EECB UPDATE

ENERGY EFFICIENCY IMPROVEMENTS IN COMMERCIAL BUILDINGS

NEWSLETTER

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EDITORIAL

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The Interim Report of the Expert Group on Low Carbon Strategies for Inclusive Growth indicates that the residential and commercial sectors account for 29% of the total electricity consumption in the country. The commercial floor space in the country is likely to increase from 425 million m^2 in 2005 to 1114 million m^2 in 2017/18. Assuming an annual growth rate of 8% for office and retail spaces and 10% for the hospitality sector, the electricity consumption from the commercial building sector will pose serious concerns for the country.

Owing to rapid new construction activities with opportunities to employ efficient materials and best practices, energy efficiency in the building sector assumes greater significance in India. In line with this, the Energy Conservation Building Code (ECBC) was developed by the Government of India for new commercial buildings under the powers conferred to the central government through the Energy Conservation Act 2001. The state governments have the flexibility to modify the code to suit local or regional needs and notify them. It is important to note that while ECBC has been developed by the Bureau of Energy Efficiency (BEE), its enforcement lies with the state governments and urban local bodies through notification within their states. As of now, ECBC has been made mandatory through notification by 9 states and about 12 states are in the process of issuing notification.

Several initiatives have been taken by the Government of India to help implement ECBC in states. The 'Energy Efficiency Improvements in Commercial Buildings' (EECB) is one such project being implemented across the country. The EECB project is jointly promoted by UNDP-GEF and BEE, with BEE as the implementing partner. The project has carried out a number of activities ranging from developing an institutional framework for capacity building to benchmarking and demonstration projects.

This newsletter is aimed at sharing information and knowledge generated under the EEBC project and also to raise awareness about building energy efficiency in India. We welcome feedback from its readers.

Hope you enjoy reading what has been put together by the project team.

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Energy Efficiency Improvements in Commercial Buildings

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Background

The building sector in India contributes to five per cent of the country's gross domestic product. Growing at about 30% per annum, the sector is worth US$ 12 billion. The electricity consumption by large commercial buildings is currently about seven per cent of the country's overall electricity consumption, and is growing at about eight per cent annually. It is estimated that new buildings can reduce between 30% and 40% of their energy consumption by incorporating appropriate design interventions in the building envelope, lighting, heating, ventilation, and air-conditioning systems. The expected addition of commercial building floor area in India is growing at about eight per cent per year and hence achieving energy efficiency in this sector is important.

In May 2007, the Bureau of Energy Efficiency (BEE) proposed an Energy Conservation Building Code (ECBC) that sets minimum energy performance standards for new commercial buildings. The ECBC, however, is currently not mandatory due to a number of challenges such as lack of appropriate knowledge and capacities at various government levels, limited availability of trained designers and architects, and absence of suitable energy-efficient materials and equipment in the local market. To clearly outline exact activities and outputs required to achieve energy efficiency in commercial buildings, UNDP-GEF has initiated a project on 'Energy Efficiency Improvements in Commercial Buildings' in partnership with BEE, Ministry of Power, Government of India.

About the project

The project aims to address information, capacity, institutional, and financial barriers that will help in bringing ECBC under a mandatory regime. The project will assist the Government to implement and operationalize the ECBC, through comprehensive and integrated approach that will focus on:

1. Strengthening of institutional capacities at various levels to implement ECBC and other energy efficiency programmes of commercial buildings;
2. Developing technical expertise and awareness raising of key partners;
3. Demonstrating ECBC-compliance in eight model buildings (with total floor area of 1.47 million m^2) in five climatic zones;

PROJECT INFORMATION

Area: Environment and Energy, UNDP

Budget: Total: US$ 21,027,660

- US$ 5,200,000 (Global Environment Facility)
- US$ 2,976,596 (Bureau of Energy Efficiency)
- US$ 1,787,234 (Swiss Agency for Development and Cooperation)
- US$ 11,063,830 (Others)

Duration: 2010–2017

Government Counterpart: Ministry of Environment, Forests, and Climate Change, Government of India

Implementing Partner(s): Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India

Location(s): National

The project website URL is www.eecbindia.com. Last updated: August 2016

4. Formulating fiscal and regulatory incentives for investors; and
5. Monitoring, evaluation, knowledge sharing, and learning.

Estimated reduction in annual direct carbon dioxide (CO_2) emission through ECBC compliance in the eight demonstration commercial buildings of five different climatic zones is 90.7 $ktCO_2$ (kilo tonnes of carbon dioxide) per year or 181.4 $ktCO_2$ during the project duration, assuming the buildings are operational for two years, and 2.27 million tonnes of CO_2 cumulatively over 25 years of their lifetime.

Developments so far

The activities can be broadly categorized into following outcomes, and the developments achieved under each outcome are given below.

1. Strengthen institutional capacities at various levels on the enactment and enforcement of ECBC for commercial buildings
   - Notified ECBC in 10 states: Andhra Pradesh, Haryana, Karnataka, Odisha, Punjab, Rajasthan, Telangana, Uttarakhand, Union Territory (UT) of Puducherry, and West Bengal.
   - Established ECBC Cells in five states: Chhattisgarh, Haryana, Karnataka, Punjab, and Uttar Pradesh.
   - Developed energy performance index (EPI) for commercial buildings for different categories of buildings based on the total sample size of 1160 buildings (Table 1).
2. Enhanced technical capacity and expertise of local building practitioners and service providers:
   - Trained 89 ECBC Master trainers through nine training programmes.
   - Trained 3300 building sector stakeholders on ECBC implementation through 82 training programmes. The participants of the training programmes included architects, design professionals, developers, contractors, and building material suppliers.
   - Identified the following institutes in six states for supporting training and capacity building of key stakeholders:
     - Administrative Staff College of India, Andhra Pradesh
     - Rachna Sansad Institute of Architecture, Maharashtra
     - Energy Management Centre, Kerala

Table 1. Energy performance index of different categories of buildings (kWh/m^2/year)

Type	Warm and humid	Composite	Hot and dry	Moderate	Simple average
Office building, less than 50% air-conditioning	101	86	90	94	93
Office building with more than 50% air-conditioning	182	179	173	179	178
Shopping mall	428	327	273	257	321
BPOs	452	437	–	433	440
Hotels – up to 3 star	215	201	167	107	173
Hotels – above 3 star	333	290	250	313	297
Hospitals	275	264	261	247	262
Institutes	150	117	106	129	126

- Ela Green Buildings and Infrastructure Consultants, Chhattisgarh
- Arunachal Pradesh Energy Development Agency, Arunachal Pradesh
- Administrative Training Institute, Karnataka.

It is expected that these programmes will be continued at the respective institutions beyond the project life.

3. Increased number of new commercial buildings that are ECBC-compliant
   - Supported 14 demonstration commercial buildings for ECBC compliance. The following five projects are nearing construction completion:
     - KK Guest House, Bengaluru, moderate climate
     - Dhanvantri OPD block, Jaipur, composite climate
     - SMS Medical College, Jaipur, composite climate
     - UPERC Office Building, Lucknow, composite climate
     - SAMVAD Office Building, Naya Raipur, composite climate.
4. Enforced fiscal incentives and regulatory frameworks incentives for investors and developers of energy-efficient buildings
   - Provided part of the incremental construction cost for ECBC compliance to three demonstration projects.
5. Readily available and easily accessible/shared information and knowledge products on best practices regarding energy-efficient building technologies and measures
   - Developed 37 knowledge products, which can be accessed through project website (www.eecbindia.com). (Market Assessment of Energy Efficient Building Materials, Implementing Energy Efficiency in Buildings, etc.).

Looking to the future

- Create 11 more ECBC cells to support the states in issuing ECBC notification, institutionalizing training and building capacity on design compliance to ECBC.
- Issue ECBC notification in 10 more states during the project period. The project will support seven of them. Further, the Government of India is keen to ensure that all the states in India will issue ECBC notification.
- Identify institutes in 10 more states and train the trainers, so that the training component is continued beyond end of the project.
- Provide energy simulation tools to state PWDs/ULBs to design and evaluate the potential of energy-efficient strategies. Software like DesignBuilder/IDA, ICE, etc. are used to design buildings for ECBC compliance.
- Include ECBC in the curricula of architecture and engineering educational institutions (SPAs, IITs, IIMs, NITs, construction management institutes, etc.).
- Mobilize commitment from potential energy-efficient model buildings cumulating to built-up area of 1 million m^2 in five clusters from different climate zones.

Formation of Energy Conservation Building Code (ECBC) Cells in States

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Background

The Energy Conservation (EC) Act, 2001, empowers the state governments to facilitate and enforce efficient use of energy and its conservation. The state governments have to designate state designated agencies (SDAs) in consultation with the Bureau of Energy Efficiency (BEE) to coordinate, regulate, and enforce the provisions of the EC Act in their states. Thus the SDAs are the strategic partners for the promotion of energy efficiency and energy conservation in the country. The role of the SDAs in assisting the states to complete the process of notification is critical.

Most of the government buildings in a state are constructed and maintained by state public works departments (PWDs). Improvements in the design of new building construction and operation of existing buildings have vast energy saving potential. Although the percentage of government construction as compared to overall construction would be limited, the leadership provided by state PWDs would be critical for the private sector to follow. To achieve this objective, capacity building of officials of state PWDs is essential. Training and capacity building is a continuous exercise and would also be extended to the private sector after identifying the needs of a state.

UNDP–GEF–BEE Project on Commercial Buildings

A project on energy efficiency improvements in commercial buildings has been initiated under the UNDP–GEF–BEE programme. This project would assist in the implementation and operationalization of the Energy Conservation Building Code (ECBC) through a comprehensive and integrated approach with focus on (a) strengthening of institutional capacities at various levels to implement ECBC and other energy efficiency programmes for commercial buildings, (b) developing technical expertise and generate awareness among key partners, (c) compliance with ECBC to be demonstrated in eight model buildings in five climatic zones of the country, (d) formulating fiscal and regulatory incentives for investors, and (e) monitoring and evaluation; and (f) knowledge sharing and learning. The BEE is the implementing agency of the project.

In the 12th Plan period, the targets of the BEE Buildings programme are:

- 75% of all new commercial buildings to be ECBC-compliant and
- 20% of the existing commercial buildings reduce energy consumption through retrofits.

The BEE would also work towards creating ECBC Cells in all the states, facilitating the implementation of ECBC in the states, and eventually moving towards a mandatory regime of ECBC enforcement.

In the 11th Plan period, 15 states had either notified ECBC in the state gazette or amended it as per their local requirements. There are 7 states, which had proposed to adopt ECBC during 2014/15. The current status of ECBC implementation in the states is given in Box 1.

In Category 1 states/UTs, where the notification has already been issued, the role of the state PWDs becomes extremely vital as they now have mandatory provisions to comply with. This would require capacity building at the state PWDs to meet all the compliance provisions under the state ECBC. Therefore, it was proposed that an ECBC Cell be created in each of the state PWDs.

Box 1. Status of ECBC Implementation in states

Category 1
States/Union Territories (UTs) where ECBC has been notified
10 States/UTs
Rajasthan, Odisha, Uttarkhand, UT of Puducherry, Andhra Pradesh, Punjab, Telangana, Haryana, West Bengal, and Karnataka
Category 2
States/UTs that have amended ECBC for their state and progressed
10 States/UTs
Uttar Pradesh, Kerala, Chhattisgarh, Gujarat, Tamil Nadu, Maharashtra, Bihar, Himachal Pradesh, Madhya Pradesh, and Delhi
Category 3
States/UTs that have not moved ahead
Jharkhand, Goa, Assam, Tripura, Arunachal Pradesh, Meghalaya, Nagaland, Mizoram, Manipur, Sikkim, Jammu and Kashmir* and UTs of Daman Diu, Lakshadweep, Chandigarh, Andaman and Nicobar Islands, Dadar and Nagar Haveli

Once the notification is issued in the other states, ECBC Cells will be created in those states as well. The primary objective of the Cell is to build the capacities of the PWD for ECBC compliance. While the consultants in the Cell will play a facilitative role, the lead in all the tasks will be taken by the Nodal Officer deputed by the respective state PWD.

In Category 2, where the states have amended the code to suit their local needs, the role of SDAs is extremely critical as the process of notification requires continuous liaison with all the concerned departments. On various accounts, the SDAs have conveyed lack of technical resources as a major hindrance. This is because the SDA is a single nodal point for a diverse portfolio that includes Buildings, Standards and Labelling, Industry, Ag-DSM, Mu-DSM, etc., among other responsibilities. Due to this, there is lack of penetration for the buildings component. With the ECBC pushing for a mandatory regime in the 12th Plan period, the SDAs will play an extremely important role. Keeping this in mind, it is proposed to strengthen the capacities of the SDAs mentioned in Category 2 by creating an ECBC Cell within the SDAs.

In Category 3, where the states have not moved ahead, ECBC Cells would be created in the SDA. The primary objective of the Cell here would be to assist the state in amending the code for its adoption in the state to suit their local requirements and progressing towards its notification.

Until August 2016, ECBC Cells have been established in three Category 1 states (Haryana, Karnataka, and Punjab) and two Category 2 states (Chhattisgarh and Uttar Pradesh).

The role of an ECBC Cell in the implementation of the code in respective states is captured in Figure 1.

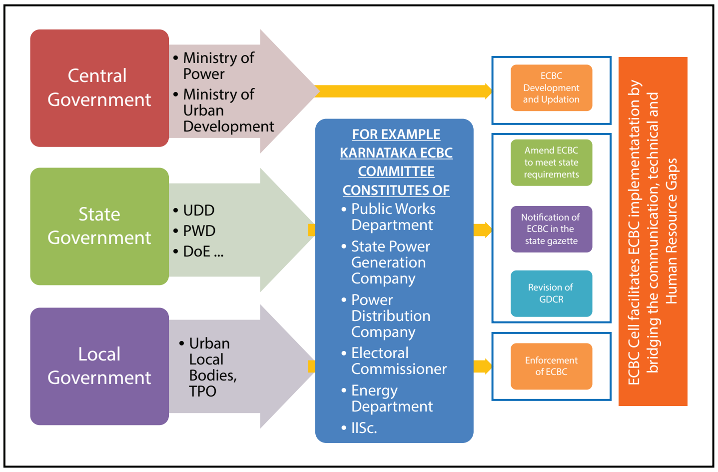

Figure 1. Role of ECBC Cell in its implementation

Study on Market Assessment of Energy-efficient Building Materials: Focus on Building Envelope

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Introduction

The building construction industry in India at present contributes about 10% of the gross domestic product (GDP). The industry is expanding rapidly at over 9% a year, largely by the strong growth in the services sector. Electricity consumption in the commercial sector in India accounts for about 8% of the total electricity supplied by the utilities and has been growing annually at about 11%–12%. Figure 1 shows the electricity consumption pattern in commercial buildings in the country.

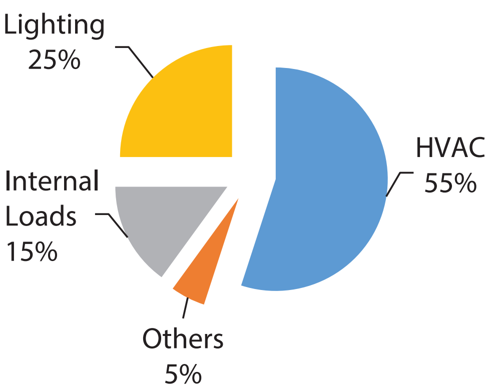

Figure 1. Electricity consumption pattern in commercial buildings

In response to the growing concern towards energy conservation, the Bureau of Energy Efficiency (BEE) has developed an energy efficiency action plan focusing on various thrust areas. One of the key areas was the design of Energy Conservation Building Code (ECBC). ECBC has been developed as a voluntary code for all new commercial buildings having a connected load of 100 kW or greater or contract demand of 120 kVA or greater. ECBC provided minimum performance standards for the following components:

- Building envelope (walls, roofs, windows)
- Lighting (indoor and outdoor)
- Heating, ventilation, and air-conditioning (HVAC) system
- Solar water heating
- Electrical systems

Before making ECBC mandatory, it is imperative to analyse the market preparedness for such energy-efficient building materials. This article focuses on the market assessment study initiated by United Nations Development Programme (UNDP) and BEE to assess and identify the sales of energy-efficient building materials in India.

Project approach

The project team followed a three-step approach to assess the building material market in India and its possible coherence with ECBC in India (Figure 2).

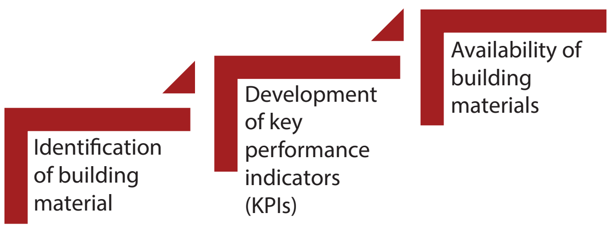

Figure 2. Approach for market assessment

Identification of building materials

The building envelope, electrical and mechanical systems, and building aesthetics are the three critical components of a building that offer the scope for energy conservation. Table 1 lists the building materials that were identified under each of these components.

Table 1. Building materials identified for energy conservation

Building aesthetics	Building envelope	Electrical and mechanical systems
High performance glass Energy-efficient windows External movable blinds for shading of glass façade Reflective paints	**Wall materials** AAC blocks, Hollow clay blocks, Fly ash bricks **Wall and roof insulation materials** XPS, EPS, Glass wool, Mineral wool, PUF **Insulated pre-fabricated wall and roof panels** **High performance glass and energy-efficient windows** External movable blinds for shading of glass façade	**Efficient lighting systems** Compact fluorescent lamps, T5 fluorescent lamps, LEDs Lighting controls, Occupancy sensors **HVAC** High efficient chillers Centrifugal, Screw, etc. Water-cooled and air-cooled chillers; Economizers Heat recovery system; Variable refrigerant volume; Variable refrigerant flow; Variable frequency drives **Service hot water** **Energy-efficient motors and transformers**

Development of key performance indicators

The study has developed key performance indicators (KPIs) for different materials. The performance indicators were divided into following three sub-indicators to compare their performance, assess their availability, and their associated benefits.

1. Technical specifications and test standards
2. Market structure, market size, and market forecast
3. Cost–benefit analysis

Availability of building materials

After freezing the KPIs, the availability of all identified building materials applicable for commercial real estate sector was assessed. The market analysis was divided into following sub-heads to assess the availability and performance of different building materials in India.

- Market structure and size of identified materials
- Supply chain and availability
- Key technical specifications
- Identification of applicable test standards and labs
- Cost–benefit analysis and its applicability
- Recommendations and next actions

Consultations were held with a number of stakeholders for each building material to arrive at the market data. Based on the above data points, the KPIs were finalized for different building materials.

The remaining part of the article would cover market assessments of energy-efficient building materials for the building envelope and HVAC.

Market assessment of materials for building envelope

The building materials covered as part of the building envelope for the commercial building sector are (a) wall material, (b) insulation (wall and roof), (c) fenestration, and (d) cool roofs/reflective paints.

Wall material types

Different types of wall materials are used in commercial buildings. A few of the important materials and their applicability are presented in Table 2.

Table 2. Walling materials and their applicability

Wall material	Major application	Applicability to commercial real estate buildings	Market structure
AAC blocks	Masonry work in commercial buildings	Yes (one of the best wall material options)	Almost 50% organized
Fly ash bricks	Mostly applicable to small to medium houses and buildings	Stakeholder interaction suggested that fly ash bricks are not that popular in commercial real estate sector. More effort needed to make it suitable for commercial constructions	Highly unorganized
Hollow clay blocks	Mostly applicable to small household where normal bricks are available at a slightly higher cost	Stakeholder interaction suggested that hollow clay blocks are not popular in commercial real estate sector	Highly unorganized

It can be inferred from Table 2 that, AAC block is the one mostly preferred for commercial real estate construction.

AAC block: market and demand forecast

The overall AAC block market stood at 3.5 million m^3. This comprised both residential and commercial sector applications. It was established through stakeholder consultations that the overall market grew at a CAGR of almost 10% from 2008 to 2010. However, in the past two to three years, this growth dipped to a CAGR of 5%, due to the slowdown in the real estate market. The negative growth can also be attributed to the preference of glass over AAC blocks and other construction materials. The market analysis suggests that out of total 3.5 million m^3 market, the market of AAC blocks in the commercial building sector stood at 1.22 million m^3 in 2012/13.

The current capacity of the AAC block manufacturers and suppliers is 5 million m^3. Out of this, approximately 35% caters to the commercial market. This leaves the manufacturer with a capacity of 1.75 million m^3 for the commercial real estate sector. Thus, new capacity addition will be required in 2016/17 under a moderate scenario and in 2015/16 in an optimistic scenario.

Fly ash bricks: market and demand forecast

There are about 40 major thermal power plants in India producing around 15 million tonnes (MT) of fly ash every year. Despite availability of fly ash, the fly ash brick market is highly unorganized and is confined to a few regions of the country. The location of manufacturing units is dependent on their proximity to thermal power plants.

The market for fly ash bricks is more confined to the eastern and south-eastern regions of India. During interactions with stakeholders, it came out that due to high cost of clay bricks in these regions (Rs 8–10 per piece), the people of these regions prefer fly ash bricks, which are available at half the price.

Insulation materials (wall and roof): market and demand forecast

Major wall and roof building insulation materials are: (a) rockwool, (b) glasswool, c) polyurethane foam (PUF), and (d) extruded Polystyrene foam (XPS).

The insulation market primarily depends on capital projects such as airports, malls, and stadiums. Post 2008 till 2012, the market in India grew at 15% year on year. It is estimated that from 2012 to 2015, the market is expected to grow at 10%.

The building insulation segment forms a minor part of the overall insulation market. Thus, end users (from the building sector) do not procure insulation materials directly from producers, but from intermediaries. These intermediaries deal in various kinds of insulation materials and do not exclusively deal with building insulation materials. Therefore, it is difficult to estimate the building insulation market in India. However, from stakeholder interaction, it can be estimated that the building insulation segment has a 10%–15% share of the current total insulation market. The building insulation market in 2013/14 stood at 0.53 million m^3, and if it follows the BAU scenario, no additional capacity will be required till 2020.

Fenestration/glass: market and demand forecast

With technology, use and popularity of glass have increased widely in the past three decades. Glass finds application in real estate as well as automobile sector. The glass category is further categorized to conventional glass and high performance glass.

The Indian glass market is estimated at 1.19 billion USD (Global: 75 billion USD). The estimated volume is 1.5 lakh MT per month. High performance glass is approximately 10% of the overall glass usage in India.

The manufacturing capacity for basic float glass in India is 6000 MT per day (excluding glass production for containers, crockery, bottles and others). The glass manufacturing industry is completely organized, with five major players and their nine manufacturing plants in total.

Stakeholder interactions suggested that only 30% of the glass manufacturing capacity has been exploited till date. The glass industry in India is well equipped with sufficient capacity to cater to the demand for the next eight years without any capacity addition.

Cool roof/reflective coatings: market and demand forecast

A cool roof is a roof that reflects or emits the sun's heat back into the sky instead of transferring it into the building below. Green roofs are defined as roofs that support vegetation. They consist of vegetation and soil, or growing medium, planted over a waterproofing membrane. They may require additional layers such as drainage layer, roof barrier, and irrigation system.

The cost of such reflective coating varies from Rs 22 to Rs 35 per sq.ft. Major factors affecting the cost of reflective coatings are the location of the building, height of the building, the type of roof surface, conditioned area below roof surface, roof condition, etc.

According to stakeholders, the current consumption rate of reflective coatings in commercial buildings in India is less than 1%. It is because there is lack of awareness about the product and the technology. Due to regular maintenance requirement, green roof is adopted mainly in residential buildings and not in the commercial buildings of India. As per stakeholders, about 5% of the commercial buildings in India has adopted this method.

HVAC

HVAC is a complex system with lots of products/ appliance systems available.

Market structure, size, and forecast

The room air-conditioner (RAC) market comprises window and split air-conditioners (SACs). The RAC market in India has been on a high growth trajectory for the past few years. It grew from a market size of 1.25 million units in 2005/06 to 3.3 million units in 2013/14. Considering the assessment carried out, it was established that there is a clear decline in the window air-conditioner (WAC) market as customers are increasingly opting for SACs.

The analysis of data of forecasted sales shows an upward trend with the 2020/21 sales value reaching 7 million units. This result is consistent with the literature available on the market forecast for Indian RAC industry, which predicts a 10%–13% CAGR growth in the next five years.

The market for VRF/VRV stood at 25,000 units in 2013/14 and was expected to reach 30,000 units by 2014/15. The market for VRF/VRV systems has grown by over 30% in value terms and total cooling capacity sold, due to a fall in average selling prices. The growth rate in market volume is higher. The growth rate till 2015 is predicted to be around 20%. VRFs/VRVs are fast replacing ducted split systems in offices, small commercial and high-end residential sectors due to better part-load efficiencies, associated energy savings, and competitive prices.

Analysis of the data and stakeholder interaction suggested that light commercial AC market in India is largely dominated by Cassette ACs constituting around 90% of the total light commercial AC market. Cassette AC market grew rapidly with a CAGR of around 27%, growing from 40,000 units in 2011 to 65,000 units in 2013. Data reveals that the floor-standing AC market has grown even faster, with a CAGR of around 30%. The market of floor-standing ACs was 4156 units in 2011 and it grew to 7000 units in 2013. Based on the assumption that this growth will continue in the future at the same rate, the forecasted sales for Cassette ACs for 2020 comes to about 3.5 lakh units.

Sales of chillers of capacities 101–350 kW and >700 kW dominate the market. Sales decreased in 2012 primarily because of the global economic downturn and the resultant decrease in demand from Indian customers.

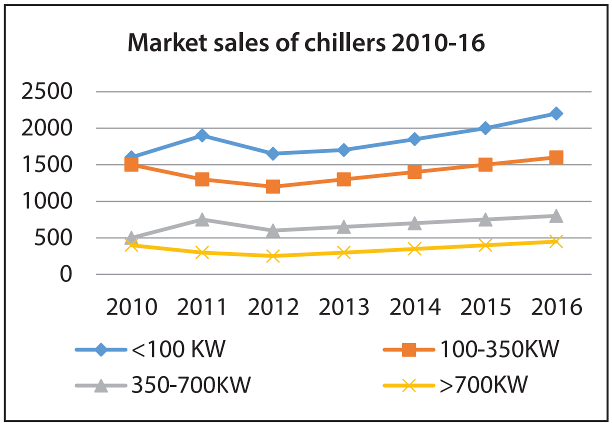

Figure 3. Market for chillers and sales projection

An optimistic growth projection puts the chiller market to touch about 7000 units in 2019/20.

The AHU market expanded nearly 48% by volume from 2010 to 2012. The FCU market on other hand has echoed this trend, registering a growth of 33% in sales by volume. Lately, local brands have overtaken international brands in Indian markets, both in the AHU and FCU sectors. By reducing manufacturing costs, these local brands have also driven the selling prices.

Stakeholder interaction suggested that economizers are supplied in India as per the demand from different building owners, commercial real estate developers etc. Manufacturing or supplying economizers is not a concern, but the only barrier is proper awareness about the associated benefits.

It is also important to develop test standards and facilities for testing HVAC products in India.

PACE-D Technical Assistance Programme: HVAC market assessment and transformation approach for India

Energy Conservation Building Code: Karnataka Initiatives

Karnataka ECBC Cell Team

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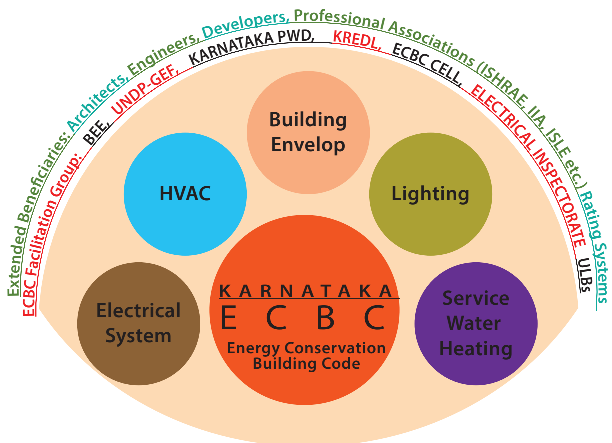
Introduction

To give impetus to energy conservation in the country, Government of India enacted the Energy Conservation Act (EC Act) on 1 March 2002. Under the Act, the Government of India established the Bureau of Energy Efficiency (BEE), a statutory body under the Ministry of Power (MoP), Government of India. Under this EC Act, BEE has prescribed Energy Conservation Building Code (ECBC) for the country in 2007.

ECBC in Karnataka

Karnataka is one of the most proactive states, which is spearheading the implementation of ECBC. The state of Karnataka has modified ECBC to suit its local requirements and a notification was issued in the Gazette of Government of Karnataka (part IV-A) on 27 November 2014. The ECBC is applicable to all buildings or building complexes in the urban area that have a connected load of 100 kW or greater, or a contract demand of 120 kVA or greater, or having conditioned area of 500 m^2 or more and used for commercial purposes. It is applicable for both government and private buildings.

The ECBC sets minimum energy performance standards for buildings and covers building envelope; heating, ventilation and air conditioning; service hot water systems; interior and exterior lighting; electrical power and motors including thermal comfort in non-centrally air-conditioned/heated buildings. The code would provide multiple options for compliance, that is, prescriptive for each sub-system and overall system or using trade-off between sub-systems or whole building performance-based compliance, as per the prescribed procedure. The code is getting implemented through collaborative efforts of multiple stakeholders: BEE, United Nations Development Programme–Global Environment Facility (UNDP–GEF), Karnataka Public Works Department, Karnataka Renewable Energy Development (KREDL), Electrical Inspectorate, and ECBC Cell.



According to the notification:

Urban local bodies will be responsible for the enforcement of ECBC with respect to private buildings and Public Works Department (PWD) and Architectural Department of PWD will be responsible with respect to state government buildings. The Department of Electrical Inspectorate, Government of Karnataka, is to inspect electrical installation in the buildings, which are ECBC compliant.

These directives for the implementation of ECBC in Karnataka will ensure construction of energy-efficient buildings with reduced electrical energy demand by about 30%–40%.

Activities of ECBC Cell in Karnataka

Organisational Structure

Following a memorandum of understanding (MoU) signed between BEE, KREDL, and All India Institute of Local Self Governments (AIILSG), the AIILSG has set up an ECBC Cell for one year duration in the office of Principal Chief Architect, Karnataka PWD. The ECBC Cell team comprises two architects/planners and two engineers. This team, over the past seven months, has been assisting Karnataka PWD and the state designated agency (KREDL) in mainstreaming ECBC in the state. Figure 1 captures the operational structure of the ECBC Cell in Karnataka.

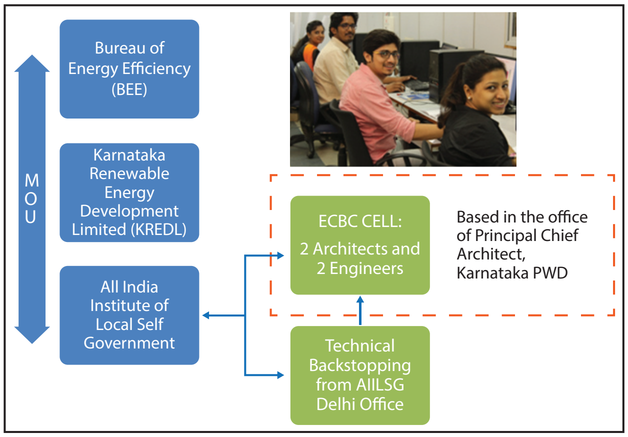
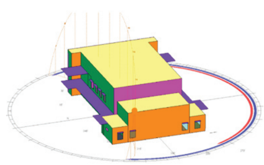


Figure 1. Structure of the ECBC Cell in Karnataka

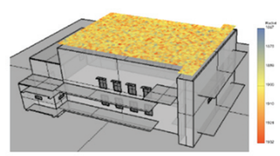
Technical Assistant for Energy Efficient Building Design

Under the UNDP–GEF–BEE EECB Project, the ECBC Cell has been mandated to make at least 10 of the PWD's new buildings energy efficient. The Cell follows integrated building design, where performances of all the applicable energy-efficient strategies (related to building envelope, lighting, HVAC, renewable energy integration, etc.) specific to the project were evaluated using state-of-the-art simulation tools. The team also performs financial analysis of the feasible strategies to make informed decisions. The results of the analysis are then presented to the entire PWD architectural team and through collaborative process, specific ECBC-compliant strategies are selected.

The Cell has provided this advisory service for an auditorium building in Bengaluru. The proposed interventions (in building massing, envelope, lighting, HVAC, etc.) will augment the occupant comfort while bringing an energy savings of 42% as compared to a business-as-usual design. The available roof area of the auditorium can be used to install 45 kW_p of photovoltaic (PV) applications (Figure 2). Currently, the team is working on four distinct PWD projects: an engineering college, a hospital project, an office building, and a parking-cum-dormitory building.



Sun-path analysis for shading design



Analysis for photovoltaic potential

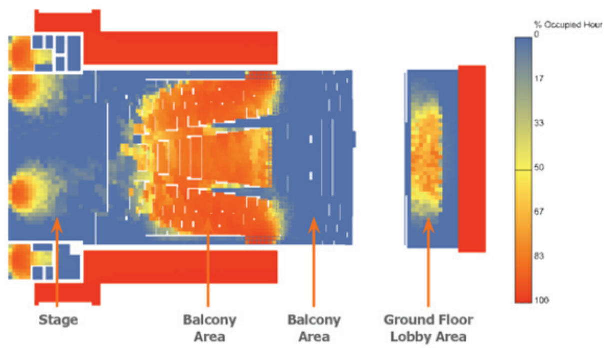


Figure 2. Daylight analysis of auditorium building

Updation of Karnataka Schedule of Rates

Another major intervention by ECBC Cell is to provide assistance to PWD to update the Schedule of Rates (SoR) of Karnataka. The SoR is a reference document

Box 1. Energy-efficient technologies proposed for Karnataka SoR

Building envelope

- Insulated walls, AAC blocks, perforated clay blocks, hollow concrete blocks
- Insulated roofs, reflective roof finishes, vegetated roof
- Double glazing, high performance single and double glazing
- UPVC window frame, aluminium frame with thermal break

Solar water heaters

- Flat/plate collectors
- Evaluated tube collectors

Energy-efficient lighting

- LED lamps/luminaires
- Lighting control

Energy-efficient HVAC system

- Super-efficient fans
- Star-rated unitary air-conditioners
- Inverter technology air-conditioners
- Variable refrigerant flow systems
- Central chilled water system
- Indirect direct evaporative cooling unit
- Chilled beam
- Radiant slab cooling

Solar photovoltaic

followed by PWD and some public sector undertakings for providing material and technology specifications and for cost estimation of buildings.

Karnataka has two SoR documents: one for Civil and the other for Electrical and Mechanical. These SoR documents with minor modifications are being followed in three PWD zones – South Zone, North Zone, and North-east Zone. Updating of SoR is performed by the office of Chief Engineer, Karnataka PWD, under the chairmanship of Secretary, PWD. Next updating of the SoR is scheduled in September 2016.

The ECBC Cell had collated specification information and cost information of several energy-efficient products. Box 1 provides the list of strategies proposed. The proposal of energy-efficient building materials and technologies was exhaustively discussed and reviewed by the Architecture and Engineering Departments of Karnataka PWD. The revised version of SoR documents will have separate chapter on Karnataka ECBC-compliant material and strategies.

0ther Activities of ECBC Cell

The ECBC Cell has developed geo-referencing maps for the state of Karnataka to place climatic zones, districts, administrative divisions, and green-rated buildings. The Cell has also compiled a directory of manufacturers and suppliers of energy-efficient products. Periodic seminars are organised by the Cell for PWD architecture team to develop awareness and skills on building physics, energy-efficient materials and technologies, and use of energy simulation tools. In the coming months, the Cell will assist in the updation of Development Control Rules to include ECBC clauses provisions.

Building Energy News

International Conference on Energy Efficiency in Buildings (ICEEB) 2015

UNDP–GEF–BEE hosted an International Conference on Energy Efficiency in Buildings during 17–18 December 2015 in New Delhi. The conference was organized to create a platform for different countries to share their experiences, learning, and best practices in implementing energy efficiency in the building sector. It was an optimal opportunity for the international community to learn from each other and understand how to assimilate energy-based initiatives into building climate-resilient infrastructure in an environment of rapid growth and urbanization.

The conference started with an Inaugural session which was addressed by Mr Manuel Soriano, Senior Technical Advisor, UNDP, Bangkok; Dr Jaco Cilliers, Country Director, UNDP, India; Dr Ajay Mathur, the then Director-General, Bureau of Energy Efficiency; and Mr Susheel Kumar, Special Secretary, Ministry of Environment, Forests, and Climate Change, and GEF India Operational Focal Point. During different sessions over two days, the participants debated on the implementation issues of ECBC within the states, similar experiences in other countries, benchmarking and verification in India, and case studies by Indian stakeholders. The concluding session discussed the best ways to continue the work done.

A compendium was also published, which consists of information on international projects, implementation experiences, and lessons learnt. The conference helped the Indian stakeholders to learn, ideate, conceptualize, and execute projects that are relevant and appropriate to the Indian context and align with the national agenda on energy efficiency.

L-R: Mr Sanjay Seth, Secretary I/C, BEE; Dr Jaco Cilliers, Country Director, UNDP India; Mr Susheel Kumar, Additional Secretary, MoEFCC; Dr Ajay Mathur, the then Director-General, BEE, Mr Manuel Soriano, Senior Technical Advisor, UNDP Bangkok

Building Energy News

Net Zero Energy Portal

The Ministry of Power and the United States Agency for International Development (USAID) have launched India's first integrated web portal designed to promote and mainstream Net Zero Energy Buildings (NZEB) in India on 27 May 2016. The portal (www.nzeb.in) was launched by Shri Pradeep Kumar Pujari, Secretary, Ministry of Power, and Ambassador Mr Jonathan Addleton, USAID Mission Director to India.

The portal is the first of its kind in India as it provides comprehensive information about Net Zero Energy Buildings. The portal also hosts the NZEB Alliance, an industry-wide body set up to drive the Indian markets toward highly energy-efficient buildings.

Shri P K Pujari outlined his vision to mainstream Net Zero Energy Buildings in India in addition to the implementation of minimum energy efficiency standards in buildings. He also acknowledged the collaboration of the USAID and BEE in the update process of the Energy Conservation Building Code (ECBC) to reflect the market changes and technological advancement.

Congratulating the BEE and USAID on the culmination of their three-year effort to develop the portal, Ambassador Mr Addleton remarked that 'USAID is pleased to partner with the Government of India on this initiative to promote Net Zero Energy Buildings across India. This portal will provide a wealth of information for policy makers, developers, architects, engineers, sustainability consultants, and academia, and will surely allow the vibrant Indian building industry to leapfrog towards energy efficiency standards and practices.'

Disclaimer: This newsletter has been compiled based on inputs from individual authors. The views expressed in this publication do not necessarily reflect those of the United Nations Development Programme and the Bureau of Energy Efficiency, Ministry of Power, Government of India.