0.1663	0.1698	0.1734	0.1770	0.1806	0.1843	0.1880	0.1917	0.1955	0.1993
11	0.1469	0.1504	0.1540	0.1575	0.1611	0.1648	0.1684	0.1721	0.1758	0.1796	0.1834	0.1872	0.1911
12	0.1397	0.1432	0.1468	0.1504	0.1540	0.1577	0.1614	0.1652	0.1690	0.1728	0.1767	0.1806	0.1845
13	0.1336	0.1372	0.1408	0.1444	0.1482	0.1519	0.1557	0.1595	0.1634	0.1672	0.1712	0.1751	0.1791
14	0.1284	0.1321	0.1357	0.1395	0.1432	0.1470	0.1509	0.1548	0.1587	0.1626	0.1666	0.1706	0.1747
15	0.1241	0.1277	0.1315	0.1352	0.1391	0.1429	0.1468	0.1508	0.1547	0.1588	0.1628	0.1669	0.1710

Following the announcement of the SOP, the Program Owner can publish a Program Roll-out Manual with the details of the SOP program. The program manual aims at describing the SOP and its implementation including the eligibility of consumers, technologies etc., application process, roles and responsibilities of various stakeholders. The Table of Contents for the Program Roll-out Manual is given in Table 41:

Table 41: Table of Contents for Program Roll-out Manual

S.No.	Parameter	Description
1	Definitions	This section would cover definitions of the key terms: e.g. Standard Offer Program, Program Owner, Aggregator, Energy Service Providers, Consumer, SOP Price, etc.
2	Program Brief	The section would include a brief write up about the program(s) (1-2 pages). It would cover the overall construct of the program and aspects such as the background, intent, goals, eligibility, measures covered, summary of incentives, implementation flowchart, M&V methodologies, etc.
3	Consumer eligibility and required documentation	This section would cover aspects such as: a) The category or the type of consumers eligible for participating in the offered SOP (for e.g. residential, non-residential, commercial, industrial, agricultural, or, hotels, malls, hostels, etc.), minimum period of being engaged with the utility (e.g. for new/ open access consumers) b) Checklist of documents required to be submitted to the utility/ Aggregator C) Information about the agreement that will need to be signed by the consumer with program owner/Aggregator/energy service provider
4	Eligibility of measures	This section would cover aspects such as: 1. Defining the 'peak' period for the utility (e.g. 12 noon to 3 pm for utility targeting small commercial consumers, or 5 pm to 7 pm for utility targeting agriculture consumers, etc.)for which the demand reduction and savings are targeted and thus the eligible measures

S.No.	Parameter	Description
4	Eligibility of measures	2. Specifying the basis, the eligible size and age of the old inefficient technology to be replaced. For e.g. for a chiller replacement program the minimum size of the inefficient chiller may be specified as 50 TR and/or chiller to be replaced should have been used for at least 8 years 3. Types of peak demand and energy reduction measures eligible under the program offered (including the eligibility of the new installations). For e.g.: a) Retrofit program for technologies such as LED lights b) A program for operational modifications for lighting and air-conditioning c) New installations for technologies d) Both retrofit and new installation along with operational modifications, etc. 4. Specify and indicate the time duration of the offered program by defining the way in which the program benefits will be allotted (such as on a first-come-first-served basis) and also boundaries of the program (depending on the type of measure) in terms of: a) Maximum number of installations that will be done under the program , b) Number of consumers that will be enrolled c) Maximum load that will be enrolled under the program Total incentives that will be rolled out in a year
5	Application process	This section would explain: 1. the entire procedure for the consumers on how to apply for the participation in the program detailing the various phases of submission and the different forms to be filled in by project sponsor, consumers, etc., For e.g. Phase-1 (1st submission): Form-1: Application form, requiring customer contact, project sponsor and site contact Form-2: Customer agreement and information about the payee Form-3: Project description and energy savings estimate Phase-2 (2nd submission): Energy efficient measure installation confirmation report Phase-3 (3rd submission): Verification of equipment performance report (if M&V case) 2. How, when and where the forms need to be mailed 3. Specify the entity by which any costs incurred during the application process will be borne (for e.g. the consumer)

S.No.	Parameter	Description
6	Determination of savings	This section indicates: 1. The approach and the method used along with mathematical equations to determine the baseline energy consumption and the energy savings due the measure implementation along with specifying the minimum standards used to establish the baseline. For e.g. Standardized savings approach or Full M&V with current government minimum standards as the baseline 2. Schedule of the M&V to be done for the estimation of the energy and the demand savings depending on the type of the measure. For e.g. pre-installation measurements to be done for a LED lighting retrofit program for estimating the baseline consumption and then post installation measurements is done to get new consumption and thus energy savings 3. Specifying the minimum standards used to establish the baseline performance
7	Incentive Payment	This section includes details on different ways of incentive payment, basis and the schedule of the various incentive payments (how the incentive payment will be made). For e.g. 1. Incentive payment for the kWh savings paid at a certain rate per kWh on an annual basis 2. Incentive payment at a certain rate per peak kW demand reduced at the initial stage of the project, or 3. The incentive payment will be made as a first cost rebate on the technology cost paid on installation (e.g. 50% discount on 5 star fans), or 4. A bill discount for a predefined period paid from month of installation for a period of 6 months or 5. As a combination of both first cost rebate and bill discount (different for different technologies) 6. along with the mode by which the incentives will be paid by the utility to the consumer
8	Dispute Resolution	This section would include details on process to follow for resolving disputes, which may be related to warranty service, damage to fixtures or other infrastructure at consumer's premises as a result of installation of the appliance etc. The section would also list call centre numbers to be contacted by the consumers in case of any issues and lodging complaints.

Table 42: Summary of Provisions in Agreements and Contractual Documents

S.No.	Parameter	Description
1.	Definitions	The section includes the description of the terms and phrases related to the contract, the parties involved and SOP offered. For e.g. alternative and efficient energy appliances, Principle contacts, operational team, etc.
2.	Broad Scope of Work	Defines the work and the functions for which the party (e.g.Aggregator) is engaged by the main stakeholder (program owner/utility) and the agreement is done
3.	Energy Management Plan	Gives the plan process flow overview starting with the way Aggregator will approach the consumer, perform survey, collect data and finally suggest them the appropriate end use technologies which need to be implemented (from the ones offered by the utility)
4.	Baseline arameters	This section includes the baseline parameters related to the consumer energy consumption (e.g. wattage and usage of present electrical installations, technical parameters of new electrical installations) to be accepted by both the consumer and the Aggregator
5.	Project Implementation Schedule	In this the time schedule for the various steps and ways to be carried out by the Aggregator in the energy efficiency measures implementation (to be followed by the Aggregator after signing the agreement) is defined
6.	Equipment rranties	This section explains the conditions to be fulfilled by the Aggregator as part of the agreement (between Aggregator and consumer) including: 1. The good and proper equipment working condition, new purchase and written warranties covering all parts and equipment performance. 2. Cost of any damage to the equipment and its performance including damage to the property and equipment of consumer premises due to failure in warranty rights exercise to be borne by Aggregator 3. All the warranties shall be for a minimum of 1 year and specify use of only new and not reconditioned parts in case repairing 4. Transfer and extension of all the warranties to the consumer by the Aggregator after expiry of the agreement

S.No.	Parameter	Description
7.	Period of Agreement	This section specifies the time period for which the agreement is valid from the date of commencement including the date of termination. The provision for the extension of the agreement for pre specified number of months (e.g. 6 months) after expiry is also mentioned
8.	Performance by Aggregator	Indicates the responsibilities of the Aggregator regarding various tasks/phases of the Aggregator and consumer including: 1. proper construction, installation, repair of equipment and professional, technical accuracy of services to be provided by the Aggregator 2. Consumer's right to review, direct and approve the work performed by the Aggregator
9.	Obligation of Aggregator	The parameter specifies the obligations to abide by the Aggregator as per the agreement. For e.g. those related to follow the construction schedule, equipment warranties, performance, services and repairs, training of staff of consumer for equipment operation, providing technical and operational information, etc.
10.	Obligation of Consumer	The section specifies the various obligations regarding the responsibilities to be performed by the consumer in entire SOP implementation process. For e.g. 1. Provision of sufficient space by the consumer for the installation 2. Consumers shall notify Aggregator within 24 hours regarding any malfunction in equipment, interruption in energy supply, etc. 3. Consumer shall not move, remove, modify in anyway the equipment or any part without prior approval of Aggregator, etc.
11.	Determination of Energy Savings	Specifies the methodology of how the assessment and determination of the energy savings is done. The utility defines the appointment of the M&V agency and then how the savings are estimated through base lining and then measurement of the actual post installation consumption

S.No.	Parameter	Description
12.	Monitoring and Verification	The parameter specifies the M&V agency which will carry out the M&V of the equipment installed along with the various responsibilities and the tasks to be performed by the agency as part of M&V such as ensuring continuous proper M&V of equipment as per plan, submitting monitoring reports each year on decided time, etc.
13.	Payment Schedule	Indicates the commencement of the payments to the Aggregator by utility as per the defined clause of energy savings determination. It also defines the responsibilities of Aggregator and conditions regarding the payment such as, raise of monthly invoice on or before 7^{th} of the month, the utility will make the payment within 15 days of receipt of invoice, Aggregator will process the payment to the consumer within 15 days from payment received by utility, etc.
14.	Ownership	The section defines regarding the ownership of the various type of equipment viz. existing equipment and new equipment. The existing one will be owned by consumer and the new one will be owned by the Aggregator till the agreement period and after that the transfer of ownership to consumer will be there.
15.	Insurance and Indemnification	The section defines the insurance and liability terms to be followed by the Aggregator regarding various aspects and people involved. Including, the Aggregator is required to give compensation to cover all of its working employees, provide insurance compensation for any casualty and liability of equipment and liability insurance for employees, possession and service of equipment and also compensation for any damage to equipment or other property on consumer premises
16.	Events of default	Provides all the possible conditions for the consumer and the Aggregator under which both will be responsible for leading to default regarded as the events of default. For e.g., Material failure by the consumer to comply with any of terms and conditions of the agreement, Failure of Aggregator to process the consumer's share of savings within 15 days from receipt of payment by the utility, etc.
17.	Remedies upon default	The section defines the procedure or solutions to be done in the case of an event of default by the consumer or the Aggregator. For e.g. in case of default by the consumer a Joint Committee comprising of consumer an Aggregator will resolve the problem and the provisions to be referred in case of dispute or doubts regarding the agreement, etc.

S.No.	Parameter	Description
18.	Termination of agreement	The conditions under which the agreement can be terminated are defined in this section. The section explains the requirement for termination such as agreement between Aggregator and utility can be terminated by giving prior notice minimum of 30 days before, etc. and also it specifies the transfer of the rights amongst the Aggregator and utility and the share of energy savings upon termination of agreement by the other
19.	Change in control	Under this part the need for the notification of the change or transfer of the ownership, control of the business, etc. of one entity (amongst Aggregator and utility) in order to exercise the desired changes to be done in the agreement related to the impact on the conditions
20	Force Majeure	All the involved parties (utility, Aggregator) can change respective members of operational team or principal contacts with proper notification
21	Assignment	The section specifies the steps to be performed in case of a force majeure by a party. For e.g., 1. In the event of force majeure the fulfilment of obligations of both parties shall be suspended in whole or part without payment of compensation by parties to each other 2. Party invoking force majeure shall promptly inform other party Both parties can terminate agreement in case it is evident that implementation will be postponed by more than 12 months due to force majeure, etc.

S.No.	Parameter	Description
22.	Assignment	Defines the non-transferable nature of the agreement (between consumer and Aggregator) or part thereof can be assigned to any other firm without prior written approval of the utility or the consumer and even with prior permission for tie up with other firm, etc. the Aggregator will be responsible for performing all its responsibilities as per agreement
23.	Representation & Warranties	The section describes and declares the warrants and assurance of various parties involved to the other regarding its authentic presence for undergoing the agreement and performing its responsibilities by assuring the presence of all requisite power, authority, licenses, permits and franchises for performing the various tasks
24.	Compliance with Law & Standard Practices	This section specifies the necessity of the Aggregator to perform its obligations legally in compliance with all the applicable federal, state and local laws or rules and regulations for safe and proper practices
25.	Independent capacity of the contractor	It specifies that any agent and employee of the Aggregator will act independently and perform the tasks and not as the agent of the utility (distribution licensee) or the consumer
26.	Severability	As per this part in case of any section of the agreement being declared as invalid as per any court (jurisdiction), all the other parts will remain valid and enforceable until declared invalid by law or court
27.	Complete agreement	This specifies that the agreement along with all the annex attachments constitutes the entire document between both the parties and cannot be modified, amended, or terminated except by a written agreement signed by both the parties
28.	Costs	This section specifies that all the costs being incurred by both the parties during the preparation of this agreement shall be borne by each of the parties respectively

S.No.	Parameter	Description
29.	Waiver	The section specifies that the failure of any of the party to enforce one or more terms and conditions or right or power under the agreement at any time shall not be treated as a waiver or a bar to the right of the party to exercise any term or power as per the agreement
30.	Notices	It specifies the mode in which any notice should be given by one party to the other. The notice by one party as per the agreement should be given in writing and delivered by hand or sent by registered post/AD to the address indicated by the other party. It also defines the day when the notice will be served. For e.g. notices delivered by hand during normal business hours will be served on the same day, etc.
31.	Survival	This section defines that the termination of the agreement can survive until the obligations of the parties as defined by various clauses have been fully discharged

Flyer to be distributed by the distribution utility while announcing the program and a sample registration form are given in Figure 22 and Figure 23:

Figure 22: Sample Program Announcement Flyer

Standard Offer Program
By
<Utility Name>

Save upto **80%** of power consumption by replacing your old equipment with efficient equipment and also get incentives

The following programs are currently being offered by <Utility Name>

New Technology	Old Technology	Category	Cost of Technology (Rs)	Annual Savings (kWh)	SOP Price (Rs / kWh)	Payback Period (months)
LED Bulb	Incandescent Bulb	Residential	450	66	0.83	17
5-star Fan	Inefficient Fan	Residential	2,000	165	2.62	22
5-star Split AC	Inefficient Window AC	Residential	30,000	979	3.30	50
5-star Refrigerator	Inefficient Refrigerator	Residential	18,000	657	3.00	47
Reciprocating Water-Cooled Chiller	Reciprocating Air-Cooled Chiller	Commercial	18,00,000	144540	1.67	15

How to enroll:

1. You can visit the website: www.abcdefg.com/sop
2. You can call the customer care @ (+91) 11 9999 9999
3. You can also email us at abcde@fgh.com

Figure 23: Sample Consumer Registration Form

Consumer Registration Form (on the website of the utility)

Consumer Name :

Consumer Number :

Consumer Category :
(Drop Down menu)

Contact Number :

Contact Email ID :

Various outreach, communications and marketing approaches may be used for socializing the SOP concept, reaching out to consumers, convincing them about the SOP and enrolling them into the program. Some of the options are as follows:

- Printing information about the program on consumer electricity bills
- Sending separate flyers about the program along with the electricity bills[31]
- Sending information sent through sms or email
- Information displayed on the utility website
- Information displayed on social media pages and utility blogs[32]
- Display of information about the program at bill payment centers, housing colonies, industrial/ commercial hubs
- Conducting demonstration projects in industrial hubs
- Conducting focus meetings in housing colonies and industrial/ commercial hubs
- Release of press note about the program
- Including information about the program in other outreach activities undertaken by the utility
- Creation of a separate Standard Offer Program website

[31] *Consumers are more likely to notice a separate flyer sent with the bill than information printed on the bill*
[32] *E.g. Facebook, Twitter*

The available information on some of the programs implemented or under implementation in various states is given in the table below:

Table 43: DSM Initiatives Undertaken by Utilities in India[33]

State	Company	Type	Appliance	Target Consumers R	C	I	A	P	Number of units replaced[34]	Status of the project	Comments
MAHARASHTRA	Tata Power Company–Distribution	Manual Demand Response	-		■				-	Completed	Savings achieved: 15MW
		HVAC	Thermal Storage		■					Completed	Incentive: Rs 1/kWh shifted. A total of 17,000 TRH enrolled Savings: 740 kVA, 4MU
		HVAC	Ceiling Fans	■	■				16000+	Under-Implementation	Incentive: Rs 600/ fan Savings achieved: 24 W/fan
		HVAC	Air Conditioners	■	■				700+	Under-Implementation	Incentive: Rs 5000 / AC
		Refrigeration	Refrigerator	■					1500+	Under-Implementation	Incentive: Rs 4500 / AC
		Lighting	T-5	■	■	■			3300+	Completed	Incentive: Rs 150 / AC
		Lighting	LEDs		■	■			1000	Under-Implementation	Incentive: Rs. 300 / LED
		Other	Walk Through Energy Audit	■	■	■			100+	Under-Implementation	Offered for Residential housing societies and Industrial and Commercial Consumers with loads < 50 kW; Incentive: Free for the

[33] MP Ensystems compilation, reproduced from report titled 'International Experiences of Outsourcing DSM Implementation', submitted for a project implemented under contract from the British High Commission under the Prosperity Fund India Program. Sources include: www.bee-dsm.in, www.dsm-
[34] india.org, discussions with utilities, media reports.

SHAKTI SUSTAINABLE ENERGY FOUNDATION

MP ENSYSTEMS Advisory Pvt. Ltd.

State	Company	Type	Appliance	Target Consumers					Number of units replaced[34]	Status of the project	Comments
				R	C	I	A	P			
		Other	Energy Audit		■	■			120	Under-Implementation	Incentive: 25% cost borne by customers and 75% by utility.
		Other	Standard Offer		■	■				Under-Implementation	Any kind of Energy Efficiency Program. Incentive of R.s 1/kWh offered.
	Reliance Infra – Distribution	Lighting	CFL	■	■	■			6,00,000	Completed	Savings: 38 MU
		Lighting	T-5 FTLs	■		■			4000	Completed	Savings: 0.15 MU
		HVAC	Ceiling Fans	■		■			12,127	Under-Implementation	Savings: 1.01 MU
		HVAC	Air Conditioners		■				50	Under-Implementation	Savings: 0.19 MU
		Refrigeration	Refrigerator	■					3700	Under-Implementation	Savings: 0.57 MU
	Brihan-Mumbai Electric Supply and Undertaking (BEST)	Lighting	T-5 FTLs	■	■				25,000	Under-Implementation	Incentive: Rs. 200 Savings: 11-12 W/ tube light
		HVAC	Air Conditioners		■				200	Under planning	-
		HVAC	Ceiling Fans	■	■				5000	Under-Implementation	Incentive: Rs. 700/ fan offered

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MP ENSYSTEMS Advisory Pvt. Ltd.

State	Company	Type	Appliance	Target Consumers					Number of units replaced[34]	Status of the project	Comments
				R	C	I	A	P			
	Maharashtra State Electricity Distribution Company Limited (MSEDCL)	HVAC	Ceiling Fans					■	5000	Under-Implementation	Undertaken for own buildings
		Agriculture DSM	Agriculture Pump sets				■		2,200	Under-Implementation	
		HVAC	Ceiling Fans					■	20,000	Under-Implementation	
		HVAC	Chillers					■	30	Under-Implementation	15 chiller replacem-ents and 15 chiller retro-commissioning
RAJASTHAN	Jaipur Vidyut Vitran Nigam Limited (JVVNL)	Demand Response	-	■					17	Completed	Savings: 88 MW
TAMIL NADU	Tamil Nadu Generation and Distribution Corporation (TANGEDCO)	Lighting	CFL	■						Completed	
		Agriculture DSM	Agriculture Pump sets				■		3700	Under-Implementation	
ANDHRA PRADESH	APEPDCL	Lighting	CFL	■					3,80,000	Completed	
		Agriculture DSM	Agriculture Pump sets				■			Under-Implementation	
	APEPDCL	Lighting	CFL	■					16,50,000	Completed	
	All utilities	Lighting	LEDs	■						Under-Implementation	EESL as implementation partner

State	Company	Type	Appliance	Target Consumers					Number of units replaced[34]	Status of the project	Comments
				R	C	I	A	P			
DELHI	BSES Yamuna Power Limited (BYPL)	Lighting	CFL	■					6,00,000	Completed	Savings: 35 MW
	Tata Power Delhi Distribution Limited (TPDDL)	Lighting	LEDs	■						Under-Implementation	80 lakh bulbs across Delhi
			Air Conditioners	■							
		HVAC	Refrigerator	■						Under-Implementation	
		Demand Response	-		■	■		■		Under-Implementation	Savings: 34 MW
	BSES Rajdhani	Lighting	LEDs	■						Under-Implementation	
	Uttar Gujarat Vij Company Limited (UGVCL)	Lighting	CFL					■	6,100	Completed	Implemented in UGVCL's own offices
		Pumping	Agriculture Pump sets			■			12,929	Under-Implementation	
		HVAC	Ceiling fans					■	75000	Under-Implementation	Savings: 1.5 MW; Target consumers: educational and medical establishments
	Madhya Gujarat Vij Company Limited (MGVCL)	HVAC	Ceiling fans					■	75,000	Under-Implementation	Savings: 1.5 MW; Target consumers: educational and medical establishments
	Paschim Gujarat Vij Company Limited (PGVCL)	HVAC	Ceiling fans					■	95,000	Under-Implementation	Savings: 1.9 MW; Target consumers: educational and medical establishments

State	Company	Type	Appliance	Target Consumers					Number of units replaced[34]	Status of the project	Comments
				R	C	I	A	P			
GUJARAT	Dakshin Gujarat Vij Company Limited (DGVCL)	HVAC	Ceiling fans					■	75000	Under-Implementation	Savings: 1.5 MW; Target consumers: educational and medical establishments
HARYANA	Uttar Haryana Bijli Vitran Nigam Limited (UHBVNL)	Lighting	CFL	■					3,50,000	Completed	Subsidy to consumers: Rs. 80 per CFL
		Agriculture DSM	Agriculture Pump sets				■		210		
		Lighting	CFL	■					20,00,000	Completed	
KARNATAKA	Bangalore Electricity Supply Company Limited (BESCOM)	Street Lights	Timer Switch					■	10,000		
		Lighting	CFL	■					37,00,000	Completed	Maximum of 4 CFLs/ household. CFL exchanged with incandescent bulb at Rs. 15.
		Agriculture DSM	Agriculture Pump sets				■		277	Completed	29.23 MU saved from Apr, 2011 to Jun, 2013
		Agriculture DSM	Agriculture Pump sets				■		1,00,000	Under-Implementation	Contract signed with EESL for program implementation
		Lighting	Efficient Ballast	■					5,298	Completed	Total cost of program : Rs. 66.90 Lakh. Estimated savings: 0.35 MU/ annum

State	Company	Type	Appliance	Target Consumers					Number of units replaced[34]	Status of the project	Comments
				R	C	I	A	P			
KARNATAKA	Hubli Electricity Supply Company Limited (HESCOM).	Street Lights	Timer Switch					■	9700	Under-Implementation	Savings: 1.5 MW; Target consumers: educational and medical establishments
KARNATAKA	Gulbarga Electricity Supply Company Limited (GESCOM)	Street Lights	Timer Switch					■	110	Completed	Subsidy to consumers: Rs. 80 per CFL
PUDUCHERRY	Electricity Department, Puducherry	Lighting	CFL	■					7,35,000	Completed	Subsidy to consumers: Rs. 310, Savings: 50MU

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