Program for
Net Zero Energy Buildings in India

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Introduction

Residential and commercial buildings account for about 33% of the total electricity used in India. With rapid urbanization, there has been a steady exodus from rural parts of the country to urban areas, leading to increased energy consumption especially in the commercial sector. According to India's Central Electricity Authority (CEA), while the electricity consumption in the commercial sector at present accounts for about 9% of the total electricity consumption in the country; this has been growing at a rate of about 12-14% annually (Fig. 1) over the last five years, compared to the overall electricity consumption growth rate of about 6% in India. This is driven primarily by strong growth in the services sector leading to ever-increasing energy consumption in the existing buildings, as well as increasing energy intensity of newly constructed commercial buildings. Furthermore, due to the shortage of electricity supply from utilities, on-site power generation systems using diesel and natural gas have increasingly become the norm in commercial establishments in India.

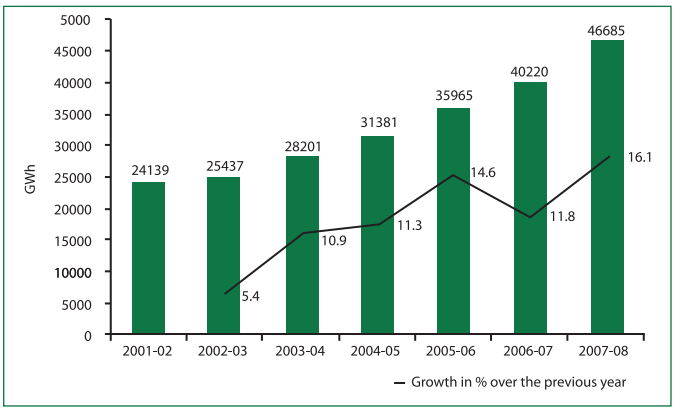


Figure 1: Growth in electricity consumption in commercial sector in India)

Source: Adapted from *Central Electricity Authority All India Electricity Statistics. General Review 2006 and 2009*

USAID ECO-III Project has estimated that the total commercial floor area in India was 659 million sq.m. in 2010. With a conservative annual growth rate of between 5-6%, this is expected to reach 1.9 billion sq.m. by 2030. This means over 1.2 billion sq.m. of new commercial floor area, which is approximately twice of what exists at present, will be added in India over the next 20 years. This will lead to a further strain on electricity demand. Given the relatively long lifespan of buildings, of 50 years or more, this represents a significant opportunity for incorporating energy efficiency measures in new buildings in order to substantially reduce energy consumption in buildings for decades to come.

The Bureau of Energy Efficiency (BEE), Ministry of Power, launched the Energy Conservation Building Code (ECBC) in 2007, for voluntary adoption in the country, under the Energy Conservation Act of 2001. The Code regulates minimum energy performance in commercial buildings with a connected load of 100 kW or more. BEE has also developed a Star Rating Program for existing commercial buildings, which is based on actual energy performance of the buildings, expressed as an Energy Performance Index (EPI) measured in terms of annual electricity consumption per unit of built up area (expressed in kWh/m^2/year). These are landmark initiatives by the Government of India for improving energy efficiency in commercial buildings. However, given the over-dependence of fossil fuels for electricity needs and global challenges related to greenhouse gas emissions, there is a pressing need to go further, beyond driving incremental increases in energy efficiency in buildings. A long-term strategy needs to be developed to gradually reduce consumption of energy derived from fossil fuels by gradually enhancing utilization of energy generated through renewable energy sources. With this in mind, USAID ECO-III Project has started an initiative to promote a program for Net Zero Energy Buildings (NZEBs) in India.

Rationale for NZEB

A Net Zero Energy Building (NZEB), by definition, generates as much energy as it consumes over the course of a year through the deployment of energy efficient building design and technologies, and generation of on-site energy through systems utilizing solar power, urban waste, biomass, geothermal energy, etc. At the heart of the net-zero energy building definition is the idea that the building can meet all its energy requirements from cost-effective, locally available renewable energy sources. The overall objective of this initiative is to assist policymakers and stakeholders to direct efforts and resources over the next five to ten years so that these could facilitate the development of a NZEB program for the country.

This initiative could potentially tie in well with the National Solar Mission and National Mission on Sustainable Habitat that are being implemented under the Prime Minister's National Action Plan on Climate Change. The National Solar Mission aims to increase the share of solar energy in the total energy mix and targets an addition of 22 GW of solar power by 2022, of which 2 GW is set aside for off-grid installations; while the National Mission on Sustainable Habitat aims to take up the implementation of ECBC and other energy efficiency practices for construction of buildings in India.

There is also a growing realization that major breakthroughs in reducing energy use in buildings will entail combining whole-building design approaches with state of the art energy-efficient technologies (e.g. super-efficient building envelope, low-energy comfort conditioning and lighting systems, advanced metering and control systems, etc.) and on-site renewable energy technologies (e.g. building integrated photovoltaic, solar thermal, etc.). A long-term NZEB program would encourage the development of cutting edge research and cost-effective technologies to bring about step changes in the energy use in commercial buildings.

Broad challenges for NZEBs entail inclusion of financial incentives, policy and regulation, codes and standards, industry culture, extensive training and education, etc. Therefore, an effective approach to bring a step change in reducing energy consumption in the building sector will entail developing the right policies as well as the necessary scientific, technical and research capabilities. Coupled with the accompanying policy support, this can, over a period of time, help make NZEBs economically viable. This is particularly important with a view to encourage net zero energy at the community scale. To realize all the "potential" benefits, there is a need to put together dedicated teams that have the knowledge, experience, and the expertise to make this happen.

In this context, the establishment of an academia-industry-government consortium (an enhancement of the Public-Private Partnership model) can enable technology and knowledge transfer to make NZEB for all new buildings a reality in India.

Partners for NZEB

To bring this vision of NZEB to fruition, USAID ECO-III Project proposes to adopt a broad-based participatory approach to bring together some of the world's leading practitioners and thought leaders on a common platform. Some of the organizations that have agreed to partner as part of the NZEB Consortium on this path-breaking initiative include:

- *CEPT University* – India's premier academic institute offering undergraduate and graduate programs in the areas of natural and built environment and related disciplines. Its Centre for Sustainable Environment and Energy (CSEE) aims at providing an impetus for research in energy efficiency in built environment and energy. Its objective is to carry out in depth research in energy efficient building design, energy efficient building construction process, environment friendly construction materials and resource audit & management.
- *Vastu Shilpa Consultants (VSC)* – A celebrated architecture firm founded by one of the doyens on Indian contemporary architecture, Dr. Balkrishna V. Doshi. Over the years, VSC has developed and consistently embraced a design methodology that revolves around design teams framed at the outset of each project to work together from concept phase to completion so as to provide a consistent attitude towards conceptual issues and technical matters to assure proper implementation of each project.
- *Schneider Electric India* – Schneider Electric India Pvt. Ltd (SEI) is a 100% subsidiary of Schneider Electric Industries SAS, a global specialist in energy management. With a strong force of over 7,700 employees, the company is well known for its unique vision, progressive management and above all, its exemplary Quality.
- *The Weidt Group, Inc. (TWGI)* – An acclaimed building energy design consulting firm with experience in providing design assistance on a building that has been conceived and operating as NZEB for over 5 years; also currently working on a NZEB for a commercial developer. TWGI is also part of the Zero Energy Commercial Buildings Consortium under the Zero Net Energy Commercial Buildings Initiative launched by US DOE.
- *Clanton & Associates, Inc.* – An award-winning lighting design firm that has practiced environmentally sensitive and sustainable design for over 20 years. Their project portfolio includes the greening of the White House and the greening of the Empire State Building.

In addition, some prospective partners that have expressed preliminary interest in supporting and guiding the NZEB Consortium include:

- *US Department of Energy (DOE)* – DOE, currently leading the US building sector with a goal to achieve cost effective and commercially competitive NZEBs for homes by 2020 and for all commercial buildings in the US by 2025. DOE's National Renewable Energy Laboratory (NREL) is leading the way in NZEB innovation. To make NZEBs more prevalent and to meet DOE's goal of marketable NZEBs, NREL is developing and testing energy modeling and optimization tools, technologies for low-energy buildings, whole-building design processes, and systematic performance metrics and monitoring. A key focus area will be to combine all these tools and processes to help the industry design well-integrated buildings that reach the goal of cost-effective NZEB.
- *Carnegie Mellon University's Center for Building Performance & Diagnostics (CBPD)* – CBPD is the first National Science Foundation's (NSF) Industry/University Cooperative Research Center (I/UCRC) dedicated to the building sector in the US. CBPD is a part of the Advanced Building Systems Integration Consortium (ABSIC), which is a university-industry-government partnership to pursue research, demonstration, and development for improving the quality and performance of commercial buildings and building systems.

The Way Forward

USAID has a successful track record of leadership in facilitating centers of excellence in India – the CII-Sohrabji Godrej Green Business Centre is a shining example of this leadership. Also, under the USAID-funded bilateral ECO-III Project, the following three Regional Energy Efficiency Centers have been started:

- Center for Energy Efficiency for Buildings at CEPT University, Ahmedabad
- Center for Energy Efficiency for Home Appliances at the West Bengal Renewable Energy Development Agency, Kolkata
- Center for Energy Efficiency for Small and Medium Enterprises at SEE-Tech Solutions Pvt. Ltd, Nagpur

The Center for Energy Efficiency for Buildings at CEPT University is conceived to be a low-energy building and it is proposed that the scope of this Center be amplified so that it becomes the hub of activities related to high performance buildings based on the core principle of NZEB. This means that this Center becomes the nodal point for a nationwide NZEB initiative in India. A corollary to this approach would be that the building housing the Center be designed and built as the flagship project, as a NZEB pilot/demonstration project. The design of this building with a NZEB target is currently underway, with ECO-III providing technical assistance.

Approach

The approach for developing NZEB initiatives in India envisages the following:

1. ***Strategic Roadmap***

   USAID ECO-III Project will develop a NZEB Strategy Roadmap for India. This initiative has the potential to bring together all the important stakeholders of building industry and technology providers from India and US in shaping the large-scale NZEB implementation in India. This would entail:

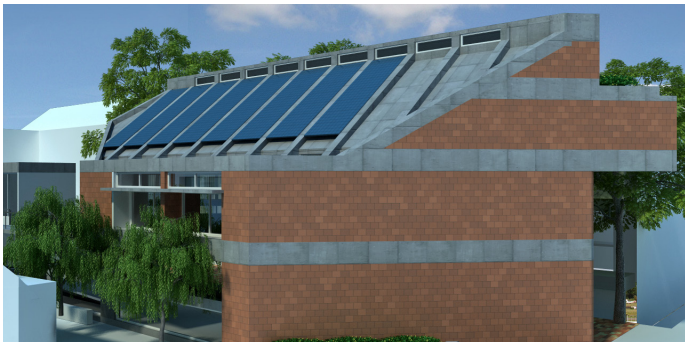
   a) Identification and development of a collaboration framework between US DOE National Research Laboratories, US academic institutions and research centers (e.g. Center for Building Performance and Diagnostics and Lighting Research Center) and CEPT University: This is a key activity because design and construction of Net Zero Energy Buildings necessitates

that the initiative be backed up by extensive scientific and technical R&D expertise for new technologies and improved practices. ECO-III Project, with its partners, will facilitate the development of this framework. Another key element of this activity will be to establish an academia-industry-government consortium that will not only assist in the design and construction of NZEB for the Center but also help in shaping the agenda for the Center. This Consortium will be driving the NZEB initiative in India.

b) Organization of a series of NZEB workshops and possibly an exchange program that would include organizing two workshops in India featuring speakers from US DOE and its national research laboratories supporting its NZEB program, NZEB case studies, technology suppliers and vendors (high performance energy efficient technology providers, on-site renewable energy generation technology providers, advanced metering and building controls technology providers). The culmination of these workshops and exchange programs would be the formulation of a Strategy Roadmap for scaling up of NZEB approaches in India.

2. ***Pilot Project for Demonstration of Technologies***

Creation of a framework for technology adoption/replication and showcasing through demonstration projects: In order to pursue an effective NZEB program, it is important to start investing in both technologies and research, and demonstration of appropriate technologies suitable to the local conditions and requirements. Technologies that may be considered for pilot project could possibly include white/cool roof technologies, spectrally selective glazing, insulation materials, ground source heat pumps, efficient lighting and daylighting integration systems, building management systems, super-efficient cooling/heating systems, solar photovoltaic systems, urban waste/biomass energy systems, etc. for their possible application in the pilot project.



3. ***Production of a Documentary Film***

Creation of a documentary film that documents the various aspects of a Net Zero Energy Building can help build awareness. Given the fact that, under this program, there will be a number of pilot projects in the near future, this documentary will be a useful resource for the people involved in the construction of NZEB as well as for the purpose of general awareness in the construction industry.

Stakeholders and their Roles

1. **Government of India:** Ministry of Power/Bureau of Energy Efficiency and Ministry of New and Renewable Energy, concerned state level agencies and institutions, etc.

   Role: Mandate, coordination, policy interventions, possible funding

2. **US Government:** US Department of Energy, USAID

   Role: Providing strategic, navigational and technical guidance

3. **Academic/Research Institutes:** Center for Building Performance and Diagnostics at Carnegie Mellon University, Center for Environmental Planning and Technology, National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, etc.

   Role: Awareness creation amongst decision makers; conduct advanced research, provide technical know-how

4. **Private Sector Partners:** Vastu Shilpa Consultants, Schneider Electric India, The Weidt Group, Clanton & Associates, VMS Consultants, Pankaj Dharkar & Associates, Antech Consultants, London Infotech, Mechartés Simulation Experts, Riverbank Studios, etc. (for illustrative purposes)

   Role: Participation in building selection and data gathering; building design and construction, product innovation, testing and demonstration

Call for Partners

We are looking for partners to adopt, support and strengthen this Program on NZEB, and thus would welcome interested companies and institutions to approach us giving details of their possible inputs and contribution towards the Program.

For any additional information and suggestions, please contact:

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