# Green Building-
# Innovative Technologies

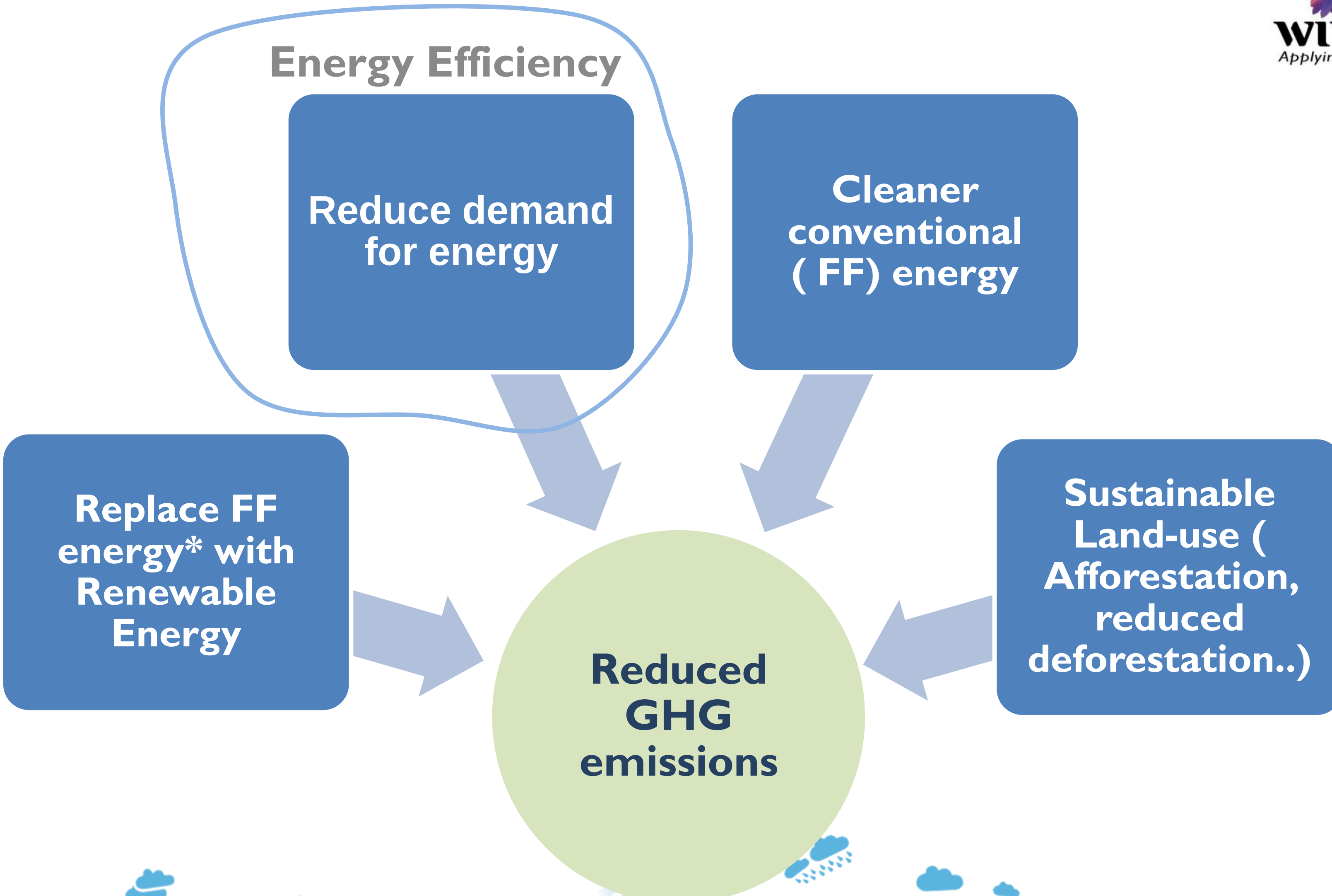
WIPRO
Applying Thought

Wipro EcoEnergy

Reduce.
Recover.
Replace.

Setting the context

# The four models for reducing GHG emissions



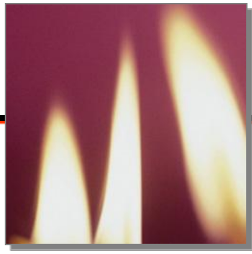
# Sustainable habitat - multiple dimensions of Sustainability

| | |
|---|---|
| Green Buildings | • Cooling efficiency – Earth Air tunnels, Geothermal, Chilled Beams etc<br>• Lighting efficiency - LED lighting, |
| Green Transportation | • More efficient IC engines<br>• Lighter materials for car body – resulting in higher efficiencies |
| Green Grids | • Smart grid management resulting in reduced T&D losses |
| Green ICT | • Hardware virtualization resulting in greater information processing per cycle<br>• More energy efficient PCs, Servers and Routers |
| Green Industry | • More efficient industrial motors & pumps<br>• Improved production processes e.g. Smelt reduction in steel industry<br>• Waste to heat recovery in industrial processes |
| Green homes | • Energy efficient home appliances e.g, Energy Star ACs, refrigerators, PCs etc |

# Options for change – technological and behavioural

## Emission reduction

Renewables



A further shift to natural gas

Bio-products

Carbon capture and storage

Nuclear power

## Energy conservation and efficiency

Mass transportation

Road transport

Buildings

Low energy appliances


Doing things differently

Building related

# Building Sustainability

- Factors impacting sustainability
  - Effective Use of soil & Landscapes
  - Efficient Use of Water
  - Energy Efficient & Eco Friendly Equipment
  - Effective Control & Building Management Systems
  - Use of Renewable Energy
  - Use of Recycled/Recyclable Materials
  - Improved indoor air quality for health and comfort
- Benefits
  - Reduces energy and water consumption
  - Reduces ecological footprint
  - Improves quality of workspace

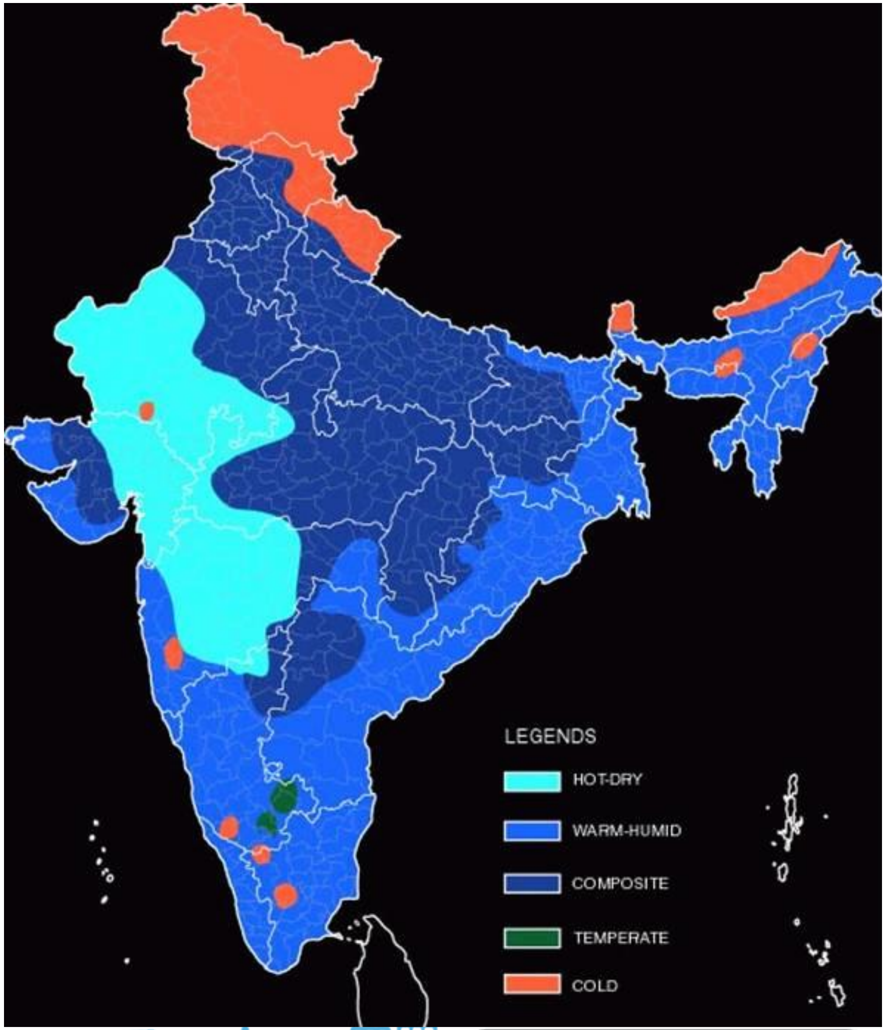
**Wipro has set up the largest number of green facilities in**

**Wipro Gurgaon**

**The Highest rated LEED Platinum facility outside the US**

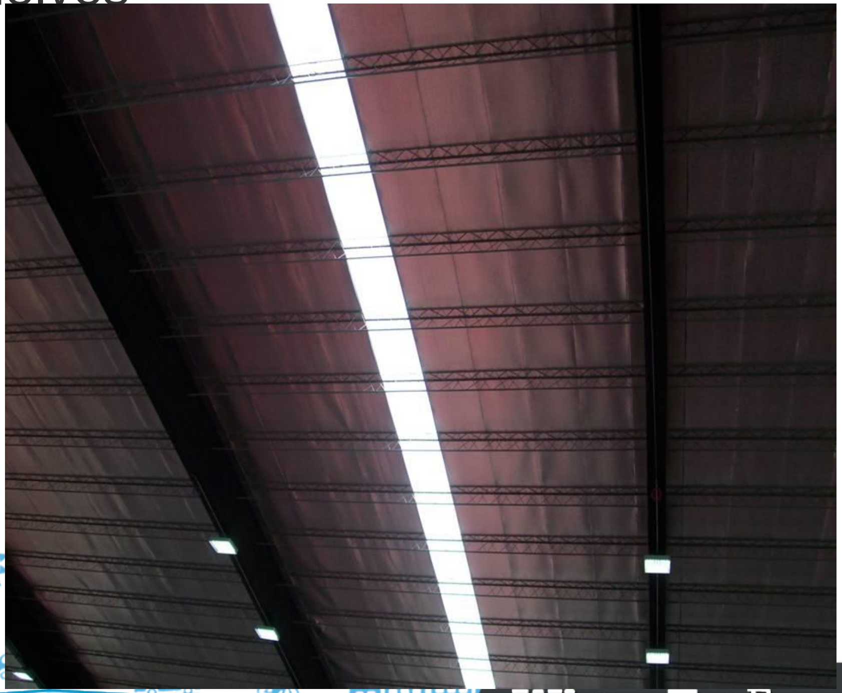
# Indian Complexity

- Five climate zones
  - 1. Composite (Delhi)
  - 2. Hot Dry (Ahmadabad)
  - 3. Hot Humid (Kolkata),
  - 4. Moderate (Bangalore)
  - 5. Cold (Shillong)
- Wide variation in climate within each location
- Requires customised solutions



# Building Design – Daylight Modeling

- Daylight simulation coupled with window location/design to minimise lighting load
- Interiors designed to keep high lighting-load areas close to daylight span
- Window design to include light shelves



# Building Design – Shade Analysis

- Reduces glare without loss of sunlight. Improves thermal performance

Full Building


Facade

Individual Window

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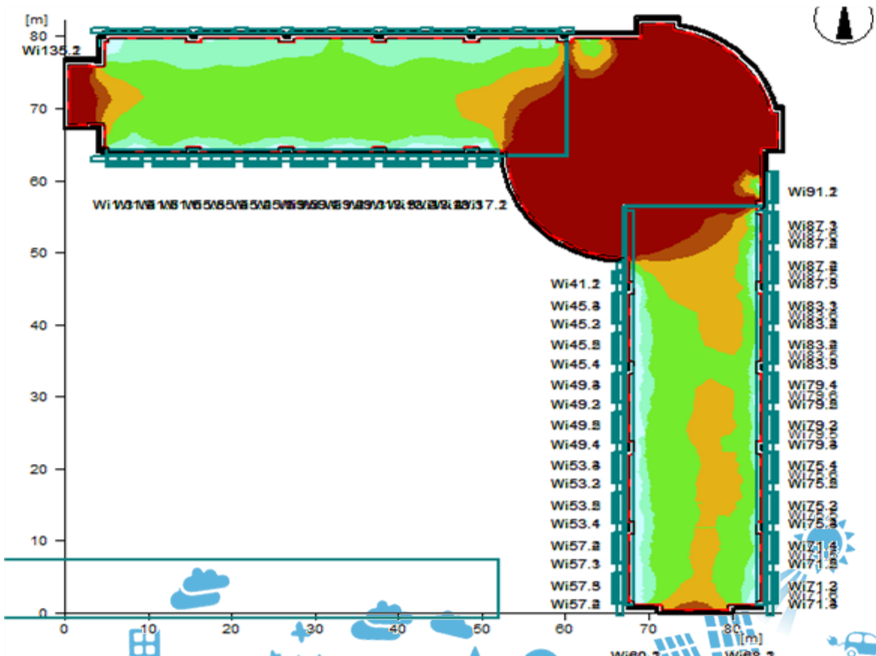
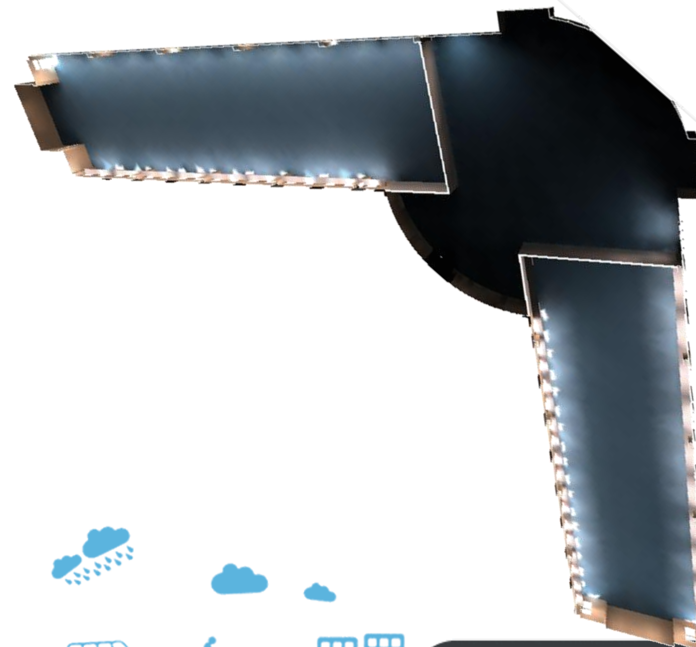
# Building Design – Heat

- Good energy modeling reduces heat transfer coefficient by upto 40%, and building energy consumption by 6%. Examples:
  - East and west walls with sandwich insulation and air gap
  - Restrict glazing to north and south facades
  - Window to wall ratio < 40%



# Building Design – strategies

- To improve indoor air quality to ASHRAE 62-2001 (< 530 ppm):
  - Couple naturally ventilated areas with CO2 sensors
  - Use low VOC paints sealants and adhesives. E.g.: carbon compounds < 250 gms/litre for anti-corrosive paints
  - Laminates used for interior should be free from urea formaldehyde
- Use of low-flow flush, urinals and closets
- All electrical and ventilation system to be coordinated with building management system (BMS). Water consumption could also be metered through BMS
- Landscaping integrated with building design and plant processes:
  - Construction of swales and ponds for water collection which could be used for tertiary treatment
  - Reuse of ETP treated water up to tertiary level for flushing and landscaping
- Use low water-intensive plants; especially reduce lawn area
- Use drip sprinklers to reduce evaporation loss
- Choose native plants; they are most likely to survive with minimal care

# Building Materials – Roof

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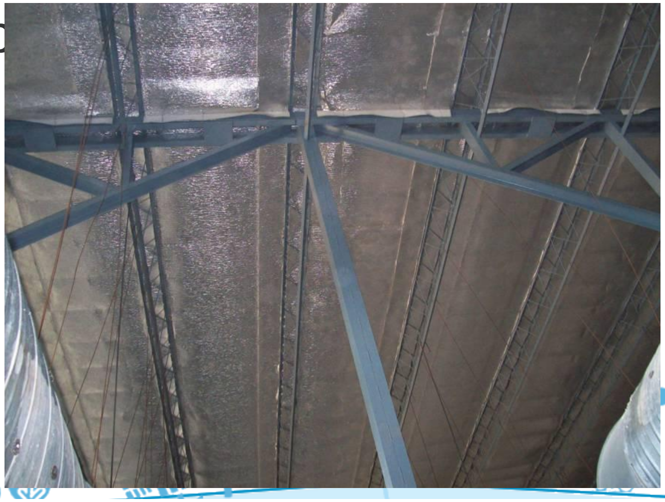
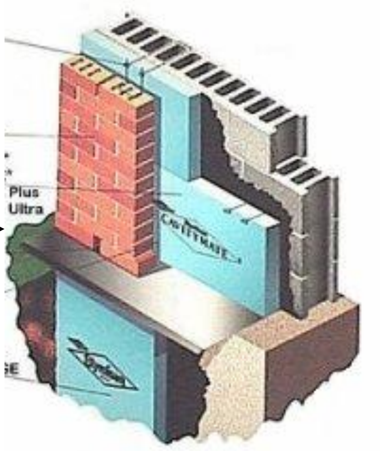
Applying Thought

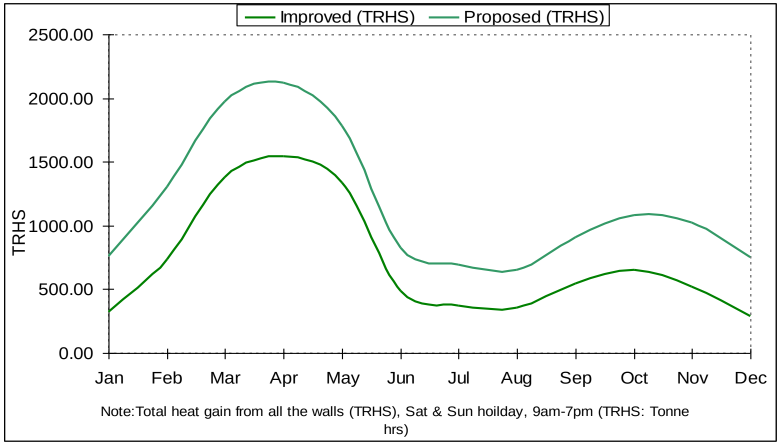
- Insulate composite slab roof with 75mm extruded polystyrene. Reduces heat transmission by 50%
- Truss insulation of PEB ceiling with 75mm rockwool
- Roof finish with high reflexive material; SRI > 78. Reduces heat transmission b



# Building Materials – Walls & Windows

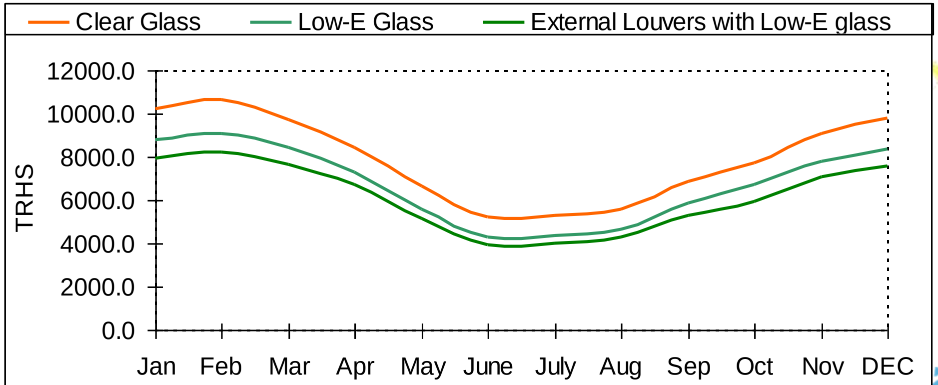
- Use AAC or cellular concrete blocks (0.12-0.15 btu) to reduce U-factor
- Better material can reduce heat gain from walls by 35%




Note:Total heat gain from all the walls (TRHS), Sat & Sun hoilday, 9am-7pm (TRHS: Tonne hrs)

- Use of low-E glass with double glazed windows
- E.g.: 6mm glass + 12mm airgap + 6mm ecologic (ST150, light blue gray, U factor of 0.33 btu) has 21% reflectance 39% transmittance
- Reduces heat gain by 15-20%




Note: Total heat gain from the windows from 9am-7pm throught the year (sat & sunday holiday)- Tonne hrs

# Green Materials:

The choice of a green material depends on following parameters:

1. Physical suitability: Its physical properties like compressive strength, tensile strength, water resistance etc.
2. Dependability: Its dependability on other materials for its aesthetic or functional efficiency.
3. Cost: Affordability subject to the budgetary constraints.
4. Aesthetics: Its aesthetic blend with the entire schema of things
5. Workability: Ease with which it can be used

# Green Materials:

6. Environmental performance:

- Embodied energy
- Recycled content
- Recyclability
- Toxic Emissions (if any)
- Carbon footprint
- Water footprint
- Life cycle Impact

Other area of applications

# Data Centre's

A data center is said to be efficient when its POWER UTILIZATION EFFECTIVENESS (PUE) is lower.

In a data center, air conditioning is the most energy consuming parameter. Efficient design of air conditioning would bring down the overall power consumption on the services.

The other levers to enhance the energy efficiency includes better passive shell design , design of IT infrastructure, efficient design and better equipment selection related to UPS, DG and lighting

# Data Centre’s

- Quick start centrifugal chillers with VFD thus eliminating the need of DX PAC units during power change over.
- Real time energy simulation, efficient air flow management by using containment strategy, EC fans for the PAC units.
- Efficient design of controls by mapping the chillers operating curve and integrating the same with building load profile and ambient temperature profile.
- Efficient pumping system design – Primary variable pumping system, Vertical pumps etc.
- Integrating Pre cooling and free cooling technologies to reduce the OPEX.
- Minimizing the transmission loss on the electrical side by efficient design.

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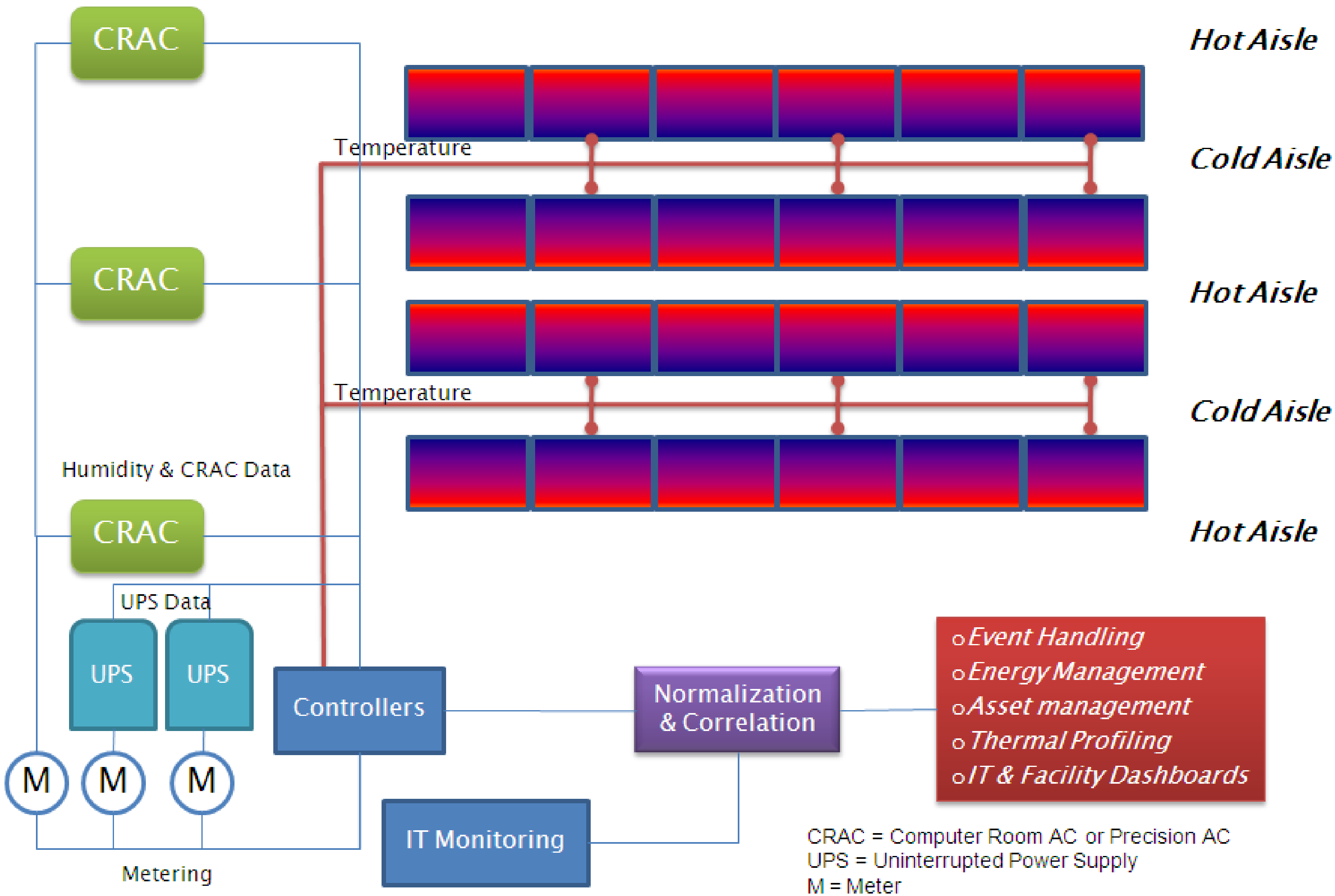
# Technology approach to Data Center energy efficiency -




CRAC = Computer Room AC or Precision AC
UPS = Uninterrupted Power Supply
M = Meter

# Saving approach thru technology application-

- Closed Loop Cooling system – Cooling based on sensing the heat at the back of the racks, active tile sensing the heat to provide needed CFM, and pressure sensors under the floor giving feed back to PAC to deliver needed CFM.
- Variable CFM through electronically commuted motor and backward curved fans. Thermal modeling and CFD will be used to optimize air flow
- Power consumption based on the dynamic heat load.
- Air tunnel pre cooling of incoming fresh air to chiller based on geothermal technology to improve saving.

<u>Savings</u>

- Saving in excess of at least 20% in the power consumption. Hence the original and revised power consumption across the stages would be (in KVA) –

| | Standard cooling | Adaptive cooling |
|---|---|---|
| Stage 1 | 1456 | 1165 |
| Stage 2 | 2155 | 1673 |
| Stage 3 | 2155 | 1724 |
| Stage 4 | 2790 | 2232 |

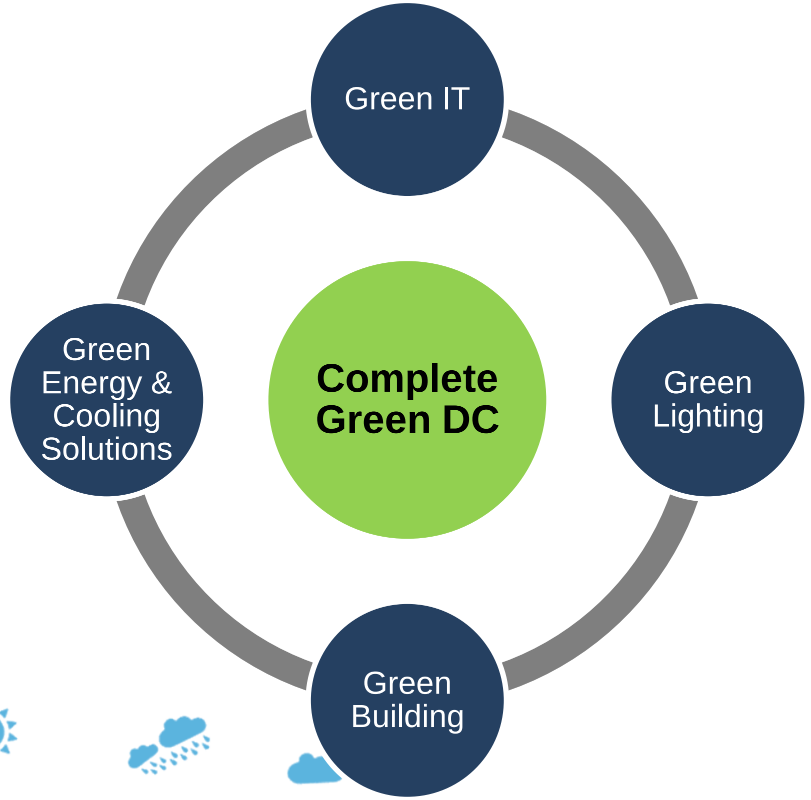
*Hence, power consumption schedule would give a saving of Rs. 178 million over a period of 5 years*

# A first in India – EE and RE systems used in LEED certified DC

**EcoEnergy @ DataCentre**

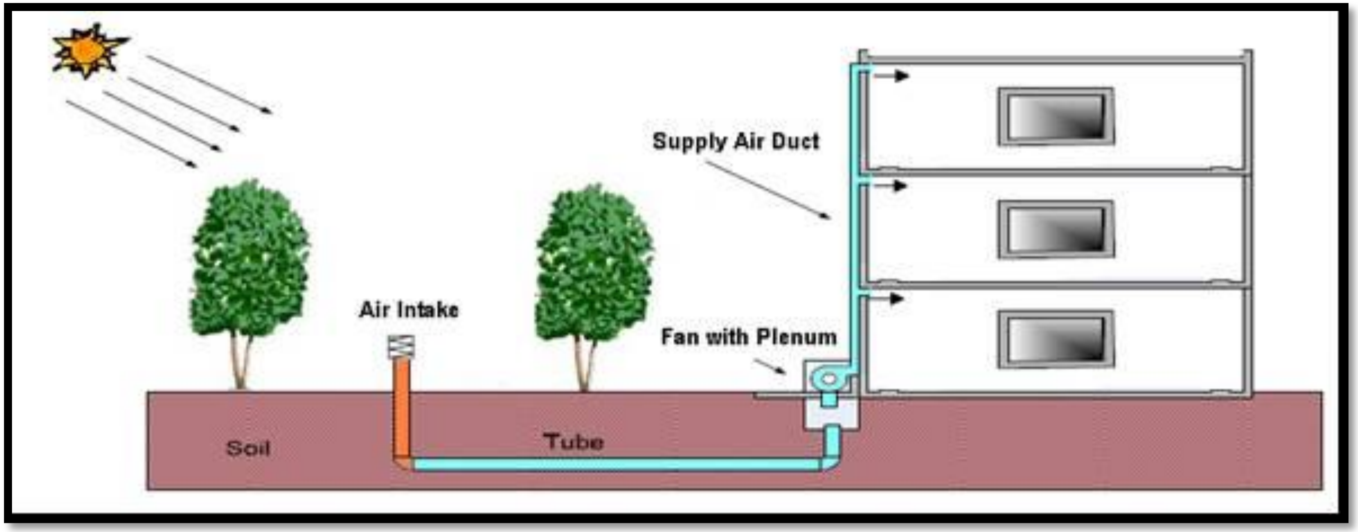
Technically reliable, Industrial scale, Financially prudent

- For DataCentre - complete green solution
- Green System implemented :
  1. 80TR Geothermal + Earth air tunnel
  2. Rainwater Harvesting
  3. 1000LPD Solar Thermal ETC water heating system
  4. Energy modeling
  5. LED/CFL Lighting solution
  6. LEED Certification
- Customer IRR of 17-22%



# Innovative Cooling solutions

## Earth Air tunnel

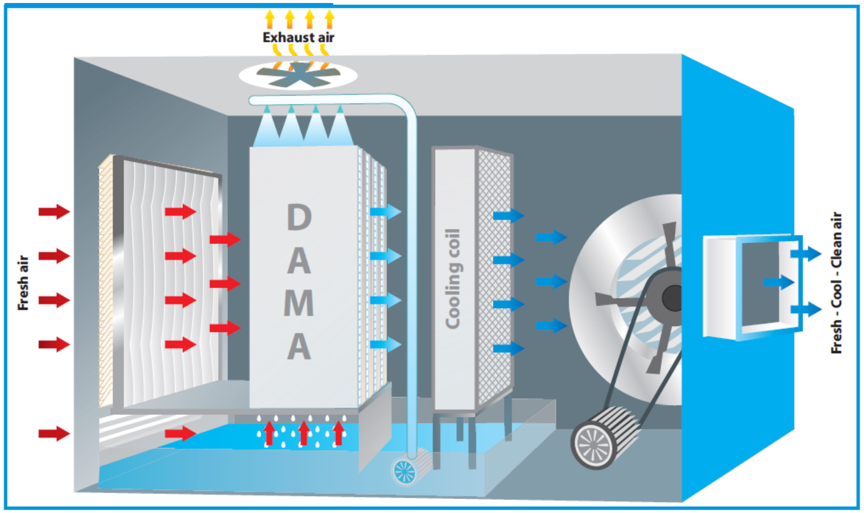



- Heat rejected to ground where the temp. is relatively constant round the year
- Can be used with contrasting climatic conditions in various seasons of a year
- Used to precool / preheat the air
- Wipro has adopted innovative cooling solutions in most of the projects.

# Comfort cooling in a factory environment

- Energy efficient and eco friendly

- High enthalpy reduction in the First stage closed Heat exchanger where water is passed resulting no humidity this air air cooling to 28deg C;
- 2nd stage further reduces air with direct wter contact to 24 deg C bring within comfort cooling zone .
- Although the humidity will be around 70 – 75 % during pre and post monsoon period, it would not lead to greater discomfort when the space temperature is around 27 – 28 $^0$C.
- When compared with Air conditioning system less operating and maintenance cos
- Better indoor air quality and work environment. Very low CO2 levels.

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# Innovative cooling solutions

## Geothermal Cooling

•Heat rejected to ground where the temp. is relatively constant round the year

•Can be used with contrasting climatic conditions in various seasons of a year

•Efficiency achieved is as high as 20 ERR.

•Useful for smaller cooling / heating requirements.

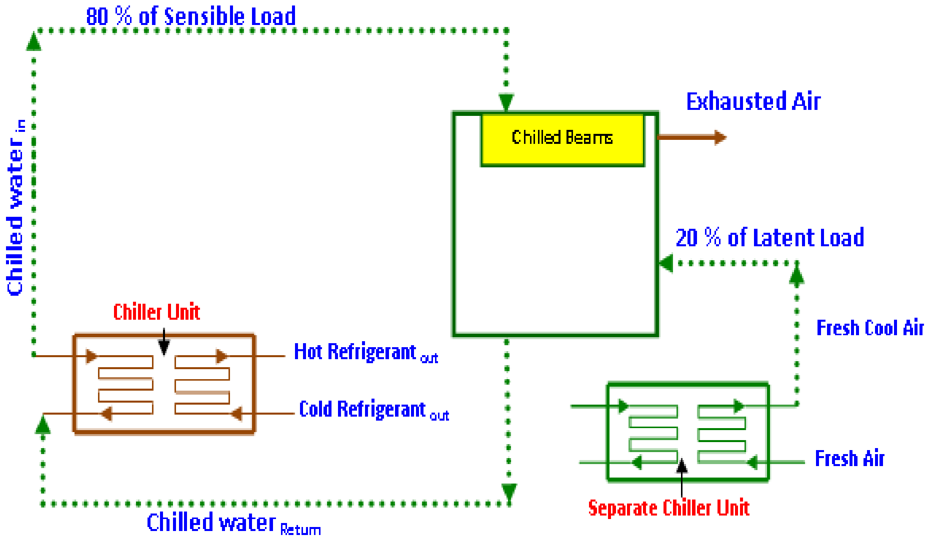
# Chilled Beams – results energy saving

•It is a type of passive cooling system

•Major difference between conventional cooling and chilled beam system is chilled beam handles SENSIBLE and LATENT loads separately where as in conventional cooling both are handled simultaneously.

•Fresh air (SENSIBLE load ) is handled separately and passed into the chilled beams. This induces convection which makes the room air pass through the chilled beam coil and back to the conditioned space, hence cooling the conditioned space. No fan for air circulation , water temp at 12 deg , flow rate lower

• LATENT load is handled thru separate fresh air handling.




# Energy savings and merits of chilled beam system

•***Fan Energy Savings*** – No huge air handling units

•***Chiller energy Savings*** – Increase in chilled water set point temperature, hence lower chiller power consumption

•***Heating Energy Savings***

•***Excellent Indoor Air Quality and Odor Control*** – Pre treated fresh air through dedicated air handling units

•***Excellent Air Movement and Uniform Air Temperatures*** – No hot and cold spots as the air distribution is uniform

•***Space Savings*** – No AHU room required

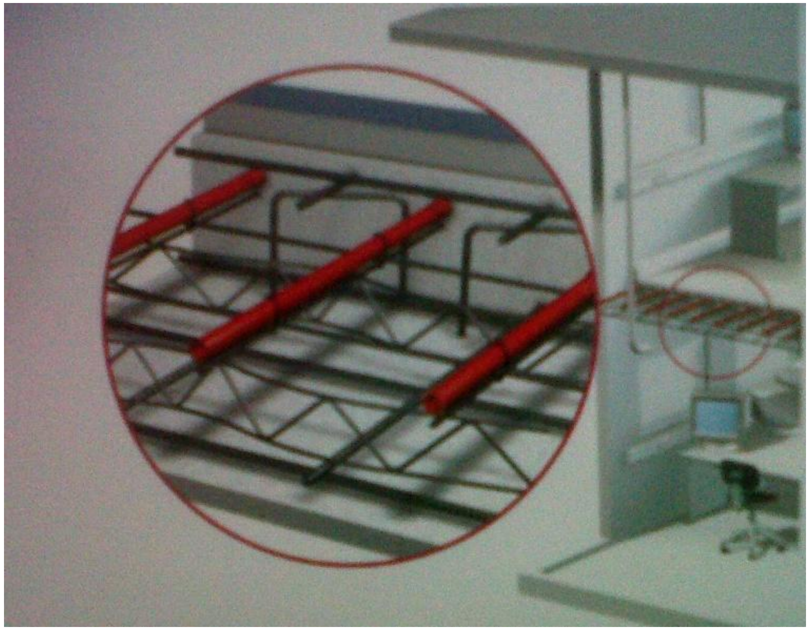
•***Very Low Noise Levels*** – Passive cooling

# Simple payback calculation

| Sl. No | Description | Proposal 1 Conventional | Proposal 2 - Chilled beams |
|---|---|---|---|
| A | Parameters | | |
| 1 | Capacity of plant - TR | 300 | 300 |
| 2 | Plant Configuration | 1 x 300 TR | 1 x 230 TR chiller + 1 x 70 TR Brine chiller |
| 3 | Energy Source | Electrical | Electrical |
| 4 | Electrical Load - KW | 570 | 450 |
| | KVA | 512 | 432 |
| 5 | Cost of electrical power - Rs/KWH | 6 | 6 |
| 6 | Capital cost Rs. In Lakhs | 210 | 275 |
| 7 | Differential in capital cost - Rs in Lakhs | 65 | |
| | | | |
| B | Operational cost | 102.60 | 81 |
| 1 | Saving in Energy cost / Annum - Rs in Lakhs | 21.60 | |
| 2 | Saving in first year | 21.60 | |
| 3 | Pay back period - Year | 3.01 | |

# Radiant Heating and Cooling

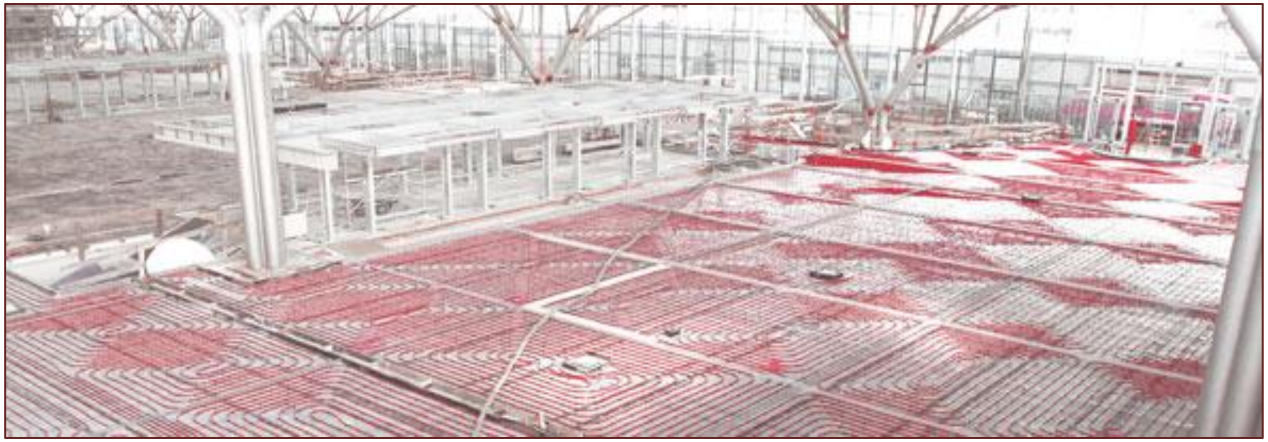
**CONCRETE CORE TEMPERING – Using the Structural System**



- Concrete Core tempering is a new energy efficient way to build which has flywheel effect in case of load/supply variations.
- Reduce your operating costs by approx. 6-12%
- Possible use of alternative energy sources
- The system would require a small AC system to remove peak loads, dehumidify the air (to avoid condensation) and to supply fresh air.
- The main cooling load is covered by concrete core tempering system, allowing for reduced air exchange rates, AHU's, ducts and fans.

# Radiant Heating and Cooling

**UNDER FLOOR HEATING –**
It can used either for a new build or a retrofit and can be made to suit almost any floor type.



The method circulates warm water through a closed loop where the water is reused.

- It provides quite comfort with uniform distribution of warmth.

- Heating via radiant energy avoiding dryness associated with conventional heating systems.

- One can choose an energy source to heat the water like – gas, solar, heat pump, geothermal.
- Maximize performance with optimal control through room thermostats with integrated timer's

# Radiant Heating and Cooling

**Radiant Panel Heating and Cooling**

•Aesthetically beautiful with acoustic properties enhances radiant cooling systems can be used for new builds or existing structures.

•Use of drywall panels to activate vertical and horizontal surfaces.

•Save upto 30% in heating and cooling energy usage.

•Hygienic, safe and easy to maintain.

# Thank you

Visit: www.wiproecoenergy.com