Terminal Evaluation Report

of the UNDP-GEF-BEE Project

Energy Efficiency Improvements in Commercial Buildings (EECB) INDIA

(PIMS 4043), GEF Project ID 3555

by

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Region and countries included in the project: South Asia Region, India
GEF Operational Focal Area: Climate Change Mitigation (CCM-2) Promote Market Transformation for Energy Efficiency in Industry and Buildings (GEF-5)
Executing Agency/Implementing Partner: Bureau of Energy Efficiency, Ministry of Power
Project period evaluated: April 2011 to 31 December 2017

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- Mr. Abdullah Nisar Siddiqui, Mr. G. Kanagaraj, Ms. Meenal Anand & Ms. Shatakshi Suman of Project Management Unit

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ACRONYMS

APR-PIR	Annual Project Review / Project Implementation Report
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BEE	Bureau of Energy Efficiency
BEEP	Indo Swiss Building Energy Efficiency Project
CCM	Climate Change Mitigation
CEO	Chief Executive Officer
CO	Country Office (UNDP)
ECBC	Energy Conservation Building Code
EE	energy efficiency
EEMB	Energy Efficiency Model Building
EMIS	Energy Monitoring Information System
ESCO	energy service company
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gases
GHMC	Greater Hyderabad Municipal Corporation
GoI	Government of India
GRIHA	Green Rating for Integrated Habitat Assessment
IGBC	India Green Building Council
kWh	kilowatt-hour
LEED	Leadership in Energy and Environmental Design
MNRE	Ministry of New and Renewable Energy
MoEF	Ministry of Environment and Forest
MoUD	Ministry of Urban Development
MoP	Ministry of Power
MWh	megawatt-hour (million watt-hours)
MTE	Mid-Term Evaluation
NGO	non-governmental organization
NIM	National Implementation Modality
OECD	Organization for Economic Cooperation and Development
PM	Project Manager
PMU	Project Management Unit
ProDoc	Project document
PWD	Public Works Department
RTA	Regional Technical Advisor (UNDP)
SDA	State Designated Agencies
SDC	Swiss Development Cooperation
SMEs	small and medium-sized enterprises
tCO_2	metric tonne of carbon dioxide
TERI	The Energy and Resources Institute
ToR	Terms of Reference
TPA	third party assessor
UDD	Urban Development Department
ULB	Urban Local Body
UNDP	United Nations Development Programme
USAID	US Agency for International Development
USD	United States Dollars
UT	Union Territory

Executive Summary

Project Summary Table

Project Title:	Energy Efficiency Improvements in Commercial Buildings			
GEF Project ID:	3555		*at endorsement (Million US$)*	*at completion (Million US$)*
UNDP Project ID:	4043	GEF financing:	5.200	5.200
Country:	India	IA/EA own:		-
Region:	Asia Pacific	Government	2.977	[1]476.720
Focal Area:	Climate Change CC-4	Other:	12.851	[2]3.500
FA Objectives, (OP/SP):	OP-5	Total co-financing:	15.828	480.220
Executing Agency:	Bureau of Energy Efficiency, Ministry of Power, Gov. of India	Total Project Cost:	21.028	485.420
Other Partners involved:		Project Document Signature (date project began):		April 28, 2011
		(Operational) Closing Date:	Proposed: March 31, 2015	Actual: December 31, 2017

Brief Description of the Project

Of India's total electricity consumption, about 8 percent is being consumed by large commercial buildings. Electricity consumption in this sector has been growing nearly 8 percent annually, thus needing faster adoption of energy efficiency measures. It is estimated that new buildings can reduce between 30–40 percent of their energy consumption by incorporating appropriate energy efficiency interventions in envelop design, along with efficient air-conditioning and lighting systems.

In May 2007, the Ministry of Power (MoP) and the Bureau of Energy Efficiency (BEE) launched the Energy Conservation Building Code (ECBC) which sets minimum energy performance standards for new commercial buildings. The code is on voluntary basis due to a number of factors such as lack of appropriate knowledge and capacities at various government levels, limited availability of trained designers and architects, and limited awareness on energy efficient materials and equipment in the country.

Keeping in view the prevailing scenario in the country, the Ministry of Environment, Forest, and Climate Change, Government of India, initiated the Project on Energy Efficiency Improvements in Commercial Buildings (EECB) in partnership with UNDP. The project was signed between and GOI and UNDP with an implementation period of 4 years starting April 2011. Project's Mid-term review was undertaken in 2014 and on the basis of its recommendation the project was granted a

[1] Within the project timeframe, 16 public sector demonstration buildings have been constructed and a further 29 are under construction with a total area of 1.32 million m2. Using 2012 Plinth Area Rate for RCC framed structures (INR 23500/m2) and 1US$ =INR 65, this accounts for an investment of 476.52 million US$. A further 0.2 million US$ is in-kind support from BEE.
[2] Swiss Development Cooperation (SDC) contribution

no-cost extension. The project closed on 31 December 2017

GEF-UNDP's intervention was aimed to assist the Government to implement and operationalize the ECBC, through a comprehensive and integrated approach that focused on (a) Strengthening of institutional capacities at various levels to implement ECBC and other energy efficiency programs for commercial buildings, (b) Developing technical expertise and awareness raising of key partners; (c) Compliance with ECBC demonstrated in 8 model buildings in five climatic zones, (d) Formulating fiscal and regulatory incentives for investors and (e) Monitoring, evaluation; knowledge sharing and learning.

Eight demonstration buildings were foreseen with an estimated annual direct carbon dioxide emission reduction of 90.7 ktCO2 per year or 2270 $ktCO_2$ cumulative direct emission reductions over a 25 year building lifecycle.

Project Results

The project has been successful in promoting ECBC compliance and preparing the basis for mandatory ECBC enforcement in Indian states. The project's most significant achievements can be summarized as follows:

- Mandatory enforcement of the ECBC in the municipality of **Hyderabad, Telangana** state. The Greater Hyderabad Municipal Corporation (GHMC) has incorporated the ECBC in their municipal by-laws. Beginning in 2017, new commercial buildings (currently estimated at about 2 million m2 per year) are required to be ECBC compliant. The resulting direct and post-project direct emission reduction is significant (approx. **3000 $ktCO_2$** considering a 20-year post-project influence period). The project supported mandatory implementation with capacity building (incl. training, ECBC Cells and demonstration buildings), and the training and accreditation of 106 Third Party Assessors to verify ECBC compliance. As the forerunner, Telangana State and Hyderabad Municipality is now the model for mandatory ECBC implementation and enforcement at the state and local levels. The experiences and processes can be shared and replicated in other states where keen and competitive interest is already evident.
- Mandatory enforcement of the ECBC for public buildings in **Karnataka**. State. In 2016, the Karnataka Public Works Department updated their Schedule of Rates to include ECBC compliance construction and the ULB incorporated ECBC provisions in their by-laws. The project supported ECBC conformity with capacity building (incl. training, ECBC Cells) and demonstration buildings. Beginning in 2017, new public buildings in Karnataka (currently estimated at 0.4 million m2 per year) must be ECBC compliant. The resulting direct and post-project direct emission reduction is approx.**700 $ktCO_2$** considering a 20-year post-project influence period.
- **ECBC Cells** have been set up by the project in 14 states throughout India. Each ECBC Cell is made up of 4 persons (architects and engineers) who assist at the state and local level to implement the ECBC. ECBC Cells address information, knowledge and human resource gaps to ECBC uptake. They organize trainings and have supported some 17 ECBC demonstration buildings. ECBC Cells form a network of experts answering to the BEE who are able to share and cross-reference local procedures, experiences and problems between states and municipalities in order to ease and speed up mandatory ECBC implementation. Having recognized their effectiveness to streamline ECBC implementation, the BEE is in the process of implementing ECBC Cells in all remaining states and territories.
- Under the project, **16 demonstration building** have been completed and a further 29 are under construction. These buildings demonstrate in different regions that ECBC compliant buildings realize energy savings in the range of 15-20% with only 2% additional costs for construction and pay-back under 4 years. These demonstration buildings sparked interest among government and private sector alike. The demonstration

buildings realized under the project will save a total of 146.7 GWh/year. Direct lifecycle (25 year) emission reduction from demonstration buildings is **3320 $ktCO_2$**

- **106 Third Party Assessors** have been trained and accredited under the project to check and certify ECBC compliance at the building design, construction and completion stages. Local government bodies and building developers in any state can engage these experts to verify ECBC compliance in the building approvals process.
- **122 master trainers** have been identified and trained by the project. These experts have been engaged in various states for capacity building among diverse stakeholders.

Table 1 – Summary of Key Project Targets and Results Achieved

Item	Indicator	Target	Achieved
1.	Annual energy savings from demo projects,	110.6 GWh/y	146.7 GWh/y
2.	Lifecycle (25yr) emission reduction from demo bldgs	2276 $ktCO_2$	3220 $ktCO_2$
3.	ECBC conform buildings in the commercial sector	116.77 million m2	[3]470 million m2
4.	Average EPI of new buildings by EoP	180 kWh/m2/y	192 kWh/m2/y

Table 2 - Evaluation Rating Table

Evaluation Ratings:			
1. Monitoring and Evaluation	***rating***	**2. IA & EA Execution**	***rating***
M&E design at entry	**MS**	Quality of UNDP Implementation – Implementing Agency (IA)	**S**
M&E Plan Implementation	**MS**	Quality of Execution - Executing Agency (EA)	**S**
Overall quality of M&E	**MS**	Overall quality of Implementation / Execution	**S**
3. Assessment of Outcomes	**rating**	**4. Sustainability**	**rating**
Relevance	**R**	Financial resources:	**L**
Effectiveness	**S**	Socio-political:	**L**
Efficiency	**S**	Institutional framework and governance:	**L**
Overall Project Outcome Rating	**S**	Environmental:	**L**
		Overall likelihood of sustainability:	**L**

Summary of Conclusions

The project has been successful and has achieved its objectives in terms of key targets, institutional and capacity building, leveraging co-financing investment and follow-up activities. The demonstration projects commissioned under the project will realize a direct GHG emission reduction of 3220 $ktCO_{2eq}$ over the lifecycle of investments. The project has played an important role in laying the basis for and promoting the uptake of ECBC, and has significantly contributed to creating the technical and organizational basis necessary for the take-off of ECBC in the building sector. Various financial incentives related to the LEED and GRIHA green building labeling systems provided further impetus for ECBC implementation. The project supported a sound and sustainable basis for the uptake of the ECBC in India.

The management and implementation within the BEE was a key factor contributing to the effectiveness of the project. BEE, as the champion of ECBC, took over the management role in

[3] 470 million m2 building area has been registered under voluntary green building rating systems (GRIHA, IGBC) in India. Of these, 27.6 million m2 have been occupied, audited and certified. Green certified buildings are ECBC conform.

the project. Their know-how, management skills, technical expertise and enthusiasm have ensured an efficient coordination with other initiatives in the sector and the post-project sustainability of project initiatives such as the ECBC cells and training programmes.

Even though the project faced a 30-month delay at start-up (April 2011-November 2013) in order to procure and organize project management, it was able to gain momentum and complete many essential activities within the subsequent four years and in most cases has achieved sustainable and strategic results meeting the original expectations.

Recommendations

Recommendation 1: Support the momentum built up during the project to roll out mandatory enforcement of ECBC in all Indian states and UTs. Use the positive examples of Hyderabad, Telangana and Karnataka as demonstration models for other states and municipalities. Support information and experience exchange and competition between municipalities to generate public and government interest and spur decision-makers into action.

Recommendation 2: Continue to support and strengthen ECBC Cells to streamline future ECBC implementation at state and municipal levels. Ensure a positive flow of information, experience and discourse between the State Department and the Cells to streamline ECBC implementation at all levels and among necessary stakeholders;

Recommendation 3: Follow up on the model of Karnataka and Rajasthan states to support government ministries and departments to enforce ECBC compliance for all public buildings.

Recommendation 4: The project initiated a Building Energy Passport (BEP) and Energy Monitoring Information System (EMIS) for India. BEP-EMIS Tool was conceptualized as an IT-based online tool to be used for (i) compliance checking during their design, construction and operation stages and (ii) monitoring of buildings energy performance during their operation stage. BEE must pursue implementation and dissemination of the BEP-EMIS tool after project closure. The EMIS is to be used to verify ECBC 2017 compliance

Recommendation 5: The ECBC addressed the commercial building sector. The residential building sector in urban areas is growing at a substantial rate and has a strong potential for energy savings. The energy and GHG savings in this sector should be pursued in follow-up policy changes, programmes and initiatives aimed at urban areas which build on the structures and successes of this project**.**

Recommendation 6: Various provisions in ECBC require testing and certification to conform to mandatory and prescriptive measures in the Code in accordance with International Testing Standards. This requires certified testing facilities and well trained testing professionals to perform the tests. There is a need to establish such facilities and expertise in Indian test labs.

Recommendation 7: The ECBC should be adapted in the future to provide for the retrofitting of existing buildings.

1 INTRODUCTION

The Terminal Evaluation of the UNDP-supported GEF-financed Project 'Energy Efficiency Improvements in Commercial Buildings (EECB)' in India was implemented from October 30, 2017 to January 31, 2018. The evaluation mission took place from December 4 to December 10, 2017.

Purpose of the evaluation

In accordance with UNDP and GEF M&E policies and procedures, all full and medium-sized UNDP support GEF financed projects are required to undergo a terminal evaluation upon completion. This report concerns the Terminal Evaluation (TE) of the project, 'Energy Efficiency Improvements in Commercial Buildings (EECB)' in India (GEF ID 3555) to assess project implementation and results achieved from its start in April 2011 to its closure in December 2017.

The evaluation process is intended to promote accountability and transparency, to assess whether the project has achieved its objectives, to synthesize lessons to help guide future design and implementation of GEF-funded activities and to contribute to the overall assessment of results in achieving GEF strategic objectives aimed at global environmental benefits.

Scope and Methodology

This Terminal Evaluation has been conducted according to the guidance, rules and procedures established by UNDP and GEF as reflected in the UNDP Evaluation Guidance for GEF Financed Projects. It is founded on evidence-based information that is credible, reliable and useful. The evaluation has followed a participatory and consultative approach and sought to ensure close engagement with key government counterparts, UNDP Country Office, project team, the UNDP GEF Regional Technical Adviser, and key project stakeholders. The evaluation included a field mission to India and visits to demonstration sites in Delhi, Hyderabad and Bengaluru. The TE was carried out in strict adherence to the Terms of Reference received (Annex 1), and included the following three stages:

(i) Preparatory Evaluation Work

This initial stage involved extensive desk reviews by the evaluation team members of project-related documentations such as the project document, progress and annual reports, mid-term evaluation report, focal area tracking tools, project files, national strategic and policy documents, and any other materials that the evaluators considered useful for an evidence-based evaluation assessment. The documents were partly provided by the UNDP Country Office and partly obtained through research on internet.

As part of the preparatory work, an TE Inception Report was prepared and submitted to UNDP CO for approval; it included a preliminary itinerary for the field mission including site visits, a tentative list of interviewees selected to provide a broad sample of the achievements and influence of the project, and a general interview questionnaire format (Annex 7) for project team, stakeholders and beneficiaries.

(ii) Evaluation Mission

The evaluation mission in India took place from December 4 to December 10, 2017. Meetings were held with key project stakeholders at the beginning of the mission to brief on the purpose and methodology of the TE, to obtain latest update on the project, and to finalize the mission schedules and arrangements. Key participants included UNDP India Country Office (UNDP CO) and the Bureau of Energy Efficiency (BEE).

The evaluation mission consisted of interviews with the UNDP team, the project management unit, key stakeholders and selective beneficiaries. Discussions with other relevant stakeholders were conducted remotely via Skype. In addition, visits to selective pilot sites in Delhi, Hyderabad and Bengaluru were conducted. The mission was concluded on December 9, 2017 with a wrap-up meeting with UNDP CO.

(iii) Preparation of the Terminal Evaluation Report
Following the mission, the collected data, interviews and materials received during the mission were carefully reviewed and analyzed in accordance with UNDP Project Evaluation Methodology. All data was then consolidated, and based on accountable information and opinions of the stakeholders with all sources and assumptions given, a draft Terminal Evaluation Report was prepared and submitted to UNDP CO for review and feedback.

UNDP India Country Office subsequently circulated the report to key project partners for review. Consolidated questions and comments on the draft TE Report received from UNDP CO were reviewed, responded to and incorporated into the final Report. An "audit trail" has been included to indicate how the comments received were (or were not) addressed in the final TE Report.

Structure of the evaluation report

The structure of this Terminal Evaluation Report corresponds to the *Evaluation Report Outline* as documented within the TOR for the assignment.

This Terminal Evaluation is based on a performance assessment approach guided by the principles of results-based management. The evaluation tracks impact and results per the project's Logical Framework. The contribution of project outputs and project management is evaluated with reference to the achievement of the project outcomes and overall objective. This Terminal Evaluation reviews the implementation experience and achievement of the project results against the Project Document endorsed by the GEF CEO, including any changes made during implementation.

2 PROJECT DESCRIPTION AND DEVELOPMENT CONTEXT

Project start and duration

The project document was signed in April 2011 between the Government of India and UNDP. The original planned project duration was 4 years (to end of March 2015). The Inception Workshop with stakeholders for the project was held in July 2011 at New Delhi. Due to delays in procurement and organization of the PMU, the project experienced a delay of some 30 months. Late 2013 the project began activities towards greater ECBC compliance in India. The mid-term review of the project was conducted in October 2014 with recommendations for a no-cost extension of the project. The project closed on 31 December 2017.

Problems that the project sought to address

Considering the vast potential for energy conservation in the country, the Indian government in 2001 enacted the Energy Conservation Act (EC Act). The EC Act provided the legal framework, institutional arrangement and a regulatory mechanism at the Central and State level to move towards energy efficiency in the country. The Bureau of Energy Efficiency (BEE) was formed as the statutory body under Ministry of Power to facilitate and coordinate energy efficiency initiatives at the central level.

According to the Construction Industry Development Council, construction of commercial buildings has grown at 8% per annum, and accounted for nearly 22 million square meters (m2) in 2005. Energy inefficiency in the commercial buildings sector is rampant. Of India's total electricity consumption, about 8 percent is being consumed by large commercial buildings and electricity consumption in this sector has been growing nearly 8 percent annually. Most commercial buildings in India have an Energy Performance Index (EPI) of 200-400 kWh/m2/y, while similar buildings in North America and Europe have EPI lower than 150 kWh/m2/y.

In 2007, BEE with USAID developed the Energy Conservation Building Code (ECBC) for commercial buildings (note: government, public and private sector buildings with various uses such as hospitals, hotels, office buildings, shopping malls, airports, schools, etc qualify as commercial buildings under the ECBC.) The code defines EE requirements for four building

components: a) Building Envelope; b) Comfort Systems and Controls; c) Lighting and Controls; and d) Electrical and Renewable Energy Systems. Further, 5 climatic regions are considered. To demonstrate compliance with ECBC, a project can use either a 'Prescriptive Method' or a 'Whole Building Performance Method'. ECBC compliant buildings have an EPI of 180kWh/m2/y or less. Case studies have shown that EE designs and measures could lead to energy savings of the order of 20-50% with payback period varying from 3 to 7 years.

The ECBC was issued on a voluntary basis as many barriers first had to be addressed before the code could be applied on a mandatory basis. The barriers identified at the baseline (2010) were:

A. Policy and institutional barriers

a. **Absence of mandatory standards**: There were no minimum energy performance standards for most buildings and building components in any of the building bye-laws.
b. **Absence of policy guidelines**: state and local level governments did not have clear guidelines to implement and enforce building energy efficiency policies.
c. **No structure for ECBC implementation**: There was no institutional structure at the national, state and local levels for handling ECBC administration and enforcement.
d. **Lack of government champions due to knowledge gap**: There was a lack of knowledge about benefits from energy efficiency in buildings among politicians and policy makers at all levels.

B. Technical and managerial capacity barriers

a. **Strong first cost bias**: Building developers were reluctant to invest in EE measures during design and construction as they do not profit from building energy efficiency.
b. **Lack of awareness**: Building designers and owners were unaware of energy-efficiency opportunities and techniques.
c. Lack of technical expertise: There were very few technical experts and consultants providing building energy efficiency related services.

C. Materials and technology barriers

a. **Non-availability of energy efficient equipment/materials** in the local marketplace: Most energy efficient equipment and materials were imported, often with high cost mark-ups and duties imposed.
b. **Lack of equipment testing/certification**: Programmes for standards and testing equipment for energy-saving features of building materials and equipment were not in place.

D. Finance barriers

a. **Lack of financial incentives** for energy-efficient equipment: Energy-efficiency of buildings was not given due consideration in funding and incentives from the government. There was a need for innovative financing schemes to promote EE in buildings.
b. **Lack of awareness**: The lack of awareness of the short amortization cycle and/or the lack of incentives for investors and contractors to build ECBC compliant buildings and/or lack of awareness that low energy bills can be a powerful marketing argument for future rental contracts.
c. **High cost of borrowing money**: This can be a strong impediment to incremental investment in efficiency that would be offset by future savings of energy costs.

UNDP-GEF's intervention aimed to address these barriers and to support the urgent implementation of the ECBC for new commercial buildings. Mandatory application of the ECBC was realistic only after the capacity, institutional and financial barriers related to ECBC implementation were suitably addressed.

Immediate and development objectives of the project

In May 2007, the Energy Conservation Building Code (ECBC) was launched on a voluntary basis. To address the barriers to mandatory application mentioned above, the Energy Efficiency Improvements in Commercial Buildings (EECB) Project was designed and initiated in partnership with UNDP.

The goal of the project was the reduction of GHG emissions from new commercial buildings through increased compliance with the ECBC.

The project envisaged the following key outcomes:

- Outcome 1: Strengthened institutional capacities at various levels on the enactment and enforcement of ECBC for commercial buildings
- Outcome 2: Enhanced technical capacity and expertise of local building practitioners and service providers
- Outcome 3: Increased number of new commercial buildings that are ECBC compliant
- Outcome 4: Enforced fiscal incentives & Regulatory frameworks incentives for investors and developers of EE buildings
- Outcome 5: Readily available and easily accessible/shared information and knowledge products on best practices regarding EE building technologies and measures

Baseline Indicators established

At the start of Project the share of electricity consumption by large commercial buildings was about 8% of the country's overall electricity consumption, and it was growing at about 8% annually. Air-conditioning and lighting were the two most energy consuming end-uses in the commercial building sector. It was estimated that new buildings could reduce between 25-40% of their energy consumption by incorporating appropriate design interventions especially in the building envelope and adoption of energy efficient air-conditioning and lighting technologies and systems.

Main stakeholders

The Project's main stakeholders included the following institutions and organizations:

Bureau of Energy Efficiency (BEE) is the statutory body formed in 2004 under Ministry of Power to implement the EC Act and to facilitate and coordinate energy efficiency initiatives at the national level. BEE is mandated to reduce the energy intensity of the economy by actively working with stakeholders to accelerate the implementation of energy efficiency measures.

BEE served as the Implementing Partner on this project, playing a central role in market transformation of new commercial buildings to be ECBC compliant and guiding policy and institutional changes to regulate the construction of new commercial buildings in India;

Ministry of Power (MoP) serves as the central authority and it guides BEE in meeting program objectives and in implementation of activities listed in EC Act 2001. MoP is the nodal ministry for developing and/or amending energy efficiency related policies and programs;

The Green Rating for Integrated Habitat Assessment (GRIHA) was jointly developed by The Energy and Resource Institute (TERI) and the Ministry of New and Renewable Energy (MNRE) in 2007. It is an indigenous rating system for "green buildings". It considers the provisions of the National Building Code (NBC), the Energy Conservation Building Code (ECBC) and other IS codes, local bye-laws, other local standards and laws. All buildings having built-up area more than 2,500 sqm, except for industrial complexes, are eligible for certification under GRIHA.

The Ministry of New and Renewable Energy (MNRE) supports the GRIHA rating system. Its involvement and participation helps align the GRIHA rating system with the ECBC;

Ministry of Urban Development (MoUD) at the Central Government, is the apex body for

formulation and administration of the rules and regulations and laws relating to the housing and urban development in India. MoUD has served as a resource and guide for ECBC implementation;

Ministry of Environment and Forest (MoEF) is the GEF focal point for India and provides oversight of the quality of the Project;

Central and State Public Works Department - CPWD and State PWDs have the responsibility of designing, construction and maintenance of Central and State government buildings respectively. These departments are important members in the Project Steering Committee to guide management decisions and project monitoring and evaluation. Their role was integral to the successful implementation of ECBC under the project;

State Designated Agencies (SDAs) were identified under the EC Act 2001 to assist BEE in implementation of energy conservation programs in respective states. The SDAs play an important role in coordinating and institutionalizing the implementation of ECBC at the State level;

Swiss Development Cooperation (SDC) has been supporting Indo-Swiss Building Energy Efficiency Project (BEEP) in India. This organization as an indirect co-financier of the Project, served as a member of the technical advisory committee advising the Project on technical issues, reviewing energy studies, data collection and data management;

US Agency for International Development (USAID) played a significant role in developing and implementing ECBC and other building efficiency related projects in India. Their ECO III Project (2007 – 2011) worked closely with BEE in promoting extensive awareness on ECBC through several knowledge products, training and sharing experiences from its other building programmes

Expected Results

The goal of the project has been "Reduction of GHG emissions from new commercial buildings through the compliance with Energy Conservation Building Code (ECBC)"

The objective of the Project has been the "Operationalization of the Energy Conservation Building Code (ECBC) for new commercial buildings".

Project's envisaged following outcomes:

- Outcome 1: Strengthened institutional capacities at various levels on the enactment and enforcement of ECBC for commercial buildings
- Outcome 2: Enhanced technical capacity and expertise of local building practitioners and service providers
- Outcome 3: Increased number of new commercial buildings that are ECBC compliant
- Outcome 4: Enforced fiscal incentives & Regulatory frameworks incentives for investors and developers of EE buildings
- Outcome 5: Readily available and easily accessible/shared information and knowledge products on best practices regarding EE building technologies and measures

Eight demonstration buildings were foreseen with an estimated annual direct emission reduction of 90.7 $ktCO_2$ per year (= 181.4 $ktCO_2$ to EoP assuming the buildings are operational for two years during the project duration) which equates to **2270 $ktCO_2$** direct lifecycle (25 year) emission reductions.

3 FINDINGS

3.1 Project Design / Formulation

When the BEE issued the ECBC at the national level in 2007, it had restricted power to mandate the ECBC in the field. In particular, mandatory implementation of the ECBC required the involvement of state and local governments to review and, as necessary, modify the code considering regional and local needs before endorsing and enforcing it. The approval and notification processes required to realize country-wide mandatory implement of the ECBC is a involved process especially considering that the diverse state and local government bodies (SDAs, UDDs, UDAs, etc.) of 29 separate states and 7 territories need to be informed, engaged and brought on-track.

The project was designed to facilitate the implementation of the ECBC as a mandatory regime for new commercial buildings in India. The main objective of the project was to reduce GHG emissions in the commercial building sector of India by mainstreaming ECBC conformance. This objective formed the basis for the supporting outcomes, outputs and activities. The intended outputs were goal-oriented, addressing diverse stakeholder groups (government, building professionals, developers, etc.) with well-conceived capacity building and engagement programmes. The scope of activities was ambitious considering the quite short (four-year) implementation timeframe and the complexity the relationship between decision-makers at the national, state and local levels.

The project was appropriately designed with an good mix of actions to involve the relevant government agencies, educational institutes, building owners and their associations, users, industry and service providers (architects/engineers, building material manufacturers, builders/contractors/developers), as well as investors and financial institutions.

The project design was comprehensive in that it recognized and addressed the capacity gaps and key risks. It was recognized in the design stage that that there was a lack of know-how and expertise on ECBC implementation among the relevant stakeholders at the state and municipal levels which the project sought to address. Accordingly, the project's design included extensive awareness and capacity building activities and the development of demonstration projects with ECBC compliance.

Analysis of LFA/Results Framework (Project logic /strategy; Indicators)

As an instrument for planning activities under the implementation framework defined in the Project Document, the logframe was complicated as a tool for project management and for reporting to UNDP and GEF. The logframe did not adequately facilitate tracking of implementation targets for each year of project implementation and was unsuited for the operational evaluation of project progress. Although indicators, targets and deadlines were defined in the logframe, several lacked a clear means for tracking progress and impact outside the project with definitive sources of validation in the market, such as external indicators and targets with which to track the real market uptake of EE technologies; numbers of ECBC conforming buildings.

In the mid-term evaluation weaknesses in the project logframe as a monitoring and evaluation tool were identified. Recommendations to simplify the logframe matrix included the objective of reducing the number of indicators from 79 to a more appropriate number for project management. Specifically, it was suggested that a number of redundant indicators be removed and that targets be adjusted so that they were clear and realistically achievable and within the timeframe of the Project.

Assumptions and Risks

The project assumed a strong and continuous political will within the Government of India and its

agencies at the state and local levels to implement and enforce the ECBC. A lack of political will was considered to be a moderate to high risk at the project start. In fact, the project team encountered various degrees of resistance at state and local levels which frustrated some actions and activities.

With the project intervention, the ECBC compliance rate for new commercial buildings would increase. It was forecast in the Project Document that the rate of compliance with ECBC would be at 10% from 2011 until 2013, 20% in 2014, 35% in 2015, 50% in 2016, 65% in 2017 and 80% from 2018 until 2025. These buildings were expected to meet the SEC of 180 kWh/m2/year.

The project design addressed barrier removal activities including:

- Strengthening institutional capacity at the national, state and local levels to implement the ECBC;
- Knowledge transfer to key stakeholders on ECBC ranging from awareness raising to technical training of professionals;
- Increasing confidence and experience in the pilot implementation of ECBC compliant buildings;
- Creating an enabling environment for investments into energy efficient buildings; and
- Generating knowledge products on ECBC compliance that can be disseminated along with other EE knowledge products from other government EE priority initiatives.

The lack or high cost of the construction materials necessary for ECBC conformity was also recognized as a risk. The major risk was that the commercial building developers may not voluntarily adhere to ECBC because of additional costs. The experience with other initiatives (LEED India and TERI-GRIHA) has seen that the leading private sector developers have begun endorsing and incorporating these systems and the trend is catching on – albeit gradually.

There was almost no experience and knowledge of ECBC with the relevant stakeholders at the state and municipal levels. This included government but also developers, engineers and building owners. This lack of capacity coupled with a complex relationship between government administration at the national, state and local levels placed further risks on the project achieving the intended outcomes within the short 4-year Project period.

The lack of capacity to implement, enforce and monitor ECBC at all levels within the government (national, state and local) was a significant barrier which the project sought to overcome with well-organized and extensive training programs.

Other significant risks identified in the Prodoc (table 10) included:

- Failure to secure the necessary support and action of state and municipal authorities on the mandatory implementation of the ECBC within the time frame
- Failure to secure interest and support of building developers, owners and consumers to comply with the ECBC
- Lack of available experts to deliver training
- Delays in the construction of demo projects

The risks outlined were logical and robust. Project activities were generally appropriate and strategically designed to address these risks.

Lessons from other relevant projects (e.g., same focal area) incorporated into project design

The project had been selected under the “umbrella EE program” Programmatic Framework Project for Energy Efficiency in India (GEF project 3538) and was thus prioritized by India’s Bureau of Energy Efficiency (BEE) and Department of Economic Affairs (DEA). The project was designed to supplement BEE’s activities in the buildings sector and build upon other initiatives and programmes including TERI-GRIHA and LEED-India.

BEE initiated a Standards and Labelling Program for equipment and appliances in 2006 to help consumers make an informed choice about the energy saving, and thereby the subsequent cost saving potential of the relevant product. Labels on appliances show energy requirements and a star rating from one to five stars, with a five-star rated appliance being the most energy efficient. The scheme has been implemented for 21 appliances, eight of which (air conditioners, colour TV, electric geysers, etc.) are mandatory.

BEE also introduced a star labelling programme for commercial buildings based on their energy performance index (EPI.) The buildings are rated on a one to five-star scale, with more stars meaning more energy efficiency. The star rating is available for day-use office buildings, BPO/IT offices, shopping malls and hospitals. Data collection is done via a standardized format. For day-use office buildings and shopping malls, the EPI in kWh/m2/year is considered for building energy performance. For BPO buildings, the Average Annual hourly EPI (AAhEPI) in Wh/h/m2 is considered for building energy performance. EPI and AAhEPI bandwidths are used to give the star rating to the buildings. The bandwidths are different for different climate zones.

As executing partner, BEE was able to ensure that the activities on ECBC for commercial buildings were properly coordinated with other projects and initiatives in the sector which BEE oversaw and promoted, such as ECBC for residential buildings, appliance energy standards and labelling, renewable energy in buildings and linkages with incentive schemes. Further, as implementing partner of USAID´s ECO-III project, BEE could ensure exchange of experiences in training and building code development. The cooperation between the project and USAID served as a platform for training courses for awareness workshops on energy efficiency measures, ECBC and building regulations, and sharing of experiences in such training programs design and implementation. The staff at BEE who was responsible for the USAID-BEE initiative was actively involved at PPG stage of this project.

Planned stakeholder participation

The partnership strategy was well designed to include key stakeholders and decision makers at all levels in project implementation. This included the necessary top-level policy and decision makers, public utilities, key state institutions and design organizations, universities, other specialized expert organizations, as well as the active participation of private sector developers.

The project was implemented under a National Implementation Modality (NIM) with the BEE as executing partner. The advantage of the NIM modality was that it strengthened national ownership and supported the role of the BEE as the national hub for energy efficiency projects and programmes in India. As project leader, BEE ensured continuity and coordination among different programmes and stakeholders (GEF, USAID, SDC, LEED, etc.), and it ensured that no redundant effort was expended and that best practices were scaled up as necessary. Further, as the government agency responsible for ECBC, the BEE takes over where the GEF project left off, providing continued support for the training programs and local cells supporting ECBC uptake.

The problematic of the NIM was evident in the early stages, where government procurement procedures and approvals were largely responsible for delays in the formation of the project management unit. UNDP assisted with procurement procedures streamlined to GEF project implementation.

A Steering Committee (SC), was established as prescribed in the project document and met regularly to provide strategic and management directions to guide project implementation. The Steering Committee included stakeholders from parallel initiatives including the SDC BEEP project.

Replication approach

The project design takes advantage of the repetitive nature of the government administrations at the state and local levels. By designing and implementing guidelines, training and capacity building programs for one state, it was recognized these could then be repeated between India's 29 states and 7 territories. Within this structure, the PMU was able to initially focus on 10-20

states that had first adopted ECBC, and where there were concentrations of new commercial building construction and adequate local capacity to address ECBC and EE in new buildings.

UNDP comparative advantage

The project effectively builds on UNDP's strong experience in India and East Asia in promoting, designing and managing sustainable energy and environmental protection programmes in the EE sector, while strengthening the capacity of government institutions. UNDP involvement in India has included projects related to resource use including energy efficiency and renewable energy. The UNDP Country Office in Delhi was active in ensuring quality assurance, transparency and due process, closely guiding and supporting the project management team to overcome bottlenecks and adopt appropriate adaptive management measures to achieve results. Where necessary, staff and consultants were contracted according to the established Rules and Regulations of the United Nations and the financial transactions and procurement activities similarly followed due process and the same Rules and Regulations.

Linkages between project and other interventions within the sector

The EECB project was part of the "Programmatic Framework Project for Energy Efficiency in India" (GEF project 3538). Five projects on energy efficiency were proposed under this program:

1. Energy Efficiency Improvements in Commercial Buildings (UNDP);

2. Chiller Energy Efficiency Project (World Bank);

3. Financing Energy Efficiency in Small and Medium Enterprises (World Bank);

4. Promoting Energy Efficiency and Renewable Energy in Selected SME clusters in India

(UNIDO); and

5. Improving Energy Efficiency in the Indian Railways System (UNDP).

The project was implemented under the BEE who was directly responsible for realizing the ECBC under a USAID cooperation. The BEE managed several projects and initiatives (GEF, USAID, SDC, EU) and facilitated the development, coordination and management of activities and synergies with further initiatives which would continue beyond the lifetime of the project.

The project effectively collaborated with other programmes and activities managed under the BEE including USAID and SDC. Further the project worked closely with LEED India and TERI-GRIHA to establish the ECBC as the benchmark for Energy Efficiency Building in India.

Indo-Swiss Building Energy Efficiency Project (BEEP) is a bilateral cooperation project between BEE and the Swiss Agency for Development and Cooperation (SDC). The project is designed to complement the BEE's programme on building energy efficiency and is focused on developing and mainstreaming new methodologies, guidelines and tools to design energy efficient buildings; creating awareness and building technical capacities; and testing of new technologies/products. The duration of the first phase of the project was five years (2012-16) and the programme has recently been extended to November 2021.The overall objective of the project is to reduce energy consumption in new commercial buildings and to disseminate best practices for the construction of low energy residential and public buildings.

Management arrangements

At the project design stage, the arrangements were prescribed for implementation of the project under the NIM execution modality, with Bureau for Energy Efficiency (BEE) as the Executing Agency / Implementing Partner and UNDP as the Implementing Agency. The BEE appointed a National Project Director (the Director General of BEE) to assume overall responsibility for project implementation, ensure the delivery of project outputs and the judicious use of project resources. The National Project Director was to be assisted by a Programme Management Unit headed by the Project Manager (PM) and responsible for overall project coordination and implementation,

consolidation of work plans and project papers, preparation of quarterly progress reports, reporting to the project supervisory bodies, and supervising the work of the project experts and other project staff.

A Steering Committee (SC) was to provide strategic decisions and management guidance to implement the project. The SC was to be made up of representatives of relevant ministries and government departments, and UNDP, and to be chaired by the NPD.

3.2 Project Implementation

The project document was signed between and GOI and UNDP in April 2011. The implementation period was planned as 4 years. Due to delays in procuring and establishing the Project Management Unit, the project did not effectively take off until November 2013 following a 30 month delay. The project's Mid-term review was undertaken in Oct. 2014 and on the basis of its recommendation the project was extended to 2017. The project closed on 31 December 2017

Project progress was delayed in the first 2 years by two key factors:

- The project was delayed by procurement of staff. A project manager was hired in August 2012 but was released in October 2013 and not replaced until 2017 when one of the Assistant Project Managers took over the role.
- In the meantime, the management of the project fell upon the National Project Director (the Director General of BEE) who was replaced in September 2012 and then reinstated in August 2013.

With the project objective of supporting ECBC conformity for new commercial buildings, the challenge was to make the institutional arrangements in 29 separate states and 7 territories in India. Under the direction of BEE and the PSC, the PMU set up 14 ECBC cells to coordinate ECBC implementation at the state level, to support direct communications between the SDAs who would promote ECBC and the UDDs who integrate ECBC with local building by-laws and enforce it. The PMU focused activity on the 20 states that have adapted ECBC and where there were adequate new commercial building construction volumes and local capacity to deal with EE issues in new buildings. The role of the ECBC cell (under the direction of BEE) was to facilitate ECBC compliance efforts between the BEE, the SDAs and the UDDs, and other agencies as appropriate. Project resources were also being used to augment BEE's on-going activities on monitoring and evaluation of the ECBC program through market surveys, studies and surveillance; this enabled the formulation of benchmarks for different categories of buildings in various climatic zones as well as the formation of easy to implement compliance guidelines for the above mentioned state and local institutions.

During the terminal evaluation mission, it was emphasized that once BEE advises the States to implement ECBC, there are a number of stages which need to be passed through to achieve ECBC mandatory regime in any State. The key stages and processes are:

1. Review and amendment of ECBC: Each state forms an advisory committee to look into climate, social and economic conditions in different parts of the state and to provide recommendations and as necessary specific amendments to the ECBC appropriate for implementation within that State.
2. Issue of ECBC Notification: The recommended (revised or amended) provisions are examined by the state government within its own government departments, public works departments and other authorities, institutions, and other concerned stakeholders. As an outcome of this process, the state government issues the notification in the public domain advising all the concerned in the construction of public and/or private building sector to take necessary steps for ECBC compliance.
3. Incorporation of ECBC in building bye-laws: After the release of the notification, the Urban Development Department (a state level wing of Ministry of Urban Development) develops the 'Model Building Bye-Laws' for the State and releases the same to all the Municipalities (or Elected Urban Local Bodies) in the State for incorporation in their

building bye-laws.

4. Review & enforcement of ECBC at municipal level: Each municipality in the state has the power to accept fully or further review and modify the 'model building by-laws' before announcement and enforcement of their final bye-laws for construction of buildings in its municipality.
5. Incorporation of ECBC provisions in building design: Depending upon the enforcement level and ease of implementation within the state, the building owners are expected to incorporate ECBC provisions in their buildings. To facilitate such provisions in government buildings which are designed, constructed and maintained by the respective PWDs, normally prevailing Schedule of Rates are revised to include costing parameters related to energy efficient building materials and equipment. While, the building developers look into incremental costs and benefits for ECBC compliance, and host of parameters including whether such projects will have significant edge over their competitors in the prevailing market.
6. ECBC compliance verification: For any building, as general practice, the municipalities inspect the compliance with building bye-laws and these are normally verified by the municipality at three stages, namely design, during construction and at completion of construction. The same is true for ECBC implementation and its compliance.

By and large, the process of enforcement and compliance of ECBC at any State level involves the series of stages mentioned above, the engagement of several government departments and a large number of widely spread out municipalities all across the State, which are empowered to implement the ECBC in accordance with their own local level assessments, priorities and urgency considerations. The enforcement task becomes more challenging in a vast country like India having 29 States with thousands of municipalities.

Though the project was aimed to implement ECBC in 20 States out of 29, the problem of setting up a mandatory ECBC regime at the State level became a daunting task for the Project. It relied on the need for an effective functional institutional arrangement to support the BEE to guide the process of ECBC enforcement and compliance at the state level.

The project utilized resources to set up these institutional mechanisms within the appropriate state agencies. Additional challenges for adoption of ECBC regime were associated with the fact that such arrangements and understood roles and responsibilities varied from one state to another as the capacities and priorities of the states varied considerably in the context of initiation and management of the entire process of ECBC compliance.

In order to ease the prevailing complexities and mobilize ECBC process at the State levels, the Project took several institutional and capacity building initiatives which included a) Involvement of State Designated Agencies (SDAs) located in majority of States, which works in coordination with BEE's priorities and guidelines, b) Establishment of ECBC Cell in each State to work along with SDAs and concerned government departments. The role of the ECBC cell was to facilitate ECBC compliance efforts between the SDAs, UDDs, and other state level agencies, c) Carrying out of ECBC awareness workshops, d) Utilization of academic institutions for development of 'Master Trainers' for using them further in 'Training of Trainers' programmes, e) Appointment and engagement of Regional Technical Advisors, f) Conducting of training programmes for building construction professionals, etc.

Through these initiatives and applying adaptive management, the project was able to raise the level of awareness and engagement on ECBC and its implementation among several state government departments, public works departments, practicing architects, building managers and engineers, commercial buildings developers in the private sector all over in the country. Many States started working on the path of ECBC implementation, though slowly. The State Government especially of Karnataka and Andhra Pradesh led the efforts in their respective States, though during the Project period, Andhra Pradesh was divided in two States namely Telangana and Andhra Pradesh

Karnataka State issued ECBC notification in 2014 and developed an ECBC Roadmap and Action

Plan especially for new government buildings. During 2016, it also started revising ULB's building bye-laws to incorporate ECBC provisions. Telangana State with its capital city at Hyderabad, enforced ECBC in its Greater Hyderabad Municipal Corporation (GHMC) for all government and commercial buildings having specified built up area. These States worked in the development of ECBC compliant demonstration buildings with support from the Project. Several other States have gradually begun following a similar path on ECBC implementation and construction of demonstration buildings.

Adaptive management (changes to the project design and project outputs during implementation)

To increase the efficiency of Output 1.2 (Strengthened mechanisms and structures for ECBC implementation and gathered energy performance data), **ECBC cells** were established within state government agencies (SDAs and UDDs) to assist them at the state and local levels to implement the ECBC. These 4-person teams consisting of engineers and architects were able to deliver practical technical know-how and procedures concerning building energy efficiency and ECBC implementation on the ground. They helped organize training and assisted at the local level with review and notification of the ECBC. They formed a network to share experience and best practice between states and the BEE.

ECBC cells in the states and territories have also taken up 17 additional demonstration projects. The ECBC cells use and demonstrate dynamic energy simulation software (Designbuilder) provided by the EECB project for evaluating potential of energy efficiency strategies and code compliance in these buildings.

In Telangana State which has assumed a leading role in the mandatory implementation of the ECBC, 106 **Third Party Assessors (TPAs)** were accredited under the project following 4 training programs. These TPAs are specially trained to check and certify ECBC compliance in the design, construction and completion stages of new buildings. The TPAs with their specialized technical capacity, enable the local government to outsource the responsibility to check and enforce ECBC conformity of building projects. The training of TPAs replaces original activities under Output 1.2 to train and accredit local authorities and is a strategically appropriate change considering that the TPAs can eventually work throughout the country.

The Mid-Term Evaluation suggested that activities under Outcome 4: Financial and regulatory incentives were no longer necessary as the additional costs of EE measures were considered to be only marginal at 2-3% of the building budget (as compared to 10-15% expected in the ProDoc). Despite this, the BEE and PMU pursued other means to engage developers and building owners to invest in EE including tax incentives and additional floor area bonus for green buildings. These schemes are discussed under Results (Component 4.)

The changes to the project were duly approved by the project steering committee. The changes were strategically appropriate for long-term impact were well coordinate with other initiatives in the sector and helped to achieve sustainable project results.

Partnership arrangements (with relevant stakeholders involved in the country/region)

As the central hub for technical, management and political issues concerning energy efficiency the BEE was able to coordinate the initiatives of international donors (GEF, USAID, SDC and EU), government counterparts and other participants. Through the promotion of activities and coordination of key stakeholders including government counterparts at various levels, private sector and other international organizations active in the country, the BEE was able to efficiently augment the impact and results of the project and to avoid overlapping of efforts. It was generally appreciated that the achievements and successes realized through the synergy far exceeded the sum of what could have been achieved individually by these initiatives. Further, the project initiatives provided a platform for promoting good cross-government coordination and collaboration.

The Project has been responsible for the engagement of state-owned institutions through 1 and 2-day workshops. These involved four academic institutions, each one providing awareness raising training to officials of UDDs and private sector stakeholders. The project has supported the creation and training of EC cells within the UDD in Maharashtra state. Training has been provided to the officials of Government of Andhra Pradesh and further requests were received for training and capacity building support from the states of Kerala, Odisha, Haryana and Gujarat.

One of the major challenges with the stakeholder engagement efforts of the Project has been the lack of success in engaging private sector owners of commercial buildings space. The effectiveness of this engagement, however, is more complex given that most commercial buildings are leased out providing less incentive for the building owner to comply with ECBC. As such, these owners and developers may comply with ECBC standards but have less incentive to exceed ECBC standards, and energy consumption levels are left to those who lease the building. BEE estimates that more than 75% of commercial buildings fall under this category of building ownership and usage.

UNDP and BEE exercised effective management actions and provided quality support to ensure the timely realization of project outputs and outcomes.

Feedback from M&E activities used for adaptive management

The internal communications between the project and its key stakeholders was through PSC and PAC meetings. Prior to each meeting, participants were provided with detailed minutes of the previous meeting as well as other documents that serve as information to enhance the discussions. This practice has led to productive discussions and effective coordination between initiatives. This is considered good practice for other projects.

The Project carried out periodical Project Steering Committee meetings and Project Advisory Committee meetings to review the progress of the Project and also take appropriate decisions and corrective actions wherever needed keeping in view the state level issues and the feedback received from the ECBC Cells, SDAs, partner institutes and concerned central and state government departments.

Project Implementation Reports were prepared periodically by PMU for effective monitoring and evaluation of the Project and also to keep track of the progress and results.

Recommendations from MTE

Recommendation 1: Request an extension with no budget increase

Recommendation 2: Make changes to the current PPM

- •Reduce the number of Project indicators and retain indicators that have relevance (from 79 to 20)
- •Reset targets so that they are achievable and realistic within the timeframe

Recommendation 3: Focus on the formation and strengthened capacity of ECBC cells for the remaining duration of the Project

Recommendation 4: Strengthen outreach to private sector commercial building owners on ECBC

- •Include LEED and GRIHA certified buildings as being ECBC compliant
- •Initiate star-rating system within ECBC to reward EE buildings that exceed minimum ECBC requirements

Recommendation 5: Provide additional training programs to reduce risk of non-compliant ECBC buildings

Recommendation 6: Strengthen outreach to other UNDP-GEF projects on EE in buildings to expand knowledge network.

Unfortunately, as a result of indecision regarding the project extension, the reworking of the Project Logical Framework was not carried out. As pointed out in the Mid-Term Evaluation, this would have made project Monitoring and Evaluation much more effective as a Project Management tool.

Project Finance

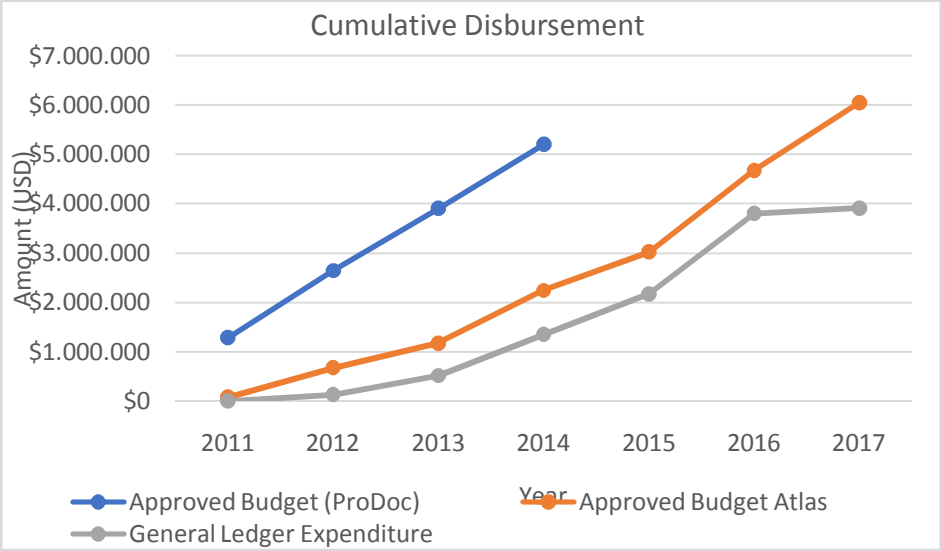
The total budget at CEO Endorsement/Approval was USD 21,027,660, broken down as follows:

- GEF Grant: USD 5,200,000
- Government (cash): USD 2,299,174
- Government (in-kind) USD 677,422
- Bilateral Agency (SDC) USD 1,787,234
- Private Sector (DLF): USD 11,063,830

Table 3: Details of Project Co-Financing

Partner Agency		Co-Financing Amount		Activities to date
	Target (USD)	to August 2014 (USD)	EoP 2017	
SDC	1,787,234	3,500,000	3,500,000	Completed 10 design charrette for new buildings totaling 0.8 million m^2 of building space
BEE	2,976,596	100,000	200,000	Training, capacity building support, creation of EC cell in UDD, Government of Maharashtra, in-kind support from BEE NPM and NPD
DLF	11,063,830	0	0	None due the PSC decision to keep the Project focused on public buildings for demonstrations of ECBC compliance
Govern-ment	0	0	476.520.000	Public sector demonstration buildings (complete or under construction) amounting to 1.32 million m2
Total:	21,027,660	3,600,000	480 220 000	

Table 4 - Project Expenditures under the Project



At project closure, the cumulative GEF funds disbursement totaled US$ 5.2 million, with a 100% delivery rate.

Monitoring and Evaluation Design at Entry and Implementation (*):

The project document contained a Monitoring and Evaluation Plan and Budget that was generally

in accordance with established UNDP and GEF policies and procedures. M&E activities, lead responsible parties, budget and timeframe were clearly identified in the Monitoring and Evaluation section of the project document.

The project's M&E used only a fraction of the indicators on the Project Logframe. As mentioned in the Mid-term evaluation, the indicators were too numerous and in many cases ambiguous for the PMU to effectively track. Some of the indicators were duplications of other indicators, some indicators precursors to other indicators which could easily have been eliminated to reduce M&E. Some of the indicators refer to unavailable information (such as the indirect GHG emissions), others were not cost-effective or efficient to monitor (such as surveys on the satisfaction of the training workshops).

Expenditures on M&E cannot be assessed as the PMU made little reference to the Logframe for monitoring of progress. If the Logframe had been more concise, the M&E efforts of the PMU could be better evaluated.

Based on the above evaluation, the TE evaluators rate the Monitoring and Evaluation Design at Entry and Implementation as **Moderately Satisfactory (MS).**

UNDP and Implementing Partner Implementation / Execution (*), Coordination, and Operational Issues

The Bureau of Energy Efficiency (BEE) is the statutory body under Ministry of Power to facilitate and coordinate energy efficiency initiatives at the central government level. BEE is directed to reduce the energy intensity of Indian economy by actively working with stakeholders to accelerate the implementation of energy efficiency measures. The BEE acted as 'Implementing Partner' (GEF Local Executing Agency). UNDP provided overall management and guidance, and was responsible for monitoring and evaluation of the project as per GEF and UNDP requirements. In 2016 & 2017 some of the activities of Annual Work Plan (AWP) were implemented through direct country office support including the Energy Efficient Model Buildings (EEMB) programme, development of ECBC User Guide & Design Guidelines, establishment of ECBC Cells in Himachal Pradesh and Cuttack City, roll-out of Energy Monitoring Information System (EMIS) and Building Energy Passport (BEP) work etc. There were periodic interactions and bi-monthly meetings between BEE, PMU and the UNDP Country Office to roll-out project activities.

The Director General of the BEE acted as the National Project Director (NPD) for the project. The NPD was responsible for overall guidance to project management. This includes adherence to the Annual Work Plan (AWP) and achievement of planned results as outlined in the Project Document (ProDoc), the use of UNDP funds through effective management, and well-established project review and oversight mechanisms. The NPD's responsibilities also include ensuring co-ordination with various ministries and agencies, providing guidance to the project team to co-ordinate with UNDP, reviewing reports, and looking after administrative arrangements required under the Government of India and UNDP.

A Project Management Unit (PMU) has been established to implement the project. The PMU is headed by National Project Coordinator (NPC), the Director BEE. He was responsible for implementing day-to-day activities in co-ordination with the NPD. The NPC was supported by three project staff, and one administration and finance staff. As needed, adequate numbers of technical experts in different disciplines, and project management consultants with expertise in project, finance, legal matters, etc. were associated on longer-term or short-term basis.

UNDP and Implementing Partner Implementation / Execution is rated **Satisfactory**

3.3 Project Results

Overall results (attainment of objectives) (*):Satisfactory

On the basis of the data and information and Project Implementation Reports provided by the PMU, the evaluation team has consolidated the following table which includes baseline and

targets set out at the end of the Project (EOP):

Success Criteria (from Logframe)	**Assessment**
Cumulative GHG ER from start to EoP: 181 $ktCO_2$ (Prodoc p.76 -Target is based on energy savings in demo buildings of **110.6 GWh/yr** and is equivalent to direct (25yr lifecycle) ER of **2267 $ktCO_2$**)	8 completed demos save 8.1 GWh/yr +22 EEMB buildings (under constr.) save 118.5 GWh/yr +17 ECBC cell demos (under constr.) save 20.1 GWh/yr =Total savings of **146.7 GWh/yr** have been secured by EoP equivalent to direct (25yr lifecycle) ER of **3220 $ktCO_2$** Additional ERs resulting from ECBC enforcement in 2 states have not been here considered. Target is **achieved**
New building space compliant with ECBC by 2014 (EoP) **116.77 million m2**	**470 million m2** building area has been registered under voluntary green building rating systems in India. Of these 27.6 million m2 have been occupied, audited and certified green buildings. ECBC conformity is required for green buildings. Target is **achieved**
Average energy consumption of new buildings **180 kWh/m2/y** (compared to 210 kWh/m2/y baseline)	Benchmarking study has shown average of **192 kWh/m2/y** (Demonstration projects show an average of 130 kWh/m2/y) The target is **not achieved** due to low uptake and enforcement of ECBC at state and local levels
Direct energy savings in the project by EoP: **221 GWh/y**	146.7 GWh/y from pilot projects 60.0 GWh/y from ECBC conform bldgs in Telangana state 12.0 GWh/y from Karnataka PWD **218.7 GWh/y** have been secured by EoP The target is **achieved**
CO2 emission avoided - indirect emissions by 2020 **2.7 - 49 million tCO2**	The basis of the calculation is an increased ECBC enforcement rate in new buildings from 10% in 2011, to 20% in 2014 to 80% by 2018 (table 12 Prodoc) which has not been achieved. At EoP the enforcement rate remains at 11.6%.

The project has been successful in preparing the basis for mandatory ECBC enforcement in various Indian states. The project's most significant results in terms of global emission reductions are summarized under the section Impact:

The aim of the project was to assist the Government to implement and operationalize the ECBC. The project set up guidelines with which the local and state governments could implement the code. In many states, the state nodal agencies established to promote renewable energy also acted as state-designated agencies for promoting energy efficiency.

Outcome 1: Institutional Capacity Development

Success Criteria (from Logframe)	**Assessment**
20 states carry out the mandatory implementation through a clearly defined and effective institutional structure by EoP	**10 states and 1 territory** have adapted and notified ECBC. An additional 9 states have amended the ECBC and are at an advanced stage of adoption. However, mandatory enforcement requires further steps; ECBC provisions have been incorporated in the bye-laws of only 4 states and at the local level, only 2 municipalities have included ECBC in local building bye-laws. The target is **not achieved** due to slow uptake and enforcement of ECBC at state and local levels
Number of buildings covered in commercial buildings database by EoP: **1000**	**1160 buildings** have been documented in the commercial building benchmarking database.
50-100 accredited local authorities (at municipal level) to validate and verify mandatory commercial building compliance with the ECBC by EoP	**106 Third Party Assessors** (TPA) trained and accredited to check ECBC compliance have been registered in Telangana state. Target has been **achieved**
Number of satisfied users of the information system each year: **250**	**2975** visitors to the project web-site. Approx. 1000 users of the ECBC App. Target has been **achieved**.

ECBC Cells: ECBC cells at the state level were established to strengthen local institution capacities and actions to implement the ECBC. Each ECBC cell consists of a team of about four experts (engineers and architects) stationed at SDAs for a period of one to two years, who assist the state to evaluate the current guidelines and to help identify the gap to strengthen and comply with ECBC. With support from the project, four states have notified the ECBC. ECBC roadmaps were prepared with project support for 16 states. The Roadmaps identify financial incentives to spur the ECBC market and the regulatory framework necessary to implement ECBC. ECBC cells help facilitate the process of notification.

- Co-ordination with all the relevant state departments (SDA, UDD and PWD) for integration of ECBC provisions within the building regulations including compliance mechanisms
- Assist in the issuance of ECBC notification. This is the end output that has to be delivered by the state cell.
- Assist in the integration of ECBC within the local building regulations
- Support project preparation and implementation for demonstration projects,
- development of Action Plan/ state specific roadmap, Reporting database structure for ECBC compliant and energy performance of government revision of SoR etc.
- Support training & capacity building of ECBC professionals in state including identification of training resource centre and facilitation of conduction of ECBC intensive training programme in the state etc.

Under the project ECBC cells has been established in 14 states. The BEE has begun efforts to establish the ECBC cells in the remaining states and territories.

EPI Benchmarking: Energy Performance Index (EPI) is a number that indicates overall energy

performance of a building. EPI can be used to benchmark the performance of a building. This can be a very useful tool for building developers to assess how their buildings are performing and take corrective actions, and for the authorities who need to ensure that the buildings they approve comply with ECBC. At the baseline year, only a broad EPI was established. However, India being diverse in terms of climatic zones and category of buildings, it was necessary to establish EPI for different scenarios. Data was collected from 1160 commercial building from different climatic zones, namely, warm and humid, composite, hot and dry, and moderate.

The project produced a benchmarking study of commercial buildings. The energy consumption data for 1160 buildings among all the 5 categories of commercial buildings in the various climatic zones has been collected. In addition, the project prepared a tool for buildings registry.

The key milestone for bringing the ECBC implementation into the mandatory regime was to include the code provisions in the building bye-laws.

- Four states where ECBC provisions are included in the bye-laws are Punjab, Haryana, Telangana and Andhra Pradesh.
- Karnataka and Kerala states are in the process of having their bye-laws revised to include ECBC provisions.
- Telangana state through Administrative Staff College of India (ASCI) has initiated training of Third Party Assessors (TPAs), who will check ECBC compliance of buildings. Total of 106 TPAs were accredited in Telangana after conducting 4 training programs.
- Greater Hyderabad Municipal Corporation (GHMC) has included the ECBC compliance in their building approval system.

Role of Third Party Assessors (TPA) is important for checking the code compliance during design, construction and operation of the buildings. ASCI had conducted 7 training programmes and had identified 106 TPAs (out of 152 participants) in Telangana state. The elaborate residential TPA training programme was organized over five consecutive days. TPAs are empanelled by successfully qualifying the written examination towards the end of the training programme.

The BEE updated the ECBC in 2017 with the technical support of USAID, and in part with assistance from the project (specifically with the introduction of **ECBC+** and **Super ECBC** ratings.) The ECBC V2 was launched by the Minister of State for Power, Coal, NRE and Mines, Shri Piyush Goyal on June 19, 2017. **ECBC V2** compliant buildings are 20% more energy efficient than conventional building and the categories **ECBC+** and **Super ECBC** buildings are respectively 30-35% and 40-45% more energy efficient than conventional buildings.

The project began work on developing a Building Energy Passport (BEP) and Energy Monitoring Information System (EMIS) for India. The BEP-EMIS Tool is conceptualized as an IT- based online tool to be used for (i) compliance checking during their design, construction and operation stages and (ii) monitoring of buildings energy performance during their operation stage. The BEP-EMIS tool will conform to ECBC 2017 and BEE star labelling for buildings technical requirements along with EMIS capabilities. The tool will serve as a platform to keep track of all building related energy performance data. BEP-EMIS will have customized access (based on privilege rights) to the key stakeholders involved in the compliance and enforcement of ECBC 2017 and BEE star labelling for buildings. The BEE will follow up on this activity.

Outcome 2: Technical Capacity Development

Success Criteria (from Logframe)	**Assessment**
Number of training workshops designed and conducted by EoP: **10**	The EECB project has organized **73** two-day capacity building workshops which were attended by 2756 participants. In addition, **88** one-day awareness workshops were attended by 4048 participants. **5680 building sector professionals** were trained. The target is **achieved**
Number of trained architects and design professionals, developers and contractors and building material suppliers by EoP: **1500**	
Number of accredited building energy auditors, energy audit firms and ESCOs by EoP: **1000**	**422** building energy auditors have been accredited The target is **not yet achieved**
Number of training of trainers workshops for creating awareness on ECBC and other EE programmes conducted by EoP: **15**	**11** training workshops were carried out to generate and update 122 master trainers. The target is **adequately met**
Number of developed course curricula and modules on ECBC and EE in buildings incorporated in academic institutions by EoP: **5**	The Council of Architecture signed a MoU with BEE in June 2017 to include building EE in the curriculum of architecture education. A roundtable discussion with the Council of Architecture, leading academic institutions and other stakeholders was held. The target is **not yet achieved**

The activities of this component were focused on raising awareness and development of skills of building sector stakeholders for ECBC implementation. Capacity building is required at various levels and for various stakeholders e.g. government officials, architects, engineers, developers, material vendors etc.

- One-day programmes were focused on raising awareness on applicability and implementation of ECBC. The content of the training programme includes introduction to building physics, scope of ECBC, energy efficient strategies and compliance mechanism. EECB project had organized 88 one-day awareness programme, which was attended by 4,048 participants.
- Two days intensive training programmes focused on the technical content of the code. The topics covered were scope of the code, administration and compliance approach, building envelope, lighting, HVAC, service hot water and electrical equipment. The master trainers engage the participants to develop their technical expertise by explaining the code in detail and by performing hands on exercises. EECB project had also organized specialized two-day training programmes on Whole Building Performance Method using energy simulation tools. Project has conducted 73 two-day training programmes and these programmes were attended by 2,756 participants.
- The project identified three regional institutions; Malaviya National Institute of Technology in Jaipur, Centre for Environmental Planning and Technology in Ahmedabad and

International Institute of Information Technology in Hyderabad for conducting training of trainers' programmes. The training of trainer programme was conducted over two-three days, where experienced building energy efficiency professionals along with faculties from the regional institutions review the content of the code. The performance of the participants was evaluated based on their understanding of the code and through written subjective examination. Candidates qualifying both oral and written examinations are accredited as Master trainers, who can further build capacities of building sector stakeholders across the country. The project has organized eleven training of trainers programme and pool of 122 master trainers was identified.

- To make energy efficient building design a widespread practice, it is important to integrate this subject in the curriculum of architecture and engineering education. In September 2017, an exposure visit was organized to Russia for understanding the activities of UNDP-GEF Project "Buildings energy efficiency in the North-West of Russia". The project had implemented elaborate training packages on building energy efficiency for different stakeholders e.g. elementary school, primary and secondary school, graduate and postgraduate courses, vocational training programmes and pensioners. The publications developed by UNDP Russia were found to be useful by the Indian counterparts and EECB project had done the English translation of these documents.
- The project organized 5 regional workshops in collaboration with NITI Ayog and, which was instrumental in wider acceptance of ECBC by top officials from the states. This is the first time such regional workshops had happened in the country where participants from the adjoining states had discussed their approach, challenges and success for the implementation of ECBC.

Master trainers: A master training scheme was developed under the project to create a pool of technical experts called master trainers. The master trainers are not only trained to support planning process but also to support implementation of ECBC. Three institutes, namely, CEPT University, Ahmedabad, Gujarat; Indian Institute for Information Technology, Hyderabad; and Malaviya National Institute of Technology, Jaipur have been identified to impart the master training. The states of Andhra Pradesh and Maharashtra have identified the need to institutionalize training and capacity-building activities within their states to create state-specific cadre of professionals, and the project is providing this support.

Training energy auditors: BEE established the concept of energy auditors in the country. They are expected to act as energy counsellors, carrying out energy audits, providing recommendations to industry and other establishments on improving energy efficiency. There are two categories of energy counsellors—energy managers and energy auditors. Both have to appear for an exam conducted by BEE, three papers are common for both categories; however, energy auditors have to clear an additional paper. The BEE provides certification to those who qualify in these exams and they are called Certified Energy Managers (CEM) and Certified Energy Auditors (CEA), respectively. There are about 10,000 CEMs/ CEAs. The project is making use of the skill set available in promoting building energy efficiency. Against a target of training 1000 energy auditors, 413 were trained under the project. A short duration training covering orientation to building energy, updates on guidelines will suffice as they already are well versed with energy efficiency aspects.

Awareness programmes: As building energy efficiency aspects are fairly recent, it was important to create awareness with all stakeholders, namely, property managers, architects, building professionals, developers and contractors, municipal authorities, etc. In this regard, several programmes have been conducted. The project has created awareness to about 300 personnel in 10 programmes against the targeted 1500 in 50 programmes. In addition, the project has also trained 15 persons as trainers. These programmes have been pan India, first set of programmes have been conducted in the following states, namely, Andhra Pradesh, Bihar, Chandigarh, Chennai, Gujarat, Maharashtra, Puducherry, Raipur, Thiruvananthapuram, Tripura, Uttarakhand and Uttar Pradesh. • Market Assessment of Energy Efficient Building Materials: To increase the building manufacturers to make use of product testing results in improving their

building material products, the study reviewed 17 building materials. Objective of this activity was to develop key performance indicators (KPI) for building materials for the assessment of building materials market in India under the following categories: a) wall material, b)insulation, c)fenestration, d)hvac, e)lighting, f) solar heater. The draft reports for the building materials such as the autoclaved aerated concrete (AAC) blocks have been completed. Three KPIs were identified; they are:

1. Technical specifications/ test standards
2. Market structure/size/forecast
3. Cost-benefit analysis

Outcome 3: ECBC Compliance Demonstrations

Success Criteria (from Logframe)	**Assessment**
8 demo buildings with total energy saving of **90.7 GWh/y**	8 completed demos save 8.1 GWh/yr +22 EEMB buildings (under constr.) save 118.5 GWh/yr +17 ECBC cell demos (under constr.) save 20.1 GWh/yr =Total savings of **146.7 GWh/yr** have been secured by EoP Target is **achieved.**

These buildings are expected to provide continuous data and learnings of ECBC interventions so as to help other potential builders get a first-hand exposure.

Experience from feasibility analysis of **8 realized demonstration projects** under the EECB project shows that implementation of ECBC-compliant building costs 2%–3% more than the conventional building. A significant part of the incremental cost gets compensated against the optimized design and reduced sizing for lighting, HVAC, transformer and power, back-up etc. Feasibility reports of ECBC-compliant demonstration projects show 15% – 30% energy savings compared to conventional buildings and through the operation energy savings, the incremental cost can be recovered within 3–4 years.

	Project	Area	EPI kWh/m2/y		Saving
	Name	m2	base	real	MWh
DEMONSTRATION PROJECTS	Academic Block, SMS Medical College, Jaipur	13975	142,8	97,0	640
	Kumar Krupa Guest House (hotel), Bangalore,	19875	148,0	97,0	1013
	Dhanvantri OPD block, SMS Hospital, Jaipur	12660	456,0	294,0	2051
	Chhattisgarh Samvad Office building, Raipur	10541	184,7	47,0	1451
	UPERC Office Building, Lucknow	5288	165,1	87,0	413
	T-Hub offices, Hyderabad, Telangana	6286	635,3	446,0	1190
	Energy Management Institute offices	4000	243,9	182,0	248
	Hubli Court, Hubli, Karnataka	24525	140,7	97,0	1072
	TOTAL	**97150**			**8078**

Through UNDP country office support, an assignment on "providing assistance to Energy Efficiency Model Buildings (EEMB) in the private sector" was commissioned. The identified cluster level agency had performed following tasks.

• Task 1: Mobilize (Sign up) commitment from potential energy efficient model buildings cumulating built up area of 200,000 m2 per cluster
• Task 2: Evaluate and endorse building design drawings, specifications for ECBC compliance
• Task 3: Monitor construction progress, provide guidance and recommendations to align with

ECBC
• Task 4: Review As-built drawings and equipment, confirm compliance to design
• Task 5: Acquire, verify performance data and demonstrate 15% reduction on baseline Energy Performance Index (EPI).

The action aimed to mobilize 1 million m2 of built-up area of Energy Efficient Model Buildings in five clusters. The project provided financial incentive of 1USD per m2. The incentive is primarily provided to install latest online building equipment and performance monitoring, measurement data logging systems (EMIS, BMS, Smart Meters, etc.). **23 EEMB projects** with total built-up area of 1 million m2 were identified for assistance. 7 have been completed and 13 more are under construction at EoP. Implementation of recommendations from the feasibility reports is expected to reduce the annual energy consumption in these buildings by some 118.5 GWh.

	Project	Area	EPI kWh/m2/y		Saving
	Name	m2	base	real	MWh
ENERGY EFFICIENT MODEL BUILDINGS (EEMB)	Municipal Corporation Office, Sonipat	20557	144,2	80,8	1303
	AIMS Hospital, Faridabad	247379	383,2	181	50030
	Iskcon Temple, Dwarka	18103	309,6	177	2400
	UNDP India Complex, New Delhi	5000	200,0	80	600
	Ford Foundation Offices, New Delhi	2440	203,7	93	270
	Unnati Offices, Greater Noida	3500	100,0	93	25
	VCL Group Office, Gurugram	1835	193,0	115	143
	AIPL Business Park, Gurugram	90000	174,2	101	6588
	KPCL Corporate Office, Bengaluru	17821	180,9	105	1352
	KPCL Corporate Office, Raichur	8446	239,9	143	818
	BIC Office, Bangalore	4420	238,1	131	473
	Nirlon Knowledge Park, Mumbai	165000	222,4	121	16737
	Fluent Grid, Vishakhapatnam	36576	202,3	117	3121
	Esplanade by Forum, Bhubaneshwar	83680	336,3	226	9233
	Priyamvada Birla Campus, Kolkata	60895	96,5	54	2587
	Admerus R & D Labs, Hyderabad	7716	105,9	54	400
	Gaudium School, Hyderabad	44600	100,5	40	2698
	ITC Kohinoor, Hyderabad	81570	411,5	255	12766
	CSE Institute, Alwar	4070	165,9	81	346
	Jaquar Flagship Office, Jaipur	6970	163,2	78	594
	Twin Star office, Rajkot	57014	213,0	116,6	5495
	Blue Ski Commercial Office, Surat	3782	254,3	126,5	483
	TOTAL	**971374**			**118462**

ECBC Cells in the states and UTs had also provided technical assistance for 72 building projects of which **17 are under construction or completed** resulting to total built-up area of 321,000 m2. The cell members use dynamic energy simulation software (DesignBuilder) provided by EECB project for evaluating potential of energy efficiency strategies for code compliance in these buildings. Implementation of recommendations by ECBC Cells will result in annual energy savings of 20.1 GWh

	Project	Area	EPI kWh/m2/y		Saving
	Name	m2	base	real	MWh
ECBC CELL TECHNICAL ASSISTANCE	M&C Block, Kamla Nehru Hosp, Shimla	4.070	323	250	295
	Civil Hospital at Theog	4.235	323	250	307
	Circuit House at Willey Park, Shimla	7.260	115	86	212
	Hospital OPD Block, Shimla	11.437	426	272	1757
	State central library, Shimla	1.968	212	106	208
	REIL Training, R&D Centre, Jaipur	4.700	233	156	361
	Government Engineering College	34.220	143	63	2750
	DC Office Building, Mysuru,	29010	164	89	2163
	Christian Medical College, Ludhiyana	69677			0
	G3S Builders, Jalandhar	19231	79	53	511
	Indian Institute of Technology, (IIT) Ropar	47777	192	85	5109
	Post Grad. Inst. of Medical Ed., Sangrur	42970	231	164	2900
	Punjab State Power Corp. Ltd. Patiala	22800	245	179	1510
	District Collectorate Buildings,	14656	314	201	1652
	Panchayath sadan, Kavaratti	1254	244	182	78
	DESM&E headquarters, Gangtok	2427	115	86	71
	TSECL Corporate offices, Banamalipur	3300	244	182	204
	TOTAL	**320992**			**20088**

Outcome 4- Enforcement of fiscal incentive and regulatory frameworks

Success Criteria (from Logframe)	**Assessment**
3 approved fiscal and regulatory incentives for EE building initiatives approved and enforced by EoP	**4** incentive programmes were supported. These were: -fast-track environmental clearance for green rated projects, -extra ground coverage or Floor Area Ratio for projects, -rebates in property tax and -awards programme for green building Target has been **achieved**
25 dedicated EE building financing schemes active and effective by EoP	A financing scheme was not pursued. The MTE noted that a financing component was no longer required considering nominal additional costs of EE measures and quick pay-back.
298 million US$ investment in EE buildings in commercial building sector by EoP	approximately **5520 million US$** has been invested in green commercial buildings by EoP. Target has been **achieved**.

A study to analyze the current regulatory and fiscal incentives framework has been initiated in 16 states (states that had moved ahead with ECBC implementation in the 11th Plan Period). The draft report for all the 16 states has been prepared and stakeholder consultations have been conducted in 11 states. Also, the state of Maharashtra has devised a green building incentives scheme

Three demonstration projects were assisted with gap funding for implementing recommended

energy efficiency materials and technologies. These are:

- Energy Management Center, Thiruvananthapuram, Kerala
- Dhanvantri Hospital Building, Jaipur, Rajasthan
- T-Hub building, Hyderabad, Telangana

Outcome 5: Enhancing information and awareness

Success Criteria (from Logframe)	**Assessment**
Number of knowledge sharing products developed by EoP: **15**	**20** knowledge sharing products have been produced including web-site, ECBC App, videos, newsletters, reports, templates, guidelines and case studies. Target has been **achieved**

List of Knowledge Products
1. 4 Nos. Newsletters
2. EECB Brochure
3. Project Video: 8 mins, 2 mins, 30 Sec
4. 4 Case studies videos
5. Template for Notifications
6. Template for Bye laws updating
7. Template for Schedule of Rates
8. Template for ECBC Compliance Reports: Design/Construction/Operation Check
9. ECBC 2017 Course Modules
10. ECBC 2017 Video Tutorials
11. One-page Case Studies of Each Demonstration Projects
12. Energy Efficient Material and Technologies Manufacturer Directory
13. Market Assessment Report
14. Energy Performance Benchmarking Report
15. Implementing Energy Efficiency in Buildings: Proceedings of ICEEB Conference 2015
16. ECBC 2017 User Guide
17. ECBC 2017 Design Guidelines
18. ECBC 2017 presentation slides
19. Rolling Building Energy Efficiency in Cities
20. ECBC Mobile App

The ECBC APP was developed covering the various aspects of the code, which aims at enhancing the awareness levels of stakeholders as well as providing technical guidance towards its conformance. Additionally, in the ECBC APP, with a view to assist compliance to the code, an 'Expert System' was developed with the objective of supporting architects and design professionals to assess the impact of their designs and its conformance with the code requirements. The key features of ECBC App are

- Full access to the ECBC database or values for all types of buildings in different climate zones and operation hours in a smooth intuitive tree view structure.
- A calculator for the Envelop Trade-off method for quick onsite calculations for future compliance verifiers and commissioning agents. This has been implemented but is under testing phase.
- Quick tool for U-value calculation for multi-layer assemblies.
- The Climate Zone Evaluator based on GPS coordinates (GPS integration is under development).
- The Building Physics Expert System for five climatic zones of India.

A project website was in place http://eecbindia.com/. The showcase product under the website was the ECBC Mobile Application that makes ECBC much more readable and user-friendly while making it easy to carry and to refer. Seven feasibility reports of the demonstration projects and 16

draft state specific ECBC roadmaps can be downloaded from the project website.

The most significant development of the project has been the institutionalization of the training activities within the state. To develop the institutional and technical capacities to comply with ECBC, actions have been undertaken. The project supported 20 states in developing ECBC roadmaps, established ECBC cells in 20 states. The concept of master trainers was developed and 122 master trainers were trained. Three institutes participated in training. The institutes are—CEPT, Ahmedabad; IIIT, Hyderabad and MNIT, Jaipur. In addition, three more institutes are identified for imparting institutional training, namely, Rachna Sansad Institute of Architecture in Maharashtra, Energy Management Centre in Kerala and Ela green Buildings & Infrastructure Consultants in Chhattisgarh.

The project has supported fine-tuning the EPI. At the baseline, the EPI was an average of 210 kWh/m2 /year (with range of 200 to 400 kWh/m2 /year for different categories, at times going up to 600 kWh/m2 /year). A sample of 1160 buildings were covered. There is significant difference in EPI for different categories of buildings. The EPI varied to some extent in different climatic conditions. The four types of climatic conditions covered were warm and humid, composite, hot and dry and moderate. The following are the average EPIs in kWh per m2 per year:

- 93 kWh/m2 /year for office buildings using less than 50 per cent air-conditioning [range 86 to 101 for different climatic zones]
- 126 kWh/m2 /year for hospitals [range 106 to 150 for different climatic zones]
- 173 kWh/m2 /year for hotels up to 3 star category [range 107 to 215 for different climatic zones]
- 178 kWh/m2 /year for office buildings using more than 50 per cent air-conditioning [range 173 to 182 for different climatic zones]
- 262 kWh/m2 /year for hospitals [range 247 to 275 for different climatic zones]
- 297 kWh/m2 /year for hotels above 3 star category [range 250 to 333 for different climatic zones]
- 321 kWh/m2 /year for shopping malls [range 257 to 428 for different climatic zones]
- 440 kWh/m2 /year for BPOs [range 433 to 452 for different climatic zones]

Following experience sharing programmes were organized with International partners during the project duration:

- International Conference on Energy Efficiency in Buildings (ICEEB) in New Delhi, 17–18 December 2015
- International Conference on “Energy Efficient Building Design: Experiences and Way Forward" in New Delhi, 28-30 November 2016
- Visit of Russian delegation to India
- Visit of Indian delegation to Russia

The project 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 share experiences how to assimilate energy-based initiatives into building climate-resilient infrastructure in an environment of rapid growth and urbanization. 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 published, which consists of information on international projects, implementation experiences, and lessons learnt.

In September 2016, a six-member delegation of the UNDP-GEF Project ‘Building energy efficiency in the North-West Russia’ visited the cities of Delhi and Jaipur by the invitation of UNDP

India to explore local experience in the field of energy savings. On September 12, a round-table was held to exchange experiences in the field of energy saving in buildings between India and Russia. The event was attended by experts working for public sector undertaking, bilateral and donor agencies in the domain of building energy efficiency.

Mr. Vitaly Bekker, Project Manager, Building Energy Efficiency in North-West Experience Sharing: Visit of the Russian Delegation to India Russia, UNDP-GEF Project, presented the activities and achievements UNDP-GEF project in North-West Russia. The Russian project has similar intervention areas, namely, implementation of building energy efficiency code, support to demonstration projects and capacity building of stakeholders. Mr Andrey Dodonov, Project Consultant, Energy Management Information System (EMIS) Establishment, presented the benefits of implementation of EMIS for developing building energy performance benchmarking and demand side management.

The project jointly organized a half-day session on “International Experience of implementing building energy efficiency code and Mainstreaming ECBC implementation in India” with Indo-Swiss Building Energy Efficiency Project (BEEP) during the International Conference on "Energy Efficient Building Design: Experiences and Way Forward" from 28th-30th November 2016.

As part of experience sharing, a four-member Indian delegation visited Russia during 11–15 September 2017. At Moscow, the Indian delegation held a round-table discussion with the Russian counterpart and learned more about the progress of the UNDP-GEF Building energy efficiency project in the North-West of Russia.

In a first of its kind exercise, the Alliance for an Energy Efficient Economy (AEEE) working under the guidance of the National Institution for Transforming India (NITI Aayog) and the BEE, with support from the UNDP-GEF project, conducted five ECBC regional workshops in 2017 (Chandigarh - February 9-10, Ahmedabad - March 15-16, Guwahati - March 23-24, Ranchi - April 19-20, Hyderabad - April 27-28) covering all 29 states and 7 UTs of India. These regional workshops, focused exclusively on government officials belonging to Urban Development Departments (Town and Country Planning, Roads and Building or Public Works Department, major Municipal Corporations or City government officials - many of them from the initial list of 108 smart cities, Development Authorities and State Housing Boards) and Energy Department (State Designated Agencies, Chief Electrical Inspectorates). The workshops highlighted the dire need to immediately amend and notify ECBC in all Indian states and UTs and for the state energy & urban development departments to work together to accomplish this task without any further delay. The results of discussions were compiled in the ‘Roadmap to Fast Track Adoption and Implementation of the ECBC at the Urban and Local Level.’

Based on the review of all available information, the Overall Results were rated **Satisfactory**.

Relevance (*):

According to the figures (2013-14) of the Ministry of Statistics and Programme Implementation, GOI, India’s building sector consumes about 31% (882 billion kWh) of the total energy produced. The commercial building sector accounts for nearly 9%. It is estimated that the total built up area of commercial buildings will surpass 1.9 billion m2 by 2030. This would be a threefold growth from 2015 levels when the built-up area was 847 million m2. The urgency to realize cost-effective energy saving measures in these buildings during construction is more urgent than ever.

Immediate implementation of ECBC in the commercial building sector remains crucial for three reasons:

- First, a significant part of the commercial building construction is yet to happen even though almost 700 million sq. meters of commercial building space has been built over the last 10 years and timely implementation of ECBC will bring along energy efficient stock leading to noticeable rewards in the form of energy savings, reduced greenhouse gas emissions, thermally comfortable habitats for occupants etc.
- Second, ECBC success would pave the way for other initiatives including residential

building energy efficiency initiatives. The residential building sector has a high energy saving potential, primarily due to its sheer size and faces an urgent need for a focused and sustained national level initiative.

- Third, the effective implementation of ECBC aligns with India's Nationally Determined Contribution commitments presented at the COP21 meeting in Paris as a key lever to mitigate climate change.

Based on the review of all available information, the project was rated **Relevant**.

Effectiveness (*)

The **Effectiveness** of the project strategy is evidenced by:

- 218.7 GWh/y energy savings secured by demonstration projects, mandatory enforcement of ECBC in Telangana State and ECBC conform buildings in Karnataka State
- 3220 $ktCO_{2eq}$ emission reductions from demonstration buildings. The original target of 2267 $ktCO_{2eq}$ has been met and surpassed.

Based on the review of all available information, Effectiveness was rated **Satisfactory**.

Efficiency (*)

The **Efficiency** of the project is supported by:

- Quality inputs and collaboration from stakeholders and national and international technical experts at established funding level contributed to cost-efficiency
- ECBC cells, training programmes and networking
- Strong coordination with other initiatives in the sector

Based on the review of all available information, Efficiency is rated **Satisfactory**.

Country ownership

The takeover of ownership of the Project by the BEE played a key role in the ultimate success of the project. The BEE is a champion of EE building growth. The BEE acts as the central hub for technical, political and managerial competence concerning energy efficiency. As such it was able to coordinate the project activities among key stakeholders in government, private sector and international donors.

Further, the Project design was formulated with extensive coordination with national stakeholders and international donors. There was close involvement of key stakeholders from parallel initiatives through participation in the Project Steering Committee.

The EECB project in the project duration was able to set-up institutional mechanisms for rolling out regulatory frameworks, demonstration projects and capacity buildings for effective implementation of ECBC code across the country beyond the project timeframe. Bureau of Energy Efficiency (BEE) had agreed to continue implementation of following project activities:

- Support to Energy Efficiency Model Buildings

- Functioning of ECBC Cells in 24 States and 6 Union Territories

- Further development and Implementation of Building Energy Passport and Energy Monitoring Information System tool for code compliance and building energy performance benchmarking

- Capacity building programs for building sector stakeholders in states and cities

- Inclusion of building energy efficiency in the curriculum of architecture and engineering education

The country ownership is evident in the strong interest and participation of stakeholders from the public and private sectors.

Total government cash and in-kind contribution is estimated at US$ 476.7 million accounted to demonstration buildings, this far exceeds the original targeted amount of $2.977 m.

Mainstreaming

The project addresses the UNDP priorities of clean and affordable energy, responsible consumption and production, climate action and sustainable cities and communities. Further, industry, innovation and infrastructure were supported as were decent work and economic growth

Gender and Development

During project implementation, due attention was given to including women participation in the project activities

Sustainability (*):

Financial:

Financial risks to ECBC sustainability are low given that GoI funding under the 12th Five-Year Plan is available which is being utilized by BEE to provide capacity building support in states through the SDAs. Under this Project, the capacity building support and creation of ECBC cells have been carried out in 24 states and 6 territories which the BEE has agreed with GoI finances to continue to support. Under the project, state governments committed funds towards constructing further ECBC compliant buildings.

Financial sustainability is rated **Likely**

Socio-political:

Private sector building owners are expected to embrace ECBC compliance as it will either reduce energy costs of those building owners who occupy the building or the building will have a higher demand amongst renters and leasers given the reported lower energy costs to operate the building.

Socio-political sustainability is rated **Likely**

Institutional framework and governance:

The BEE is the champion of ECBC implementation. As the national hub of action and initiatives concerning EE in the building sector, it ensures sustained efforts to reach mandatory ECBC enforcement following the project. Further, the project has assisted to have a mandatory ECBC implemented in Hyderabad municipality. This will serve as a model and challenge for other municipalities and states towards ECBC uptake.

Institutional framework and governance sustainability is rated **Likely**

Environmental

The environmental benefits of building EE in terms of reduced GHG is self evident.

Environmental sustainability is rated **Likely**

Based on the review of all available information, the overall project Sustainability is rated **Likely**.

Impact

The project's most significant impact in terms of GHG emission reductions can be summarized as follows:

- Support for mandatory enforcement of the ECBC in the municipality of **Hyderabad, Telangana** state. The Greater Hyderabad Municipal Corporation (GHMC) has incorporated the ECBC in their municipal by-laws. Beginning in 2017, new commercial

buildings (currently estimated at about 2 million m2 per year) are required to be ECBC compliant. The resulting direct and post-project direct emission reduction is significant (approx. **3000 $ktCO_2$** considering a 20-year post-project influence period). The project supported mandatory implementation with capacity building (incl. training, ECBC Cells and demonstration buildings), and the training and accreditation of 106 Third Party Assessors to verify ECBC compliance. As the forerunner, Telangana State and Hyderabad Municipality is now the model for mandatory ECBC implementation and enforcement at the state and local levels. The experiences and processes can be shared and replicated in other states where keen and competitive interest is already evident.

- Support for the mandatory application of the ECBC for public buildings in **Karnataka**. State. In 2016, the Karnataka Public Works Department updated their Schedule of Rates to include ECBC compliance construction and the ULB incorporated ECBC provisions in their by-laws. The project supported ECBC conformity with capacity building (incl. training, ECBC Cells) and demonstration buildings. Beginning in 2017, new public buildings in Karnataka (currently estimated at 0.4 million m2 per year) must be ECBC compliant. The resulting direct and post-project direct emission reduction is approx.**700 $ktCO_2$** considering a 20-year post-project influence period.
- Under the project, **16 demonstration building** have been completed and a further 29 are under construction. These buildings demonstrate in different regions that ECBC compliant buildings realize energy savings in the range of 15-20% with only 2% additional costs for construction and pay-back under 4 years. These demonstration buildings sparked interest among government and private sector alike. The demonstration buildings realized under the project will save a total of 146.7 GWh/year. Direct lifecycle (25 year) emission reduction from demonstration buildings is **3320 $ktCO_2$**

4 CONCLUSIONS, RECOMMENDATIONS AND LESSONS

Conclusions

When the ECBC was launched in 2007 at the national level, code adoption, implementation and enforcement on the ground was recognized as a complex process involving multiple stakeholders, most critically those at state and local levels. The involvement of multiple government departments at various levels, with overlapping roles and responsibilities often differing from state to state is a major challenge to streamlining ECBC implementation. The technical and administrative capacity in terms of staff and know-how at the state and local level is often limited. States like Andhra Pradesh, Telangana, Karnataka, Punjab and Kerala have lead the way with strong commitments, training and awareness raising programmes, amendments to bye-laws and the PWD Schedule of Rates and the introduction of online tools for efficient implementation. But many states still lag behind.

Table 5: Status of ECBC Implementation in States[4]

State/UT	Andhra Pradesh	Arunachal Pradesh	Assam	Bihar	Chandigarh UT	Chhattisgarh	NCT of Delhi	Goa	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Jharkhand	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Manipur	Meghalaya	Mizoram	Nagaland	Odisha	Puducherry UT	Punjab	Rajasthan	Sikkim	Tamil Nadu	Telangana	Tripura	Uttar Pradesh	Uttarakhand	West Bengal
ECBC Amendment	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓	✓	✓					✓	✓	✓	✓		✓	✓		✓	✓	✓
ECBC Notification	✓									✓				✓	✓							✓	✓	✓	✓			✓			✓	✓
Notification in state bye-laws	✓									✓																		✓				
Notification at Municipalities	✓																											✓				
Enforcement	✓																											✓				
Schedule of Rates -PWD														✓																		
ECBC Cell	✓			✓		✓	✓			✓	✓			✓	✓	✓	✓					✓		✓				✓		✓		
Training & Capacity Development	✓	✓				✓								✓	✓		✓							✓				✓				
Energy Simulation Software						✓				✓				✓					✓					✓						✓		

The uptake of the ECBC in the majority of states has been slow. Only 11 states had notified by 2017. Further, the implementation of the ECBC at the local level within the states which have notified ECBC is behind expectations. There remains an urgent need to support initiatives to fast-track mandatory ECBC implementation at the state and local levels.

Ten years after ECBC was launched, the BEE launched an updated version of the Code in 2017, which is more stringent than the original and with three levels of compliance (ECBC, ECBC+, SuperECBC) to encourage government and private sectors to not just meet ECBC criteria but to exceed it. Considering advances in building materials, appliances, equipment and technologies,

[4] From the ‚Roadmap to Fast Track Adoption and Implementation of the ECBC at the Urban and Local Level. 2017‘

along with the availability of trained professionals, it is feasible to go beyond minimum code compliance. BEE further communicated that the adoption of ECBC across states and the inclusion of residential buildings in the EC Act will ensure further integration of energy efficiency practices in all types of buildings.

The project has been successful in preparing the basis for mandatory ECBC enforcement in various Indian states. The project's most significant achievements can be summarized as follows:

- Support for mandatory enforcement of the ECBC in the municipality of **Hyderabad, Telangana** state. The Greater Hyderabad Municipal Corporation (GHMC) has incorporated the ECBC in their municipal by-laws. Beginning in 2017, new commercial buildings (currently estimated at about 2 million m2 per year) are required to be ECBC compliant. The resulting direct and post-project direct emission reduction is significant (approx. **3000 ktCO_2** considering a 20-year post-project influence period). The project supported mandatory implementation with capacity building (incl. training, ECBC Cells and demonstration buildings), and the training and accreditation of 106 Third Party Assessors to verify ECBC compliance. As the forerunner, Telangana State and Hyderabad Municipality is now the model for mandatory ECBC implementation and enforcement at the state and local levels. The experiences and processes can be shared and replicated in other states where keen and competitive interest is already evident.
- Support for the mandatory application of the ECBC for public buildings in **Karnataka**. State. In 2016, the Karnataka Public Works Department updated their Schedule of Rates to include ECBC compliance construction and the ULB incorporated ECBC provisions in their by-laws. The project supported ECBC conformity with capacity building (incl. training, ECBC Cells) and demonstration buildings. Beginning in 2017, new public buildings in Karnataka (currently estimated at 0.4 million m2 per year) must be ECBC compliant. The resulting direct and post-project direct emission reduction is approx.**700 ktCO_2** considering a 20-year post-project influence period.
- **ECBC Cells** have been set up by the project in 14 states throughout India. Each ECBC Cell is made up of 4 persons (architects and engineers) who assist at the state and local level to implement the ECBC. ECBC Cells address information, knowledge and human resource gaps to ECBC uptake. They organize trainings and have supported some 17 ECBC demonstration buildings. ECBC Cells form a network of experts answering to the BEE who are able to share and cross-reference local procedures, experiences and problems between states and municipalities in order to ease and speed up mandatory ECBC implementation. Having recognized their effectiveness to streamline ECBC implementation, the BEE is in the process of implementing ECBC Cells in all remaining states and territories.
- Under the project, **16 demonstration building** have been completed and a further 29 are under construction. These buildings demonstrate in different regions that ECBC compliant buildings realize energy savings in the range of 15-20% with only 2% additional costs for construction and pay-back under 4 years. These demonstration buildings sparked interest among government and private sector alike. The demonstration buildings realized under the project will save a total of 146.7 GWh/year. Direct lifecycle (25 year) emission reduction from demonstration buildings is **3320 ktCO_2**
- **106 Third Party Assessors** have been trained and accredited under the project to check and certify ECBC compliance at the building design, construction and completion stages. Local government bodies and building developers in any state can engage these experts to verify ECBC compliance in the building approvals process.
- **122 master trainers** have been identified and trained by the project. These experts have been engaged in various states for capacity building among diverse stakeholders.

Corrective actions for the design, implementation, monitoring and evaluation of the project

Not applicable – the project has closed

Actions to follow up or reinforce initial benefits from the project

According to the figures (2013-14) of the Ministry of Statistics and Programme Implementation, India's building sector consumes about 31% (882 billion kWh) of the total energy produced. Out of this, the commercial buildings account for nearly 9%. It is estimated that the total built up area of commercial buildings will surpass 1.9 billion m2 by 2030. This would be a threefold growth from 2015 when the built-up area was 847 million m2.

India shall experience massive growth in the commercial and residential building sectors over the next decades. Recognizing energy efficiency as a resource and enhancing the energy efficiency of the building stock is urgent for India's development. The following follow-up actions are recommended:

1. Continue to support and strengthen ECBC Cells to streamline future ECBC implementation at state and municipal levels. Ensure a positive flow of information, experience and discourse between the State Department and the Cells to speed up ECBC implementation at all levels and among necessary stakeholders;
2. Support the momentum built up during the project to roll out mandatory enforcement of ECBC in all Indian states and UTs. Use the positive examples of Hyderabad, Telangana Karnataka, etc as demonstration models for other states and municipalities. Support exchange and competition between municipalities to spur decision-makers into action.
3. Following the model of Karnataka and Rajasthan states, support government ministries and departments to enforce ECBC compliance for all public buildings;
4. The project initiated a Building Energy Passport (BEP) and Energy Monitoring Information System (EMIS) for India. BEP-EMIS Tool was conceptualized as an IT-based online tool to be used for (i) compliance checking during their design, construction and operation stages and (ii) monitoring of buildings energy performance during their operation stage. The BEP-EMIS tool will conform to ECBC 2017 and BEE star labeling for buildings technical requirements along with EMIS capabilities. The tool should serve as a platform to keep track of all building related energy performance data. BEE should pursue implementation of the BEP-EMIS tool. The EMIS is to be used to verify ECBC 2017 compliance.

Proposals for future directions underlining main objectives

5. The ECBC addressed the commercial building sector. The residential building sector in urban areas is growing at a substantial rate and has a strong potential for energy savings. The energy and GHG savings in this sector should be pursued in follow-up policy, programmes and initiatives.
6. Various provisions in ECBC require testing and certification to conform to mandatory and prescriptive measures in the Code in accordance with International Testing Standards. This requires certified testing facilities and well trained testing professionals to perform the tests. There is a need to establish such facilities and expertise in Indian test labs.
7. The ECBC should be adapted in the future to provide for the retrofitting of existing buildings.

Best and worst practices in addressing issues relating to relevance, performance and success

The project demonstrated several best practices which resulted in the successful uptake of the ECBC and that may be adopted for the formulation and implementation of similar projects in the sector. Some of the best practices are:

- Identify motivated **model municipalities** where effective implementation of the new building code is realistic. By focusing project effort on a few forerunners, technical and procedural issues can be addressed in a small scale before being up-scaled in other municipalities. Once operative, the experiences and results can be streamlined, promoted and replicated in other municipalities. Interest and competitiveness among municipalities should be promoted through appropriate dissemination.
- **ECBC Cells** form an effective network of experts connected to the responsible central government body who are able to share and cross-reference procedures, experiences and problems in order to ease and streamline mandatory code implementation on the ground.
- **National Implementation Modality**. As the national champion and central hub for technical, management and political issues concerning energy efficiency, the Bureau of Energy Efficiency (BEE) was able to coordinate the initiatives and activities of diverse international donors (GEF, USAID, SDC, EU), other government counterparts and stakeholders. The BEE was able to effectively augment the impact and results of the project and avoid overlapping of efforts. It was generally appreciated that the achievements and successes realized through the synergy far exceeded the sum of what could have been achieved individually. Further, the activities and initiatives implemented by the project have been systematically and strategically adopted within long-range national agendas. In effect, the BEE ensures the project's long term objectives will be effectively maintained and nurtured after closure.