



Energy Scenario and Energy Efficiency: Programme and Policies of Booming India

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ABSTRACT: Energy is the one of the main drivers of the world economic progress. With zooming economic growth, construction sector investment growth in India is forecasted at 12% overall and 23% in the commercial sector. India will add 80% floor space estimated for 2030. Though the country's per capita energy consumption will remain much lower than that of industrialized countries, India's total energy consumption is expected to increase significantly arising due to population explosion and urbanization. Without a concerted effort to reduce energy intensity in buildings, the additional demand for electricity will worsen the chronic power shortage situation in India. Building sector, led by massive growth of IT, is one of the largest and the most energy intensive sectors, fuelling Indian economy to the tune of 2.3%. Growth in building sector will lead to more green house gas (GHG) emissions with serious impacts on the global environment. Adoption of energy efficiency programme in existing and new building, seriously, will be a major step in mitigating environmental degradation.

This paper examines the current practices in Indian new constructions and challenges in Energy Conservation Building Code (ECBC) implementation in improving energy efficiency. At the end, this paper summarizes potential opportunities and compares the experiences, plans, and challenges in building sector in India.

KEYWORDS: Economic growth, Energy, Building, GHG, Energy Efficiency, ECBC

I. INTRODUCTION

Spiraling prices, depleting energy resources and rising awareness to climate change are creating pressure on project managers, developers and designers to emphasize on creating more energy efficient buildings. Building designers today have a greater responsibility while designing new buildings keeping in mind the performance and green building goals within stipulated period and accuracy [1]. India is one of the largest economies in the world consuming equally large quantity of energy, as shown in figure 1. Buildings account for more than 30% of the total electricity consumption in India, the second highest share of consumption after industries. Estimates reveal that total built-up area will increase rapidly, as nearly 66% of the commercial yet to be built in 2030. Adoption of energy efficiency practices and cutting edge technologies can help to shift towards low-carbon economy. If energy is the driver of Indian economy, buildings are the modern ambassadors. A right combination should take the nation to the safe and targeted destination. Asian Countries, especially emerging economies [2], China and India, have experienced increasing demand for electricity as a result of rapid economic growth and urbanization. Rising incomes and population growth in developing Nations are of paramount interest. Primary energy consumption is expected to mirror the growth in global population, as shown in figure 2. With China and India are set to become the world's largest energy consumer indicating a distinctive shift in the energy landscape.

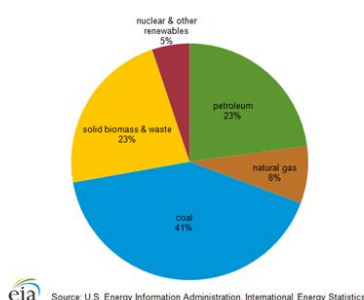


Figure.1 Total Energy consumption in India, 2011

The demand shift is to accommodate ever growing population demand for various services will have a clear impact on the consumption of all energies in the future. With world's 50% of construction activities are taking place in China, adding 'a Japan' (2 billion/million sq.ft.) every year to accommodate its spurring population.

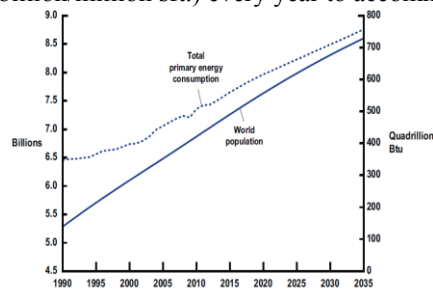


Figure 2. Growth in world population and primary energy consumption.

Source: IHS Global insight, HIS CERA, United Nations, US Bureau of the census, 21215-2

India being a cautious starter, 80% of its present construction activities yet to come up by 2030 [3], will spur massive energy demand as shown in figure. Globally buildings, both residential as well as commercial, are responsible for over 40% of their total energy and equal amount environmental emissions, while in US, buildings consume 20% of its primary energy [4].

II. BUILDING FROM ENERGY PERSPECTIVE

Energy consumption in the building sector is a function the type of construction, usage pattern, the climatic region and the energy consuming devices installed in the buildings. Different types of energy end-use in buildings such as lighting, space heating, space cooling, plug-in loads and appliances all together account for the overall energy consumption pattern of the building as shown in figure 3.

Energy consumption, not only depends on the type of the end use appliances but also on the operational efficiency and maintenance of these end use appliances. Building design and material can have a significant impact on the energy consumption levels of a particular end-use application. For instance, the overall energy consumption pattern of a typical home depends heavily on appliance efficiency.

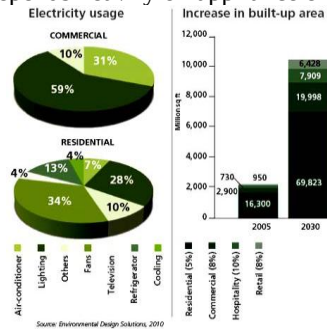


Figure. 3. Energy consumption pattern and increase in built-up area in Residential and commercial buildings in India

In a commercial building, the overall energy consumption of the building gets significantly affected by the design and selection of the building material and glazing along with the choice of appliances and HVAC systems [5].

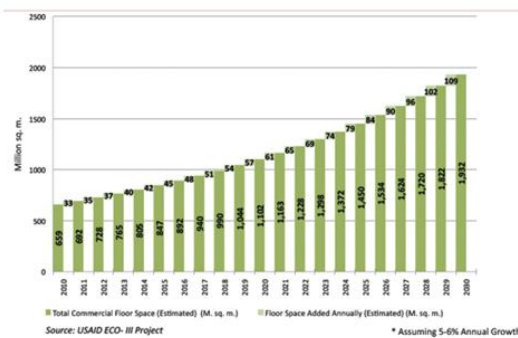


Figure 4. Growth of Building sector in India

The building sector India is experiencing a very high growth about 8% per year due to emergence of IT sector. Such a high growth led to significant increase in the energy demand in the building sector and hence large

opportunity through energy efficiency programme. The commercial building sector currently contributes to about 659 Million m². and even at conservative growth rate of 5-6% per year. The commercial building space is expected to grow to 1932 Million m². by year 2030 at the rate of 38 million m² per year as shown in figure 4.

III. BUILDING BOOM IN INDIA

While construction sector is one of the key drivers of modern economy, energy intense buildings are the ambassadors of modern world. Energy consumption in these buildings has been forecasted to rise consistently. With population over 1.2 billion, India, is consistently adding floor space in a big way, see figure 4. India's zooming economy was spurred by its liberalization policy introduced during 1996. India is a leading destination for IT and IT-enabled services. Many software companies, software

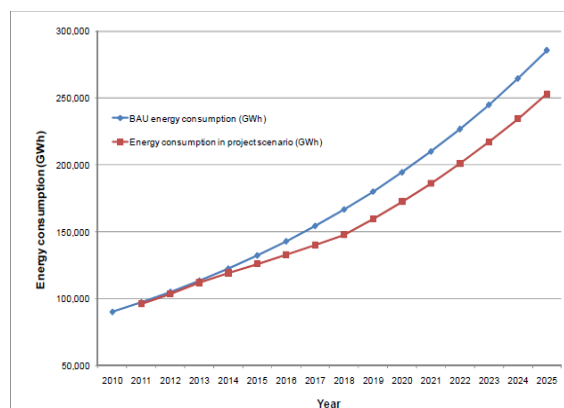


Figure 5: Forecasted annual energy consumption in the commercial building sector in Business-as-usual (BAU) scenario and project scenario

consulting firms and business process outsourcing firms have established their offices and facilities in states like Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra making an important destination for multinational companies (MNCs). Demand for office space in India is fuelled by its rapid development

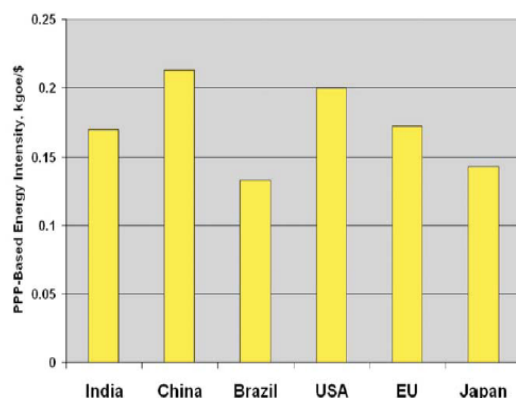


Figure 6: Total Primary Energy Intensities of the Major Economies

in IT sector combined with massive migration to cities has dramatically increased the need for energy to supply to its growing population and businesses.

IV. ENERGY EFFICIENCY IN EMERGING ECONOMY: BENEFITS AND BARRIERS

If energy is the driver, buildings are the modern ambassadors of emerging economy see figure 6. It powers human progress, from job generation to economic competitiveness, from strengthening security to empowering, energy is a great integrator. It cuts across all sectors and lies at the heart of country's core interests. Presently energy consumption in India buildings is a major concern for energy managers, see figure 7. and figure 8.

Efficiencies could be as important as harnessing of new energy resources. It is a means to deal with all three goals of energy policy-makers – inexpensive, secure, low-carbon energy. The most secure and low-carbon form of energy is not using energy at all, but to use it with utmost care and efficiency. Technological innovation is continually allowing consumers and businesses to do more with less in terms of their energy use. Policy tools

are helping overcome barriers to energy efficiency programmes, including availability of capital and knowledge of efficiency choices.

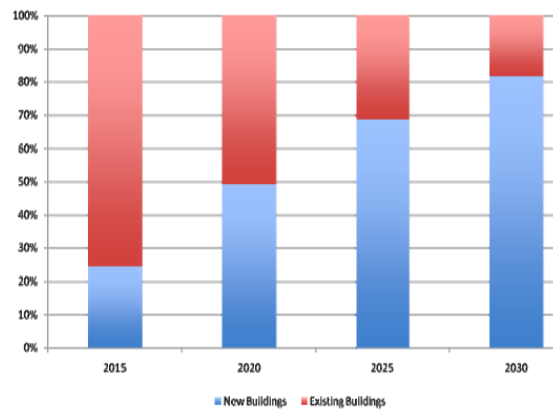


Figure 7. Annual Energy Consumption of New and Existing Buildings in India

Per capita residential energy consumption (excluding traditional biomass) is the highest in India compared to China and the US, see Figure 6. Switching from traditional biomass to modern fuels and the increasing use of modern fuels by an expanding urban population are driving factors behind this increase.

Against the backdrop of better growth in GDP and increased energy demand, increase in energy capacity shortages, and concerns over climate change, significant efforts have been made in India since early 2000 to promote energy efficiency. At the national level, formation of BEE has been a smart beginning towards mitigating energy scarcity. With the cooperation of state government and Non – Governmental organization, energy efficiency through energy-saving practices and improved technologies will temper energy demand growth and curb emissions.

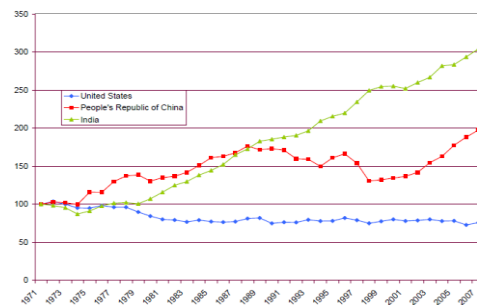


Figure 8: Residential Energy Consumption per Capita (Excl. traditional biomass; 1971=100)

Sources: International Energy Agency, Paris, France

A. ENERGY EFFICIENCY POTENTIAL

Realizing the potential savings that the energy efficiency that would bring, see figure 9. Government of India (GOI) brought in Energy Conservation Act (2001) and established the Bureau of Energy Efficiency (BEE), a National-level bureau that is responsible for establishing energy efficiency labeling and standards for appliances and for establishing energy conservation standards in building codes. It is estimated that ECBC compliant buildings

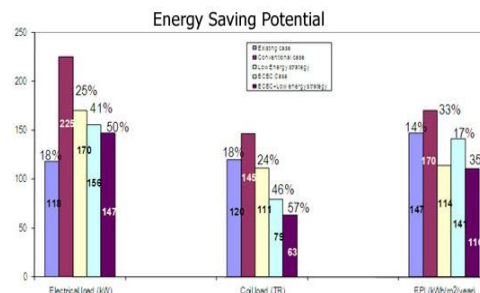


Figure 9. Energy saving potential in Indian buildings

may consume about 40% less energy than conventionally practiced buildings in India and nationwide enforcement of the building code could result in annual saving of 1.7 billion kWh units. A study of six different

buildings in the city of Jaipur (Rajasthan, India) was carried out by Tulsyan, et al. (2012). They concluded that by adopting the energy Conservation Measures (ECMs) specified in the ECBC, annual energy savings upto 17% was possible in institutional buildings and upto 42% savings could be achieved for a hospital (see Table 1). Applicability and enforcement of the ECBC creates the backdrop for implementation of energy conservation measures in the design process,

However, the scope of ECBC codes is not only limited to large commercial buildings. As the nation is building-up numerous software parks, special economy zones, shopping malls and large housing complexes energy efficiency provides an opportunity for further energy conservation in these establishments, see figure 8. BEE has developed codes for Data centres, Special Economy Zones (SEZs), Malls / Shopping Malls and large housing projects

Table I. Energy-saving Potential through ECBC Compliance in India (Tulsyan, et al. 2012)

	Government Building	Private Office Building
Specific Energy Consumption (kWh/m ² /y)	137	386
Energy Saving Potential (kWh/m ² /y)	44	128
% Energy Savings	32%	33%
	Institutional Building	Hospital Building
Overall Energy Savings	17%	42%

B. ACTIVITIES OF BEE IN INDIA

In India, the Electricity Act (2003) promotes power sector reform legislation, and, while not explicitly addressing it, has been interpreted by some state regulators as justifying utility energy efficiency. In 2009, the National Mission on Enhanced Energy Efficiency (NMEEE) established a goal to reduce energy use by 10,000 megawatts by the year 2020. The NMEEE includes four initiatives: tradable energy savings certificates, market transformation, creation of a financing platform to facilitate energy service company (ESCO) activity, and development of a broader economic framework to support energy efficiency (e.g., tax incentives). India's effort to accelerate energy efficiency through national programs recognizes the inherent challenges and supports utility energy efficiency.

BEE, in its endeavor to reduce building energy load in buildings, through energy efficiency has some initiatives to enhance efficiency for lighting, HVAC, fans and motors on short term basis, that lead to electricity savings [6]. For example, in lighting, HVAC, fans and motors following changes can bring in substantial energy savings.

- Installation of automatic voltage stabilizers for lighting circuits and operating at optimum voltage
- Optimizing the operating voltage and frequency in DG sets based on the capacity loading of the equipment
- Replacing conventional copper ballasts with electronic ballast
- Use of energy efficient lamps like CFL, T-5, Metal Halide, sodium vapour and LED lamps
- Replacing filament indication lamps in control panels with LED lamps
- Install translucent sheet to avoid day time lighting wherever feasible
- Neutral compensator at unbalanced lighting feeders
- Similarly to reduce space load on Refrigeration and air conditioning
- Installation of micro processor based temperature indicator controller for window air conditioners
- Use polyester sun film controls in the areas exposed to direct sunlight and optimize the temperature settings of the cooling system.
- Optimizing temperature settings of AHUs and install thermostat control for chiller compressor
- Replacing air cooled condensers with water cooled condensers.
- Installation of evaporative condensers for higher capacity chillers
- VFD for thermic fluid pumps catering to multiple users

C. ENERGY EFFICIENCY BENEFITS AND BARIERS

The benefits of energy efficiency are wide-ranging and multi-faceted: Energy efficiency (EE) results in lower utility bills and a positive return on investment, making it an excellent financial decision. Annual cost savings often exceed annual depreciation charges incurred. Long-term programs, such as projects to retrofit all of the nation's buildings over a 10-20 year period and adopt efficiency in all new construction, encourage continuous improvement in products, technology, and buildings. For example, owners that retrofit in 2010 will save money on energy bills that can then be invested in further savings through updated retrofits in 2020 when newer technologies are available. In this way, the cost-savings—as a percent of current energy use—keep growing over the decades. Energy efficiency results in lower energy use for the same or better quality result. It protects

against the increasing energy demand from rapid urbanization and from peak demand shortages that result in routine power cuts. India's commercial energy consumption is projected to double by 2035. The country, currently imports approximately 77 percent of its oil, 26 percent of its natural gas, and 15 percent of its coal.16. Energy efficiency will reduce dependence on energy imports and limit the volatility seen in energy prices.

Efficient buildings command higher premiums from both buyers and tenants and enjoy higher occupancy rates. Green buildings, including energy-efficient buildings, are increasingly attracting building tenants, owners, and users. : Scaling-up building efficiency will spur a market for new services and technologies, creating green jobs in the process. Companies that pioneer efficiency will gain competitive advantages in the market for efficient products and services. Well-designed efficient buildings result in increased health benefits and higher productivity for inhabitants due to better indoor environmental

quality. The first green building in India, CII-Sohrabji Godrej Green Business Centre [8] in Hyderabad, was inaugurated on 14 July 2004 (see Table I1).Lower energy use can also results in lower pollution, improving air and water quality. Energy savings lower greenhouse gas emissions, thus effectively addressing climate change and giving the country greater credibility as a global environmental leader.

Adoption of energy efficient technologies faces numerous market impediments and failures that both must work together to overcome. Some of the most significant market barriers [10] and steps to address them include:

Table II Table 1: Examples of Energy savings in LEED-rated green buildings in India

	Built-in Area (m ²)	Energy consumption (kWh)		Rating Achieved*	EPI (kWh/m ²)	Payback (Years) Annual savings (INR 000)
		Conventional	LEED-designed (Reduction, %)			
CII-Godrej GBC, Hyderabad	1858	350,000	130,000 (63%)	Platinum (56 points)	70	7 years 9,000
ITC Green Centre, Gurgaon	15794	3,500,000	2,000,000 (45%)	Platinum (52 points)	127	6 years 90,000
Wipro, Gurgaon	16258	4,800,000	4,800,000 3,100,000 (40%)	Platinum (57 points)	191	5 years 102,000

Efficiency improvement also has the potential to boost economic growth that can result in higher tax revenue for the government. As Sathaye J., and A. Gupta explains, the energy efficiency potential for India improvements in combination with new supply and can eliminate electricity shortages at the same investment level as for a business-as-usual electricity supply scenario [9]. The higher penetration of energy efficiency technologies reduces the construction of power plants thereby reducing fuel imports and India's CO₂ emissions by 300 Mt CO₂/year by 2017.

D. BARRIERS TO MARKET PENETRATION OF ENERGY EFFICIENCY PROGRAMME

The market penetration of energy-efficient technologies is often hampered by barriers that are influenced by prices, financing, international trade, market structure, institutions, the provision of information and social, cultural and behavioral factors. Many reports have documented the pervasiveness of barriers to energy efficiency improvements.

Consumer discount rates are many times higher than societal discounts rates. In industrialized countries, this has meant that incentives have been required to get consumers to adopt new technologies, even when they are clearly already in their own financial interest to do so. Similar or possibly even stronger incentives will be required in developing countries like India.

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.

No incentive to build efficient new buildings. 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.

Failure by the power sector to treat energy efficiency on the same economic basis as new capacity. This market barrier is being addressed in industrialized countries by adopting integrated resources planning techniques, and by designing and implementing demand-side management (DSM) programs.

A recent study of the macro-economic benefits of demand-side electricity efficiency improvements in India illustrates that energy efficiency costs are only a fraction of those for supply, and offer a way to eliminate the electricity deficit without increasing direct investment in capacity addition (Sathaye and Gupta, 2009) []. This study shows that energy efficiency offers a way to alleviate the deficit while potentially increasing India's economic output by US \$165 to \$500 billion and employment opportunities by over 11-33 million person-years

over the next eight years by the end of the Twelfth Five Year Plan (2012-2017). However, these impacts vary by the exact nature of the deficit, the rate of energy efficiency technology penetration and other variables.

Profound misconceptions and information gaps about the cost-savings and benefits of energy efficiency prevent owners, banks, building operators, developers, and architects from having reliable, comprehensive information at their disposal about energy use, improvements, technologies, marginal costs, benefits, and return on investment. The lack of accessible information is a major impediment to broad-scale adoption of energy efficiency measures. The lack of skilled expertise, energy-efficient products, and modeling tools impedes the development of an able workforce that an energy-efficient economy requires. The shortage of skilled know-how—on both modern and traditional energy saving techniques—among architects and engineers inhibits implementation of efficiency practices.

The relatively higher price of efficiency technologies constrains adoption of efficiency measures because of up-front capital costs, coupled with a desire to see quick returns on investment. In spite of visibly high returns on efficiency upgrades, the implied discount rates remain high. Building owners and tenants have different sets of incentives when considering efficiency upgrades. Building owners and developers are hesitant to invest in efficiency since tenants are the ones who will benefit from operating cost savings during the life of the building. Likewise, tenants are transient and do not expect to realize long-term gains. : Convenience and inertia of the status quo are powerful forces that prevent early adoption of energy efficiency practices

For India, the challenge is how to harness the power of local initiatives, by strengthening state-level electricity regulatory commissions, clarifying and improving state-level incentives for energy efficiency, and scaling up local regulatory innovation. Over the coming decades, utility-based energy efficiency could be an important complement to other sector-based policies and incentives as a means to meet national energy efficiency targets. A similar model 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 [8]. Combination of standards, incentives, labeling, information, financing, metering, leasing reform, and direct intervention with equipment suppliers and designers will shadow the barriers.

V. UTILITY-LEVEL INTEGRATED RESOURCE PLANNING (IRP) AT STATE AND NATIONAL LEVEL IN INDIA.

In its effort to adopt energy efficiency programme, BEE has implemented national utility energy efficiency programme focused to enhance use of energy efficient appliances, managed through electric utilities: an important move to meet efficiency targets through a strong regulatory framework that integrates energy efficiency into utility investment planning. This programme is implemented in New Delhi, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra, Haryana, Chhattisgarh and other states of India, already showing fruitful results.

Maharashtra state, in its effort to implement energy efficiency measures has come up with unique that supports uses an avoided cost framework—"one that explicitly takes into consideration the cost the utility avoids by not having to generate or purchase electricity". Currently, pilot programs are underway in the city of Mumbai that target lighting and cooling end uses by providing incentives to reduce the high first costs of the most efficient products (as rated by the BEE).

Karnataka state, with technical assistance from the US Agency for International Development during 2006, initiated a compact fluorescent lamp (CFL) promotion program that uses on-bill financing. On-bill financing allows customers to finance the upfront costs of the lamps and pay for them over time through their utility bills. This one of the models tried and finding success in rural areas of the state of Karnataka.

At the national level, government of India is complementing utility energy efficiency by initiating the Super-Efficient Equipment Program that will provide incentives to manufacturers to develop and sell products that are substantially more efficient than the highest BEE-rated products (e.g., brushless direct current technology for ceiling fans). BEE has also implemented the National Bachat Lamp Yojana compact fluorescent light (CFL) promotion program, see table 2, that uses funds from the clean development mechanism (CDM) to reduce the relatively higher if first costs of CFLs as compared with incandescent lamps. BEE is assisting state government agencies to support local municipalities in the promotion of energy efficient building codes [9].

Table III: Energy Efficiency Targets for Eleventh Five-year Plan (2007-2012). Source: BEE, India

S N	Name of the Scheme	Targeted Saved Capacity
1	Bachat Lamp Yojana (BLY)	4000 MW
2	Standards & Labelling programme	3000 MW
3	Energy savings in existing buildings	200 MW
4	Energy conservation building code (ECBC) implementation	500

A. SUPER EFFICIENT EQUIPMENT PROGRAM

BEE in association with the Central Public Works Department (CPWD) implemented energy efficiency performance contracting projects in nine government buildings with an estimated annual savings of approx. 30 GWh (~US 3.5 million) with a simple payback of less than two years. BEE with support from USAID ECO-II Project and a Committee of Experts developed Energy Conservation Building Code (ECBC) with an overall purpose to provide minimum requirements for energy efficient design and construction of buildings.

BEE has launched a very large Super Efficient Equipment Program (SEEP). SEEP's goal is to estimate the super-efficient equipment potential which will significantly exceed the 5-Star ratings of the equipment such as ceiling fans. Current estimates indicate a reduction of more than 30% electricity consumption of SE fans compared to 5-Star fans. SE fans refer to products that are already being marketed somewhere in the world but not in India. In order to accelerate the production and consumption of SE fans, BEE will offer tax incentives to manufacturers in order to reduce the production cost and eventually the market price of the fan. BEE intends to set up similar processes for other appliances such as refrigerators and TVs but not for ACs, which may be resisted by policy makers because these are purchased primarily by higher income consumers and will thus not benefit low-income customers.

Several states have already pursued implemented energy efficiency programs in India. An agency of the state of Maharashtra, such as the Maharashtra Energy Development Agency (MEDA), and/or the utility company, Maharashtra State Electricity Board (MSEB), could implement public benefit programs similar to those being implemented in the United States.

The Prayas Energy Group (Pune) in its report on the DSM potential in India noted that DSM programs were initiated in India by the Ahmedabad Electric Company in 1994 and several subsequent programs were initiated by utility companies in the states of Maharashtra, Delhi, Madhya Pradesh, Uttar Pradesh, and Karnataka. These focused on lighting, agricultural pumping, solar water heating, and reactive power management. The implementation of these schemes was always at the pilot or experimental scale, however, and no replication of the programs was attempted by the utility companies or required by the regulatory commissions until the recent experience in Maharashtra and Karnataka [10].

VI. GREEN BUILDINGS

The green Building is today considered as one which incorporates the best available concepts, materials, systems and technologies. Green building is one that provides a comfortable, productive and cost effective environment through optimizations based on three elements : people (owner, builder and occupants), products (materials, structure, facilities, services etc) and processes(automation, control systems, maintenances, performances etc), and the interrelations between them [11]. The Indian green building movement can be mainly associated with the government initiatives to encourage sustainability in the society and the acceptance of the green building guidelines by the

Corporate sector [12]. Buildings are responsible for approximately 40% of total energy consumption in developed countries such as United States. They are also responsible for 40% of all material flows and produce upto 15%– 40% of the waste in landfills. (Rocky Mountain Institute, 2007). Clearly, large scale improvements in resource productivity in buildings would have a profound effect on national resource consumption.

Construction sector is growing at 13% and real estate at a staggering 30%. The growing demand for office space requires office stock to increase to the tune of 20 million sft/year in New Delhi, Mumbai and Bangalore (BEE, 2007). The demand for office space in other cities is also increasing proportionately. This would undoubtedly burden the already stressed urban infrastructure. If this kind of a growth rate is to be sustainable, there is an imminent need to look at construction options, which are eco-friendly. Worldwide, green buildings have emerged as a popular solution. Since the past 5 years, it is increasingly adopted by several stakeholders of the construction industry [13] for a variety of reasons such as: 40% to 50% reduction in energy cost, 30% to 40% reduction in water consumption.

Rating and verification systems available to qualify a building as a green building: Leadership in Energy and Environmental Design (LEED). GRIHA and the recent ECBC. Buildings are rating systems practiced in India based on the features such as water efficiency, energy efficiency, material/resources consumption, indoor environmental quality and sustainable selection of site.

Indian private sector led by CII has achieved leadership in Green Buildings. Launch of CII Sohrabji Godrej GBC Platinum rated building in Hyderabad inspired many Indian companies to opt for such construction. Presently, approximately 19 Buildings have already accomplished green building ratings, out of which 5 buildings achieved prestigious Platinum rating. Further, 110 more buildings have registered for Green Building rating, Equivalent to 20 million Sq. ft of building area.

Today a variety of green building projects are coming up in the country - residential complexes, exhibition centres, hospitals, educational institutions, laboratories, IT parks, airports, government buildings and corporate offices. A strategy should be worked out to increase the penetration of Green Buildings' concept in these upcoming establishments. This could be done by:

- Increasing awareness on green buildings amongst architects, building industry community

- Conducting workshops, training programs and conferences on green buildings
- Involvement of state & central governments in policy related to green buildings
- promoting and creating market for green building materials
- Launching of Indian rating systems (LEED India) for green building

Along with promoting the green building concept in new and upcoming establishments, it is also important to encourage greening of existing buildings by retrofitting after benchmarking, with a view of formulating low-cost upgrades to building operations and replacement of failed components.

World-over, several initiatives are going on for the green overhaul of existing buildings; notably, Clinton Climate Initiative (CCI) of Clinton Foundation; Euro ACE activities in Europe etc. India has already developed remarkable capabilities in green buildings and this capacity can be easily utilized in greening of existing establishments. Also, retrofits and upgrades are being contemplated for adoption by Indian architects and builders.

VII. DISCUSSION AND CONCLUSIONS

Future growth in energy demand will place considerable stress on India's ability to garner domestic and imported energy supplies. Continued energy shortages and environmental pollution, particularly in urban areas, may be exacerbated, and the country may continue to be vulnerable. Energy efficiency offers a cost-effective solution to overcoming this risk that is almost entirely within the control of the Indian government and private sector. Building capacity to plan and implement energy efficiency programs will help advance India's energy security and mitigate the local environmental and global warming impact of unbridled energy growth, specifically coal. Improving the country's energy productivity will require a concerted effort by all sectors. For sustainable buildings renewable energy offers a substantial potential for generating electricity. Implementation of renewable energy systems in buildings shall be the beginning of becoming green for a sustainable future.

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