Roadmap for Energy Efficiency in Buildings

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Growth Profile of Indian Commercial Sector

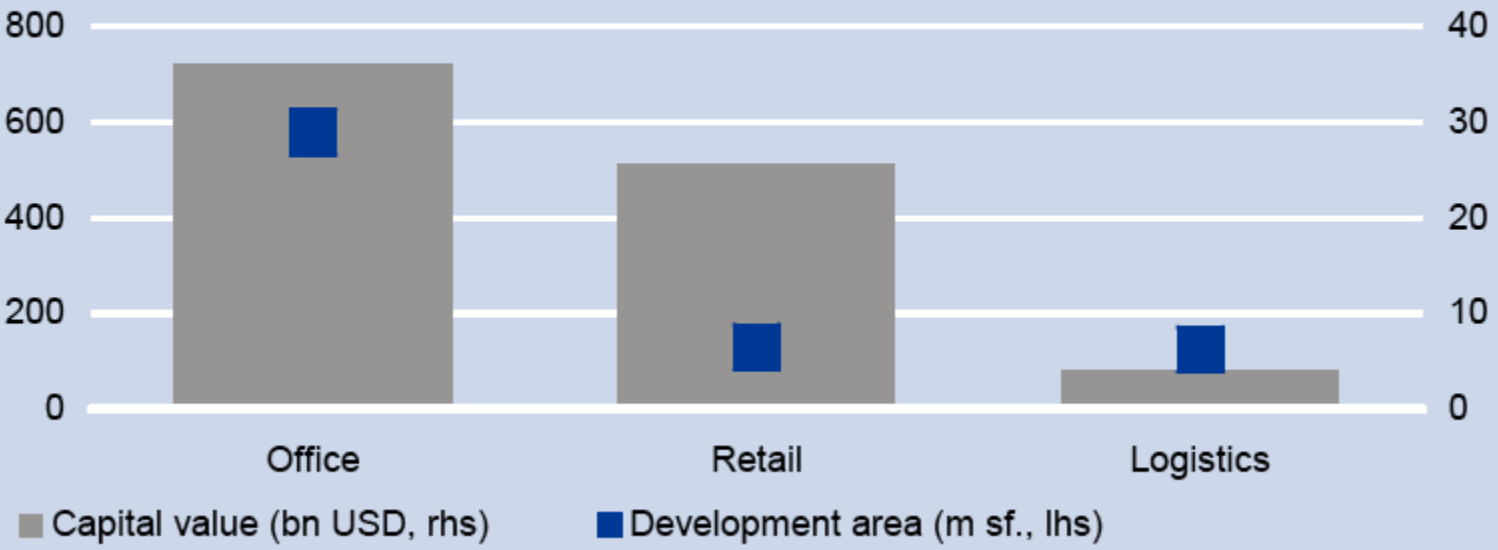



- Demand for OFFICE SPACE in India is driven by the increasing share of the services sector in the Indian economy
  - Office space supply shifting from Central Business Districts to secondary centers (office and IT parks)
  - Modern office buildings in newly developed areas enable the higher quality 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]

Growth potential on India's commercial real estate market

Change in total stock, 2006 - 2010



Sources: RREEF Research, DB Re

[1] Deutsche Bank Report on India's Commercial Real Estate Market

ENERGY IS LIFE

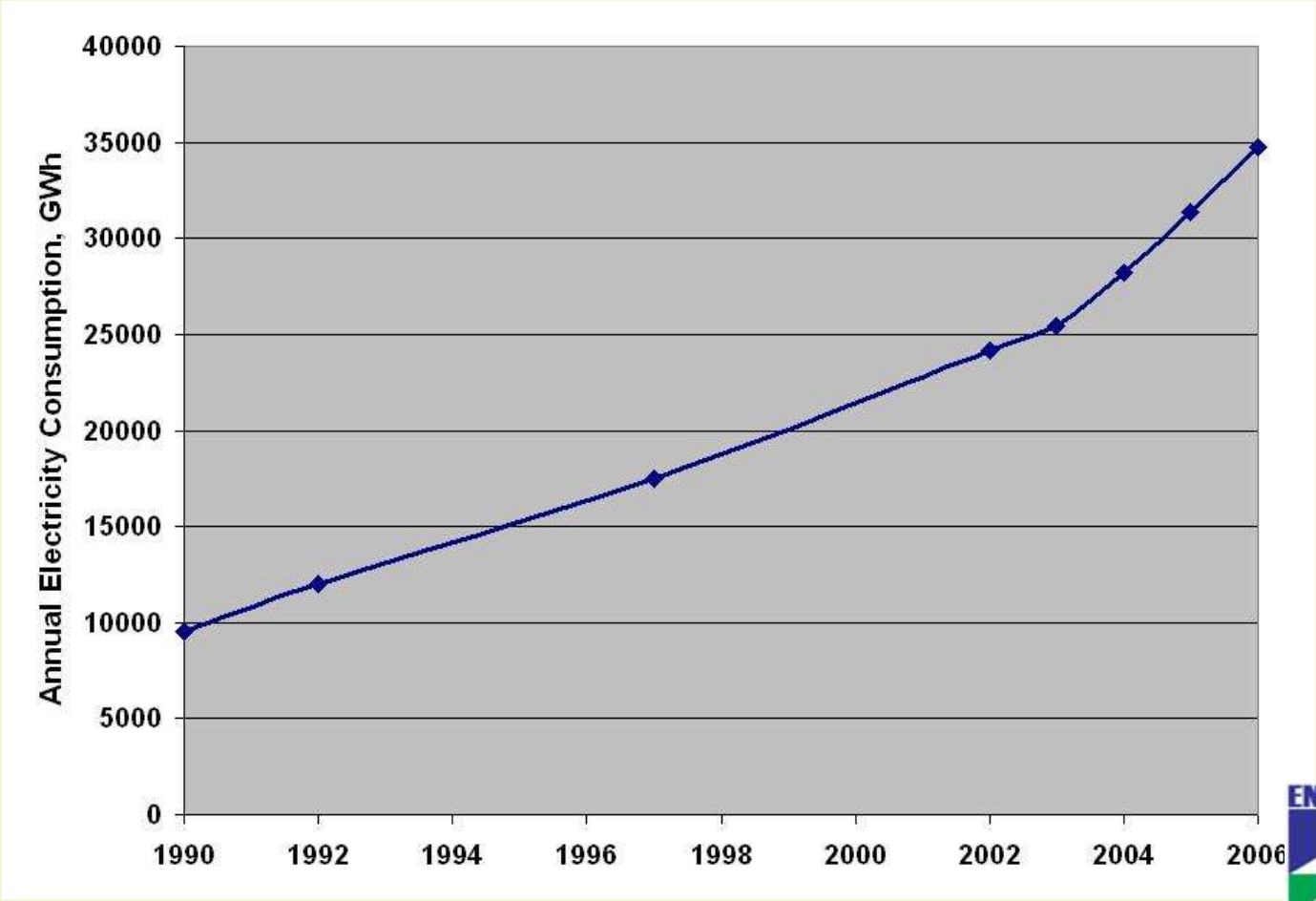
BEE

CONSERVE IT

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

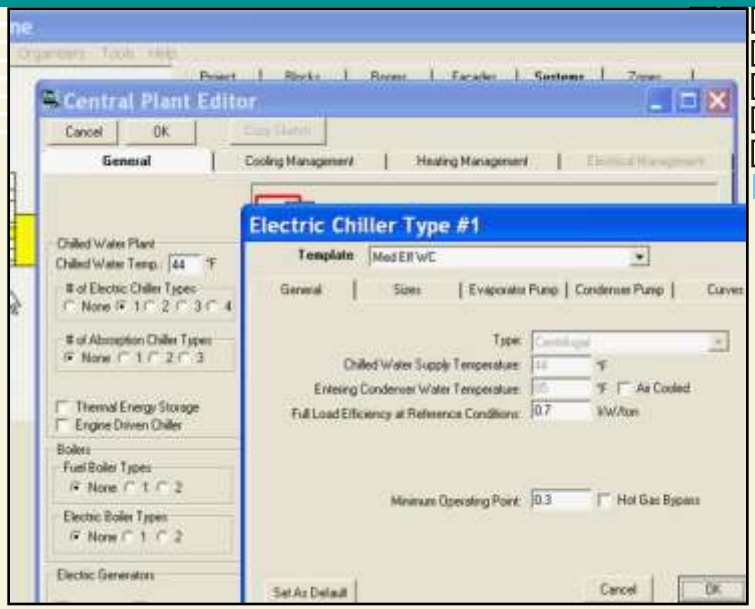
Initial energy consumption: 240 kWh/m^2/yr

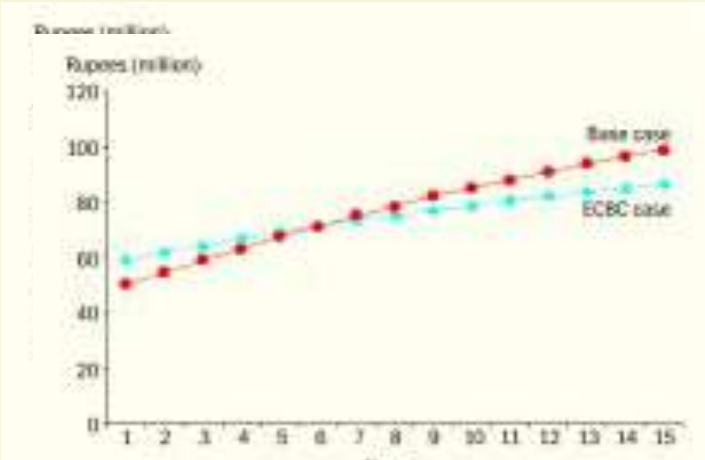
Building envelope

- Cavity wall with insulation
- Insulated and shaded roof
- Double glazing and s 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/m^2 per annum

Envelope optimisation

EPI = 208 kWh/m^2 per annum

Lighting optimisation

EPI = 168 kWh/m^2 per annum

HVAC optimisation

EPI = 133 kWh/m^2 per annum

Controls

EPI = 98 kWh/m^2 per annum

ECBC compliant CESE building, IIT Kanpur

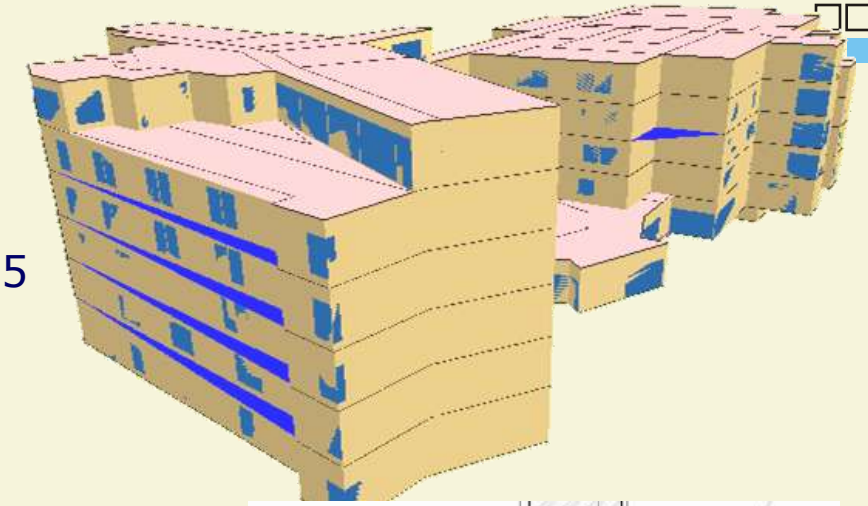
Case study 2: Fortis Hospital

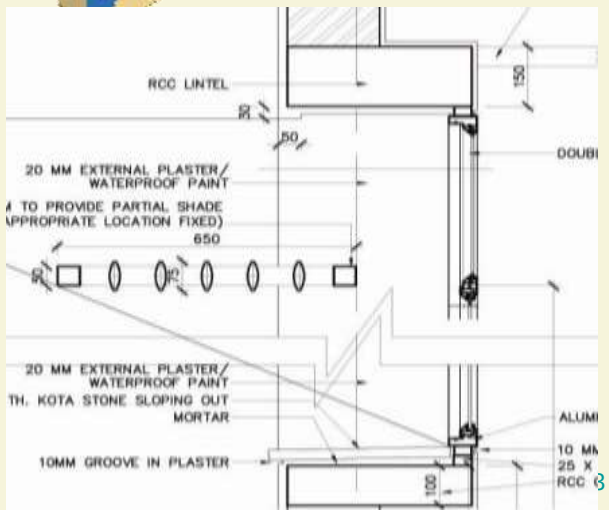
Proposed at Shalimarbagh,

New Delhi

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

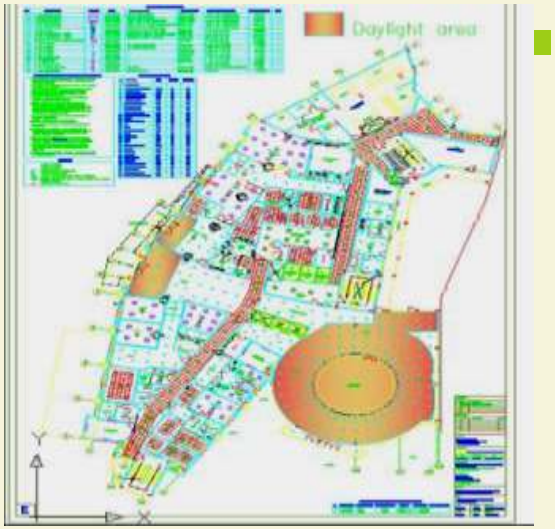
- Building envelope
  - AAC blocks
  - Insulated roof
  - Double glazing and shading for windows

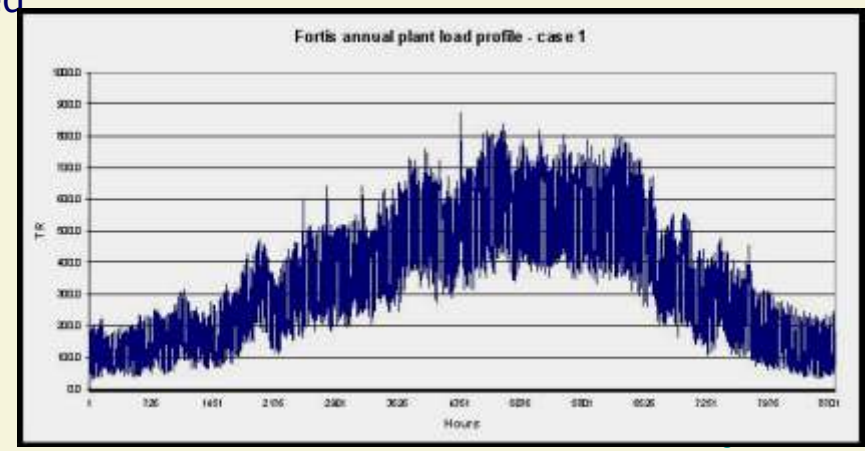




Case study 2: Fortis Hospital

- 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/m² per annum

↓ **Envelope optimisation**

EPI = 593 kWh/m² per annum

↓ **Lighting optimisation**

EPI = 476 kWh/m² per annum

↓ **Efficient chiller**

EPI = 346 kWh/m² per annum

↓ Controls for HVAC system

EPI = 312 kWh/m² 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

ECBC compliant Triburg building, Gurgaon

EPI = 86 kWh/m² per annum

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

Energy Efficiency in Existing Buildings/ facilities




- There is vast scope for energy efficiency improvement in buildings/ existing facilities.
- Energy Audit Studies have revealed a savings potential to the extent of 40% in end use such as lighting, cooling, ventilation, refrigeration etc.
- Audits identify the Energy baselines in existing facilities along with Energy Efficiency Measures.

Energy Efficiency Measures

- Energy efficiency measures bring about energy savings due to reduced energy consumptions.
- Energy savings are determined by comparing energy baseline with energy consumed after implementation of EE measures.
- Energy cost savings resulting from EE measures directly benefit building owners and occupants over the life cycle of the building.

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.

Energy Saving Companies(ESCOs)

ESCO generally act as project developers for a wide range of tasks and assume the technical and performance associated with the project. They offer the following services:-

- Develop, design and finance Energy Efficiency projects.
- Install and maintain the energy efficient equipment involved.
- Measure, monitor and verify the project's energy savings
- Assume the risk that the project will save the amount of energy guaranteed.

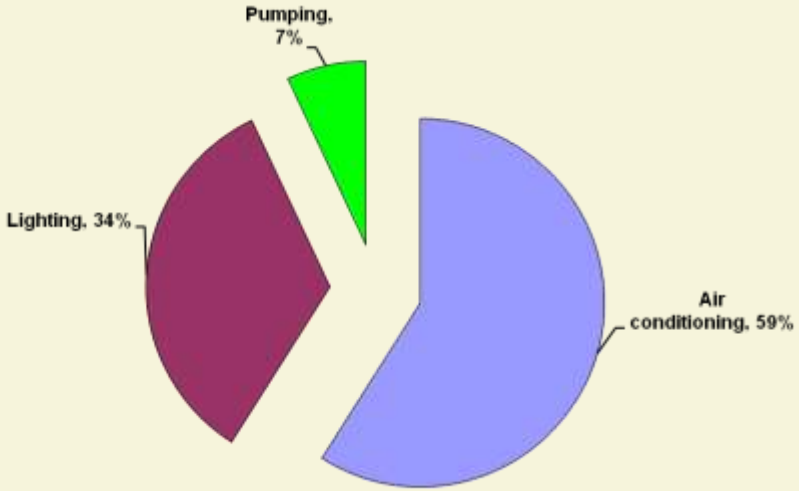
Energy Efficiency in Govt. Buildings

- Under the 1st phase of Energy Efficient Govt. Buildings Programme 9 public buildings were taken up for energy audits
- These include:-Rashtripati Bhawan, Prime Minister's Office, South Block, Rail Bhawan, Sanchar Bhawan, Shram Shakti Bhawan, Transport Bhawan, R& R Hospital, Delhi airport and AllMS.

Energy Efficiency Improvements at Rashtrapathi Bhawan

EEMs at Rashtrapati Bhawan

Energy Saving Measure	Electricity savings (kWh/ year)	Savings in lakh Rupees per year
Air conditioning	5,54,266	35.3
Lighting	3,25,028	20.7
Pumping	54,140	3.45
Total	9,33,434	59.45



Summary of Savings at Rashtrapati Bhawan through EEMs

Month & year	Target savings		Actual Savings	
	Units(Kwh)	Amount	Units(Kwh)	Amount
08/2006 to 07/2007	953688	60779920.56	1020650	6501540.50

- The savings up to the Guaranteed savings are being shared by Govt. Facility & Performance Contracting Agency in the ratio of 3:1 respectively.
- The excess savings achieved over and above the guaranteed savings in the ratio 1:1 by the Govt. Facility and the Contracting Agency.

Energy Audit Results- 1st phase

Building particulars	Annual Energy Consumption (lakh kWH)	Annual Energy savings (lakh kWH)	% Savings	Annual energy savings (Rs. Lakhs)	Investment (Rs. Lakhs)	Pay back period (years)
Rashtrapati Bhawan	34.1	9.8	27	59	51.2	1
PMO	8.3	2.7	32	16.9	50.5	3
Sanchar Bhawan	25.6	11.9	46	76	147.1	1.9
Shram Shakti & Transport Bhawan	20.4	8	39	42.9	157.5	3.7
Airport	713	145	20	586	810	1.5
Rail Bhawan	23.5	6	25	40	163	4.2
AIIMS	369	93.1	29	712	1070	1.5

Government Initiatives(2nd Phase)

- Seeing the encouraging results obtained in 1st phase of energy efficiency in Government Building Programme, 17 more Government buildings have been taken up under Phase II through Performance Contracting.
- These include Nirman Bhawan, Udyog Bhawan, Shastri Bhawan, North Block, South Block, Vigyan Bhawan, National Archives, Yojana Bhawan, Sardar Patel Bhawan, Supreme Court, Safdarjunj Hospital, SSK Hospital, Parliament House & Parliament Annex, Pariyavaran Bhawan and NIC, CGO Complex.

ONGOING INITIATIVES

- Guidelines to promote EEMs in existing buildings have been framed.
- Energy Assessment guide- Launched by BEE to promote energy efficiency in existing buildings.
- 35 ESCOs empanelled with BEE after accreditation by CRISIL/ICRA. 25 of the 35 accredited ESCOs are at levels 1 to 3 (Above Average
- BEE to support Ministry of Railways for taking up IGEAs of 20 stations/ administrative buildings.
- Hon'ble President of India has launched an initiative "ROSHINI"- BEE to take up EEMs of entire President estate.

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.

CHECK TESTING & VERIFICATION

- The Bureau will conduct regular sample checks for information provided by the building owner & the EPI
- The user of the label would agree to make available the drawings of the building/facility.
- Information of the defaulters would put out in the public domain including an advertisement in newspaper, together with withdrawal of the authority to use the label.
- Provision for challenge testing the label contents by other star rated building owner have been made in the scheme.

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

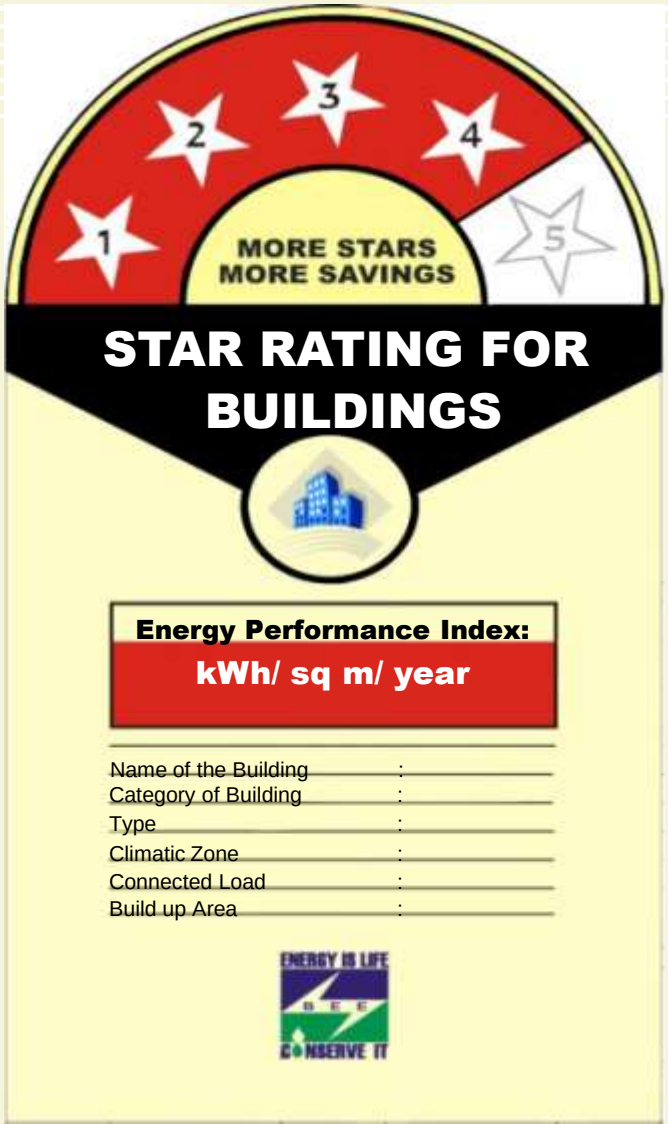
Warm and Humid

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 :


Thank You!