US-India Cooperation on Demand-Side Management (DSM): Expanding Maharashtra and Delhi Programs to National-level

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ABSTRACT

The Indian government has promoted energy efficiency through initiatives such as equipment labels, outreach activities, and voluntary building codes. Occasionally, it has implemented DSM pilot programs. Beginning in December 2007, Lawrence Berkeley National Laboratory in collaboration with the California Public Utilities Commission and the California Energy Commission signed three agreements to promote DSM programs in two states, Maharashtra and Delhi, and at the national level. In December 2009, the Indian government announced that the National Mission on Enhanced Energy Efficiency (NMEEE) will be implemented from April 1, 2010. Four key approaches are envisioned under NMEEE – creation of market for tradable energy savings certificates for large industrial customers, market transformation, creation of financing platform to facilitate ESCO activity, and development of broader economic framework (e.g. tax incentives, public procurement, etc.) to support EE.

In this paper, we focus on the market transformation approach included in the NMEEE. We discuss how the NMEEE can foster ongoing EE activities in India – for example, DSM programs initiated by regulatory commissions, administered by utilities, and funded by ratepayers. We provide an overview of the existing institutions, legal and regulatory framework, availability and capability of EE workforce, and the financial infrastructure that can support EE. Based on our experience in India in design and implementation of DSM programs, we identify missing elements that are necessary for delivering EE and achieving the potential estimated in the NMEEE. We present a critical review of previous EE initiatives in India. Finally, for Indian policymakers, we suggest a road-map that incorporates the NMEEE and would be critical for rapidly achieving all cost-effective CO_2 reductions through EE.

Introduction

The Indian economy has grown rapidly over the past decade. The rapid economic growth has been accompanied by commensurate growth in the demand for energy services. The gap between electricity supply and demand in terms of both capacity (i.e. kW) and energy (i.e. kWh) has been steadily growing in India. In the 2007-08 annual report, India's Ministry of Power reported that the electricity shortage has increased from 7% to 10% (energy) and from 11% to 17% (capacity) during the last five years. Anecdotal evidence suggests that these estimates substantially understate the actual shortage because lack of data makes it difficult to estimate the undiscovered demand.

In August 2009, a comprehensive study assessing the low carbon growth potential of India was completed by McKinsey and Company. The key results from this study – presented in Table 1 – suggest that under a "business-as-usual" scenario, India is moving at a tremendous pace with respect to all metrics. The GDP is expected to grow more than 6 times in 2030 as compared with 2005. The floor space is likely to grow five-fold during the same period.

Consequently, the power demand and energy consumption are both expected to grow five-fold, from 2005 to 2030. It should be noted that some of the key assumptions built into this forecasting exercise include:

- Reduction in technical losses (in transmission and distribution) from 20% to 12%
- 90% incandescent lamps replaced by CFLs
- 10% penetration of highest efficiency A/Cs and refrigerators; 100% penetration of “labeled” (or “star-rated”) appliances
- Increase in HVAC efficiency by 0.8% per year
- 20 GW of solar, 30 GW of nuclear, and 55 GW of wind capacity by 2030

Table 1. Trend in Key Economic, Demographic, Energy, and Environmental Metrics for India from 2005 to 2030.

Metric	2005	2030	Annual Growth Rate
GDP (billion 2000 $, real)	~650	~4,000	~7.5%
Per Capital GDP (2000 $, real)	~595	~2,720	
Population (in billions) (% Urban)	~1.1 (~29%)	~1.47 (~38%)	
Total floor space (billion sq. m) (% Commercial)	~8 (~12.5%)	~41 (~10%)	~6.4%
Power Capacity (GW)[1]	~150	~760	~6.1%
Power Generation (TWh)	~700	~3870	~7%
GHG Emissions (billion tons CO_2e)	~1.5	~5.7	~5%

(Source: McKinsey, 2009).

These vulnerabilities are being addressed through diversification of energy imports, the development of indigenous fossil and renewable energy sources, and, last but not least, reduction of the intensity of energy use of the Indian economy. Energy efficiency (EE) offers a cost-effective solution to overcoming these concerns that is almost entirely within the control of the Indian government and private sector. Improving the country’s energy productivity will require a concerted effort by all sectors of the economy including government, private, educational/research institutions, and non-profit.

The increased efficiency will permit energy companies to meet their current and future demand obligations. An analysis of the electricity efficiency potential for India shows that efficiency improvement in combination with new supply can eliminate electricity shortages at the same investment level as for a business-as-usual electricity supply scenario (Sathaye and Gupta, 2010). The higher penetration of energy efficiency technologies reduces the construction of power plants thereby reducing fuel imports and India’s CO_2 emissions by 300 Mt CO_2/year by 2017.

Efficiency improvement also has the potential to boost economic growth that can result in higher tax revenue for the government. An analysis of macroeconomic benefits for India’s state of Maharashtra illustrates that redirecting electricity saved through efficiency improvements to electricity-short businesses has the potential to increase economic output and tax revenue, which could reduce the state government’s fiscal deficit by 15-30% depending on the size of backup power generation (Phadke et al., 2005).

[1] Includes captive generation.

The Indian government has promoted energy efficiency through initiatives such as equipment labels, outreach activities, and voluntary building codes. Occasionally, it has implemented DSM pilot programs. In December 2009, the Indian government announced that the NMEEE will be implemented from April 1, 2010. Four key approaches are envisioned under NMEEE – creation of market for tradable energy savings certificates for large industrial customers, market transformation, creation of financing platform to facilitate ESCO activity, and development of broader economic framework (e.g. tax incentives, public procurement, etc.) to support EE.

In this paper, we focus on the market transformation approach included in the NMEEE. Market Transformation (MT) is defined as "long-lasting sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where further publicly-funded intervention is no longer appropriate in that specific market." [2] We discuss how the NMEEE can foster ongoing EE activities in India – for example, EE programs initiated by regulatory commissions, administered by utilities, and funded by ratepayers. We provide an overview of the existing institutions, legal and regulatory framework, availability and capability of EE workforce, and the financial infrastructure that can support EE. Based on our experience in India in design and implementation of EE programs, we identify missing elements that are necessary for delivering EE and achieving the potential estimated in the NMEEE. We present a critical review of previous EE initiatives in India. Finally, for Indian policymakers, we suggest a road-map that incorporates the NMEEE and would be critical for rapidly achieving all cost-effective CO_2 reductions through EE.

Beginning in December 2007, Lawrence Berkeley National Laboratory (LBNL) in collaboration with the California Public Utilities Commission and the California Energy Commission signed three Memoranda-of Understanding (MOU) to promote DSM programs in two states, Maharashtra and Delhi, and at the national level. This paper draws extensively on the ongoing technical assistance provided by LBNL under these three MOUs over the past two years. The technical assistance has ranged from presenting seminars for the regulators and policy-makers in India on EE issues, conducting training workshops for regulatory and utility staff, to providing detailed input to various regulatory orders, decisions, and guidelines. LBNL has also been collaborating on a range of topics with BEE including its Appliance Standards and Labeling program.

EE Potential in India

The GHG abatement potential for India was estimated to be ~2.6 billion tons CO_2e by 2030 out of which approximately, one-third was accounted by the power sector and ~10% by EE, specifically. The various EE opportunities estimated by McKinsey (2009) in terms of cost and ease of implementation are presented in Table 2. A majority of the GHG reductions from EE can be achieved either at negative (i.e. positive net benefits) or moderate cost in India. However, achieving these potential EE savings faces several barriers in the Indian context.

Several studies have attempted to estimate the EE potential for India. We refer the reader to Sathaye and Gupta (2010), McNeil et al. (2007), NPC (2009), and others for different estimates of EE potential.

[2] http://uc-ciee.org/energyeff/documents/mrkt_effts_wp.pdf

Table 2. GHG Abatement Opportunities in EE in India.

GHG Abatement EE Opportunities	GHG Abatement Potential (million tonnes CO_2e)	Cost	Ease of Implementation
Equipment and appliances	90	Negative	Moderately challenging
Lighting controls	20	Negative	Challenging
LED Lighting	35	Negative	Very challenging
New building efficiency	70	Modest (<$30/tonne)	Challenging
TOTAL	**215**		

(Source: McKinsey, 2009)

Key Barriers to EE India

Anecdotal evidence suggests that in general, Indian customers relatively more cost-conscious than their western counterparts (e.g. the US). It is commonly found that a large portion of individuals – mostly, middle and low income - promptly switch off appliances (e.g. lights, ceiling fans, television sets, etc.) when not in use. Consequently, one would expect that higher adoption of EE technology is more likely to happen in India than in the west. However, the market penetration of EE is hampered by several barriers in India that are influenced by prices, financing, international trade, market structure, institutions, the provision of information and social, cultural and behavioral factors. Many papers and reports have documented the pervasiveness of barriers to EE.[3] Some of the most significant market barriers that are observed in India include:

- Lack of awareness – Simply put, a large portion of customers do not have easy access to information on EE. The BEE has initiated a major marketing and promotion campaign to raise the awareness levels. However, this is at a nascent stage. A related problem to this barrier is the uncertainty about the quality of "new" and efficient products. Often EE products that are new on the market suffer from lack of trust, limited product warranty or lack of credibility about a warranty. This issue is particularly acute where product suppliers are unwilling to take the product back even after its performance has been demonstrated to be poor.[4]
- Lack of access to efficient technology – In many areas, especially, rural areas in India the markets have not developed so that customers have easy access to different technologies. For example, many customers use kerosene lanterns that are inefficient, expensive, and dangerous for their lighting needs in most of rural India. In recent years, a company introduced "solar lanterns" that are comparable in cost but substantially more efficient and safe. Soon after the introduction of solar lanterns, the kerosene lantern vendors noticed their sales decreasing rapidly.[5]
- Lack of technical ability to systematically assess costs and benefits of choosing efficient technology – The level of technical training necessary to assess the lifetime benefits and costs of decisions related to energy consumption is low in India. It should be noted that

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[3] A long series of papers on these topics is available at: http://uc-ciee.org/pubs/ref_market.html

[4] A recent program for replacing incandescent lamps with CFLs was implemented in Nashik (India). The quality of the CFLs was so poor that now simply associating EE with CFLs is leading customers to become suspicious of the EE concept itself (Prayas, 2008).

[5] http://www.businessworld.in/bw/2009_11_27_Deepak_Khaitan_And_His_Magic_Lamp.html

the level of literacy and education – in general – is low in India with recent estimates indicating that only ~67% of adults (i.e. > 15 years) are literate.[6]

- Economic
  - High upfront costs – The annual average household disposable income in India was ~$2500 (in 2000 $) in 2005 and McKinsey (2007) projects that it will grow to ~$7000 (in 2000 $) by 2025 under a business-as-usual scenario. Given this level of poverty, it is extremely difficult for most households to even consider investing in expensive EE even though they would be better off in the long-term with it. For example, an incandescent lamp costs ~30 cents while a CFL costs ~$2 in India. The payback period for a customer for choosing CFL over incandescent is < 1 year. Despite this favorable cost-effectiveness, the high difference in upfront costs is simply insurmountable for a large portion of the Indian households.
  - High discount rates – The problem of high upfront costs of EE, are exacerbated by the historically high discount rates of Indian customers. For a large portion of Indian households, the ability to save and invest is minimal.[7] The Reserve Bank of India (RBI) estimates that ~40% of the population does not even have savings accounts. In other words, if the monetary savings from an EE investment decision are not, practically, immediately available then the customers are less likely to invest in it.
  - Lack of access to capital – The RBI also estimates that ~85% of the population does not have any loan accounts. In other words, most of the customers do not have the access to easy credit for financing their EE investments. Absence of financial intermediation by banks and other lending institutions to promote and develop energy efficiency lending; the relative lack of private sector energy efficiency service delivery mechanisms such as ESCOs. There is insufficient understanding and assessment of the risks and benefits that accrue to the parties in an energy efficiency transaction.
  - Subsidized electricity pricing – Many EE technologies are cost effective when compared with the cost but not necessarily the price of energy supply. Electricity tariffs in India range from less than 1-4 cents/kWh for subsidized agricultural and poor customers (which constitute a large portion of the customer base of most Indian utilities) EE is thus not cost effective when compared with the low tariff price since its cost ranges upwards from 1-4 cent/kWh.
  - Split incentives – This is a classic EE barrier that has been studied in-depth in the US – see for example, Murtishaw and Sathaye, 2006 – and also applies to Indian commercial/residential establishments. Most new commercial buildings are not occupied by the owner – they are rented. The builder's objective is to construct the building for the lowest initial cost; the renters also have no incentive to invest in efficiency improvements in a property they do not own. In many cases, the renters do not even pay their utility bills directly. The electricity expenditure is recovered by the owner as part of the total rent. Consequently, tenants are not even aware of their EE savings opportunities.
- Lack of trained EE personnel - Lack of EE service providers is a critical issue in India. Most of the attention in the energy sector in India has traditionally focused on energy

[6] http://www.unicef.org/infobycountry/india_statistics.html

[7] http://www.rbi.org.in/scripts/BS_SpeechesView.aspx?Id=342

supply, which is also evident in the enormous interest expressed in solar power over the past few months. EE experts particularly those with program design, implementation, evaluation, monitoring and verification skills are lacking in the country.

- Lack of institutional and regulatory framework - Failure by regulators and utilities to recognize the benefits to utilities and rate payers of meeting demand in the most efficient manner. As a result, efficiency programs and policies may lack adequate legal and regulatory backing to be pursued by utility companies or other entities. In India, the BEE was established as mandated by the Energy Conservation Act, but state-level electricity efficiency programs that could be pursued by utility companies faced with massive electricity shortages are challenging to initiate. This market barrier is being addressed in industrialized countries by adopting integrated resources planning techniques, and by designing and implementing demand-side management programs and by making the regulatory authority to buy energy efficiency when it is the most cost-effective alternative explicit in statute

Legal, Regulatory, and Institutional Structure for EE

The Energy Conservation Act of 2001

The first important legislation that focuses on *efficient use of energy and its conservation* is the Energy Conservation Act of 2001 (referred to as EC). Under the EC, the BEE at the central-government level, and designated agencies at the state level were created in March 2002. According to the EC, the main responsibilities of BEE include – planning, managing, and implementing provisions of the EC through creation of appliance labeling/standards and energy conservation building codes; benchmarking energy use of commercial and industrial facilities; monitoring energy consumption of "designated" (or high consumption) consumers; and certifying/accrediting energy auditors, managers, and service companies. BEE also creates and disseminates relevant information, facilitates capacity building, and develops pilot/demonstration projects.

The Electricity Act of 2003

The second important legislation that included language pertaining to EE is the Electricity Act of 2003 (referred to as EA). The preamble to the EA states *efficiency and promotion of environmentally benign policies* as one of the key objectives. This objective is supposed to be achieved through the provisions that repeatedly specify *economical and efficient use of electricity* for all aspects such as distribution, transmission, tariffs, and regulation in general. Specifically, the following policies and plans are developed by various agencies under the EA:

- National Electricity Policy is prepared by the Government of India for *development of the power system based on optimal utilization of resources*.
- National Electricity Plan is prepared by Central Electricity Authority in accordance with the National Electricity Policy that provides for a short-term framework of five years while giving a 15-year perspective and would include among other things – *demand forecasts by region*, identification of location for generation/transmission capacity additions, and others.

- National Tariff Policy is prepared by the Government of India that aims to – among other things - ensure availability of electricity to consumers at *reasonable* and competitive rates; and *promote competition, efficiency in operations* and improvement in quality of supply.

The state electricity regulatory commissions (SERC) established under the Electricity Regulatory Commission Act in 1998 mandate the SERCs to promote competition, efficiency, and economy in the power sector, and regulate tariffs of generation, transmission, and distribution, and to protect the interests of the consumers and other stakeholders. The Central Electricity Regulatory Commission (CERC) – also established under the ERC – does not have direct authority over the decisions of state commissions and distribution utilities unless the issues span more than one state. However, the chairperson of CERC convenes the Forum of Indian Regulators (FOR) - a statutory body consisting of the chairperson of all the SERCs - that can provide support and guidance on DSM to the SERCs. The objective of FOR is to evolve a common and coordinated approach to various issues faced by the SERCs.

National Mission on Enhanced Energy Efficiency

In July 2008, India released its first National Action Plan on Climate Change outlining existing and future policies and programs addressing climate mitigation and adaptation. The plan identified eight core "national missions" running through 2017, one of which is on EE – National Mission on Enhanced Energy Efficiency.

The NMEEE is expected to enable several billion dollars worth of transactions in EE in India.[8] In doing so, it is expected to, by 2015, help save about 5% of annual energy consumption, and nearly 100 million tonnes of carbon dioxide every year. The NMEEE consists of the following four components, of which we focus on the 2nd component in this paper:

1. Perform Achieve and Trade - This is a market-based mechanism to enhance EE in the *designated consumers* (i.e. large energy-intensive industries and facilities). The scheme includes the setting of a specific energy consumption target for each plant, reduction of energy intensity within a three-year period (2009-2012), and trading between consumers who exceed their target and those who fail to meet their target. Not meeting the target may result in penalties.
2. Market Transformation for Energy Efficiency - Accelerated shift to EE appliances in designated sectors will be enabled through innovative measures. The initiative includes the following activities: standards and labeling, public procurement, technology program, ECBC, ESCOs Promotion, capacity building and information, and others.
3. Energy Efficiency Financing Platform - Creation of mechanisms that would help finance EE programs in all sectors by capturing future energy savings.
4. Framework for Energy Efficient Economic Development - Developing fiscal instruments to promote EE.

[8] Some estimates provided by BEE are in the range of ~$15 billion.

In December 2009, the Indian government also announced the creation of a joint venture initial equity of $45 million – named, Energy Efficiency Services Limited (referred to as EESL) - between four public-sector companies that are under the Indian Ministry of Power as the one of the main implementation arms of the NMEEE. The EESL is envisioned to lead implementation of EE projects as a "Super ESCO", provide risk guarantees to private-sector ESCOs, leverage various financing mechanisms available for the sector, develop formal partnerships with EE industry organizations to actively promote EE, and provide consultancy services as needed.

Market Transformation Vs Resource Acquisition Perspective

Traditionally, the focus of DSM programs has been on resource acquisition (RA) – i.e. treating DSM resources as an alternative to supply-side resources – see for example California EE portfolio in 2004-2006 and 2006-2008 program cycles. Therefore, the DSM programs were designed to achieve specific levels of energy (kWh) and demand (kW) savings. The savings were, typically, estimated by measuring and verifying the program participants' efficiency activities (e.g. replacing an inefficient appliance with an efficient one and receiving a financial incentive for doing so).

The program administrators – typically, utilities – did not assess whether the program savings persisted. LBNL (2010) surveyed the EE program EM&V practices in the US and found that there is a large variation in the types of market effects (e.g. free-ridership, spillover, and leakage) that are included or required by different states in estimating the EE program savings.[9] In many states the choice of whether to measure free riders or market effects is an ad hoc decision influenced by the size of the program and available budgets.

DSM experts are increasingly realizing that the RA perspective for achieving ever-increasing savings is less suitable than the market transformation (MT) perspective. For example, in September 2008, the California Public Utilities Commission issued a "Long-term Energy Efficiency Strategic Plan" that *sets forth a roadmap for energy efficiency in California through the year 2020 and beyond.* Achieving zero net energy homes in California as standard practice by 2020 and zero net energy commercial buildings by 2030 were two of the many goals included in this plan.

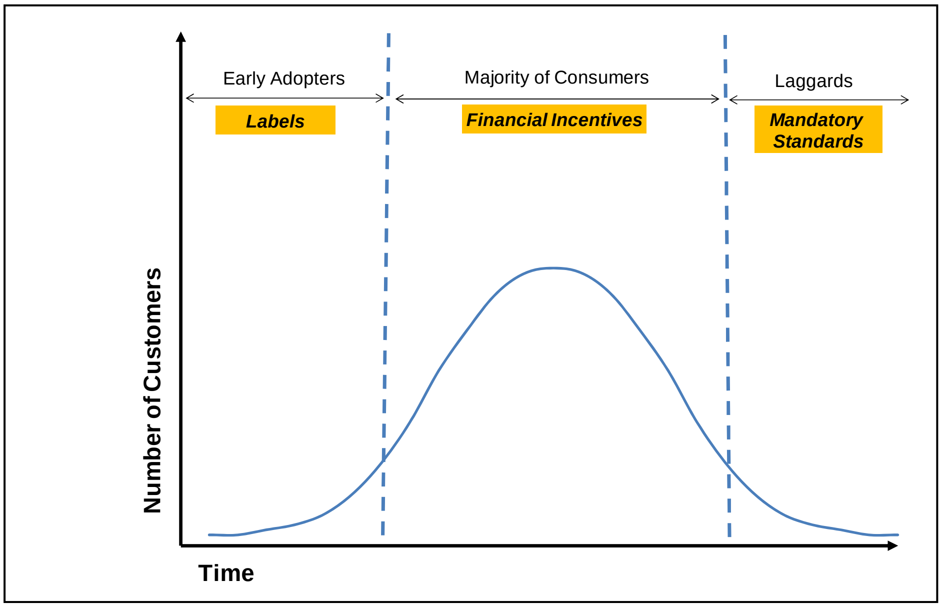
From the MT perspective, all market participants (i.e. customers, retailers, wholesalers, and manufacturers) are involved in achieving EE on an ongoing basis resulting in not just persistence but augmentation of savings. The metric for measurement of program effectiveness are trends in market share growth over time that is easier and cheaper to measure as compared with the resource-intensive EM&V of energy and peak demand savings that have to incorporate the various market effects.

In Figure 1, the key interventions that are used to achieve MT are illustrated with a schematic diagram showing market penetration of product over time. Public recognition (e.g. awards) and labeling programs address the barrier of lack of information. Minimum energy performance standards are typically implemented when the market penetration of the efficient technology has reached a high level and once the first costs are not significantly higher than the

[9] Free-ridership refers to those customers that would have made the switch from inefficient to efficient appliance without the financial incentive but take advantage of the incentive any way. "Spillover" refers to DSM program non-participants replacing inefficient appliances with efficient ones without receiving any incentive from the utility but simply because they observed the benefits accruing to the program participants. "Leakage" refers to those customers from other service territories that took advantage of the DSM programs.

conventional technology. DSM programs (e.g. providing financial incentives for addressing the high first-cost barrier) are implemented in the middle-phase of the market penetration.

Figure 1. Interventions for Achieving Market Transformation[10]



MT Activities in India – Ongoing and Planned

In the last ~5 years, BEE has focused, primarily, on the two tails shown in Figure 1 – i.e. labeling programs for the early adopters and minimum energy performance standards for the laggards. The key barriers these initiatives address are awareness, access to efficient technology, ability to assess cost/benefits of EE, and training of relevant staff on EE topics. These initiatives include:

- Since 2002, BEE has instituted annual National Energy Conservation Awards that recognize the EE best practice leaders in several different sectors of the Indian economy.
- Standards & Labeling Scheme provides the consumer an informed choice about the energy savings potential of different appliances and equipment. BEE has already established a labeling program for eleven products – namely, refrigerators, tubular fluorescent lamps, room air conditioners, distribution transformers, induction motors, pump sets, ceiling fans, LPG, electric geysers, and television sets. For four of these products labeling will become mandatory as of January 2010. Mandatory labeling makes the lowest label the *de facto* standards. Further, BEE is planning to ratchet-up these thresholds thus resulting in a steady improvement in the efficiency level.
- Energy Conservation Building Code (ECBC) cover various components such as building envelope(walls, roofs, and windows), lighting (indoor and outdoor), HVAC system, solar water-heating, and other electrical systems.

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[10] Adapted from the “Diffusion of Innovations” curve developed by Rogers (1962).

- In July 2009, Delhi state government made compliance with ECBC mandatory for all new government buildings. Key members of the Indian government are explicitly urging Chief Ministers (analogous to the state Governors in the US) to adopt the ECBC for all government buildings in their respective states.
- In the last six months, BEE has initiated star-rating programs for six types of commercial buildings including offices, hotels, hospitals, retail malls, information technology Parks, and business process outsourcing facilities.

- Accreditation of ESCOs – Since, the ESCO business model is relatively new in India, very few ESCOs exist in the first place and are not well-understood by customers and financial institutions. Hence, BEE has accredited ~30 ESCOs that conducted the technical and financial due diligence necessary to create a sense of credibility among the customers and financial institutions.

In addition to the MT initiatives, BEE has also attempted to at least facilitate DSM activities targeted to the middle-phase of the market. These programs do not directly provide direct incentives – however, they at least create the framework for appropriate DSM programs that can address barriers such as upfront costs, discount rates, and access to capital/credit. These initiatives include:

- "Bachat Lamp Yojana" is a scheme under which high quality CFLs are sold to households at the same prices as incandescent bulbs with the difference in actual cost of CFLs and incandescents being recovered from the Clean Development Mechanism of the Kyoto Protocol.
- BEE proposed to the Indian Ministry of Finance to reduce taxes on a range of efficient technologies. In the 2010-11 National Budget, the central excise duty for LEDs and CFLs was reduced from 8% to 4%.
- BEE is conducting several pilot programs to test out potential DSM program designs for increasing efficiency of agricultural pumps, municipal consumption, and others. These pilot programs are meant to be "proof-of-concept" initiatives and not full-scale DSM programs.

RA Activities in India – Ongoing and Planned

ABPS (2009) conducted an extensive analysis of the existing legal and policy framework in India for the FOR in order to assess the whether there is sufficient support for large-scale EE initiatives. Their assessment suggested that there are no specific provisions related to EE implementation in either the Energy Conservation Act of 2001 or the Electricity Act of 2003 pertaining to the electricity sector. The National Electricity Policy, a statutory policy under the EA does not provide any clear guidance on any institutional framework for implementing EE. Although the National Tariff Policy mentions Time-of-Day tariffs, it does not refer to EE explicitly. Finally, recent policies such as NAPCC make several specific provisions for EE – however, they are not statutory in nature and consequently, are not binding on the main electricity sector institutions.

Despite this lack of explicit support for EE in the key electricity sector regulations, two SERCs in India – Maharashtra (MERC) and Delhi (DERC) – have interpreted the EA to allow for promotion of utility-implemented and rate-payer-funded DSM activities.[11] The key driver behind this interest in DSM in these two states was the chronic power shortage situation and consequently, EE is viewed mainly from an RA perspective.

In May 2005, MERC ordered all four distribution utilities in Maharashtra to undertake DSM programs followed by the creation of a formal *DSM Cell* within MERC in April 2006. The May 2005 MERC order created a *Load Management Charge* of ~2.5 cents/kWh for consumption above a *prescribed* level that yielded a fund of ~$17.5 million dollars. This fund is being used by all utilities in Maharashtra over the last 5 years for developing and implementing DSM programs (mostly, targeting lighting and pumping end-uses). Two utilities in Maharashtra – Reliance and Tata – have already completed load research and several energy audits for non-residential customers. The DSM activities initiated in Maharashtra include:

- Reliance's CFL Program - CFLs worth $3.70 was provided at $1.40 with monthly installment of 15 cents for 9 months. Approximately, 200,000 consumers participated in the program under which 617,000 CFLs were sold.[12]
- Reliance's Street-lights Program - Under this project, replacement of High Pressure Mercury Vapor with Medium Pressure Sodium Vapor was carried out. Estimated savings in Energy terms is 4.56 million kWh per year and in demand terms it is 1.1 MW.
- Tata's Pilot Lighting Project - Involves replacement of T-8 FTLs using magnetic ballasts with T-5 FTLs using electronic ballasts. 50,000 FTLs were replaced in the small C&I sector.
- Since the beginning of 2010, MERC has approved a larger lighting program for T-12 and T-8 FTLs using magnetic ballasts with T-5 FTLs using electronic ballasts for three utilities – Reliance, Tata, and BEST.
- MERC is, currently, assessing four EE program proposals submitted by both Tata and Reliance that target the cooling end-use in residential (e.g. ceiling fans, and window A/C) and non-residential sectors (e.g. central chillers, and thermal energy storage).

In February 2010, MERC issued draft regulations regarding implementation of DSM programs and conducting cost-effectiveness analysis of DSM programs.[13] The regulations directed all distribution utilities in Maharashtra to make DSM an integral part of their day-to-day operations, and undertake planning, designing and implementation of appropriate DSM programs on a sustained basis and submit 5-year DSM plans along with the multi-year tariff filings; include all justifiable costs in any DSM related activity, including planning, designing, implementing, monitoring and evaluating DSM programs, to their Annual Revenue Requirement (or Rate Case); implement quick acting DSM programs that provide long-term savings including those that help reduce peak demand peak shifting and associated costly power purchase (e.g. demand response), specifically, in the urban centers; form a DSM Consultation Committee that is appointed by the Commission and consists of all relevant stakeholders.

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[11] A few other SERCs have also undertaken some EE initiatives. In this paper, we are using the example of Maharashtra to highlight the approach SERCs are either taking or likely to take to EE.

[12] Several other utilities in India have conducted similar CFL programs such as Maharashtra State Electricity Distribution Company (in Nashik, Maharashtra), BSES (in New Delhi), BESCOM (in Karnataka), Uttar Haryana Bijli Vitran Nigam Limited (in Haryana), and others.

[13] http://www.mercindia.org.in/

The draft regulations pertaining to cost-effectiveness analysis provide the Total Resource Cost test as the main hurdle test for selecting DSM programs. In addition, the programs that pass the Rate-payer Impact Measure test should be implemented. Those DSM programs that fail the RIM but their tariff impact is less than Rs. 0.01/kWh or less than 0.1% of the existing tariff can also be implemented.

Following MERC's example, in May 2009, Delhi regulatory commission included a provision for DSM activities with a budget of ~$7 million for utilities in Delhi. The utilities were ordered to submit DSM program proposals and similar to MERC – the costs would be allowed as pass through in the annual revenue requirement. The utilities are in the process of filing several proposals targeting lighting, pumping, and water-heating end-uses. The DSM program design by utilities in Delhi has referred extensively to the designs developed in Maharashtra and the draft regulations issued by Maharashtra regulatory commission.

Discussion

The fundamental difference between the Indian and U.S. power sectors is the balance between the central and state governments with respect to policy-making and decision-making. In India, the legislative, policy-making, decision-making, implementation, and financing aspects pertaining to the power sector are all dominated by the central government. The national-level policies (e.g. electricity and tariff) and plans are developed by central government organizations (i.e. Ministry of Power and Central Electricity Authority), albeit in consultation with state governments and regulatory commissions. At the same time, the regulatory structure (i.e. state electricity regulatory commissions and central electricity regulatory commission) in India is similar to that in the U.S.

On the surface, the energy efficiency initiatives launched both at the national-level by BEE and the state-level by utilities appear to be proceeding smoothly. However, there is almost no coordination among the two efforts and they appear to be moving on parallel tracks. Further, the state-level efforts appear to be driven, primarily, by the personal interest of key members of the SERCs in Maharashtra and Delhi. Similar interest is not observed in most of the other states. It is not even clear whether all the state commissions would initiate DSM efforts.

In order to address both these concerns – lack of coordination between state- and national-level efforts, and encouraging all states to initiate DSM activities – in June 2008, the FOR constituted a Working Group on "DSM and Energy Efficiency" that consisted of chairpersons from Central-level commission, three state-level commissions, and the Director-General of BEE. The Working Group considered the relevant provisions of the National Electricity Policy, Tariff Policy, and various initiatives taken by the SERCs and gave the following recommendations in September 2008:

- SERCs *should* direct all the distribution utilities under their jurisdictions to constitute EE Cells within their organizations and identify some of their own staff for handling the EE aspects
- Forum of Regulators *should* organize week long training courses in the area of DSM for the personnel of the SERCs and the staff of DSM Cells of the utilities
- BEE *may* assist the Forum of Regulators in preparation of draft model regulations for implementation of EE programs in electricity distribution sector in India including the

model guidelines/criteria for evaluation of various DSM proposals that could be used by all SERCs to initiate EE activities in their respective States.

- BEE *may* continuously interact with the Forum of Regulators to ensure that the proposed EE programs are implemented in a successful manner in identified States and are also replicated in other States.
- BEE is requested to share the case studies initially with SERCs and subsequently with all utilities in the country. BEE is also requested to develop outreach programs so that lessons from various programs under International Energy Agency – DSM Implementing Agreement are available to Indian utilities.

The Indian electricity sector is transitioning from a vertically-integrated, public-owned, and unregulated business to an unbundled, public- and private-owned, and regulated business. The shift in the decision-making structure, the increasing transparency, and consequently, public accountability in a period of chronic power shortages is hampering both state commissions and utilities to focus on DSM in a systematic manner. The various factors that are limiting the progress on DSM at the state-level – especially, when compared with the enormous EE potential that can be tapped – include:

- In many states there is only one distribution utility and that is public-owned while in other states the largest distribution utility – by far – is also, usually, public-owned. Unlike private utilities – that today serve only a few urban areas – the public utilities are less likely to be proactive in addressing their deficits as they are essentially operating in a not-for-profit mode.
- Almost all utilities across India are facing several other serious issues such as shortages of supply, transmission and distribution losses, theft, and others that carry a higher priority for the utility management than energy efficiency.
- DSM is a new area for most utilities and the state regulatory commissions. Therefore, there is a lack of understanding and expertise regarding DSM and a serious lack of high quality manpower.
- Generally, utilities are not opposed to DSM. However they tend to be risk averse. Therefore, they are often reluctant to propose and design DSM programs on their own that could fail and force the utility to shoulder the financial consequences. However, utilities appear to be quite willing to be part of DSM programs that have been already been designed, approved by some authority/agency, and in which they have no or minimal financial risk.

In contrast, BEE – as an organization – has the following positive attributes that are more appropriate for implementing EE in India:

- Legislative mandate to focus exclusively on EE activities with no other distractions
- Existing well-trained staff that have the knowledge and expertise to design and implement EE programs
- Ability to access appropriate skills from outside of the organization - e.g. consultants, international experts, etc. – as part of ongoing partnerships and collaborations with organizations such as the International Energy Agency
- Recent elevation of EE as one of the key national missions with strong support from all stakeholders

In comparison with the state-level efforts, the BEE-led national effort certainly appears to be more likely to succeed. However, there are several fundamental concerns about BEE's capability to substantially ramp up their ongoing EE efforts. These include lack of access to sufficient funds for truly market transformative EE programs and close access to the electricity customers.

Lack of access to sufficient funds – BEE's budget under the 11th five-year is envisioned to be ~$130 million. For the 2009-2010 year, BEE's budget was ~$17 million. In the recently submitted budget by the Government of India for 2010-2011, BEE's budget has been raised to ~$47 million that includes a significant portion allocated for the NMEEE. Further, BEE's budget allocation is part of the national budget and hence, is subject to competition with other national priorities such public health, education, security, and others. In contrast, the approved DSM budgets for Maharashtra and Delhi, together amount to ~$25 million. Further, as per the Forum of Regulators recommendations and the recent Maharashtra regulatory commission draft DSM regulations, utilities can pass through all of their DSM costs in their rate cases. Consequently, the utility DSM budgets can be substantially higher. For example, a recent program to replace T-12 fluorescent tube-lights (FTLs) using magnetic ballasts with T-5 FTLs using electronic ballasts was approved by Maharashtra commission. The program aims to replace ~500,000 FTLs out of a total of ~6 million in the utility service territory using a customer-rebate approach. The total cost of the program was estimated to be ~$1.4 million and the program passed all the appropriate cost-effectiveness hurdles set by Maharashtra commission. Although, this program was intended to be a pilot program – given its cost-effectiveness, one can easily imagine the possibility of the program being ramped up for 100% market penetration with a cost of ~$17 million. Given the current regulations and guidance, this is feasible at the state-level. In other words, a single program targeting one appliance in the service territory of a small utility can have a budget that is comparable to BEE's entire current budget.

BEE is based in New Delhi and has a relatively small staff in line with its small budget. Consequently, it is extremely difficult for BEE to work closely with electricity customers throughout the country in developing and implementing large-scale DSM initiatives. In addition, most electricity customers are not even aware BEE. In contrast, the utilities are well recognized, and generally trusted by customers. They have direct and routine customer contact and long-established relationships with them. The utilities also have large manpower some of which can be allocated for DSM initiatives.

BEE is a Government of India agency and hence, is subject to the whims of the ruling political party. The only accountability mechanism for BEE is through the national-level elections the results of which are based on the multitude of political considerations of the voters. In contrast, the SERCs have a mandate to protect the interests of the electricity customers and have a transparent mechanism to ensure that the utilities are held accountable for all of their activities.

Recommendations

Clearly, neither BEE nor the state-level organizations (i.e. SERCs and utilities) possess all of the attributes in one entity that are needed for the success of large-scale market transformation in energy efficiency in India. However, taken together – all three entities – BEE, SERCs, and utilities have all the attributes that have the potential to achieve market transformation in EE in India. Consequently, we recommend the following mechanism through which the market transformation component of the NMEEE can be achieved successfully:

- All state regulatory commissions must commit to initiating DSM activities in their states and issue regulations pertaining to allocation of funds and personnel inside both SERC and utility. The goal of the DSM regulations should be clearly articulated as market transformation instead of a narrowly defined resource acquisition target (e.g. XX% reduction in annual sales) and the cost-effectiveness analysis should be from the Total Resource Cost perspective. Unless all relevant entities agree to this common goal – it will be difficult to tap the enormous energy efficiency potential in India.
- All SERCs must formally commit to pursuing a common set of DSM programs that has the potential to transform the market at a national level for various sectors (e.g. appliances, buildings, and others). The DSM expertise available in India is limited. Consequently, utilizing all of it in an optimal manner to design just one set of DSM programs is more likely to lead to successful DSM implementation instead of spreading this meager expertise excessively in different states that is less likely to yield successful programs. This also reduces the cost of program design substantially and avoids the phenomenon of "reinventing the wheel".
- BEE will design DSM programs that are explicitly coordinated with their Standards and Labeling initiatives – i.e. the DSM programs will explicitly target the "middle phase" of market transformation as shown in Figure 1. These DSM programs will be implemented by all the utilities under the oversight of their respective SERCs. The DSM programs will be funded by rate-payers. BEE's responsibility for DSM program design addresses the risk concerns of utilities regarding their possible failure and the consequences.
- All state-level commissions will establish a formal relationship with the BEE under which BEE will provide the necessary technical assistance to the state regulatory commissions and utilities for implementing the common set of DSM programs and any other programs that the utilities are interested in implementing. As recommended by the FOR Working Group on DSM – this will ensure that BEE serves as the information hub on all EE topics. Rapid and effective dissemination of the best practices from different parts of the country can be ensured.
- BEE shall design the EM&V for the DSM programs. However, the EM&V will be conducted under the direct supervision of the state regulatory commissions – possibly coordinated through the Forum of Regulators. It is essential that state-level commissions provide the oversight for the DSM efforts since the funds will be obtained from rate-payers. This is the only transparent mechanism to ensure that BEE and the utilities that are designing and implementing the programs can be held accountable by the rate-payers. In addition, this will ensure that the choice of DSM programs is driven explicitly by the interests of the rate-payers.

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