Transforming the Building Energy Efficiency Market in India: Lessons from the USA

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ABSTRACT

With recent economic expansion, construction investment growth in India is forecasted at 12% overall and 23% in the commercial sector. India will add 80% of the total floor space estimated for 2030. Without a concerted effort to reduce energy intensity in buildings, the additional demand for electricity will exacerbate the chronic power shortage situation in India. Indian policymakers have started a three-pronged approach to market transformation, i.e. rating systems to recognize leaders, financial incentive programs to move the middle of the market, and codes and standards to raise the entire market to desired efficiency levels.

In this paper, we provide an overview of the status of these activities and the infrastructure for setup, scaling and compliance for each market transformation approach. We juxtapose the situation in India with the history in the USA. We provide summary statistics for key industry metrics such as energy cost, construction cost, and so forth. Recognizing the challenges in India and using lessons learned from USA experience, we present recommendations for Indian policymakers to enable rapid market transformation in the building energy efficiency sector.

Introduction

In Table 1, we provide a comparison of India and the U.S. of a few key metrics. India has a population 3.7 times that of the U.S. while the GDP is only 7% of that of the U.S. The Indian economy has grown rapidly over the past decade, accompanied by commensurate growth in the demand for energy services and an increasing vulnerability to energy supply disruptions. India's electricity consumption is still 15% and CO_2 emissions are 23% that of the U.S.

On a per capita basis, the electricity consumption and CO_2 emissions are a fraction of the U.S. – 4% and 6%, respectively. However, the electricity consumption and CO_2 emissions normalized with respect to GDP for India are 2.2 and 3.4 times, respectively, that of the U.S.[1] Clearly, electricity and energy in general, is used less efficiently in India in terms of its economic productivity as compared with the U.S. Residential and commercial building electricity consumption in India accounts for 29%, less than half that of the U.S. (71%). The most recent Indian census (2001) indicates that 72% of the Indian population lives in rural areas unlike the U.S., where 79% of the population lives in urban areas (U.S.DOT 2010 and Census of India 2010). As the rural to urban migration in India continues over the next few decades, the portion of electricity consumed by residential and commercial sectors is likely to grow rapidly.

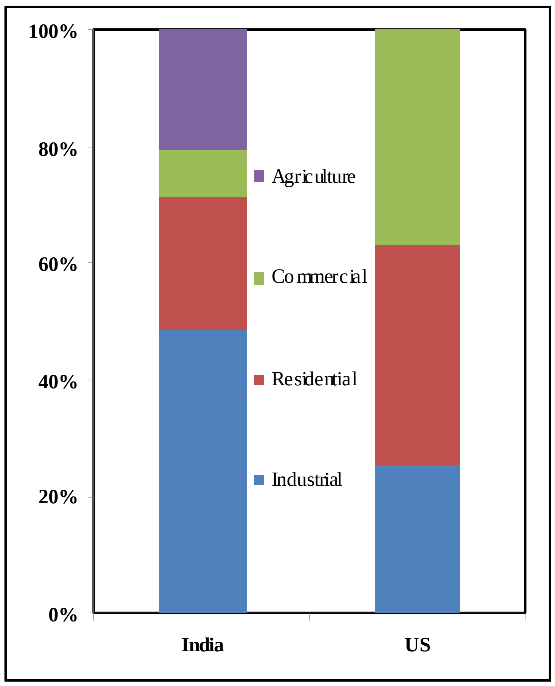
[1] If GDP is measured in terms of purchasing power parity, the electricity consumption and CO_2 emissions per GDP are ~42% and ~66%, respectively, that of the U.S.

Table 1. Comparison of India and the U.S. with Respect to Key Metrics. (IEA, 2009)

Key Metrics	India	U.S.	Ratio = India/U.S.
Population (millions)	1,123	302	3.7
GDP (billion 2000$)	771	11,468	7%
Electricity Consumption			
Total (TwH)	610	4,113	15%
per Capita (kWh)	543	13,616	0.04
per GDP (kWh/2000$)	0.8	0.4	2.2
CO_2 Emissions			
Total (Mt of CO_2)	1,324	5,769	23%
per Capita (t of CO_2)	1.2	19.1	6%
per GDP (kg CO_2/2000$)	1.7	0.5	3.4
Building Energy (typical office with A/C) – data from authors' survey of the Indian market.			
Typical Construction Cost per SF	$50	$200	0.25
Annual Cost of Energy per SF	$4.5	$1.5	3.0

In 2004-05, over 40 million square meters of commercial and residential construction were added. At 10% per annum, it is projected that by 2030, 2.3 billion square meters will be added to newly built areas (USAID-ECO-III 2010). 80% of the residential and commercial floor-space that will exist in 2030 is yet to be built in India (McKinsey 2009).

Figure 1. Comparison of electricity Consumption by Sector Between India and the U.S. (IEA, 2007)

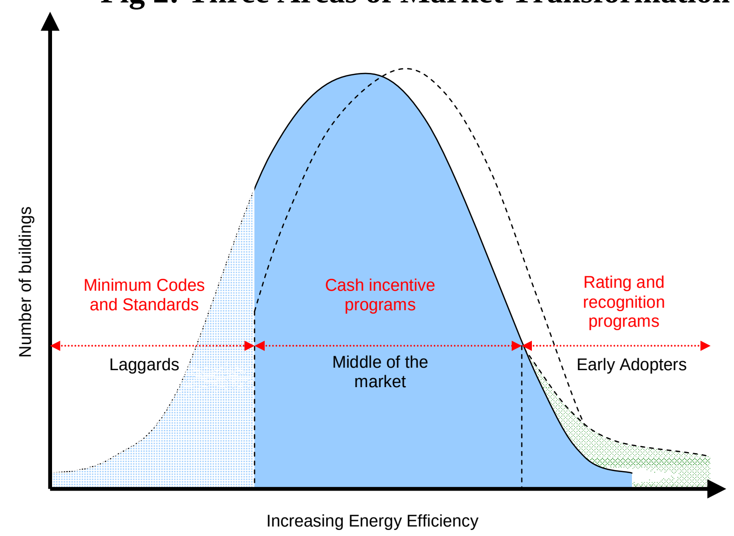


On the one hand, a recent estimate developed by USAID-ECO-III project, indicates that building energy consumption now accounts for 33% of total energy consumption in India and is growing at 8% per annum (USAID-ECO-III 2010), on the other, in 2007-8, India's Ministry of Power (MOP) reported that the annual electricity shortage has increased from 7% to 10% (energy) and from 11% to 17% (capacity) in the last five years[2]. The inability of the electricity grid to supply reliable power has prompted increased use of captive power generation that often uses diesel fuel, especially in the commercial sector. The rising demand for petroleum products is expected to be met through expensive imports. Thus the electricity demand in the new construction building sector will be one of the major challenges in maintaining India's economic growth.

[2] http://www.powermin.nic.in/indian_electricity_scenario/policy_initiatives.htm

Our investigations have shown that construction costs for commercial buildings in the USA are about 8 times that in India, while operating energy costs in the USA can be about 1/4th those in India (see Table 1). New construction program data in the USA has shown that building owners who are market leaders are willing to accept a 3-year payback while the rest of the market participating in cash incentive programs accept a payback period of about 1-year (Vaidya et al, 2002, 2006). The construction first cost versus operating energy cost comparison shows that India presents a huge opportunity for energy efficiency programs from purely a cost stand-point.

Fig 2: Three Areas of Market Transformation



In this paper, we provide an overview of the status of energy efficiency activities that have been started in recent years in India targeted to the new construction sector. We classify these activities under three areas of market transformation. Within each area, we summarize the current regulatory framework, institutions, capacity, and relevant stakeholders along with some summary statistics. We compare similar efforts carried out in the USA for each market transformation area. In the discussion section within each area, we identify lessons learned from the U.S. India comparison. Finally, we conclude with a proposal for a leap-frog approach that combines elements of the Energy Conservation Building Code with voluntary utility sponsored rebate programs to enable rapid market transformation.

Market Transformation Modes

Within the three areas of the market (see figure 2), the early adopters need little motivation and respond without a need for financial incentives. They are the risk takers and experimenters, and typically respond well to recognition. Market transformation strategies include awards and recognition programs that provide publicity to this part of the market. The middle of the market tends to be risk averse and fiscally conservative. Transforming this part of the market typically requires reducing their exposure to risk; market transformation strategies include having early adopters report their success and providing financial incentives or discounts. The laggards of the market represent its bottom. In terms of building energy efficiency they represent the most difficult customers to change, who do not respond to cash incentives or recognition. Market transformation for this area is achieved by rules and regulations that introduce minimum standards or codes to make inefficient products and practices illegal.

Lifting the Bottom with Codes and Standards

The adoption, effective implementation and enforcement of building energy codes present an opportunity to dramatically increase the efficiency of buildings in India. Energy savings associated with codes and standards can be significant. A periodic code development process, such as the California Title 24 process sets expectations of improved efficiency in the market for all the stakeholders involved. This increase in stringency over time provides an effective method of incrementally moving the entire market. Building codes are enforceable at the time of construction or major renovations when buildings proposals are submitted to enforcement and governing agencies for approvals and permits. Code compliance can also be checked at the time of a property sale when a transfer of title needs to be processed at a local government agency, but this is not common. Thus newly introduced or progressively improving building codes have little impact on existing building stock. In India, unlike the USA, where future building stock is much larger than the existing one, the potential to save energy with codes is large, provided the adoption is smooth, and the enforcement real.

Mandatory compliance of building codes serves as the starting point for all other stages of market transformation. Codes represent a baseline of minimum efficiency upon which voluntary beyond-code programs and rate-payer funded DSM programs can build. Codes are usually the first step in the market transformation curve and represent a starting place for evaluation and reporting.

Current Energy Code Conditions in India

Building energy efficiency sector in India is influenced by standards and guidelines mandated by various ministries and public development bodies like the Ministry of Power, Ministry of New and Renewable Energy, Ministry of Environment & Forests, Urban Development Departments and other market mechanisms (USAID-ECO3 2009). In 2005, India's National Building Code (NBC 2005) was revised with respect to regulating building and plumbing services to be consistent with international practices. However, mandatory building energy performance standards are not part of the adopted code. Implementation of building codes is not common and enforcement of structural, plumbing and electrical codes is almost non-existent[3]. Although the NBC defines seismic zones and contains construction measures for structural systems, these measures are rarely enforced.

In India, the first major legislation that focuses on *efficient use of energy and its conservation* is the Electricity Conservation Act of 2001 (referred to as EC). Under the EC, the Bureau of Energy Efficiency (BEE) at the central-government level, and designated agencies at the state level were created. 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" (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.

[3] Where a local official reviews the building proposal, it is only a few local bye-laws for set-backs and permissible built-up area that are checked

In 2007, BEE developed the Energy Conservation Building Code (ECBC) for energy efficient building design and construction (ECBC 2009). ECBC interlinks standards and guidelines of various standard setting bodies like Bureau of Indian Standards, National Building Council, ISO 15009, ASHRAE etc to integrate best practices. As per ECBC, code compliant buildings can be up to 60% more energy efficient than currently built conventional buildings. Furthermore, it is projected that annually India can achieve 1.7 billion kWh of energy savings through mandatory ECBC compliance. Currently, ECBC is a voluntary mechanism, with mandatory enforcement under proposal. In July 2009, Delhi state government made compliance with ECBC mandatory for all new government buildings. Following Delhi's example, India's Minister of Environment and Forests sent a letter to the Chief Ministers of the states asking them to adopt the ECBC for all government buildings.

The code was developed to cater to diverse climate zones of India and applies to new buildings with connected load of 500 kW or greater or a contract demand of 600 kVA or with a conditioned area of more than 1000 square meters.[4] Code compliance is achieved through two methods: Prescriptive Method and Whole Building Performance (WHP) (*ibid*). ECBC is influenced by international standards like ASHRAE Standard 90.1 and the Title 24 building code in California (IEA 2008). Since equipment with ECBC prescribed efficiency parameters is not readily available in the Indian market, building designers are compelled to use the WHP to demonstrate compliance (Kumar, 2008). BEE, in association with expert groups (e.g. USAID's ECO-III project), has been working on methodologies for ECBC implementation[5]. BEE's activities include introduction of ECBC and capacity building of municipalities/urban local bodies through Energy Performance Contracting, development of compliance tool for enforcement & monitoring, capacity building, awareness raising, promotion of energy efficiency building equipment through Regional Energy Efficiency Centers.

U.S. Building Energy Codes History

The United States adopted minimum building energy codes for both residential and commercial structures as an essential component in a comprehensive energy policy. That policy developed incrementally over the past thirty-five years. In their earliest form building codes were adopted in large cities to address potential threats to life, health and safety. Over time, however, various policy drivers pushed code development into the realm of building energy standards: comfort, federally backed mortgage rates, and ultimately concerns over energy supply. (NRDC 2003). In 1975 the Energy Policy and Conservation Act was adopted as a means of managing U.S. dependence on foreign oil. In 1978, the legislation was modified to require increased energy conservation standards for those states receiving federal funding. The 1992 legislative update to the Energy Policy Act (EPAct) specifically named the Council of American Building Officials (CABO) 1992 Model Energy Code (which was subsequently succeeded by the

[4] The 500 kW threshold may need to be revised if ECBC is to affect the larger building stock. As an example, of the 60,000 plus new building electrical connections reported by a major utility in New Delhi, not a single one reached the 500kW mark.

[5] The Energy Conservation and Commercialization (ECO) project is a joint project supported by United States Agency for International Development/India (USAID/I) and the Government of India (GoI). USAID ECO-III project assists BEE in ECBC implementation, Awareness and Training Programs, and development of ECBC Tip Sheets on Building Envelope, Lighting, HVAC, and Energy Simulation, etc., for capacity building and speedy dissemination of information and knowledge related to ECBC amongst practicing architects, building designers, energy auditors/consultants, State Designated Agencies and Municipalities (www.eco3.org).

International Energy Conservation Code Council (IECC)'s 1998 residential version) and the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)'s Standard 90.1 commercial version of the building energy code as the respective national model energy codes.

Adoption. While model codes for residential and commercial buildings are developed at a national level with active stakeholder participation, they are adopted at state and local levels, and they are implemented and enforced at the local (county of city) levels in the U.S. market.[6] A very small portion of states in the U.S. elect to maintain a state-specific code that may or may not meet an equivalent version of the model code. The 2009 American Reinvestment and Recovery Act (ARRA) legislation, however, requires states to adopt the 2009 IECC for residential buildings or risk losing their economic stimulus funding. In the United States, we have learned that code adoption increases with mandates and funding (1978/2005/2009 EPAct); that compliance and meaningful enforcement increases with funding, training, and assistance ; and that actual building performance is based on well educated operations and maintenance staff who can optimize the performance of that building (NEEP 2009).

Implementation. The U.S. Department of Energy has created a variety of tools, educational materials, and software packages to help residential and commercial developers and builders implement and code officials establish compliance of building energy codes. The most successful state implementation strategies create a strong *training and certification program* for code officials, increase capacity to *effectively enforce code* through a more formal third-party independent inspection process, and maintain adequate *funding* so that local jurisdictions can provide needed technical support (NEEP 2009).

Enforcement. Reviewing plans and inspecting technology installation for energy efficiency is a very rare, different, and in fact highly specialized, activity. Since code enforcement is conducted building site by building site, barriers to more effective enforcement vary by regional geography, construction practices, and marketplace circumstances. Many believe 'the code" is a bright line in the sand, but in fact there are a number of difference paths to code compliance. Being flexible, but well-trained to identify appropriate compliance paths is ideal. In the absence of well funded-training and appropriate time to increase each code official's level of education and practical application of that knowledge, enforcement can suffer.

Local building departments are checking compliance in 92% of the cases with the other 8% done by third party contractors and 89% of the code officials are licensed or certified to enforce code (BCAP, 2008). Yet, in the U.S. 40-60% average compliance rates are reported in various studies (Khan et al 2008).

Discussion. Adoption of the energy code is at a state level and voluntary for each state in the USA and in India. Once ECBC is announced as a mandatory requirement, state level adoption and compliance can be encouraged through conditional and formulaic disbursement of central government funding by the Planning Commission and the Finance Commission. Implementation of the code needs a strong enforcement mechanism. And code enforcement in India as in other developing countries is a significant challenge (Deringer et al, 2004). Given the barriers in

[6] At each stage in this process, there are opportunities to either adopt the model codes in whole cloth, or modify to improve or reduce the stringency of the model codes.

adoption, implementation and enforcement, the market transformation that can be achieved by simple mandatory code compliance will not be large (see figures 3.1, 3.2 and 3.3). We propose a method for introducing ECBC to the market and achieving implementation and enforcement of parts of ECBC in section 3.3.

Creating the Leaders with Rating Systems

Rating systems and awards programs give recognition to the leaders in the building industry. The overall market penetration of this mode remains limited (see figure 2) since this addresses a small portion of the market, and thus the overall energy savings impact is similarly small. However the recognition of the leaders is an important market transformation strategy for building energy efficiency in the larger picture. The recognition assures market leaders that they are providing value and are on the right track. Market leaders and risk takers feel rewarded when they are recognized. For the rest of the market, the recognition of the leaders moves them from the bleeding edge to the leading edge by sending the message that they have proven performance accepted by the industry.

Current Rating Systems Activity in India

Recognition to market leaders and early adopters in buildings has been introduced through three main avenues. BEE has introduced a star rating program to recognize buildings that operate more efficiently than the program benchmarks. Currently BEE has launched this program for Office Buildings and has 27 buildings that have been awarded the star rating. In future BEE will expand the star rating program to other building types. Leadership in Energy and Environmental Design (LEED-India) rating for new-buildings was launched in 2001. Since 2001, LEED-India has certified 70 buildings (a total for 35 million square meters), and 501 buildings are registered for future certification. The Green Rating for Integrated Habitat Assessment (GRIHA), actively promoted by MNRE, aims at non-air conditioned or partially air conditioned buildings. 40 buildings are currently registered under GRIHA and 2 have been awarded certification (GRIHA, 2010).

History of Rating System in the U.S.

Recognition of leaders in the industry happens in many different forms in the USA. There are numerous awards given to energy efficient buildings by organizations such as the American Institute of Architects (Top Ten Awards), ASHRAE, ACEEE etc. The awards system in the USA has matured enough where ACEEE goes beyond single building projects to recognize exemplary regional energy efficiency programs.

Rating systems such as EPA's ENERGY STAR and USGBC's LEED Green Building Rating System started off as voluntary programs. The brand recognition for both of these has been done carefully. The USGBC has taken a top down approach to adoption by branding LEED and its score as a reliable, transparent and science-based objective measure of the greenness of a building. Government agencies such as GSA, several city, county and state governments have made LEED certification a mandatory requirement for any new construction funded by them. Since the inception of LEED its market penetration over five years was 1.5% of the total U.S. non-residential market (Yudelson, 2006). After four version upgrades in the first ten years, the USGBC has envisioned a 3-year development cycle for LEED with a goal that eventually all LEED buildings become carbon neutral with zero environmental impact. The ENERGY STAR rating and label is used for equipment, appliances as well as for buildings. ENERGY STAR rating for non-residential buildings is based on real building energy consumption data for existing buildings and with projected energy consumption data for new construction. However, energy consumption for new construction can only be predicted with energy simulation models which are not very common, and this creates a significant barrier for market penetration for new construction. For homes, where the rating can be awarded based on compliance with a list of prescriptive measures, the market penetration for 2008 is higher and estimated at 17% (ENERGY STAR, 2010). Other prescriptive beyond-code standards have been introduced by the New Buildings Institute and ASHRAE; however, due to lack of specific market adoption efforts, their market penetration is rather limited.

Discussion

In the USA, rating systems and awards have had a small market penetration even within their target markets. By definition, this mode of market transformation addresses the leaders. To this end, the standards and benchmarks referenced by these rating systems are made more stringent over time. In India, the market penetration for LEED is impressive given the nascent stage of other modes. Now that recognition for the leaders is taking place, the challenge of proving actual performance remains, and IGBC-CII has taken this on as a priority. GRIHA is being adopted as a new building standard by some government agencies. Both these green building ratings systems are introducing ECBC to the market leaders. However, these rating systems are sought by a section of the market that consists of mostly big commercial office buildings. The rest of the market will need a push through the other modes of transformation so that energy efficiency can be wide-spread and lasting.

Moving the Middle with Rebates and Incentives

While building energy codes are intended to set the minimum legal standard for a building and beyond code programs like LEED set the standard for integrated building design "reach programs," rebates for more efficient building technologies move the middle of the market. Utility or government funded programs provide rebates and incentives to help buy-down the first-cost barriers to more efficient equipment installation in new construction. Whole building Commercial New Construction programs (CNC) are designed to increase the use of high performance equipment and best practices in building design in order to exceed minimum building codes. Most programs attempt to exceed code by 10 to 30 percent (York et al 2003). Best practices in CNC programs focus on whole building design in order to get an integrated package of the most cost-effective technologies.

Current DSM Efforts in India

DSM efforts in India driven by legislation and regulation started only a decade ago. Prior to that scattered and ad-hoc programs were developed and implemented in parts of India mainly because of individual state government, utility, or international aid agencies' (e.g. World Bank, U.S. Agency of International Development, etc.) interests. None of these activities had a major impact in terms of DSM savings measured and documented systematically. Recent detailed analysis of the EC commissioned by the Indian regulators suggests that the EC focuses primarily on the two ends of the market transformation curve with no explicit guidance about involving utilities and rate-payer funds in promotion and implementation of DSM in India.

In India, the second major legislation that included language pertaining to DSM is the Electricity Act (EA) of 2003. The EA applies to the electricity sector in India repealing all three prior legislations namely, Indian Electricity Act 1910, The Electricity Supply Act 1948, and The Electricity Regulatory Commissions Act 1998[7]. 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. However, the EA does not explicitly mandate any entity to undertake DSM activities. Similar implicit support for DSM is provided for in National Electricity Policy and National Tariff Policy of India. Despite this lack of explicit mandate, two State Electricity Regulatory Commissions 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. The key driver behind this interest in DSM in these two states was the chronic power shortage situation[8].

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 about 2.5 cents/kWh for consumption above a *prescribed* level that yielded a fund of about $17.5 million dollars. This fund has been used by all utilities in Maharashtra over the last 5 years for developing and implementing DSM programs (mostly targeting lighting and pumping end-uses). In April 2007, MERC ordered that the long-term power procurement plans of the utilities should include proposals on DSM. The utilities were directed to initiate load research and DSM programs on a sustained basis and as an integral part of operations. MERC reiterated that all the DSM related costs would be allowed as pass through in annual revenue requirement (ARR) of the utilities. Following MERC's example, in May 2009, DERC included a provision for DSM activities with a budget of about $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 ARR. The utilities are in the process of filing several proposals targeting lighting, pumping, and water-heating end-uses.

In June 2008, the Forum of Regulators (FOR) - entrusted with the responsibility to evolve common and coordinated approach to the various issues faced by SERCs in India - constituted a Working Group (WG) to deal with the issues related to implementation of DSM activities in the electricity distribution sector in the country[9]. The FOR invited the Director General of BEE as a Permanent Invitee of the WG. This is the first instance where the BEE and electricity regulators in India formally agreed to coordinate their activities. In September 2008, the WG issued a report

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[7] The Electricity Regulatory Commissions Act of 1998 created the State Electricity Regulatory Commissions (SERC) and the Central Electricity Regulatory Commission (CERC) as independent entities – analogous to the Public Utilities/Service Commissions and Federal Energy Regulatory Commission in the U.S.

[8] The chronic power shortage situation exists today all over India despite rapid addition of new capacity that has been unable to keep up with the rapid growth of the Indian economy over the last two decades.

[9] The FOR was created under the Electricity Act 2003 (EA 2003) and consists of Chairpersons of all State Electricity Regulatory Commissions (SERC) as members with Chairperson of the Central Electricity Regulatory Commission (CERC) as Chairman of the Forum.

on DSM that recommended SERCs to adopt many of the provisions developed by MERC. In addition, SERCs were asked to consider appropriate tariff interventions (e.g. TOU tariffs, power factor incentives, etc.) to support DSM, slightly higher return on equity for the investments made towards DSM measures, and encouragement to utilities to create their own energy service companies as unregulated activities. The report also provided recommendations regarding BEE's role in assisting FOR in developing *model* draft regulations for implementation of DSM in the electricity distribution sector in India including the guidelines/criteria for evaluation of various DSM proposals. BEE was asked to undertake development of Evaluation Measurement and Verification (EM&V) protocols for various DSM programs and serve as a developer of pilot DSM programs, disseminator of DSM-related information including documentation of DSM case-studies, and serve as a link between utilities and multinational organizations such as the DSM group in the International Energy Agency.

Various DSM-related documents such as framework, guidance, templates, and protocols are being developed in India by entities such as BEE and MERC. The first draft of methodology (released on February 2010) for estimating cost-effectiveness of DSM programs and the broader framework for approving DSM program proposals has been developed by MERC. Under the proposed methodology, MERC would evaluate DSM program proposals against three main criteria – *cost-effective from a total resource perspective, does not put undue burden on program non-participants and participants, and directly or indirectly benefits all consumers*. In addition to these criteria, MERC would give preference to DSM programs that focus on reduction of peak demand, promote efficiency in new stock, provide savings over a long period of time, and have significant greenhouse gas reduction potential. After the initial focus on lighting retrofits and appliance efficiency, in December 2009, MERC has turned its attention to building efficiency. Maharashtra utilities have developed proposals for improving the HVAC efficiency for large commercial and industrial customers in Mumbai city.

Although there are no explicit goals for DSM (e.g. achieve XX% savings in electricity sales by 20XX) and mandates for any agencies to implement DSM programs in India either at the national or state level, it is clear that the regulators at state level are increasingly focusing on developing DSM resources in their respective states. The basic principles, guidelines, and criteria discussed among policy-makers and regulators in India are narrowing down on DSM programs that affect new stock (whether residential appliances or commercial buildings or industrial processes), achieve long-term savings, and contribute significantly to reducing peak demand. In the recent WG meeting, both FOR and BEE approved in-principle DSM programs with a national-scope that provide incentives to manufacturers for increasing the market share of efficient appliances (e.g. tube-lights and ceiling fans) for which labels and standards are already mandatory. After developing and implementing minimum standards, clearly, the focus is now turning to *moving the middle* with the help of ratepayer funded incentives and an active role of utilities.

History of DSM and Incentive Programs in the U.S.

In the United States, Demand Side Management (DSM) programs began as an opportunity to demonstrate to regulators through an Integrated Resource Plan (IRP) that utilities were planning for a balance between capacity and demand resources. Regulators believed that IRPs would be able to effectively balance the utility's need to make a reasonable profit with the rate-payer's interest to get services at a reasonable price. Over time it became a mandate that the utility spend a certain percentage of revenue on energy efficiency, demand response (DR) and DSM programs. When deregulation of the utility industry began to sweep the nation in the late 90s several states passed Public Benefit Funds (PBFs), dedicated rate-payer funded resources to finance the energy efficiency programs.

Utilities were the original administrators of energy efficiency programs and spent their resources trying to intervene in the market to provide incentives for more efficient technologies and specific products. Rebates for more energy efficient components helped create markets for products by introducing them into the design and construction process. The theory was that by buying down the cost of a more efficient technology, utilities could remove the first cost barrier to more efficient products, appliances, homes and buildings. Whole building analysis in the form of energy modeling began making its way into the DSM market in the late 1980's. Pilots in the Pacific Northwest began to look at the interactive value of rebated and non-rebated design decisions in terms of overall energy efficiency. Program administrators have determined that equipment rebates are necessary, but not sufficient to accomplish desired market transformation effects[10].

In the late 2000s, public policy began to move from a spending goal for energy efficiency to savings goals. Because of the success of Renewable Portfolio Standards, regulators and public policy officials began to enact Energy Efficiency Resource Standards (EERS). These EERS were designed to set goals for energy savings. EERS are typically designed to acquire a percentage of total retail sales (base load) through energy efficiency, but some can also include peak load goals over a period of time as well. Many ambitious states set efficiency goals near 1%, 1.5% and up to 2% of total retail sales on an annual basis. Regulators, policy makers and the advocate community believed these goals would galvanize the effort and create clear measuring sticks for performance.

After thirty years learning the lessons of energy efficiency and demand side management programs, the most successful and effective program administrators in the country are still only achieving 0.8% of retail sales. Hitting targets substantially higher than 0.8 percent on an annual basis is a daunting challenge for the efficiency industry. It must be met by both utility administrators and also third-party program administrators. The staffing, portfolio design, technologies, market resources, and dollars needed to hit these ambitious goals are not yet clear and as efficiency programs – rebate, market transformation, or otherwise – rise to the challenge, more lessons will be learned.

Discussion

The utility industry in the U.S. learned some lessons, but lost a lot of time just spending money. Now that public policy has coalesced into specific energy reduction performance targets, the overall performance of portfolios of efficiency programs will be higher than 0.8%. In this respect, India has an opportunity to leap-frog the U.S. market. Setting strong public policy with performance driven results that are measured clearly and consistently has the potential to

[10] The introduction of efficient components did not always translate into lowest energy consuming buildings, since there were often no controls on how or how many of each component was used in any building. Some program administrators found that they were not making their conservation goals with rebates alone. Moreover, isolated component rebate strategies do not always take into account the interactive effects of components in buildings which function as operating systems.

affect greater change over a shorter period of time. Designing in savings via commercial new construction programs in a market that is growing at nearly 7% is one place to tap that potential for the Indian market.

Other lessons that have been learned in the U.S. are: Rating and recognition programs have a limited market penetration and overall energy savings. Adoption of energy codes at state levels can be patchy and can take a long time; mandatory compliance of energy is hard to achieve because the enforcement is done by local city and county governments with budget and personnel issues, and capacity building at this level is a huge effort.

We anticipate that in India, the mandatory adoption of ECBC at the state level will begin slowly after 2012. Capacity building at the local government level to enforce ECBC will take longer. Figures 3.1, 3.2 and 3.3 show the Business-As-Usual scenario along two alternatives market transformation scenarios that will be achieved with 1) almost perfect adoption and enforcement, 2) poor adoption and enforcement. Figure 3.3 is a more likely scenario of the near future in India. Voluntary or mandatory ECBC compliance will remain a challenge.

There is no need to wait for ECBC to become a mandatory requirement to establish the baseline for new construction programs. In fact, using DSM programs to educate the market about ECBC would be valuable capacity building effort. Currently BEE and ECO-III have undertaken benchmarking efforts to understand baseline conditions for some building types. These data can be used for new building DSM programs.

We propose a leap-frog approach for India to enable faster market transformation through financial incentive programs that are built around ECBC. In the USA, DSM programs are considered beyond code. But given the state of the market and the absence of a code, DSM programs in India will need to take the market first towards the code. A large part of the DSM portfolio will need to be a Tiered approach towards ECBC, with tiers composed of small packages of prescriptive ECBC requirements (see figure 3.4). Entry level Tiers can be designed to be easy for market adoption without much technical expertise, have low first cost and a real peak reduction. Each Tier package will be a mix of complementary requirements. One example tier can consist of the following measures:

- Maximum window-to-wall-ratio (WWR) of 40%. ECBC has maximum WWR requirement, while many commercial offices, hotels and malls are currently built with close to a 100% WWR. The 40% WWR requirement as part of Tier 1 for commercial buildings will reduce the tendency towards all glass buildings and the resulting cooling load and cooling capacity needed.
- Cooling efficiency improvement to meet or exceed ECBC requirements.

Technical analysis will be needed to review and group the requirements of ECBC into such packages of complementary ECMs. The analysis will need to be done for energy, demand, and first cost, separately for building types to set up the detailed program framework. Each successive Tier will incorporate more ECBC requirements in to the Tiers. The final Tier will be an ECBC compliant building. The Tiers will be spread out enough so that the entry level is accessible to large portion of the market, and the advanced Tiers result in very efficient buildings. A complementary whole building program that provides technical assistance in the form of project level analysis and design assistance for customers to enable them to be ECBC compliant using the performance approach can also be provided at the same time. While the Tier program reaches a large portion of the market, a complimentary Whole Building program will be applicable to large commercial buildings where a structured design, development and construction process allows for higher levels of energy efficiency.

Figure 3.1 Business As Usual Case

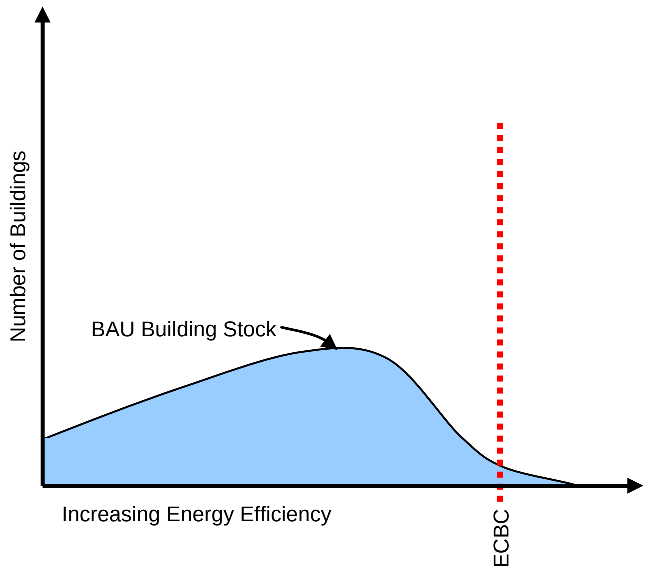


Figure 3.2 Market Transformed with Perfect Enforcement

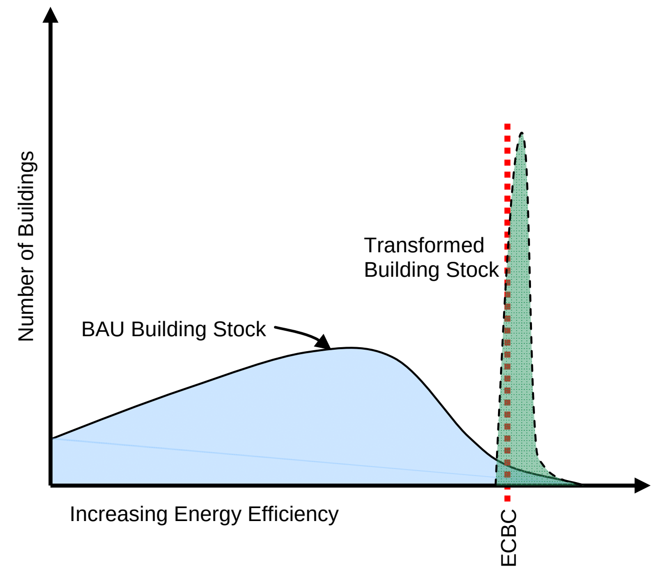


Figure 3.3 Market Transformed with Expected Enforcement

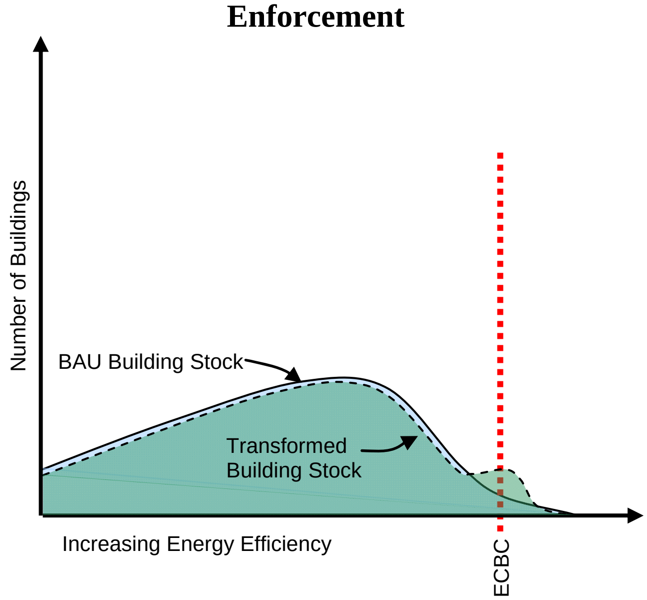
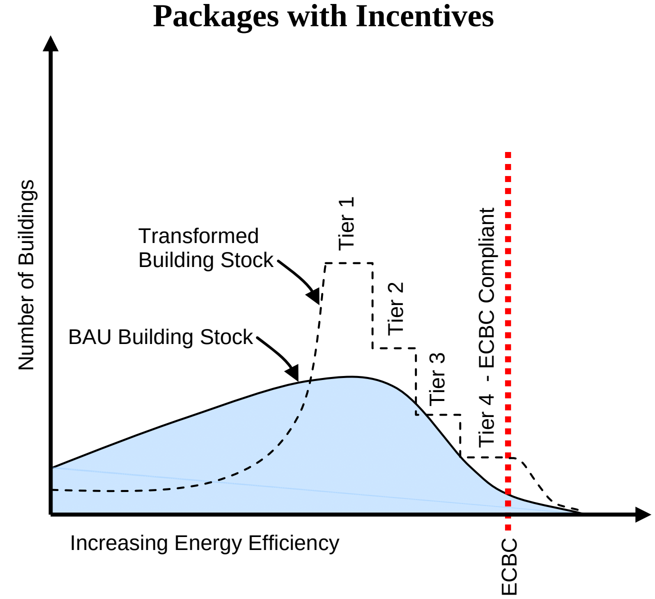


Figure 3.4 Market Transformed with Voluntary Packages with Incentives



This approach introduces ECBC to the market in bite-sized portions. The compliance is voluntary, but enforcement is achieved by utilities that have access to the customers when a new building is built with an application for a new connection. Utilities then have the opportunity to introduce the program to the customer before the building is built. The institutional and regulatory infrastructure and support required for this approach follows the framework issued for public comment by the Maharashtra Electricity Regulatory Commission (MERC, 2010). The FOR will need to provide coordination for the SERCs to implement this approach consistently across the states. Each SERC will provide guidelines and framework language similar to that of MERC to require the utilities to implement these programs. The main criteria for approval of the program will be the Total Resource Cost. Each SERC also provides oversight of the programs. Ratepayer charges for DSM programs collected by the SERCs will be allocated to BEE for some program detail and framework development work. Each SERC will also do program outreach and marketing.

BEE can provide technical assistance and overview. The details of the program in terms of the number of Tiers, the measures that are included in each Tier, and the building types that they apply to will be developed under the overview of BEE. This development work could happen under BEE's Global Environment Fund project. Energy and demand savings will be estimated in the detailed program framework document along with methods to allow the utilities to revise the calculations for their specific locales. Software tools for calculations and data collection can also developed under the overview of BEE. BEE will need to have an outreach program for customers.

Each individual utility will use BEE's detailed program framework to design incentives. Incentives can be in the form of one-time rebates at the end of construction and as alternative tariff available to the customer. Rebates and tariff adjustments can be tied to the performance of each Tier. The utility will administer the program. When a developer or building owner approaches the utility for new connection for a new building, the utility encourages them to participate in the Tiered ECBC Program. Utility staff engineers or contractors check for compliance. Each utility will also need to do program outreach and marketing.

Evaluation metrics can be discussed at the DSM Consulting Committee for each SERC and metrics for evaluation can be designed in to the reporting of the program. All savings and costs are reported to a data base that is designed and developed by BEE and maintained at the SERC. Each utility provides periodic program status to the SERC. Program direction is reviewed annually at the DSM Consulting Committee meeting. EM&V of the program is done after 5 years.

Some of the barriers that will need to be resolved during the implementation process are:

- Certain building types have the problem of split incentives where the capital cost are incurred by a developer while the operating energy cost in borne by the user or facility management agency. This is particularly true of residential construction. Commercial buildings like offices and malls are often leased by developers who continue to operate them; the split incentive problem does not exist in those cases.
- Illegal or unauthorized construction remains an issue in parts of India. These building owners will likely not participate in programs that will document the existence of such buildings.
- Utilities in India still have to deal with power theft. Where this problem is rampant in authorized construction, implementing successful DSM programs will remain a challenge.

Conclusion

In this paper we have summarized the current activities in India for energy efficiency in new construction in the three areas of market transformation. This has been juxtaposed against the history of energy efficiency market transformation in the USA. We respond to the challenges of energy code adoption, implementation and enforcement and the lack of baseline for new construction utility programs by proposing a leap-frog approach that combines elements of the Energy Conservation Building Code in to voluntary utility sponsored rebate programs. These programs introduce the market to ECBC's prescribed energy efficiency measures in bite sized portions. The approach to market transformation makes the entry level programs low cost and easy for the customers with higher Tier programs that reach ECBC levels of efficiency. We have also identified the institutional framework required to implement these programs.

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