Pragmatic Institutional Advances in the Implementation of Energy Efficiency and Demand-Side Management

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Background

Ever-increasing deficits in supply and the rapid growth pattern in the demand for electrical energy through consumer goods and appliances have resulted in a general lack of interest in energy efficiency (EE) and demand-side management (DSM) on the part of distribution utilities, except in a few visible options in some sectors. However, a recent formal evaluation of the potential of DSM and EE in the domestic, commercial, agriculture, public sector and municipal sectors developed under USAID ECO-II initiative shows a way to realize over 2000 MW demand-savings in Maharashtra alone[2]. Further, an analysis at several levels by bilateral programs, show a win-win situation from energy savings alone for the state and consumers sector with increasing tax revenues and ancillary value-addition in the energy efficiency products and services[3]. Also, an assessment of the fiscal impacts of EE/DSM conducted by IIEC in Maharashtra has pointed out the substantial benefits to the state government[4].

Policy changes and efforts related to standards and labeling of appliances (frost-free refrigerators, air-conditioners, tube-lights) and equipment (motors and transformers), initiated by the Bureau of Energy Efficiency (BEE), also are slated to provide the important policy-push towards market transformation leading to consumer awareness providing an opportunity for an informed choice[5]. Similar efforts by BEE to create capacity through a team of expert energy managers and energy auditors is aimed at the development of energy services companies leading to implementation of programmes in the industrial and commercial sectors.

Meanwhile on the regulatory front, exemplary directions by several regulatory authorities, including the Maharashtra Electricity Regulatory Commission[6] and Rajasthan Electricity Regulatory Commission, have sent several tariff signals in different sectors. Examples of time-of-use (TOU) and time-of-the-day (TOD) tariff in the commercial and industrial sectors have resulted in varying levels of demand-management and have enabled the gathering of relevant data and the testing of various tariff regimes.

Review of utility-driven EE/DSM programs

While the interventions in the industrial and commercial sectors are driven by a profit motive (reducing factor cost of production and services), the implementation of EE/DSM measures in the public and domestic sector have different end goals related mainly to the public good of sustainable development. In addition, while energy efficiency projects in public buildings and bulk water pumping sectors have promising technical solutions and favorable benefit-cost ratios, complexity of financial transactions is a challenge because of a lack of credit available for the implementing government departments. This current article highlights options in the domestic sector, with features of the interventions as listed below.

- Interventions are small and dispersed; but are large-scale (lighting) or show higher benefits (housing society water pumping) in aggregate.
- Programmes exhibit direct benefits to utilities to reduce the morning and evening peak with several spin-off effects on the tariff and bulk-purchase.
- Tariff hike and price signals, though possible, have limited potential as the utilities are expected to fulfill service obligations to the diverse (units consumed) consumer base.
- Market interventions in the domestic sectors have a wide-range of efficiency and price levels.
- Consumer interface is extremely important in both the sectors as the real benefit is possible only through a careful application and perpetual servicing of products and services.
- With diversity in the benefit-cost ratios, consumers (and their organizations) have been indecisive, and thus, a higher level of awareness creation is essential.
- Monitoring of benefits is challenging with dispersed end-use (geographical).
- In a growing economy, most end uses are susceptible to latent growth in demand.
- With metering being unreliable and expensive, concentrated load and energy consumption can be measured only at dedicated or predominantly domestic feeders for monitoring and verification.
- Both primary end-uses (lighting and housing society water pumping) show equitable benefit-cost potential to consumers, utilities and private sector product and service providers

Lighting Programmes

Domestic lighting programmes have recently been implemented in Karnataka and Maharashtra on a reasonable scale. Table 1 provides a comparison of three lighting sector programs - the BESCOM Efficient Lighting Program (BELP), and lighting programs by the Maharashtra State Electricity Distribution Company Limited (MSEDCL) and Reliance Energy Limited (REL). A comparison of these is provided below from the context of understanding the drivers, results and implementation methodologies.

Though all the above programs are 'work-in-progress', the lessons learned from the implementation so far need to be considered. We summarize the common themes and differences as follows:

- State-owned utilities need to select more than one vendor even though the investments are not made by them directly. On the other hand, private-sector utilities do not necessarily follow the same norm
- Except BELP, none of the programs were designed to carry out mid-way and post-implementation monitoring and verification. BELP monitoring and verification is primarily based on engineering calculations with authentication of data for a sample size. Feeder or distribution transformer metering on the hand could allow real time demand-reduction monitoring in addition to capturing power quality with a concentrated CFL use. A circle-wide experiment (replacement of entire stock) could dem-

Table I Comparison of Indian lighting DSM programs

	BESCOM Efficient Lighting Program (BELP)	MSEDCL Lighting Program	REL Lighting Program
Type of utility	State-owned, un-bundled	State-owned, un-bundled	Private
Driver for lighting program	Utility-initiative supported through bilateral technical assistance (USAID)	Regulatory intervention	Regulatory intervention
Lighting products	CFL + FTL	CFL	CFL
Year	2005	2006	2006
Vendor-short-listing method	Competitive, technical and financial bid comparison	Competitive, technical and financial bid comparison	Competitive, technical and financial bid comparison
Price reduction achieved compared to prevalent market price	15-20%	10-15%	15-20%
# of vendors short-listed	3	3	1
Success so far[7]	500,000 CFLs in the system	300,000 CFLs in the system	50,000 CFLs in the system
Demand and energy savings	23 MW (demand) 17 MU (annual energy)	NA[8]	NA
Current status	Extended in Bangalore urban and rural sector	Ongoing	Ongoing
Financing	Consumer and vendor-financed	Consumer and vendor-financed	Consumer and vendor-financed
Payment options	Direct + installments through utility bills	Direct + installments through utility bills	Direct + installments through utility bills
Utility subsidy	No	No	Limited
Monitoring and verification	Completed (end 2005)	NA	NA
M&V method	Engineering calculations supported through focused load survey	NA	NA

onstrate real benefits at a systemic level.

▶ Lighting programs have promoted specific replacement technologies. Perhaps, a holistic technology-neutral lighting initiative (as in BELP design) can extend higher system benefits.

▶ Extension of repayment through utility-billing system has set a trend of extending credit to consumers. Similar credit-extension can be used effectively even for higher investments in the EE programs. Supplier credit has an embedded interest burden. In case of new programs, a combined credit extended by EC fund manager would be useful too.

Housing society efficient water pumping programs

The only examples of promotion of housing society based efficient water pumping system has been in the Ahmedabad Electricity Company. As the water pumping energy efficiency at the end-use creates benefits not only in the reduction of pumping load during the peak, but also in reduction of energy bills for the societies, the promotion of shifting of pumping demand to off-peak and replacement of existing pump-sets by energy efficient pump-sets could have an even greater impact. Even at a feeder-level, this end-use energy efficiency application shows good potential for systemic load management. For example, some of the features of a typical 10 MW system benefit program are as follows[10]:

▶ Two technical options, a) use of timers to shift the pumping schedule and b) replacement of existing stock by energy efficient pump-sets are possible.

▶ 10 MW of existing load corresponds to close to 5000 pump-sets in a circle

▶ Benefit-cost ratio for a 100% utility-sponsored program under a) above is as low as one month and under b) is less than 14 months

▶ Water availability by the municipal utility and scheduling of pumping hours is accomplished as a co-managed system

▶ Similar to a lighting program, this end-use intervention needs the involvement of utilities, consumers and vendors

Proposed feeder or circle-based multi-technology implementation of DSM/EE

An emphasis on a feeder or a circle-wide DSM/EE intervention spanning multiple technologies is proposed by the authors. In particular, multi-product lighting and end-use pumping options are proposed here. Proposed implementation options span technical, programmatic and financing features.

Technical profile

The proposed unit selected for the implementation is a feeder-choke-point (Fig 1), where the domestic sector consumers are aggregated for capacity, energy throughput and billing. The important aspect of this feeder, and at a macro level - circle choke point, is the ability to track historic consumer base, uniform billing cycles, aggregate metering at the transformer and feeder-level and defined socio-economic strata. The selection of such feeders and substations is done based on dominance of domestic consumers.

The technical interventions proposed for implementation include primarily lighting and water pumping technologies. Other aspects such as the solar-water or solar-water/gas hybrid systems can certainly be added on at a later date in the program. In order to ensure replacement of certain applications in both the systems, the lighting technologies chosen will range from CFLs to 28-Watt T5 fluorescent tube-lights with electronic chokes. For the water pumping units, the proposed units include timers for pumping hours modulated with the level sensor devices at the underground and overhead water storage tanks. As the utility's involvement in this program is absolutely essential and higher level of collaboration among the utility and the consumer groups is expected, a model DSM circle developed by the utility will be evaluated through surveys carried out jointly. As indicated in Fig 1, proposed feeder-based DSM program will have the monitoring and verification plan embedded in the utility metering and billing and collection systems itself.

Benefit-cost for all

DSM/EE interventions result in benefits for all the primary stakeholders - the consumers, utility and private sector suppliers. Though benefit-cost ratios are dependent on technologies, a formal analysis of attributes (Fig 2) is possible for program possible. CFL programs, for example, show benefit-cost ratios of less than 9 months for consumers and up to 6 months for utilities in subsidy-based programs. As a part of program design, some of the attributes to be considered include the following:

▶ Though the low benefit-cost ratios attract the individual stakeholders, interventions such as the

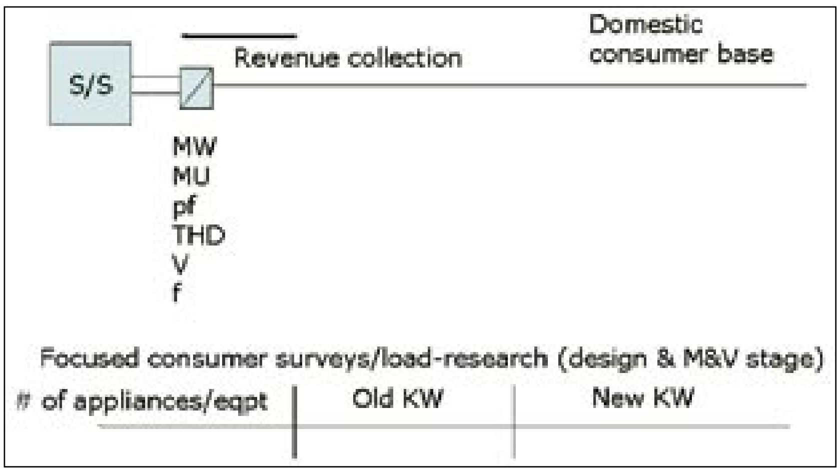

Fig 1 Conceptual feeder-based network

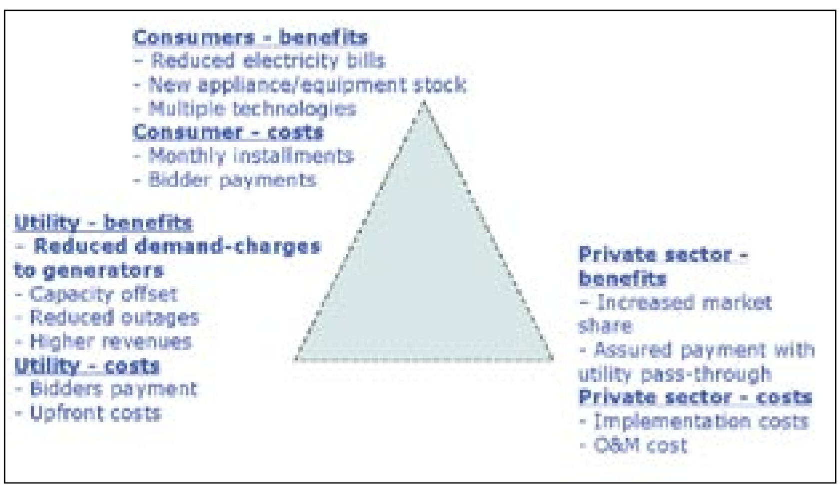

Fig 2 Attributes of Benefit-cost ratios

solar-thermal systems for example, need to be leveraged among the possible credit.

- Consumers and utilities typically are equal beneficiaries in the process, thus an inclusive approach is essential.
- As the competitive procurement process boosts reduced prices, utility-initiated competition is essential.

Financing approach

A variety of financing options (primarily funds flow) are possible (Fig 3). Utility partnership with the private sector in ensuring credit recovery has been proven in India and is an essential and powerful tool to ensure implementation of DSM/EE measures. In addition to providing mere pass-through, new thinking by the utilities to finance capital requirements is expected to provide further boost. Such investments are supported by the regulatory tariff-setting process providing recovery options through the Annual Revenue Requirements.

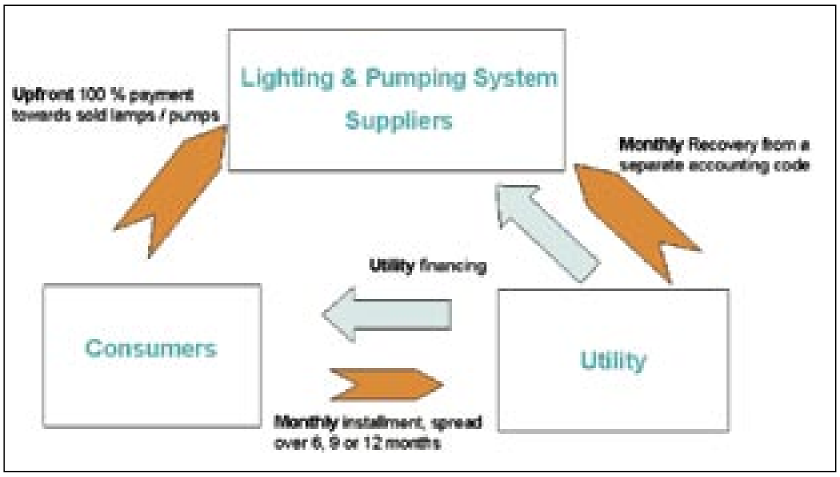

Fig 3 Financing network

Conclusions

Implementation on the ground requires an all-inclusive approach, with novel partnerships developed among the utilities, consumers and their associations and vendors. The utility is an essential institutional conduit in this implementation and needs to ensure out-of-the-box business intervention moving beyond the meters and closer to the customers and their end-uses. Meanwhile, an innovative program design and implementation through a feeder-based program necessarily embeds utility participation in design, consumer surveys, implementation and monitoring and verification - thereby enabling scale up of the EE/DSM programs at a systemic and system-wise basis.

We conclude on a positive note that Indian policy and regulatory environment has come of age and an enabling environment is now being created in the country to scale up the energy efficiency market further. Implementation of EE/DSM measures through the electricity utilities puts a better emphasis on the faster implementation in the context of the already created policy and regulatory environment leading to larger initiatives.

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8 NA = Information not yet available.

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