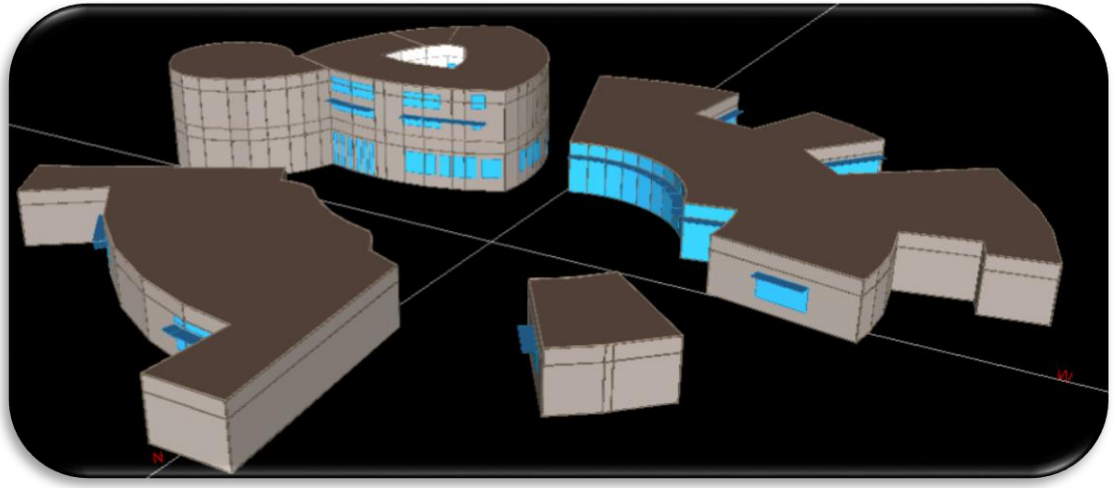
INDIA GHG PROGRAM

Promoting profitable, sustainable and competitive businesses.

Features of Energy Efficient Buildings and Relevance to GHG Emission

Webinar : 2 September 2016



WRI INDIA

Confederation of Indian Industry

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Emissions

Perception :

Emissions are bad

Perspective :

All Emissions are not Bad

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All Emissions are Not Bad

- In nature, emissions is like breathing
  - Humans take almost 7-10 Kg of air / day

- Tree example
  - Gives out oxygen
  - Still grows in abundance

- Question is :
  - How much can we emit?

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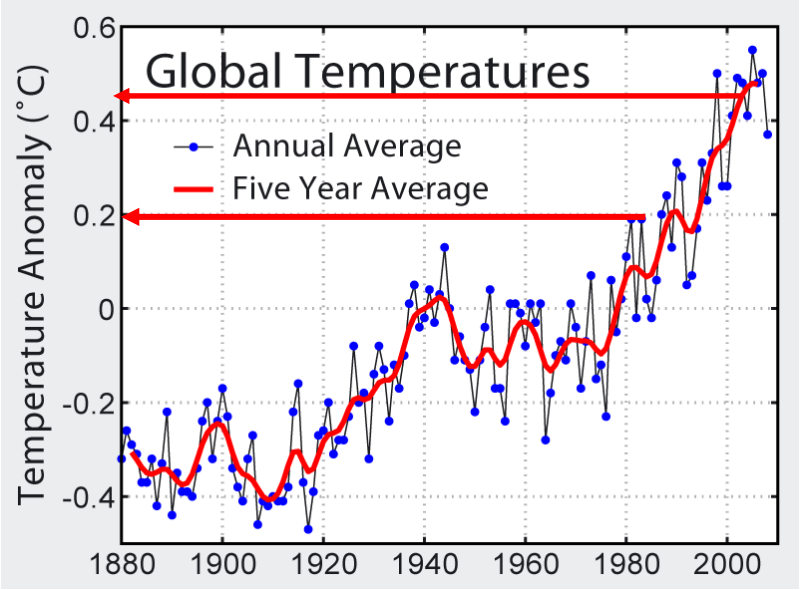
How Much Did we Emit ?

- About 30 Billion tons of CO_2 released into atmosphere every year*
- 1970s
  - How much oil is left?
- 2000s
  - Whatever is left, can we burn?

*Source :'The Ecology of Commerce' by Paul Hawken

Why are we scared of GHG emission ?

- **Coal is the predominant source of power production**
  - **55-60% of total power production**
  - **556 Million tones of coal consumption/ year**
  - **GHG India : 1850 Million tonnes**
- **How much emission ?**
- **Can we continue it ?**
- **Can we tolerate ?**
  - **heat waves**
  - **increase in global temperature**
  - **climate change**



***Exploring the environment, NASA**
http://ete.cet.edu/gcc/?/resourcecenter/slideshow/3/1

Environment

Energy → GHG

Reduction in 1 kWh
is equal to 3 kWh savings in generation

Energy is one of the major inputs for the Industrial Output & Economic Growth of any country

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Features of

Energy Efficient Buildings

& GHG Emission

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Building sector in India

- **Building consumes 40 % of the total energy**
- **Contributes 35 % GHG emission**
- **Expected growth in building stock**
  - **Five fold increase from 21 billion sft in 2005**
    - **104 billion sft in 2030**

Significant potential for improving energy efficiency in buildings

- **India plan to reduce emission intensity**
  - **33-35% by 2030 from 2005 level**

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Type of buildings ?

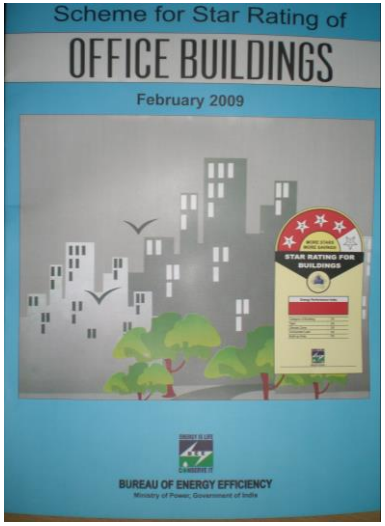
- **Residential buildings**
  - Residential society / Multi-dewelling /Individual home
- **Commercial buildings**
  - Office/IT / ITES / Hospital / Hotel / Data Center
- **Industrial building**
  - Mfg industries, process load is involved

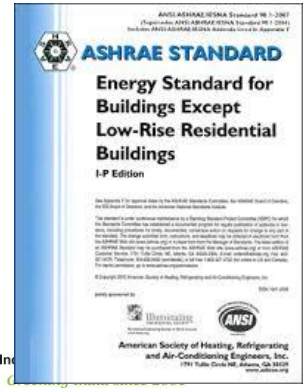
What is common in all building types ?

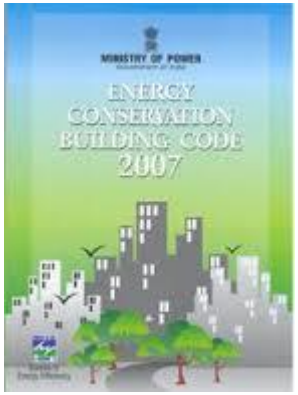
1. Building envelope (Wall, roof and glass)
2. Lighting
3. HVAC
4. Equipment

How to measure energy efficiency in buildings ?

- **Energy Performance Index (EPI)**
  - **kWh/ sq m / year**
- **Whole building simulation approach**
  - **Energy cost/ energy consumption shall be lesser in Proposed case than the Base case**
- **Chiller / Cooling**
  - **kW/TR or Cool SFT/TR or Cool CFM/TR**
- **Lighting**
  - **Efficacy (lumen/W)**

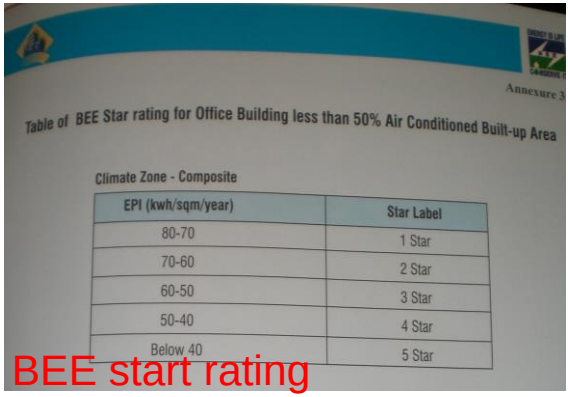






Climatic Zone	Average Annual hourly EPI AAhEPI (Wh/hr/sq m)	Star Rating
COMPOSITE	52 - 46	1 Star
	46 - 40	2 Star
	40 - 34	3 Star
	34 - 28	4 Star
	Below 28	5 Star

BEE start rating



BEE start rating

Energy Efficiency Measures

Envelope:
- Orientation
- Roof insulation
- High SRI coating
- Wall insulation
- Efficient glazing (lower SHGC)
- Sun film for glazing in the identified

Lighting:
- Install/ retrofitting lighting with LED
- Occupancy sensor
- Daylight sensor
- Voltage stabilizer
- Switching off idle running transformers
- Optimize the load on transformer

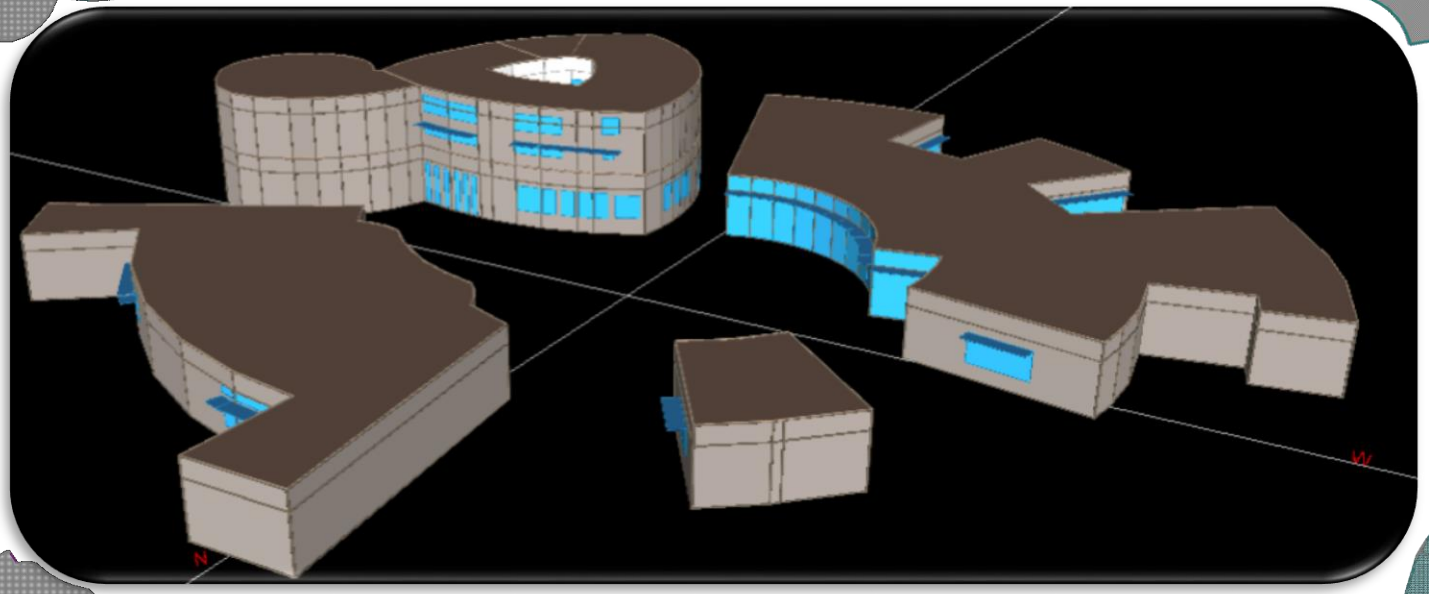
Operation of air-conditioners:
- Adaptive thermostat conditions
- Improved air movement in the conditioned area

HVAC:
- Selection of energy efficient chillers (<0.55 kW/TR)
- Efficient Motor, Fan and Pumps
- Use of IE2-IE3 motors
- Optimize the loading of chillers
- Adiabatic cooling for air cooled condenser
- Thermostatic expansion valves-EEV
- Installation of online condenser cleaning system
- VFDs pumps and AHU fans
- Installation VFD - cooling tower
- Avoid flow through idle running chillers
- Use of stand cooling towers
- Integration with geothermal based water condensers

Equipment:
- Use of star rated appliances

Tools: Energy Efficiency in Buildings

Building Energy Simulation tools :



New Buildings & Existing Building

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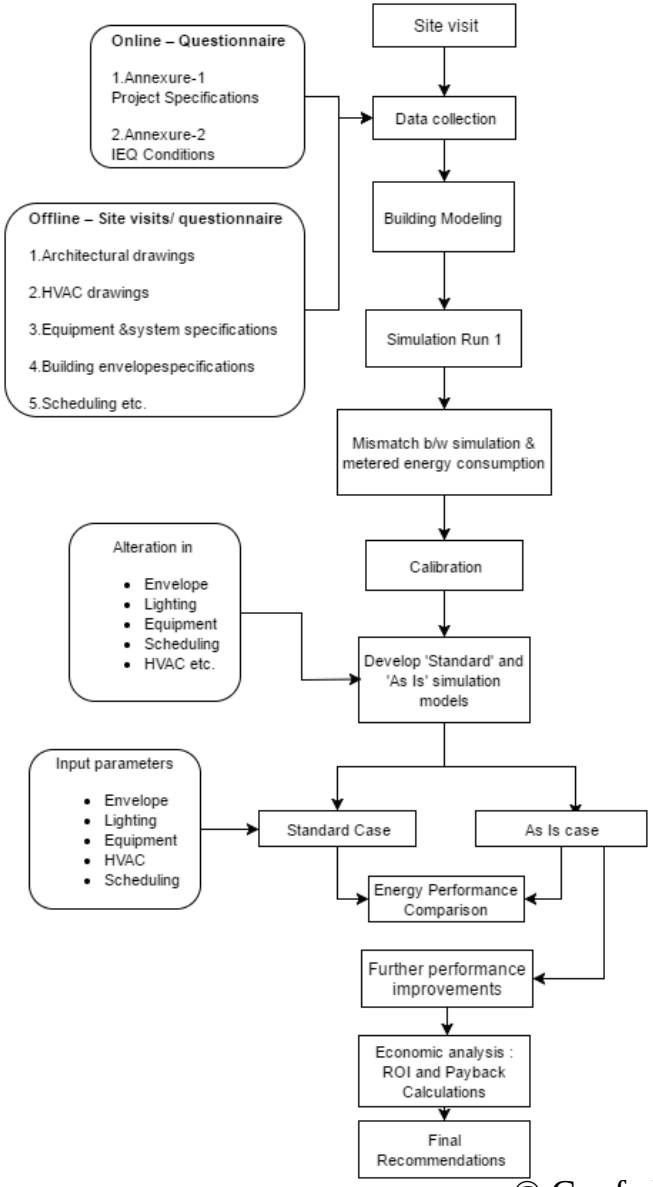
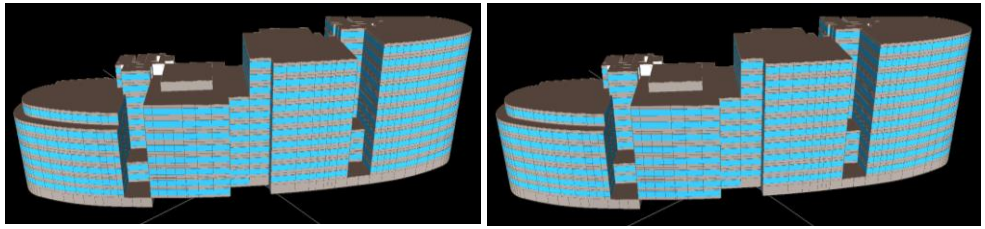
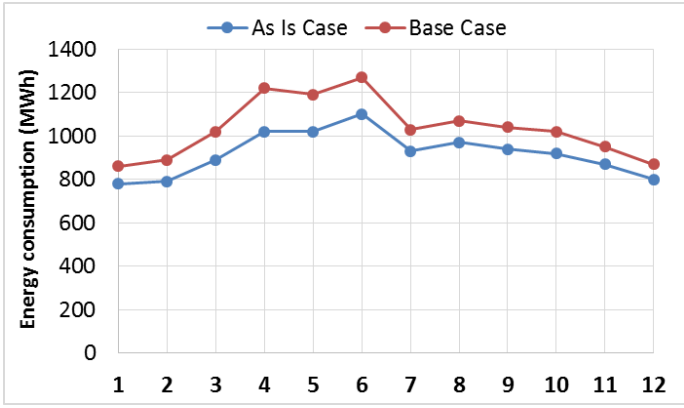
Energy Efficiency in Buildings





Base case and Proposed case simulation model



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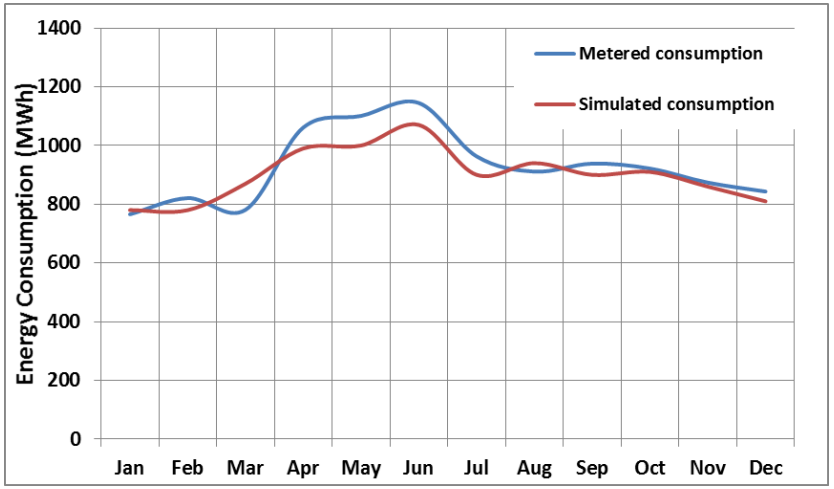
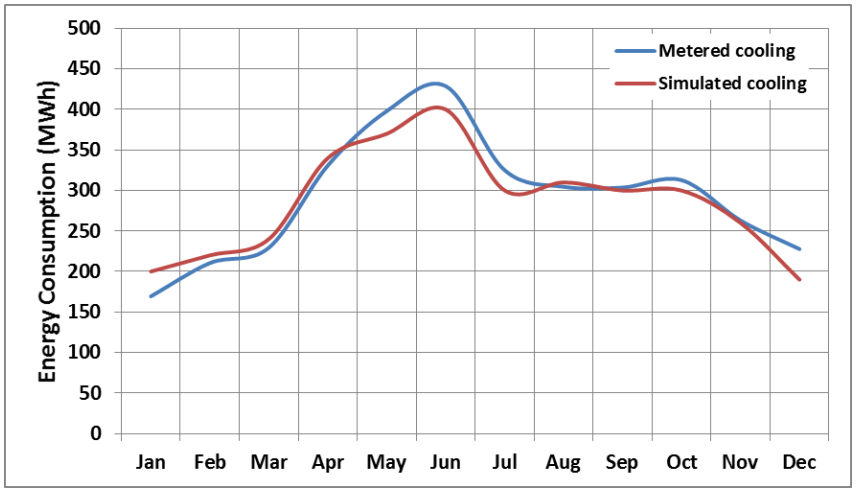
Calibration : Existing buildings

- **Calibration of simulation model**
  - **As per protocols of IPMVP, FEMP, ASHRAE 14P**
- **Building level**
- **Component /equipment level**



Calibration - Building level



Calibration – space cooling

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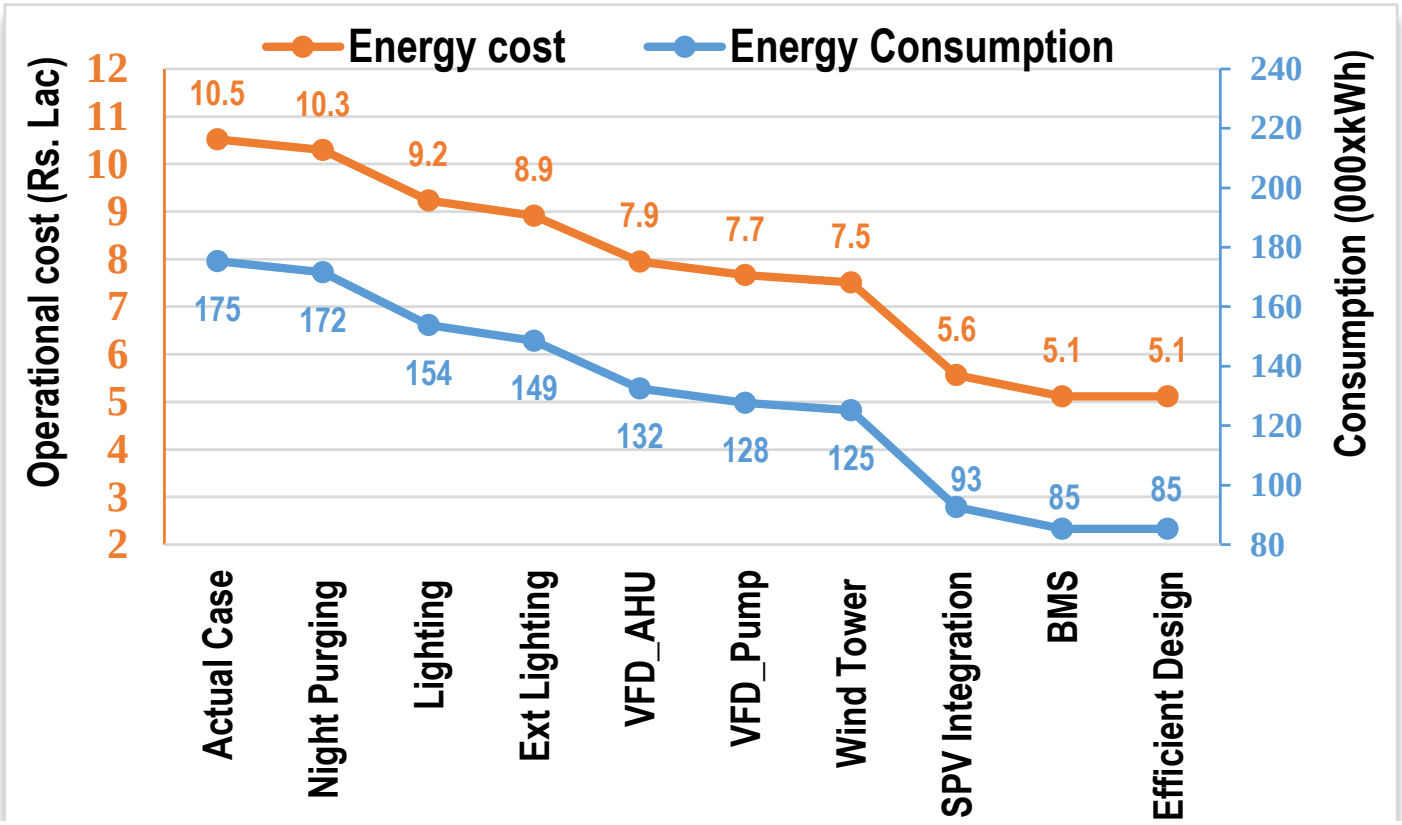
Energy Efficiency Measures and benefits

- **Energy savings : parametric analysis**



0.82 kg of CO2 per kWh

Twice as much as that of the EU

Lighting Energy Efficiency

Retrofitting of existing fixtures by LED fixtures

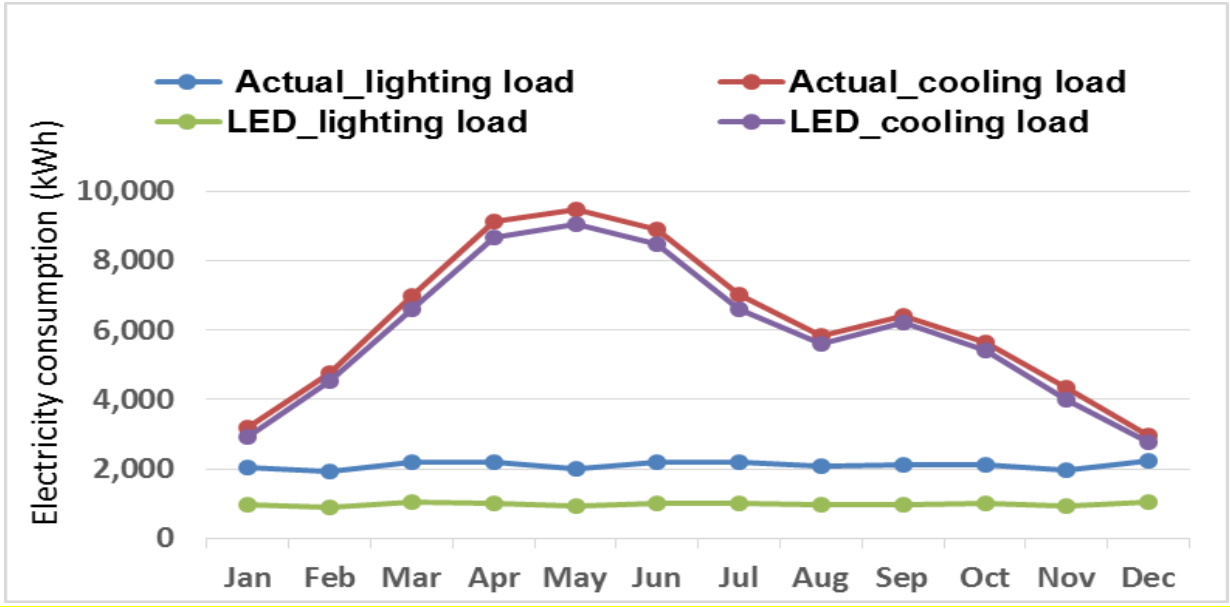
	LPD (W/ft^2)
Base case	**1.04**
Proposed case	**0.49**

Existing Lighting Fixtures
- 72 W/ fixture
- Efficacy : 60
- No of fixtures : 211

Proposed Lighting Fixtures
- 38 W/ fixture
- Efficacy : 132
- No of Fixtures : <100

Retrofitting : Lighting Energy Efficiency

- **Lighting energy saving : 52 %**
- **Cooling energy saving : 4 %**
- **Cost of fixtures : 5 lacs**
- **Payback : 3-4 years**



Operational cost saving : Rs. 1.5 lacs/ annum

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Lighting contour

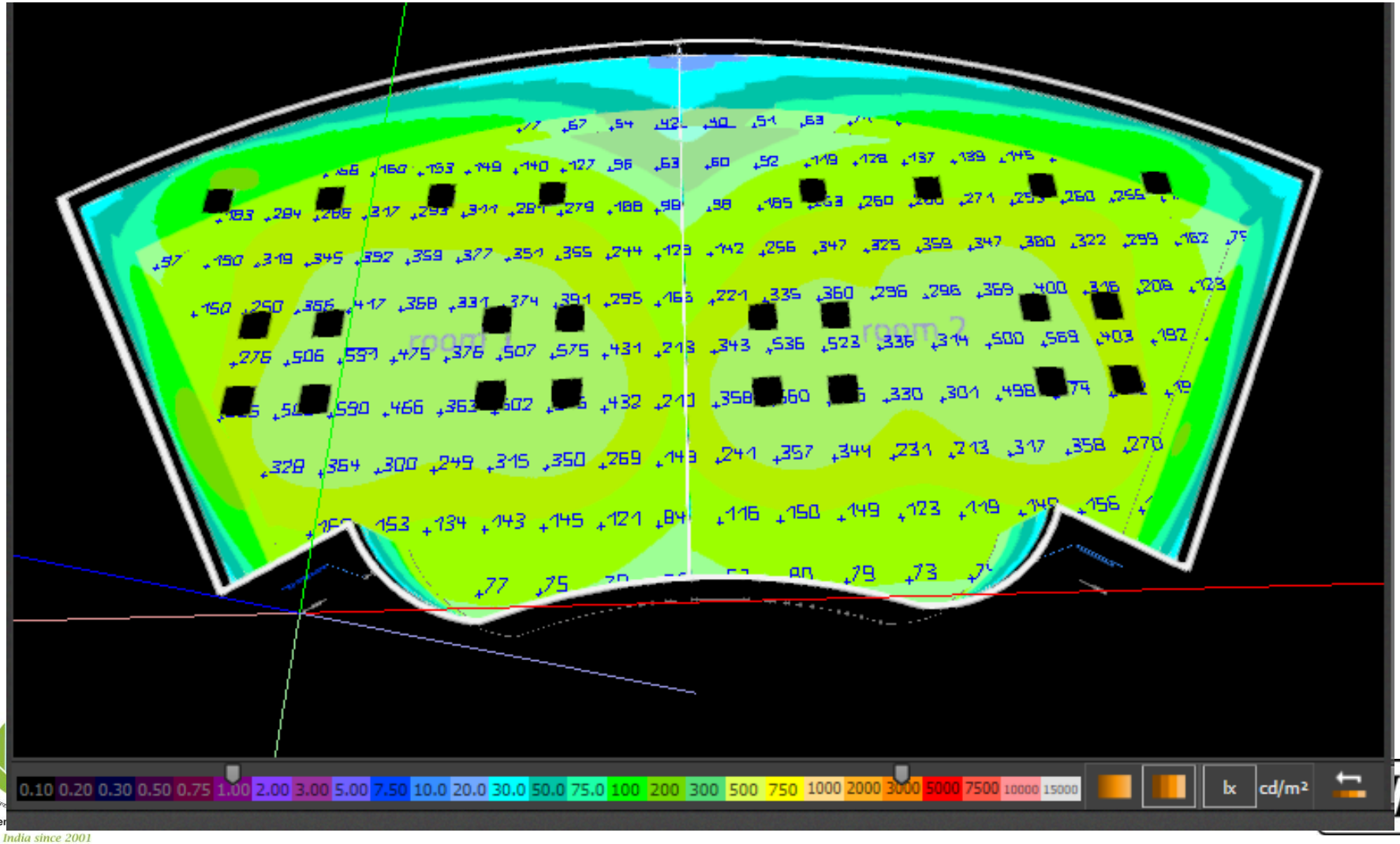
Wing A

- Maximum lux : 617
- Minimum lux : 34.6
- Mean lux : 270

Overall mean
262

Wing B

- Maximum lux :601
- Minimum lux : 33.4
- Mean lux : 255

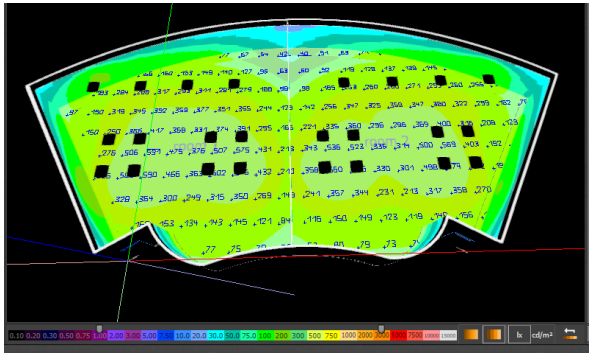


Optimise : No. of Lighting fixtures

- **Installed lighting fixtures**
  - Installed fixtures : 36 of 74 W
  - Lighting load : 2,664 W

- **Recommended lighting fixtures**
  - No. of fixtures : 24 of 40 W
  - Lighting load : 960 W

- **Savings : 1704 W**
- **Reduction in lighting consumption**
  - 63 %



- **Annual savings**
  - 1363 KWh (operation 8 hrs x100 days)
  - GHG reduction : 1172 kg CO2

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What needs to be done ?

- **Intellectual decision in selecting Energy Conservation Measure (ECM)**
  - **LCA analysis**
- **Adoption of IGBC Green building rating system**
  - **Reduction in energy, water & resources**
    - **Thereby reduction in GHG emission**
- **Building energy simulation**
  - **Simulation for new buildings**
  - **Calibrated simulation for existing buildings**
    - **Enable better predictions of energy efficiency measures**
  - **Help in strategic decisions**
    - **Energy & GHG reduction**
  - **Approach towards net zero energy/ carbon buildings**
- **Renewable energy integration**

<u>Significant potential in existing building stock</u>

Energy Efficiency and Environmental Benefits

Environmental Benefit Category	Benefits / Million Sq ft
CO_2 reduction	12,000 Tons
Energy savings	15,000 MWh
Water savings	45,000 KL
Construction waste diverted from landfills	450 Tons

Hospital Dehradun
IGBC Gold

GNRC Hospital Guwahati IGBC Gold

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Dr. Shivraj Dhaka
Counsellor | ECBC Master Trainer

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