

Energy Conservation – The IGBC Way



ITC Green Centre, Gurgaon
Platinum Rating



CII – Godrej GBC, Hyderabad
Platinum Rating



Wipro Tech., Gurgaon
Platinum Rating



NEG Micon, Chennai
Gold Rating



Grundfos Pumps, Chennai
Gold Rating

CII-Sohrabji Godrej Green Business Centre

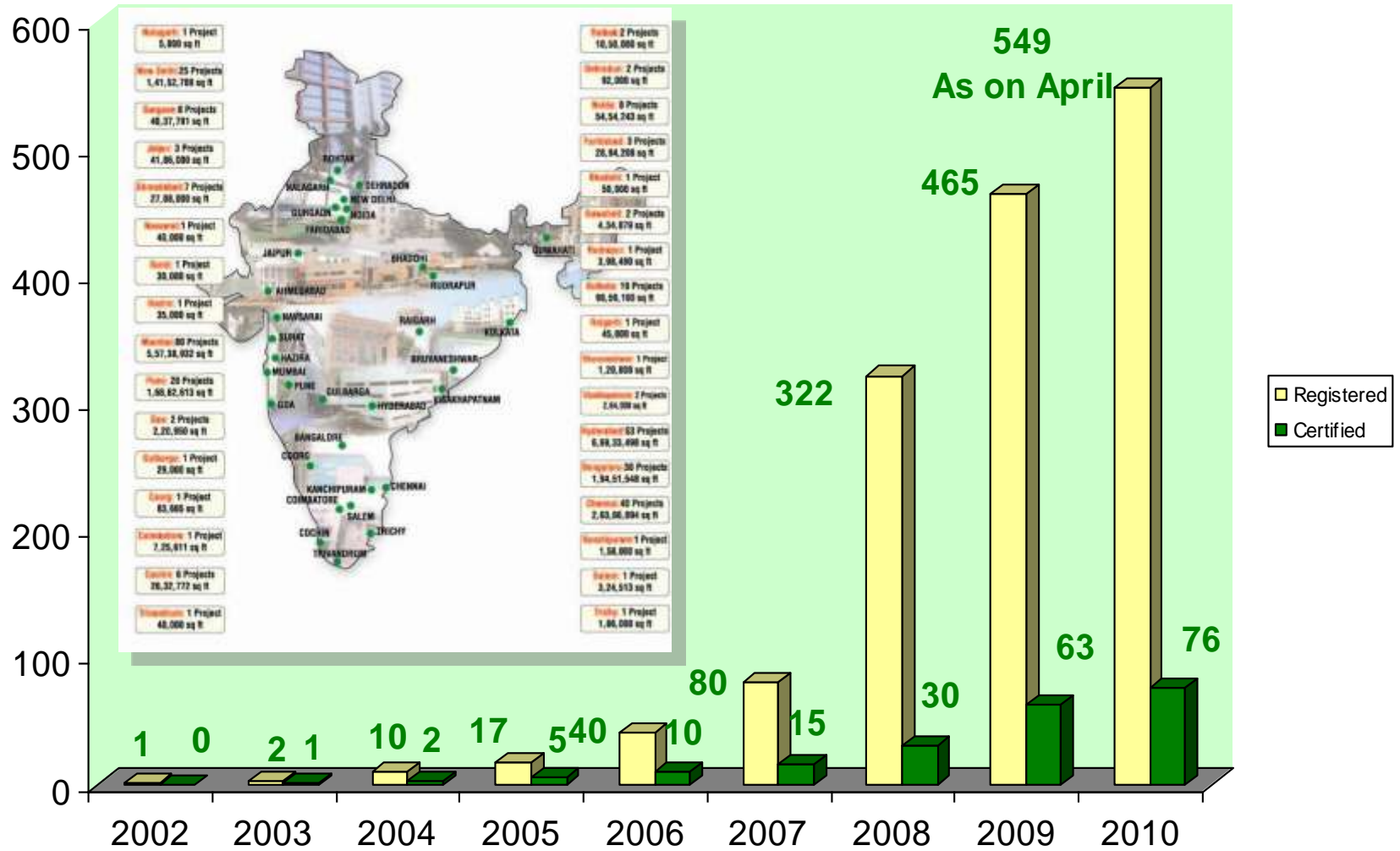


**“Centre of Excellence” for Green Buildings, Energy,
Environment, Water, Renewable Energy &
Climate change activities in India**

Green Building Movement in India

S No	Criteria	2001 →	Till date
1	CEOs & senior people involved	50	≈ 6,000
2	No. of professionals trained on Green Building concepts	10	≈ 7,000
3	No. of registered Green Buildings Built – in Area (sq.ft)	1 0	549 370 Million
4	Green Building products & equipment	5	90
5	IGBC Membership <i>(Founding Members)</i>	0	836 <i>(77)</i>
6	IGBC Local Chapters	0	9
7	IGBC AP	0	137
8	IGBC Assessors	0	10

Growth of Green Buildings in India



All types of buildings, all over the country :

IT Parks, Offices, Banks, Airport, Convention Centre, Institutions, Hotels, Residential, Factories . . .

What is Green?

Pursuit of an activity ...



Energy Efficiency



Use of Recycled/recyclable Products

What is Green?

Use of Renewable Energy



Water efficiency

**Ultimately leads to
Sustainable Development**

Green Building Vs. Conventional Building

- ❖ **Externally** : both look alike
- ❖ **Building Use** : both are same
- ❖ **Differences**
 - **Concern for human comfort & indoor environment**
 - **Operational savings**



CII-Godrej GBC

Tangible Benefits

- ❖ **Reduce operating costs**
- ❖ **Optimize life cycle economic performance**
 - **Sustained savings**

Technopolis, Kolkata
LEED CS Gold



- ❖ **Energy savings: 40 – 50 %**
- ❖ **Water savings: 20 – 30 %**
- ❖ **Reduction in initial investment**

Benefits Experienced in LEED Rated Buildings

- ❖ 3 LEED Platinum Buildings monitored to validate tangible benefits
- ❖ Benefits far exceeding the initial estimates

Building	Sq.ft	Normal Building (kWh)	Actual Building (kWh)	% Reduction	Annual Energy Savings (Rs in Lakhs)
Wipro	1,75,000	48,00,000	31,00,000	40%	102
ITC	1,70,000	35,00,000	20,00,000	45%	90
CII Godrej GBC	20,000	3,50,000	1,30,000	63%	9

- ❖ Energy consumption depends on
 - Local climate, Density of occupancy, Occupancy schedule, Orientation of the building, Internal loads

Intangible Benefits of Green Design

- ❖ **Environmental benefits**
 - Reduce impact on the environment
- ❖ **Health and Safety benefits**
 - Enhance occupant comfort
- ❖ **Improve Productivity of occupants**



Spectral Services, Noida
LEED NC Platinum

World Class Standards & Procedures

Do Green Buildings Cost More?

- ❖ **Depends on green features already considered & level of rating**
- ❖ **First cost Vs Life cycle cost**

Operational savings offset incremental cost

Cost of Green Buildings Indian Experiences

Building	Year awarded	Built-in Area (Sqft)	Rating Achieved	% increase in cost	Payback (Yrs)
CII-Godrej GBC, Hyderabad	2003	20,000	Platinum	18 %	7 years
ITC Green Centre, Gurgaon	2004	1,70,000	Platinum	15 %	6 years
Wipro, Gurgaon	2005	1,75,000	Platinum	8 %	5 years
Recently Rated Green Buildings					
Technopolis, Kolkata	2006	72,000	Gold	6%	3 years
Spectral Services Consultants Office, Noida	2007	15,000	Platinum	8%	4 years
HITAM, Hyderabad	2007	78,000	Silver	2%	3 years

- ❖ **Cost showing a decreasing trend over the years**
- ❖ **Incremental Cost lower if base design has already factored normal Green features**

Green Building Rating Systems

- ❖ **Defines Green Building**
- ❖ **Recognizes achievement on Green**
 - **Considers Local conditions**
- ❖ **Transform Markets to Green & Green products**



LEED India Green Building Rating System – Certification Levels

Rating	New Construction (NC)	Core & Shell (C&S)
LEED Certified	26-32	23-27
LEED Certified Silver level	33-38	28-33
LEED Certified Gold Level	39-51	34-44
LEED Certified Platinum Level	52-69	45-61

LEED India Green Building Rating System

Points for individual Credits

SI No	Credits	New Construction	Core & Shell
	Prerequisites	7	7
1	Sustainable Sites	13	14
2	Water efficiency	6	6
3	Energy and Atmosphere	17	14
4	Materials and Resources	13	11
5	Indoor Environmental quality	15	11
6	Innovation and Accredited Professional points	5	5
	Total	69	61

Complying with Prerequisites is mandatory for all LEED India Projects

IGBC Green Homes Certification Levels

Rating	Points for Individual Homes	Points for Multi-dwelling Units	% Points	Recognition
Certified	32-39	30-36	40-49%	Best Practices
Silver	40-47	37-44	50-59 %	Outstanding Performance
Gold	48-59	45-55	60-69 %	National Excellence
Platinum	60-80	56-75	70-100 %	Global Leadership

IGBC Green Homes Rating System

S No	Credits	Points for Individual Homes	Points for Multi-dwelling units
	Mandatory Requirements	9	9
1	Site Efficiency	8	9
2	Water efficiency	20	20
3	Energy Efficiency	22	21
4	Materials	13	12
5	Indoor Air Quality	13	9
6	Innovation	4	4
	Total	80	75

Complying with Prerequisites is mandatory for all IGBC Green Home Projects

Rating Programmes to Suit Different Building Types

❖ **One single rating cannot be applied to suit all building types**

❖ **Launched**

- **IGBC Green Homes**
- **IGBC Green Factory Buildings**
- **LEED India NC**
- **LEED India CS**

❖ **Other Programmes on the anvil**

- **IGBC Green SEZs ***
- **IGBC Green Schools ***
- **IGBC Green Cities ***
- **IGBC Existing Buildings ***
- **IGBC Landscape ***



* Rating under development

Green Building Projects in Bangalore

Name of the company	Project	Built-in area (Sq ft)	Status
ITC Limited	ITC Gardenia	7,64,994	Platinum
Cisco VTV	Cisco VTV	2,36,782	Platinum
GE India Technology Centre	GE India Technology Centre – Phase V	3,29,318	Gold
IMTMA	IMTMA	4,00,000	Certified
ISRO	ISRO Corporate Office	38,534	Ongoing
Employee State Insurance Corporation	ESI Hospital	2,58,226	Ongoing

To Sum Up

❖ Green Buildings

- Excellent opportunity to reduce operating costs from day one

❖ Tremendous benefits

- Tangible & Intangible

❖ Long term benefits



“Green makes Business Sense”

LEED India Perspectives for Energy Efficiency

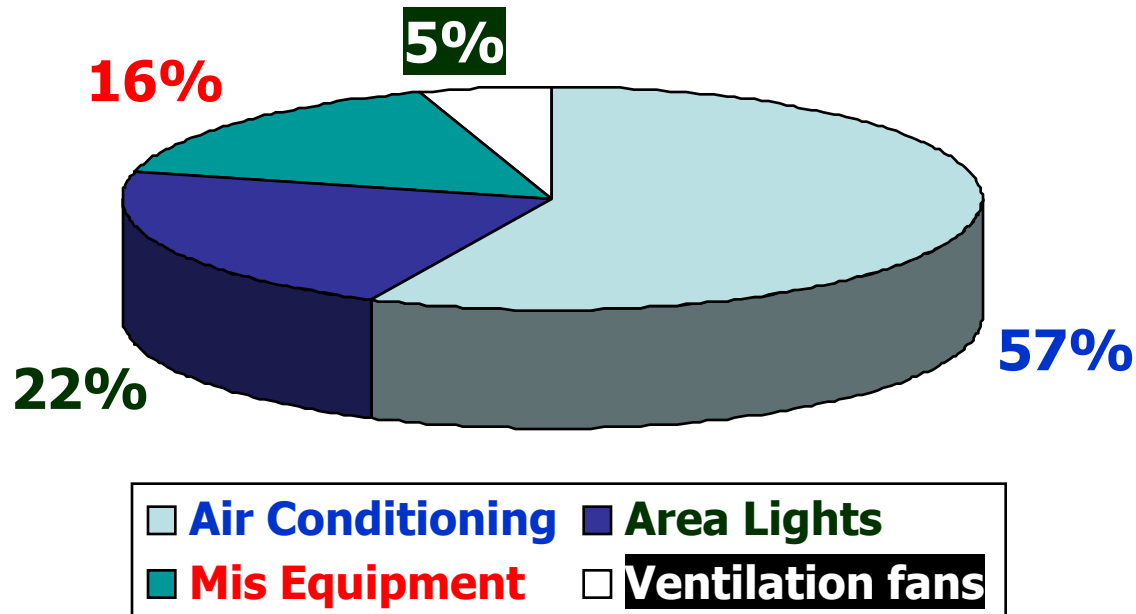
Credit	Title	Point(s)
Prereq 1	Fundamental Building Systems Commissioning	Required
Prereq 2	Minimum Energy Performance	Required
Prereq 3	Fundamental Refrigerant Management	Required
Credit 1	Optimise Energy Performance	1-10
Credit 2	Renewable Energy	3
Credit 3	Additional Commissioning	1
Credit 4	Ozone Depletion	1
Credit 5	Measurement & Verification	1
Credit 6	Green Power	1
		Total 17

IGBC Green Home Perspectives for Energy Efficiency

Credit	Title	Projects with Interiors	Projects without Interiors
Prereq 1	CFC Free Equipment	Required	Required
Credit 1	Energy Performance	10	10
Credit 2	Energy Metering	1	1
Credit 3	Refrigerators	1	NA
Credit 4	Solar Water Heating Systems: 50%, 75%, 95%	3	3
Credit 5	Captive Power Generation	1	1
Credit 6	On-Site Renewable Energy: 2.5%, 5%, 7.5%, 10%	4	4
Credit 7	Efficient Luminaries & Lighting Power Density: 20%	1	1
Credit 8	Energy Saving Measures in Other Appliances & Equipment	1	1
		Total 22	Total 21

Strategies for Energy Saving in Building

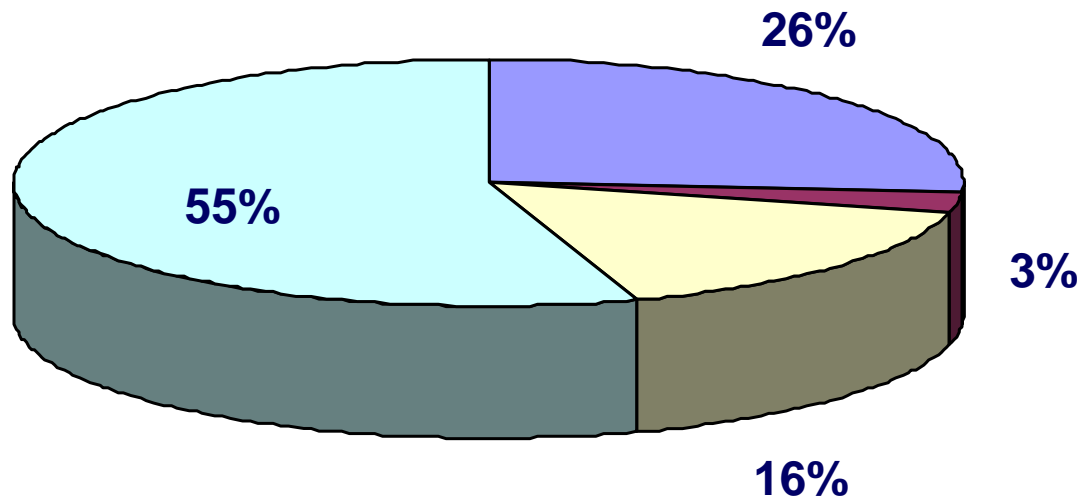
Building Energy Consumption



Break-up of energy consumption in a building

Cooling Load Components

A Break Up Of The Heat Gain Through Various Building Components



- WALL CONDUCTION
- GLAZING CONDUCTION
- INTERNAL GAINS (LIGHT, PEOPLE, COMPUTERS)
- ROOF CONDUCTION

Approach

1. Orientation

2. Envelope Measures

- **Wall, Glazing, Fenestration, Shading, Sky lighting, Roof**

3. Equipment & systems

- **Chillers, VFD, Lighting**

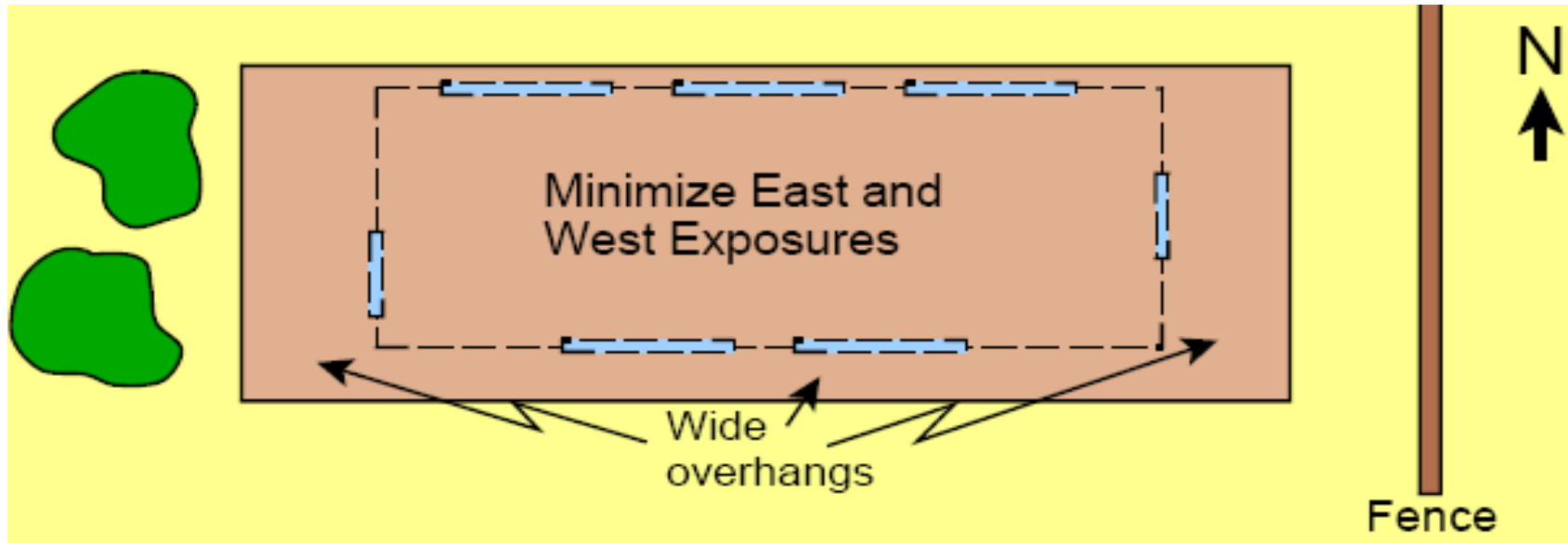
4. Controls

- **BMS, Temperature, Humidity**

5. Commissioning

- **Additional commissioning, M & V**

Orientation



- ❖ **What is the ideal orientation ?**
- ❖ **East-West ?**
- ❖ **North-South ?**
- ❖ **Does not matter ?**
- ❖ **Buffer East and West Exposures with garages, utility rooms etc.**

Saving potential : 2-3 % for 90% rotation



Envelope measures: Typical saving potential

❖ Orientation	:0.5-1%
❖ AAC wall	:3-8%
❖ Brick wall with 75mm extruded polysterene insulation	:3-8%
❖ High Albedo roofing material	:2-3%
❖ Roof garden	:1-2%
❖ Low-U glass & glazing	:6-8%
❖ Thermal break	:1-2%
❖ Roof insulation (extr. polyst)	:5-6%

Equipment & Systems

❖ Air-conditioning

➤ Chiller COP: Higher than ASHRAE 90.1

❖ VFD for supply & return fans and pumps

❖ Heat recovery wheels, economisers

❖ Controls & Building Management Systems

Chiller Performance

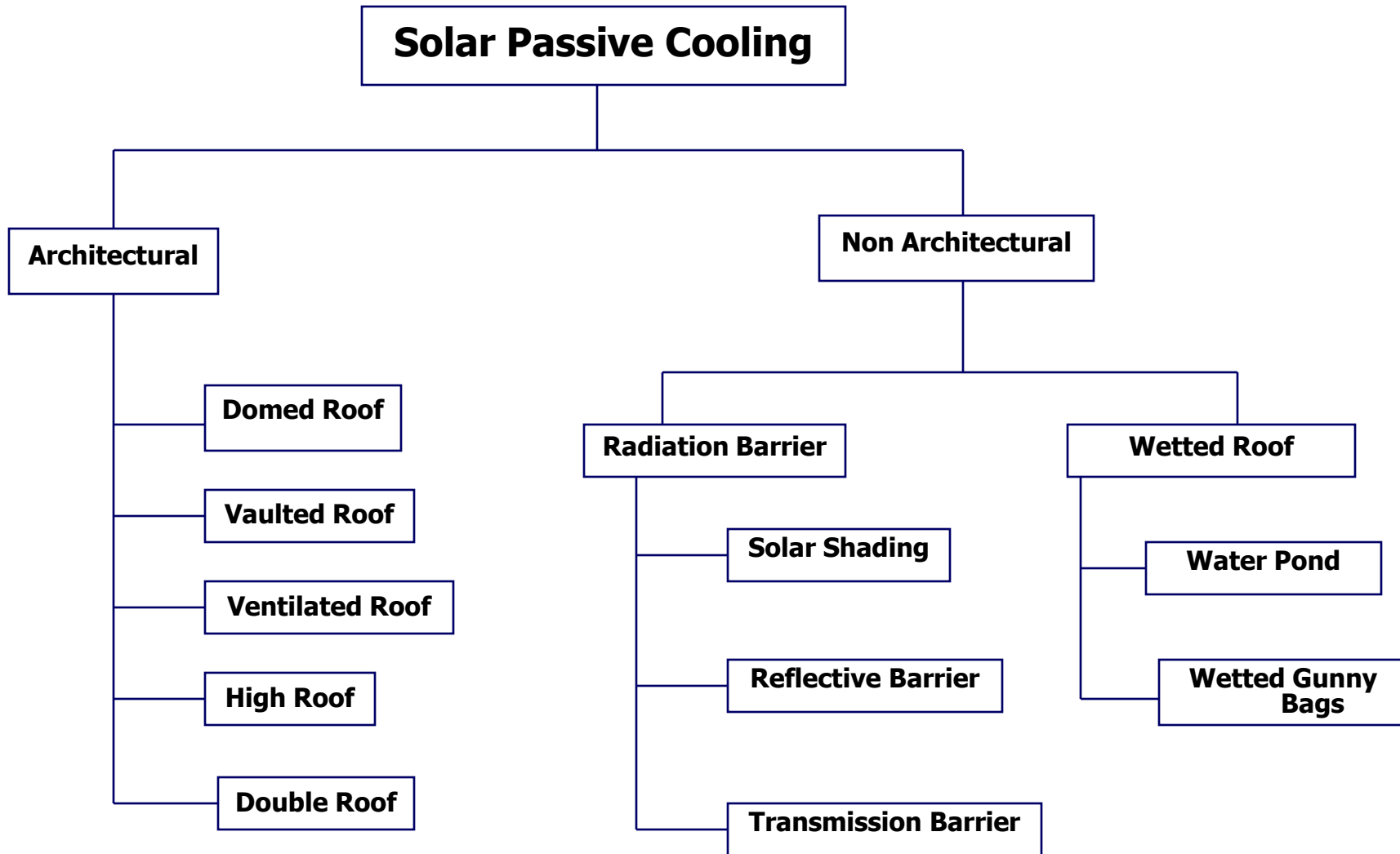
$$\text{COP} : \frac{\text{Amount of heat to be taken out}}{\text{Amount of work required}}$$

COP tested under ARI conditions:

Condenser water inlet : 29.4 deg C, outlet : 35 deg C

Chilled water inlet : 12.2 deg C, outlet : 6.7 deg C

Solar Passive Cooling Techniques



Passive Air-Conditioning Techniques

❖ **Wind Tower**

❖ **Geo-Thermal Cooling**

❖ **Earth Tunnel Cooling**



Energy Savings in Buildings

LEED Perspectives

Energy & Atmosphere

❖ Prerequisites

1. Fundamental Building Commissioning

- Engage a commissioning authority
- Commissioning Report

2. Minimum Energy Performance

3. CFC Reduction

EA Prerequisite 3: Fundamental refrigerant management

❖ Intent

- Reduce ozone depletion

❖ Attractive substitutes

- Zero use of CFC based refrigerants
- HCFC 123, HFC 134a, HFC 143a

Elimination of HCFCs and Halons

❖ Prerequisite

- Zero use of CFC based refrigerants

❖ Substitutes – HFC 134a, 407c

Refrigerant	ODP	GWP
CFC-12	1	8500
HCFC - 22	0.06	1700
HFC 134a	0	1300

ODP – Ozone depleting potential

GWP – Global warming potential

EA Credit 1: Optimize Energy Performance

- ❖ **Building simulation for Energy**
- ❖ **Energy cost budget for regulated energy components specified in ASHRAE / IESNA standard 90.1-2004**
 - **To submit Performance Rating Method compliance**

EA Credit 1: Optimize Energy Performance

- ❖ **All Non-Process Energy Components (Previously Regulated Loads)**
 - HVAC
 - Parking ventilation, Kitchen hood exhaust, Toilet exhaust
 - Service hot water systems
 - Lighting etc
 - ❑ Interior, Parking, Surface parking, Façade, Building grounds
- ❖ **Process Energy (Previously Plug Loads)**
 - Office equipment
 - Computers
 - Elevators & Escalators
 - Kitchen cooking & Refrigeration
 - Laundry washing & Drying
 - Lighting integral to equipment
 - Waterfall pumps
 - Swimming pool equipment

- ❑ **Process energy cost by default will be 25% of total energy cost**
- ❑ **If < 25%, to submit supporting documentation**

EA Credit 2 : Renewable Energy

❖ Intent

- To encourage in-situ generation of renewable energy



EA Credit 3: Enhanced Commissioning

❖ Intent

- **Ensure that owner reaps the operational benefits**
- **Verify and ensure that the entire building is designed, constructed, and calibrated to operate as intended.**

Third party / peer verification

EA Credit 4: Enhanced Refrigerant Management

❖ Intent

- Reduce ozone depletion and support early compliance with the Montreal Protocol

Green Building Concern Elimination of HCFC & Halons

- ❖ **Addition to prerequisite**
- ❖ **Environmental**
 - **HCFC & Halons**
 - ❑ **Contributes to ozone depletion & global climate change**
 - ❑ **Minimize or Eliminate**
- ❖ **Fire suppression systems free of ozone depleting substances (CFCs, HCFCs or Halons)**

EA Credit 5 : Measurement & Verification

❖ Intent

- Ensure owner gets this savings
- Accountability for building performance
 - ❑ Energy and water
- Review and fine tuning of base lines



EA Credit 6 : Green Power

❖ Intent

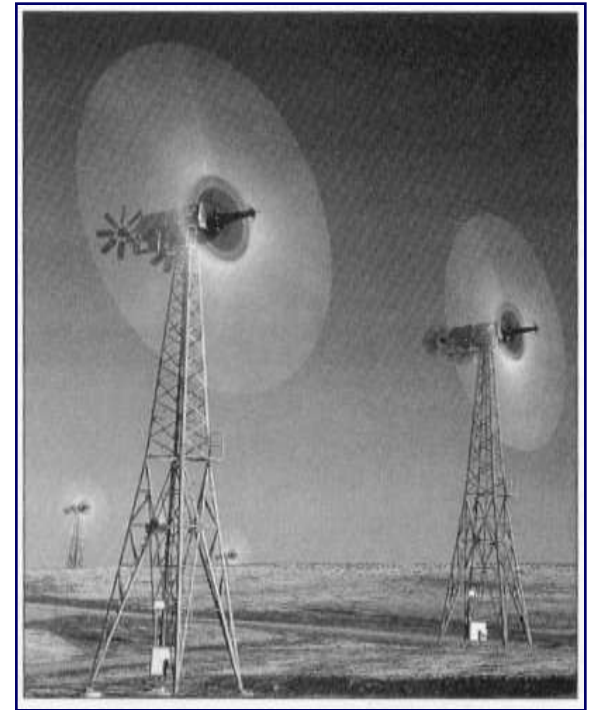
- Encourage utilities to buy renewable energy



Credit 6 : Green Power

❖ Requirements

- Purchase power generated from renewable sources
 - ❑ To meet 35% energy requirement
- Meet Green-e requirements
 - ❑ Supplier open for annual audits
 - ❑ Supplier not to purchase nuclear power



Energy Conservation Measures

❖ Envelope:

- Walls – Flyash blocks, Insulation of wall (Glass wool, Thermocol)
- Roof Insulation
- Roof garden / High Albedo roof
- Thermal break for windows
- Window shades
- Glazing: max 50% of facade area
 - ❑ U-value, SHGC, Visible transmittance

❖ Air Conditioning

- Chiller COP: Higher than ASHRAE 90.1
- Cooling tower as per CTI testing standards
- VFD for supply & return fans
- Energy efficient motors
- Heat recovery wheels / Economisers



Energy Conservation Measures

❖ Lighting

- Maximum day lighting
- 0.8 W/sq.ft density
- Daylight dimmer controls

❖ Controls

- BMS
- M & V
- Metering



CII – Sohrabji Godrej Green Business Centre, Hyderabad

A unique Public – Private Partnership
(CII, Govt of Andhra Pradesh, USAID and Pirojsha Godrej Foundation)



**“Centre of Excellence” for Energy, Environment, Green Buildings,
Renewable energy, Water & Climate change activities in India**

CII-Sohrabji Godrej Green Business Centre, Hyderabad

❖ First “Green” Building in India

- First “Platinum” rated building outside US
- First Platinum building in the World under version LEED 2.0 (other 2 buildings are under



CII – Godrej GBC building has achieved 56 points out of 59 points attempted

CII-Godrej GBC Building

❖ Demonstration of

- **Practicing what we preach**
- **Green buildings are possible & viable**
- **India can reach global environmental standards**
- **Indian construction industry can reach global standards**



Features of CII-Godrej GBC Building

Energy Efficiency

❖ Overall reduction

➤ **55% on total energy vis-à-vis**

ASHRAE

❑ **40 % on Air-conditioning load**

❑ **88% on lighting energy**



Fly Ash Block

❖ Entire Building with AAC Blocks

- Energy savings
- 40% recycled content
- U value 0.65 W/Sq.m °K
vis-à-vis 1.9 for concrete



Aerated concrete blocks made of fly ash

Chiller Units

❖ Selected as per ASHRAE 90.1-1999

- 25 TR x 2 Nos
- Water cooled Scroll Chiller
- HFC Based refrigerant
 - ❑ R 407 C
 - ❑ ODP – 'Zero'
- COP of 4.23 (0.8 Kw/TR)



Wind tower

❖ Wind tower

- Fresh air intake through towers
- Thermal mass
- water spray
- Drop in air temperature
5 – 7°C

❖ Results in 2 – 3 % reduction of air conditioning load

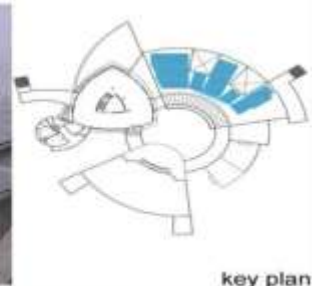


In-Situ power generation

- ❖ 24 KW capacity
- ❖ Grid connected
 - Generates about 100-110 units/day
- ❖ Meets 20 % of total energy requirement of the building



Detail of PV Panels

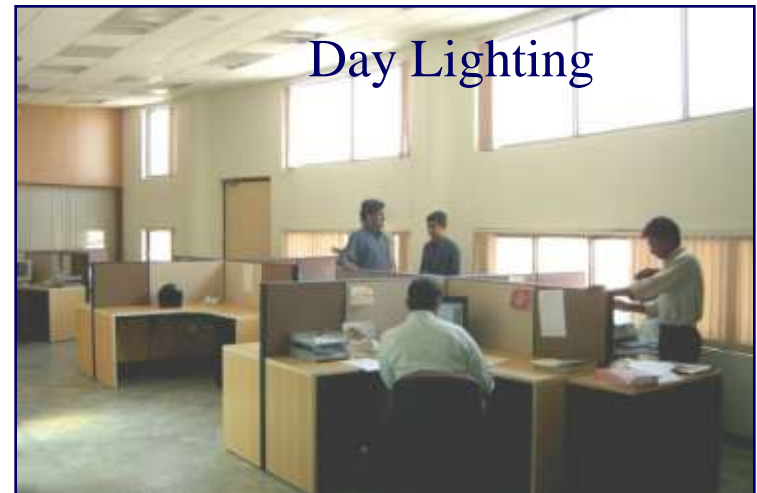


PV array installed on south-west wall

Lighting

❖ 88% on lighting energy

- Maximum day lighting
- Energy efficient light sources (CFLs)
- Occupancy and dimmer controls
- Minimum outdoor lighting



State-of-the-Art BMS

❖ Monitoring

- Air-conditioning
- Fans
- Pumps
- Lighting

❖ Scheduling of equipment operations



Sustainable site

❖ Roof Garden

- To reduce heat ingress into the building
- 2 inch deep plastic trays filled with earth
- Conventional terrace garden
 - ❑ 6-12 inch deep soil
- Load on the structure reduced tremendously



roof garden on seminar hall
detail of lawn tray

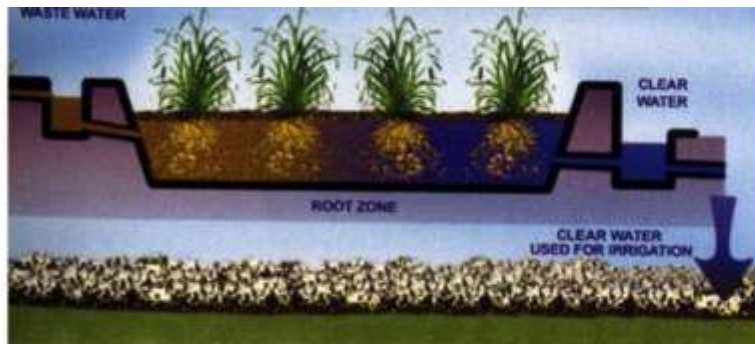


Root Zone Treatment

❖ **Wastewater treatment system**

❖ **Root Zone Treatment**

- **Biological mechanism**
- **Treated water used for irrigation**



root zone treatment process



view of typical plantation

Recycled Materials

❖ 80% of the building materials

- Post-consumer/ post-industrial recycled content
- Eg: Aluminum, Fly Ash cement & Blocks, Glass, Ceramic Tiles, wood, False roof



Day lighting

❖ **Fenestration**
maximized on the
north orientation to

- **Minimize heat gains**
from windows and
- **Maximize day**
lighting



courtyard in Technology Centre



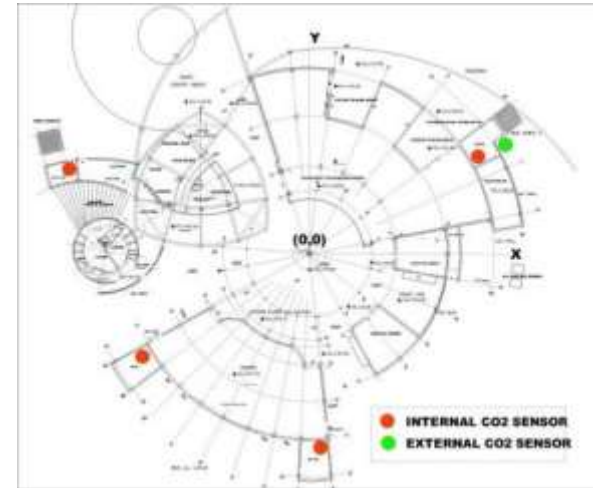
courtyard on first floor

daylight in Technology Centre



CO₂ Monitoring

- ❖ **LEED requirement**
 - **530 PPM differential**
- ❖ **Installed CO₂ sensors**
 - **Return air ducts**
 - **Out side building**
- ❖ **Controls fresh air inlet accordingly**



U Values - Wall, Roof & Glass

Type	ASHRAE 90.1 -2007 (W/Sq.m ° K)	ECBC 2008 (W/Sq.m ° K)	CII-Godrej GBC (W/Sq.m ° K)
Wall	U-value : 3.289	U-value : 0.44	U-value : 0.511
Roof	U-value : 0.357	U-value : 0.409	U-value : 0.289
Double Glazed Glass	North, U value : 6.917 SHGC : 0.617 Non-North, U value : 6.917 SHGC : 0.191	North, U value : 3.3 SHGC : 0.25 Non-North, U value : 3.3 SHGC : 0.25	North, U value : 1.67 SHGC : 0.676 Non-North, U value : 1.66 SHGC : 0.363
Air Leakage (L/Sq.m)		5 for Entrance Doors & Revolving Doors 2 for other Fenestration & Doors	



A close-up photograph of a peacock's tail feathers, which are fanned out to reveal numerous 'eyes' or ocelli. Each eye is a circular pattern of colors, including blue, green, and brown. The peacock's body is visible in the center, showing a blue neck and a greenish-yellow breast. The text 'Go Green' is overlaid in white at the top, and the website address 'www.igbc.in' is overlaid in white at the bottom.

Go Green

www.igbc.in