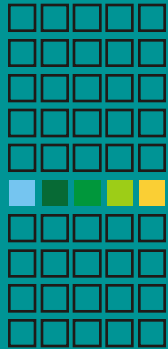


May, 2010



# Roadmap for Energy Efficiency in Buildings

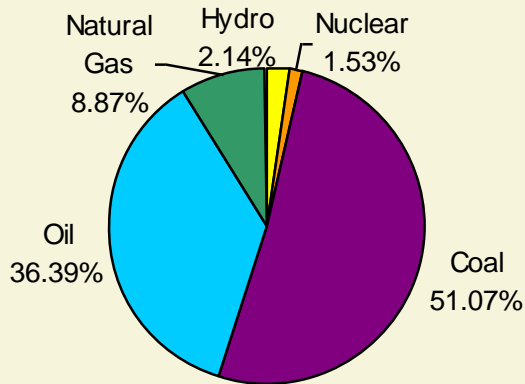
**Saurabh Yadav**

Bureau of Energy Efficiency  
Government of India

# Indian Energy Sector

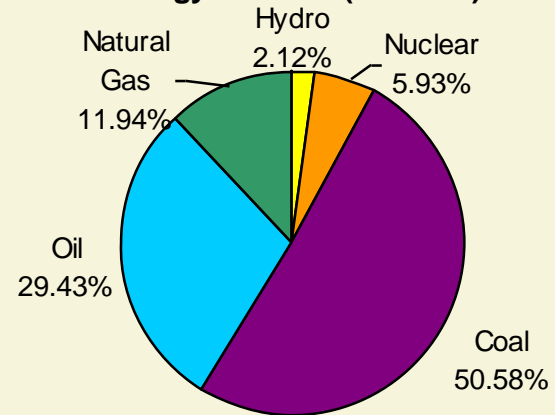


**Total Primary Commercial Energy Demand (2003-04)**



**327 Mtoe**

**Total Primary Commercial Energy Demand (2031-32)**



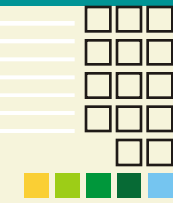
**1858 Mtoe**

**Energy requirement to increase at a CAGR of 6.4% (2004-2032) and coal to remain the mainstay**

# Energy Efficiency Potential and Outcome

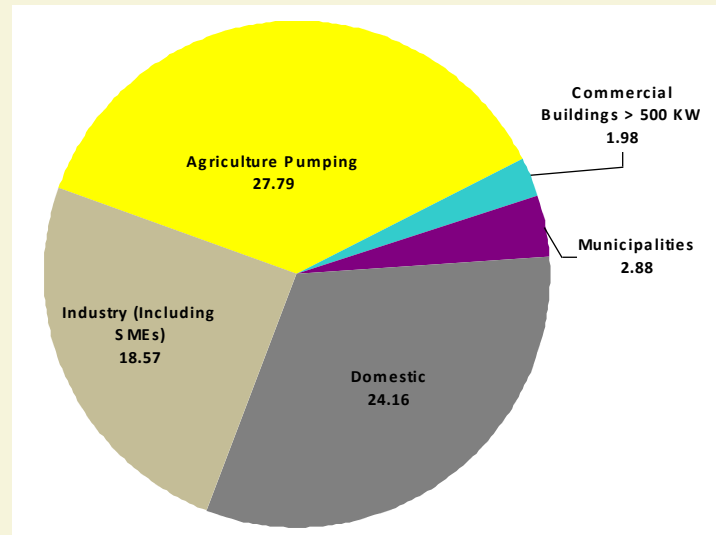
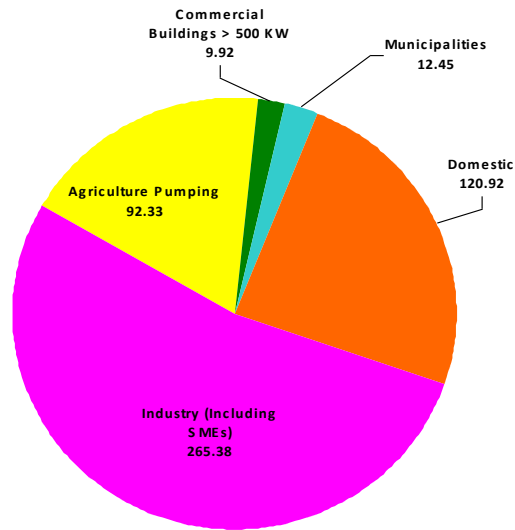


<b>Energy Conservation potential assessed as at present (IEP) (15% by DSM and 25% overall)</b>	-	<b>20000MW</b>
<b>Verified Energy Savings :</b>		
<b>📅 During X Plan period</b>	-	<b>877 * MW</b>
<b>📅 During 2007-08 and 2008-09</b>		<b>2,127 MW</b>
<b>📅 Target for 2009-10</b>		<b>2,600 MW</b>
<b>-Target for XI Plan period (5% reduction of energy consumption)</b>	-	<b>10,000 MW</b>
* Only as indicated by participating units in the National Energy Conservation award scheme, for the previous five years.		



# Electrical Energy Consumption and Conservation Potential

S. No.	Sector	Consumption (KWh)	Saving Potential (KWh)	% Savings
1.	Agriculture Pumping	92.33	27.79	30.09
2.	Commercial Buildings/ Establishments with connected load > 500 KW	9.92	1.98	19.95
3.	Municipalities	12.45	2.88	23.13
4.	Domestic	120.92	24.16	19.98
5.	Industry (Including SMEs)	265.38	18.57	6.99
	<b>Total</b>	<b>501.00</b>	<b>75.36</b>	<b>15.04</b>



# 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



# Market of EE in Buildings



Market Type	Investment Potential , bn Rs	Energy Savings (KWh)	Energy Savings (MW)	Pay Back Period* (Years)
Industrial	121.00	49.00 billion	7000	0.5
• Generic Energy Efficiency	42.00	23.70 billion	3400	
• Process Energy Efficiency	79.00	25.30 billion	3600	
• Commercial	5.70	1.71 billion	553	0.7
• Government owned	3.40	0.76 billion	360	1.0
Offices / Hospitals	0.85	0.87 billion	140	0.2
• Private Owned	1.44	0.18 billion	53	
Hotels				
Municipal	13.00	3.70 billion	1688	0.9
Totals	140.00	54.40 billion	9240	0.6



ENERGY IS LIFE  
BEE  
CONSERVE IT



# Typical Building Energy Use



## Average Energy Consumption

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



# 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  $\sim 180 \text{ kWh/m}^2/\text{year}$
  - ECBC Compliant building  $\sim 110 \text{ kWh/m}^2/\text{year}$



# 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**

- Support to Government Agencies for ECBC like MH&FW, NPTC and Haryana

## ➤ **Baseline survey of Government buildings**

- Survey completed in 27 States and 712 Government Buildings. Wide Variation on the energy use found 50-700 units /sq.mt/Year .
- A potential saving of energy in Government buildings of around 1.2 billion units annually resulting in avoided capacity of 137 MW.



# Existing Buildings- Road Map



- ESCO promotion- branding and rating of ESCOs
- Creating a pool of trained manpower- certification programme for energy auditors
- Partial Risk Guarantee fund being created
- Innovative financial instruments being evolved
- Standardised performance contract documents released
- Securitisation of performance contracts
  
- **Strong focus on Government buildings- almost 500 large buildings being targeted**



# 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 compliant building design
- Credible implementation of few demonstration project
- Setting up compliance and evaluation procedures by creating appropriate institutional mechanism .



# 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




Energy Conservation Building Code (ECBC)

## User Guide









**USAID** | **INDIA**

FROM THE AMERICAN PEOPLE

# ECBC User Guide



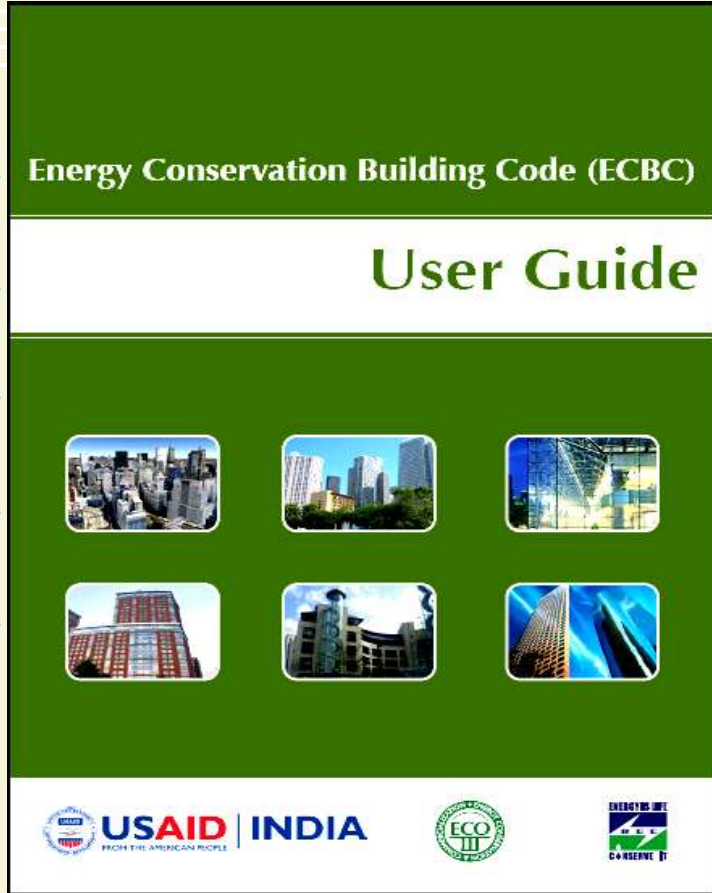
Administrative Guidance

Technical Guidance

Compliance/ Checklist

Case Studies/Examples

References



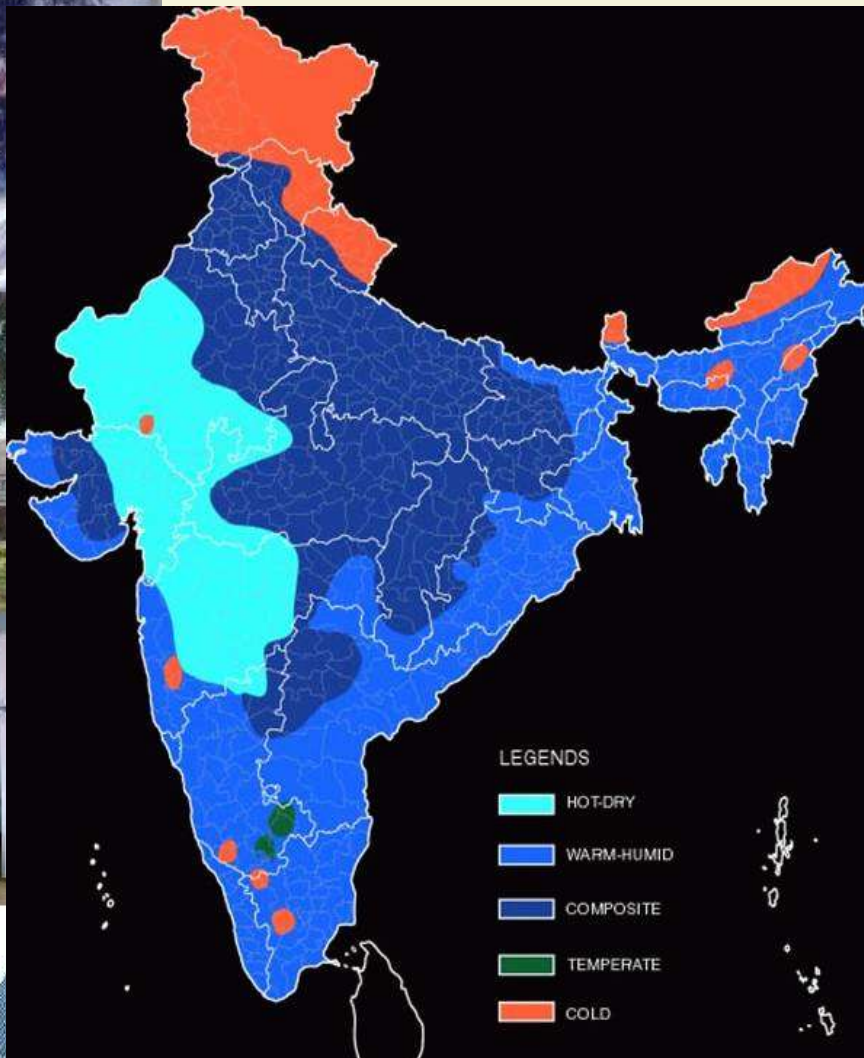
# Why is User Guide Important?



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



# Addressing Climate Zones Variations



## Five climate zones

1. Composite (Delhi)
2. Hot Dry (Ahmadabad)
3. Warm Humid (Kolkata),
4. Moderate (Goa, Bangalore)
5. Cold (Shillong)

# Why is User Guide Important?

## Building System

Envelope

HVAC

Lighting

Electric Eqpt & Systems

Service Hot Water and Pumping

## Compliance Options

Mandatory Provisions  
(required for most compliance options)

Prescriptive Option

Trade Off Option

Whole Building Performance

Energy Code Compliance



# ECBC – Tasks ahead



## ➤ **Promotion of ECBC**

- Conducting atleast 5 workshops in each climatic zones
- Workshop with manufacturers

## ➤ **Prototype buildings**

- ECBC architects to come up with design prototyres for various building types, climatic zones etc.

## ➤ **Amendment of Building By-laws**

- Review of state by laws by ECBC expert architects for incorporating ECBC provisions

## ➤ **Capacity building**

- Broaden the existing database of existing ECBC expert architects

## ➤ **Situation Analysis of ECBC compliant buildings**

- Database of ECBC compliant buildings in India



# ECBC – Tasks ahead



## ➤ **Compliance tools**

Developing compliance procedures based on:

- i) Component based (prescriptive)
- ii) System- based approach
- iii) Whole building approach

## ➤ **Compliance Test procedures**

set up a mechanism for check testing of compliance for ECBC compliant buildings at various stages:

- Design Stage
- Construction Stage
- Completion Stage



# 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.



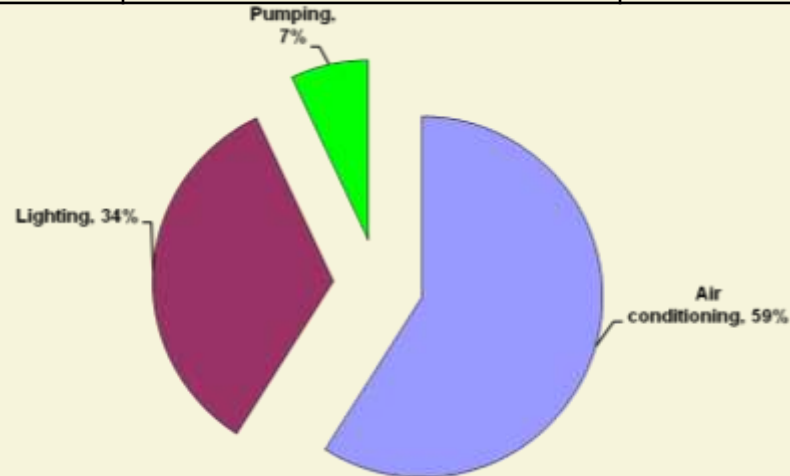
# Energy Efficiency Improvements at Rashtrapathi Bhawan



# 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



# ONGOING INITIATIVES



- An exercise for expanding the number of existing ESCOs through an open invitation and evaluation process was taken up by BEE.
- In order to create a sense of credibility amongst the prospective agencies that are likely to secure the services of an ESCO as well as the financial institutions, a process of rating ESCOs was taken up through CRISIL and ICRA.
- Rating was carried out in terms of success in implementation of energy efficiency projects based on performance contracting, availability of technical manpower, financial strength, etc.
- 80 ESCOs empanelled with BEE after accreditation by CRISIL/ ICRA. 50 of the 80 accredited ESCOs are at levels 1 to 3 (Above Average)



# Grading Scale



ICRA / CRISIL-BEE Grading	Definition	Score
GRADE 1	Very High	85 and above
GRADE 2	High	70-84
GRADE 3	Good	55-69
GRADE 4	Below Average	40-54
GRADE 5	Poor	0-39

# 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.



# 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



# Bandwidths for the BPOs



- BPOs, which primarily focus on providing service to IT related activities such as application management and application development, data centre operations or testing and quality assurance.
- BPOs may have varied hours of operation e.g. 24x7/ 24x5, 18x7, 16x7 or 16x5 etc.
- Those BPOs having a connected load of 100 kW and above and a minimum built up area of 500 Sq m would be considered for BEE star rating scheme
- Average Annual Hourly Energy Performance Index (EPI) i.e. **(AAhEPI) in (Wh/hr/sqm/)** will be considered for rating the BPO.
- This programme targets BPOs located within the following 4 climatic zones ie (Warm and Humid, Composite, Hot and Dry, Temperate)



# Bandwidths for the BPOs



## Climatic Zone - Composite

Average Annual hourly EPI AAhEPI (Wh/hr/Sqm)	Star Rating
45-40	1 Star
40-35	2 Star
35-30	3 Star
30-25	4 Star
Below 25	5 Star

## Climatic Zone - Warm and Humid

Average Annual hourly EPI AAhEPI (Wh/hr/Sqm)	Star Rating
50-45	1 Star
45-40	2 Star
40-35	3 Star
35-30	4 Star
Below 30	5 Star

## Climatic Zone - Hot and Dry

Average Annual hourly EPI AAhEPI (Wh/hr/Sqm)	Star Rating
35-30	1 Star
30-25	2 Star
25-20	3 Star
20-15	4 Star
Below 15	5 Star

## Climatic Zone - Temperate

Average Annual hourly EPI AAhEPI (Wh/hr/Sqm)	Star Rating
40-35	1 Star
35-30	2 Star
30-25	3 Star
25-20	4 Star
Below 20	5 Star

# Present status of the Scheme & Future Initiatives



- **158** applications have been received under day use office building category.
- **92 Buildings** have been found eligible for issue of a star Label under this scheme till date . ( RBI, SBI, ADB ,CPWD, Railways, kalpataru)
- **22** applications have been received under BPO category, out of which 12 BPO buildings found eligible.
- Bandwidths for IT buildings , Hospitals , Hotels and Shopping Malls under development .



# Label



**Energy Performance Index:**  
**kWh/ sq m/ year**

Name of the Building : \_\_\_\_\_  
 Category of Building : \_\_\_\_\_  
 Type : \_\_\_\_\_  
 Climatic Zone : \_\_\_\_\_  
 Connected Load : \_\_\_\_\_  
 Build up Area : \_\_\_\_\_





[www.bee-india.nic.in](http://www.bee-india.nic.in)

