Roadmap for Enhancing Energy Efficiency in New Buildings

Shabnam Bassi
Bureau of Energy Efficiency
Government of India

ENERGY IS LIFE
B E E
CONSERVE IT

ENERGY CONSERVATION ACT, 2001

- Energy Conservation Act, enacted in October 2001. BEE created as the nodal statutory body to improve energy efficiency through:
  - Standards and labeling for appliances
  - Energy Conservation Building Codes
  - Energy consumption norms for Designated Consumers
  - Certification and accreditation of energy auditors and energy managers
  - Dissemination of information and best practices
  - Capacity Building
  - Establish EE delivery systems through Public-Private Partnerships
- The Act creates the Bureau of Energy Efficiency (BEE) in the centre, and State Designated Agencies (SDAs) in the states
- 30 states have created SDAs

ENERGY CONSERVATION AND EFFICIENCY POTENTIAL

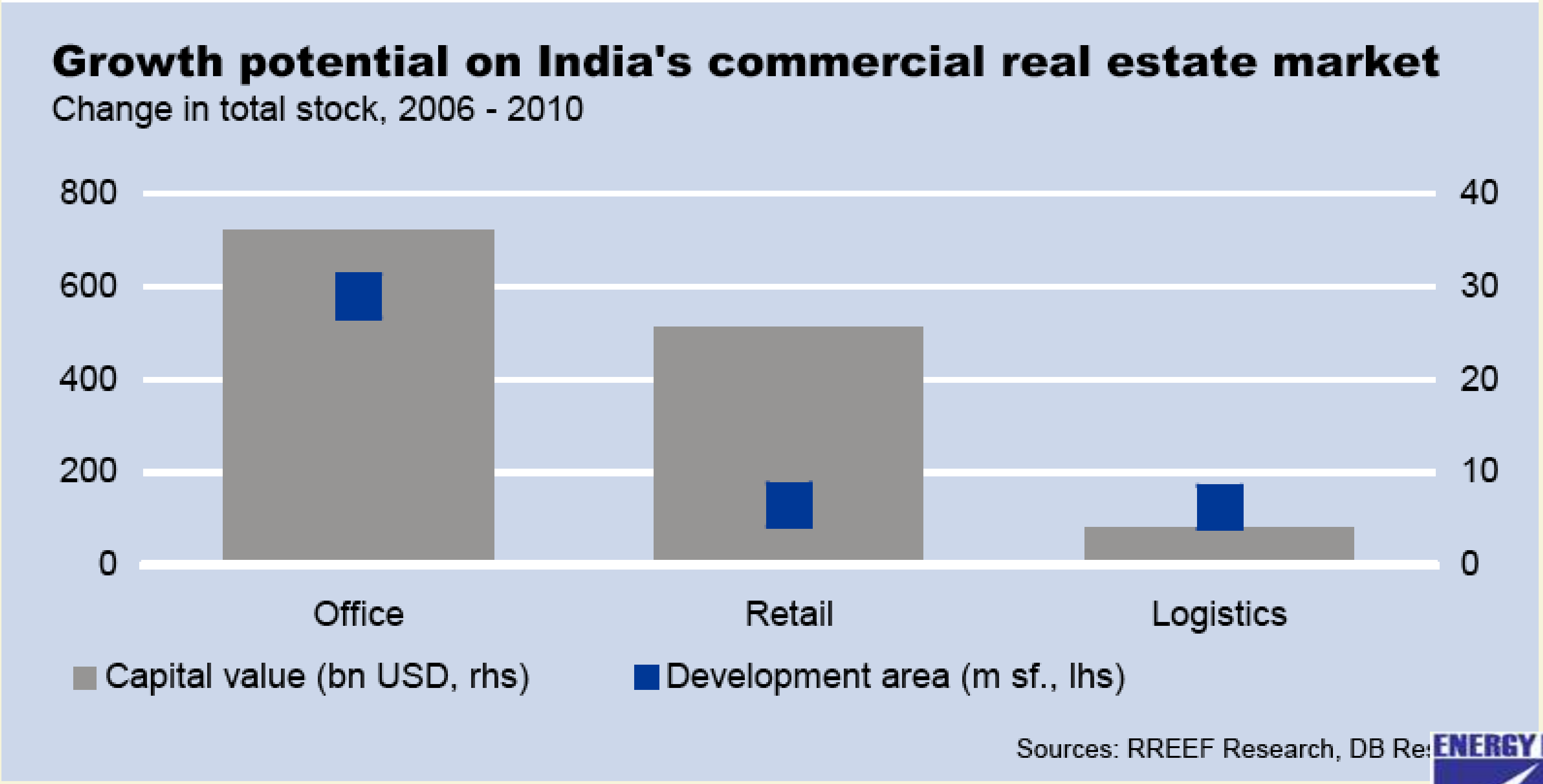
Energy Conservation potential assessed as at present (IEP) (15% by DSM)	.	20000MW
Verified Energy Savings :		
-During X Plan period	.	877 * MW
-During 2007-08 and 2008-09 (June 2008)		1208 MW
-Target for XI Plan period (5% reduction of energy consumption)	.	10000 MW

** Only as indicated by participating units in the National Energy Conservation award scheme, for the previous five years.*

Growth Profile of Indian Commercial Sector

- Demand for OFFICE SPACE in India is driven by the increasing share of the services sector in the Indian economy
  - Office space supply shifting from Central Business Districts to secondary centers (office and IT parks)
  - Modern office buildings in newly developed areas enable the higher quality standards that are essential for IT services
  - All India office market
    - 70% by IT Services companies (more than 7000 No.) in India
    - 15% by financial service providers & pharmaceutical sector
    - 15% by other sectors
    - Office stock must increase nearly 20 million sf/year in New Delhi, Mumbai, Bangalore to keep pace with growing demand
    - Conservative estimate (for India): Approx. 55 million sf/year
- SHOPPING CENTRES/MALLS
  - By the end of 2008, space of 79 million sf in 257 centers are estimated in 15 largest cities of India

Outlook for India’s Commercial Real Estate Market[1]

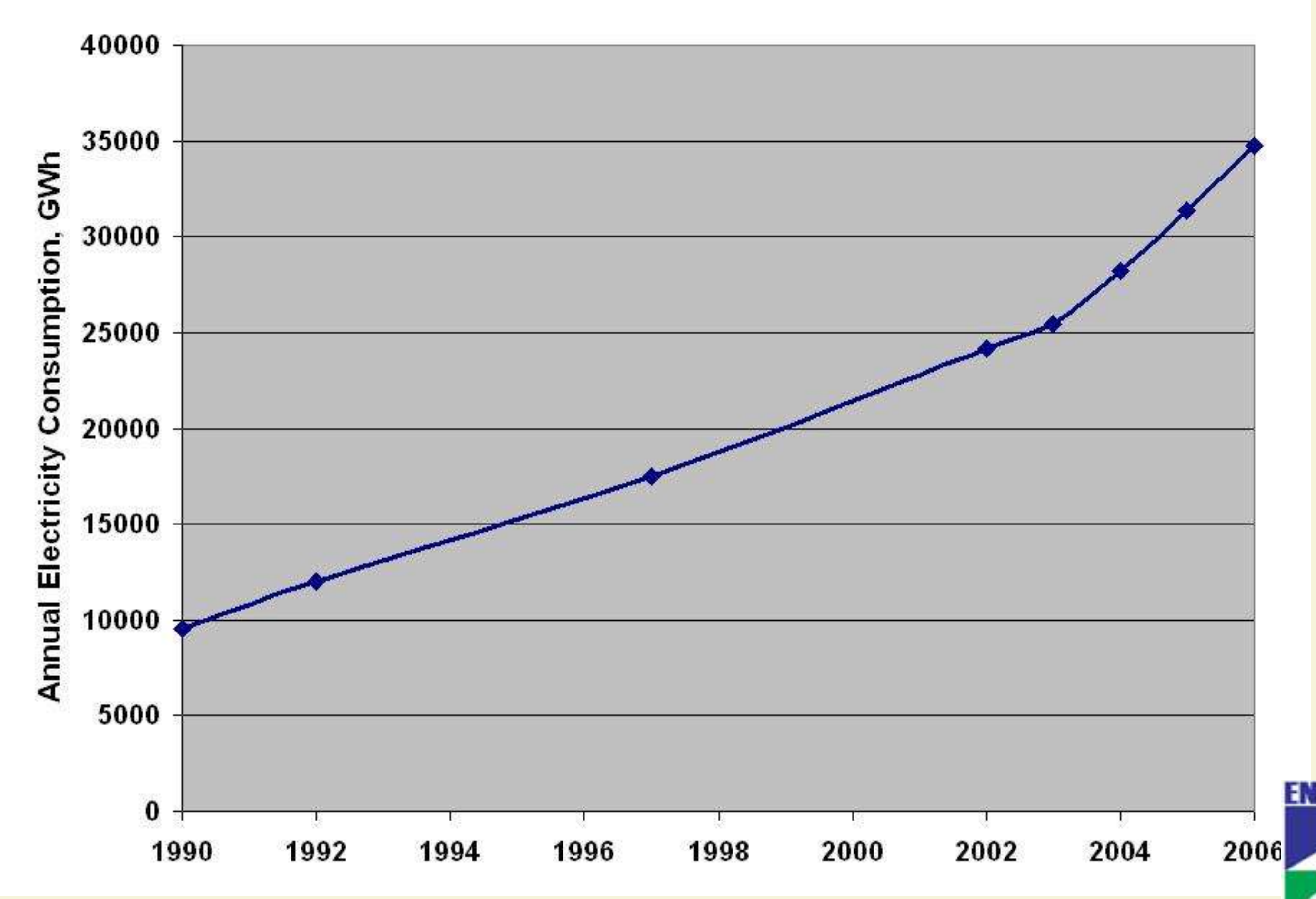


1 Deutsche Bank Report on India’s Commercial Real Estate Market

Energy IN-efficiency is rampant

- Most commercial buildings have energy performance index (EPI) of 200 to 400 kWh/sq m/year
- Similar buildings in North America and Europe have EPI of less than 150 kWh/sq m/year
- Energy-conscious building design has been shown to reduce EPI to 100 to 150 kWh/sq m/year in India – development of such buildings is restricted to environmentally-sensitive corporates
- Large scale energy-efficient building design is limited due to split incentives - builders fear that they would bear the costs, while tents would enjoy benefits

Electricity Use in the Commercial Sector is exploding !



Typical Building Energy Use

Average Energy Consumption

HVAC	55%
LIGHTING	14%
Electronics	27 %
Others	4%

What are Energy Conservation Building Codes?

- ECBC set minimum energy efficiency standards for design and construction
- ECBC encourage energy efficient design or retrofit of buildings so that
  - It does not constrain the building function, comfort, health, or the productivity of the occupants
  - Lifecycle costs (construction + energy costs) are minimized

Energy Conservation Building Code

- ECBC covering the following components prepared:
  - Building Envelope (Walls, Roofs, Windows)
  - Lighting (Indoor and Outdoor)
  - Heating Ventilation and Air Conditioning (HVAC) System
  - Solar Hot Water Heating
  - Electrical Systems
- ECBC finalized after extensive consultation
- Voluntary introduction of ECBC in May 2007; mandatory after capacity building and implementation experience
- Impact of ECBC - Reduced Energy Use for buildings
  - National Benchmark ~ 180 kWh/m^2/year
  - ECBC Compliant building ~ 110 kWh/m^2/year

Case study 1 : CESE, IIT Kanpur

Designed for IIT, Kanpur

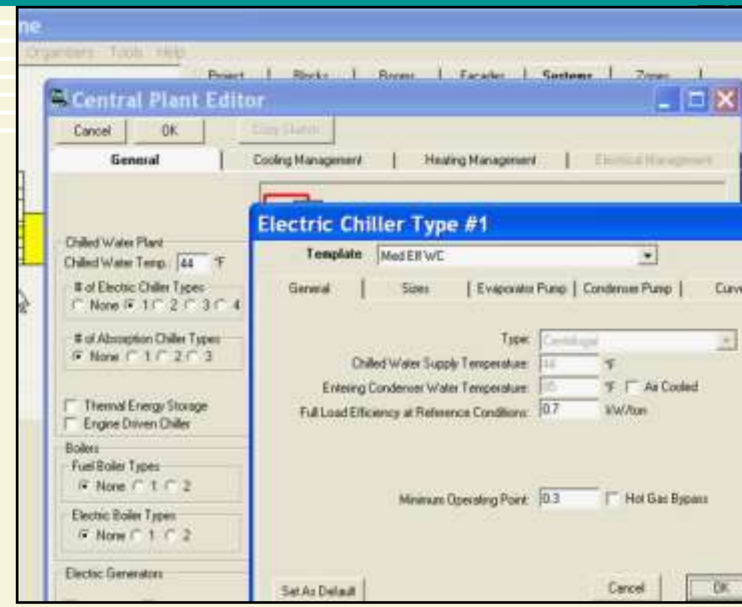
Initial energy consumption: 240 kWh/m^2/yr

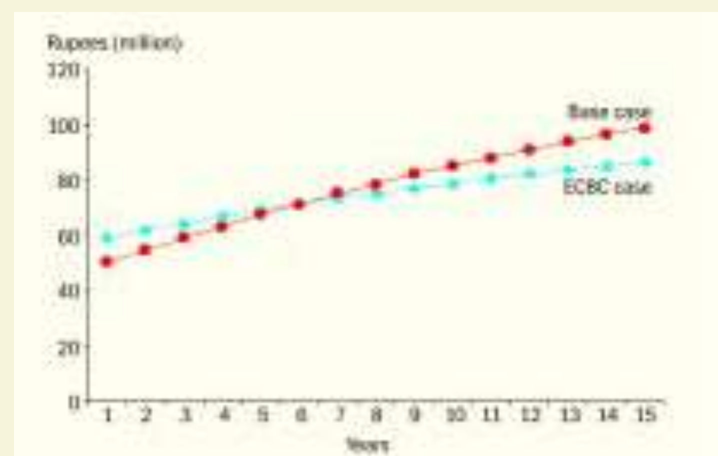
Building envelope

- Cavity wall with insulation
- Insulated and shaded roof
- Double glazing and
  windows

Case study 1: CESE, IIT Kanpur

- Lighting system
  - Efficient fixtures
  - Efficient lamps
  - Daylight integration
  - Average LPD < 1 W/ft^2
- HVAC system
  - Load calculation with optimized envelope and lighting system
  - Efficient chillers
  - Efficient condenser cooling
  - Use of geothermal energy for cooling





Case study 1 : CESE, IIT Kanpur

Base building

EPI = 240 kWh/m² per annum

↓ Envelope optimisation

EPI = 208 kWh/m² per annum

↓ Lighting optimisation

EPI = 168 kWh/m² per annum

↓ HVAC optimisation

EPI = 133 kWh/m² per annum

↓ Controls

EPI = 98 kWh/m² per annum

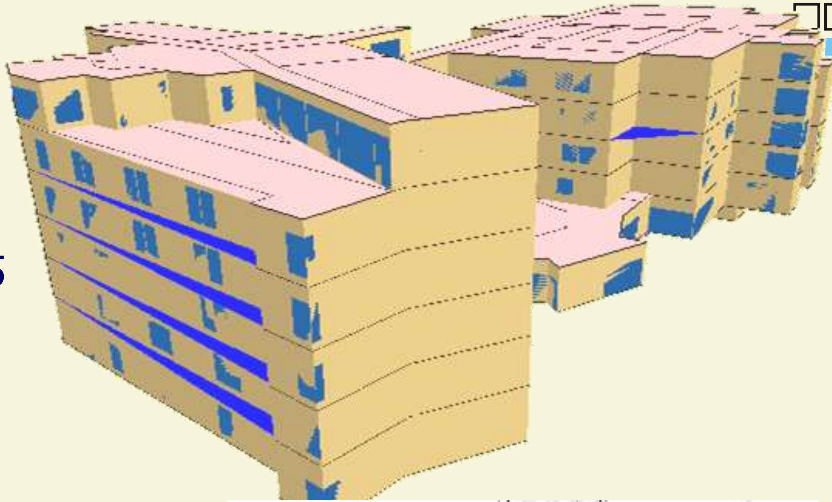
ECBC compliant CESE building, IIT Kanpur

Case study 2: Fortis Hospital

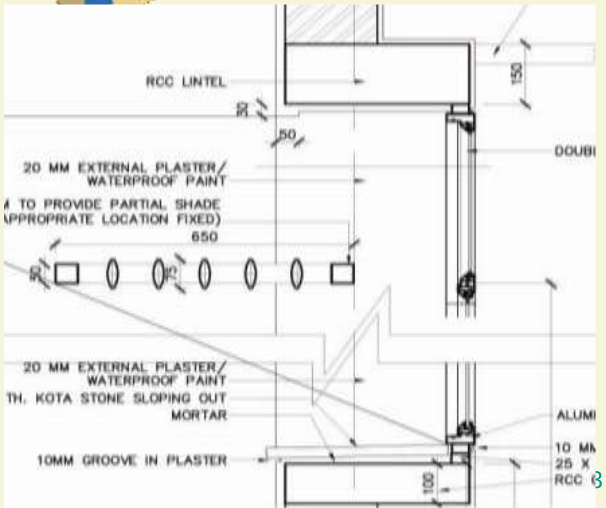
Proposed at Shalimarbagh,

New Delhi

- Initial energy consumption: 605 kWh/m^2 yr

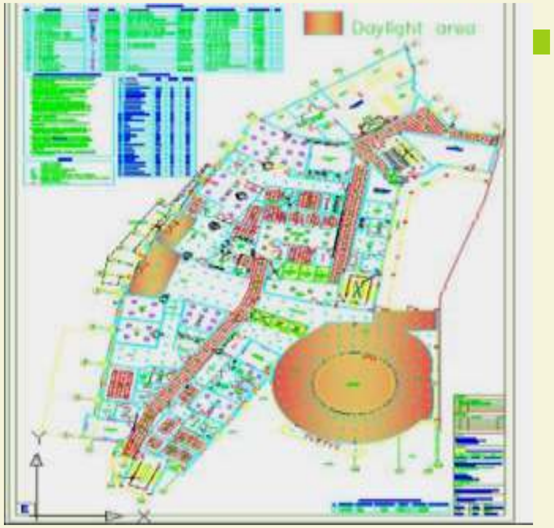


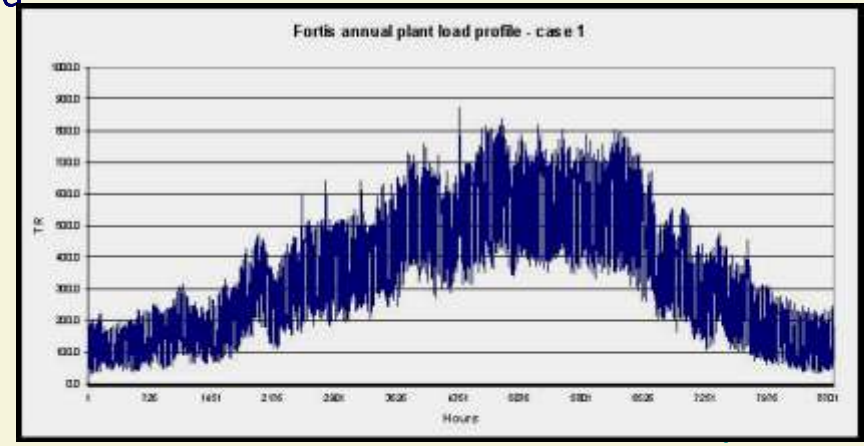
- Building envelope
  - AAC blocks
  - Insulated roof
  - Double glazing and shading for windows



Case study 2: Fortis Hospital

- Lighting system
  - Efficient fixtures
  - Efficient lamps
  - Daylight integration
  - Load reduction of 33%
- HVAC system
  - Load calculation with optimized envelope and lighting system
  - Efficient chillers
  - Efficient fans for AHUs
  - Use of VFDs





Case study 2 : Fortis Hospital

Base building

EPI = 605 kWh/m^2 per annum

↓ Envelope optimisation

EPI = 593 kWh/m^2 per annum

↓ Lighting optimisation

EPI = 476 kWh/m^2 per annum

↓ Efficient chiller

EPI = 346 kWh/m^2 per annum

↓ Controls for HVAC system

EPI = 312 kWh/m^2 per annum

ECBC compliant Fortis building, New Delhi

Case study 3: Triburg office

Base building

EPI = 186 kWh/m² per annum

↓ Envelope optimisation

EPI = 165 kWh/m² per annum

↓ Lighting optimisation

EPI = 120 kWh/m² per annum

↓ HVAC optimisation

EPI = 98 kWh/m² per annum

↓ HVAC controls

EPI = 92 kWh/m² per annum

↓ Daylight integration

EPI = 86 kWh/m² per annum

ECBC compliant Triburg building, Gurgaon

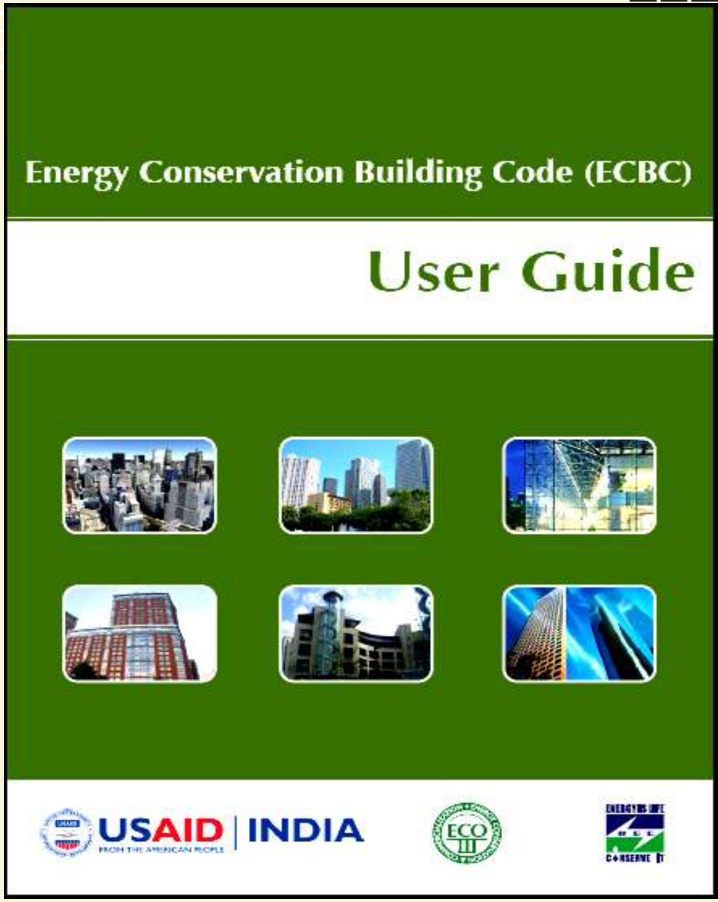
Environmentally Sensitive Design Makes Sense

- Energy savings are of the order of 50%
- Initial cost increases by 10 to 15%, but payback is obtained in 5 to 7 years
- The most cost effective way to meet the ECBC requirement is to design buildings with appropriate regard to climate and sun.
- A design not sensitive to sun and climate will have to invest more to meet the minimum ECBC standard

ECBC User Guide

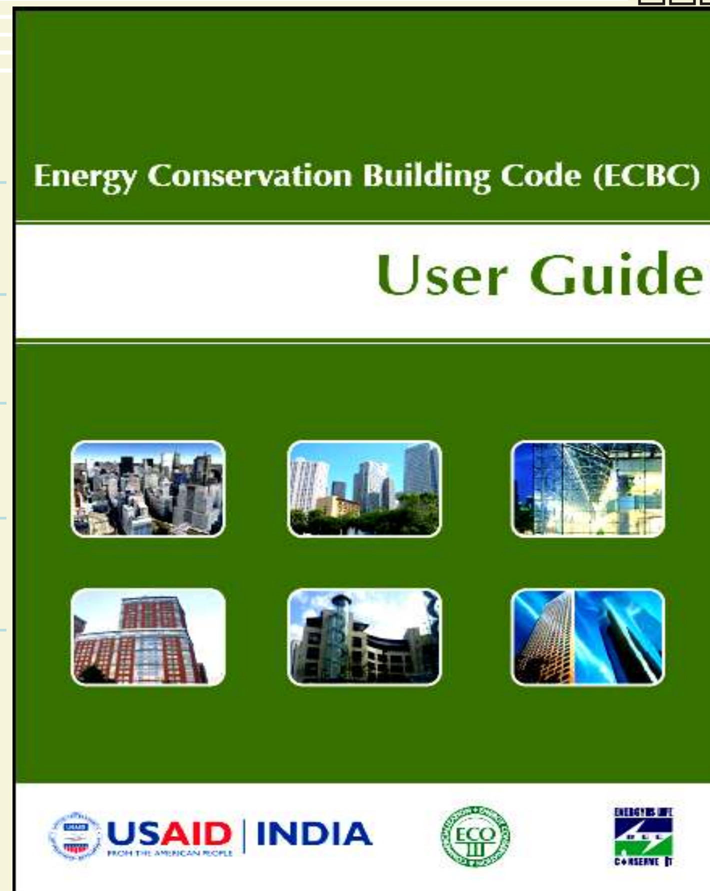
➢ Contains information related to

- ➢ Purpose
- ➢ Scope
- ➢ Administration and enforcement
- ➢ Building envelope
- ➢ Heating, ventilation, & air conditioning
- ➢ Service water heating & pumping
- ➢ Lighting
- ➢ Electrical power
- ➢ Appendixes
  - A: ECBC definitions, abbreviations, and acronyms
  - B: whole building performance method
  - C: climate zone map of India
  - D: Supplemental material
  - E: Comparison of international building energy standards
  - F: References
  - G: ECBC compliance forms



ECBC User Guide

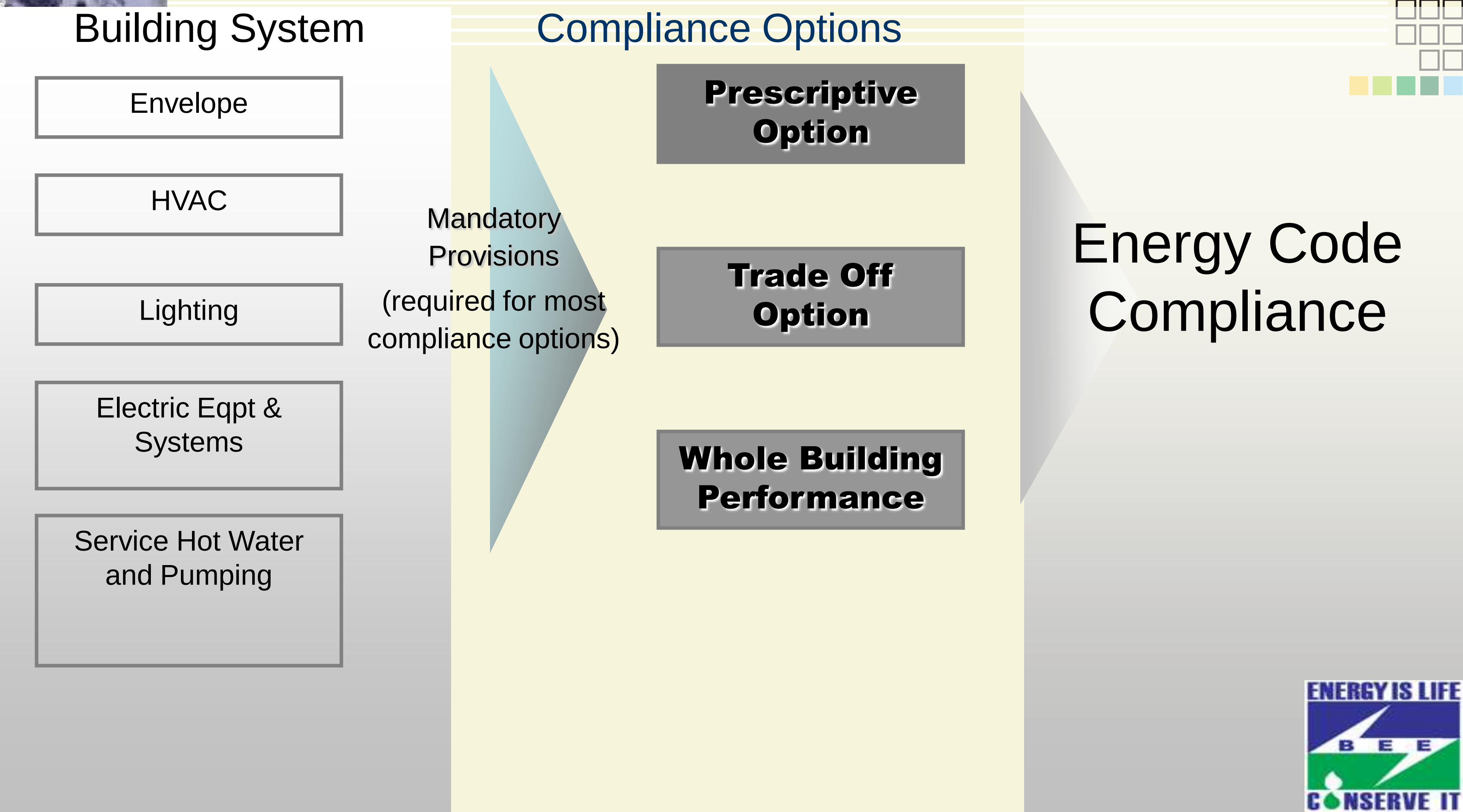
- Administrative Guidance
- Technical Guidance
- Compliance/ Checklist
- Case Studies/Examples
- References



Why is User Guide Important?

- ECBC Compliance & Implementation
  - Prescriptive option
  - Tradeoff option
  - Whole building performance option
- Fills essential gaps in ECBC (revised version - 2008)

Why is User Guide Important?



ONGOING INITIATIVES ON ECBC

- **CAPACITY BUILDING / TRAINING**
- 25 training programmes/ workshops involving about 1500 professionals have been conducted till date
- **PANEL OF ECBC EXPERT ARCHITECTS**
- To provide advice to design professionals to meet the ECBC requirements.
- BEE is providing assistance to MH&FW to develop the six AIIMS like institutes under the “Pradhan Mantri Swasthya Yojna” (PMSSY) Scheme as ECBC compliant buildings

ONGOING INITIATIVES IN ECBC

- **DEVELOPMENT OF TECHNICAL REFERENCE MATERIAL**
- Tip sheets on envelope design, lighting, HVAC and energy simulation have been developed
- **CURRICULUM DEVELOPMENT**
- 20 architectural/ engineering colleges have committed to develop architectural and engineering courses for energy efficient and sustainable building design.
- **ECBC PROGRAMME COMMITTEE**
- To facilitate development of ECBC complaint building design
- Credible implementation of few demonstration project
- Setting up compliance and evaluation procedures by creating appropriate institutional mechanism .

Barriers to Energy Efficiency

- Lack of information about comparative energy use.
- Risk due to lack of confidence in performance of new technologies.
- Higher cost of EE technologies.
- Asymmetry in sharing of costs and benefits.-especially in building sector.

STAR RATING FOR OFFICE BUILDINGS

- Large potential for energy savings both in government and commercial office buildings.
- The regulation, promotion and facilitation of energy efficiency in commercial buildings is one of the key thrust areas of BEE.
- Energy Conservation Building Code (ECBC)
  - specifies standards for new, large, energy -efficient commercial buildings.
- Energy Service Companies(ESCOs)
  - upgrade the energy efficiency of existing government buildings through retrofitting on performance contracting mode.

SCHEME FOR RATING OF BUILDINGS

- The Star Rating Program for buildings is based on actual performance of the building in terms of specific energy usage (kWh/sq m/year).
- This programme would rate office buildings on a 1-5 Star scale with 5 Star labeled buildings being the most efficient.
- Five categories of buildings - office buildings, hotels, hospitals, retail malls, and IT Parks in five climate zones in the country have been identified.
- Office buildings in the following 3 climatic zones for air-conditioned and non- air-conditioned:
  - Warm and Humid
  - Composite
  - Hot and Dry
- It will be subsequently extended to other climatic zones and building types.

SCHEME FOR PARTICIPATION

- Buildings having a connected load of 500 kW and above
- The application for each building shall be accompanied by non – refundable registration fee of Rs.1,00,000 (Rupees One lakh)
- Energy Performance Index (EPI) in kWh / sq m/ year in terms of purchased & generated electricity divided by built up area in sq m excluding basement and parking areas
- The total electricity would not include electricity generated from on-site renewable sources such as solar photovoltaic etc.
- Energy performance after completion of 1 year of operation with full occupancy of the building.

BANDWIDTHS- LESS THAN 50% AIR CONDITIONING

Composite

EPI(Kwh/sqm/year)	Star Label
80-70	1 Star
70-60	2 Star
60-50	3 Star
50-40	4 Star
Below 40	5 Star

Warm and Humid

EPI(Kwh/sqm/year)	Star Label
85-75	1 Star
75-65	2 Star
65-55	3 Star
55-45	4 Star
Below 45	5 Star

Hot and Dry

EPI(Kwh/sqm/year)	Star Label
75-65	1 Star
65-55	2 Star
55-45	3 Star
45-35	4 Star
Below 35	5 Star

BANDWIDTHS- MORE THAN 50% AIR CONDITIONING

Composite

EPI(Kwh/sqm/year)	Star Label
190-165	1 Star
165-140	2 Star
140-115	3 Star
115-90	4 Star
Below 90	5 Star

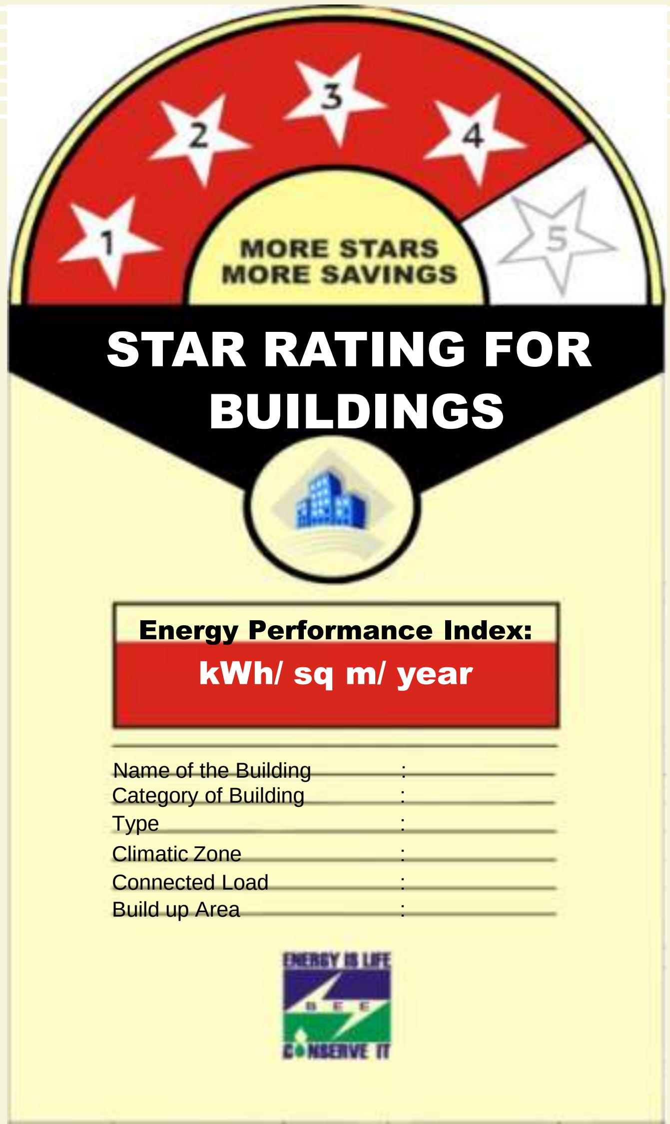
Warm and Humid

EPI(Kwh/sqm/year)	Star Label
200-175	1 Star
175-150	2 Star
150-125	3 Star
125-100	4 Star
Below 100	5 Star

Hot and Dry

EPI(Kwh/sqm/year)	Star Label
180-155	1 Star
155-130	2 Star
130-105	3 Star
105-80	4 Star
Below 80	5 Star

Label



1
2
3
4
5
MORE STARS
MORE SAVINGS
STAR RATING FOR BUILDINGS
Energy Performance Index:
kWh/ sq m/ year
Name of the Building :
Category of Building :
Type :
Climatic Zone :
Connected Load :
Build up Area :

Growth of Commercial Buildings in India

- Commercial buildings in India account for nearly 8% of the total electricity supplied by utilities.
- Electricity demand is likely to increase by 39.7% in 2011-12 as compared to 2006-07, by another 43.7% in 2016-17 as compared to 2011-12 and by yet another 37.5% in 2021-22 as compared to 2016-17.
- The real estate sector is second only to agriculture in terms of employment generation and contributes heavily towards the gross domestic product (GDP).
- In spite of the fast-paced growth of the commercial building sector, energy consumption data for the sector is largely unavailable in the public domain

Need for Benchmarks

- Absence of macro-level data is a barrier that does not allow the government to formulate market-oriented policies.
- The Bureau of Energy Efficiency, with technical assistance from USAID ECO-III project, embarked on the initiative to provide sectoral energy consumption data and undertook the preliminary benchmarking initiative.
- It is also felt that creation of macro-level benchmarks would also help in identifying exemplary buildings as well as poorly performing buildings that can be excellent targets for implementing energy efficiency measures.

Benchmarking Methodology

Step 1

Identifying Benchmarking Goals

Step 2

Identify required data and develop data collection plan

- Design the benchmarking template
- Develop data collection plan

Step 3

Data Collection

- Identify a pool of potential organizations that could provide buildings data
- Collection of data

Step 4

Data Segregation and Screening

- Segregation of data
- Elimination of outliers
- Compile data in the standard format
- Crosschecking with data providing organization in case of clarity required on data.

Step 5

Data Analysis and compute metrics

- Normalizing the data
- Data Analysis
- Plotting trends
- Compute the metrics

Step 6

Benchmark metrics and identify potential actions

- Comparing the individual building performance with Benchmark metrics
- Deciding on the action plan


Thank You!