

ECBC & its role in Smart Cities



Green Building Design & Certification | Turn-key Design & Construction | Smart Meter Manufacturing & Energy Storage

GreenTree Building Energy Pvt Ltd

B-67, Sector 67, Noida, UP- 201301 www.greentree.global

Domestic Presence

New Delhi (Registered Office) | Mumbai | Kolkata

Global Presence

Bangladesh



Transition from an Energy
Consulting to a Clean
Energy Company

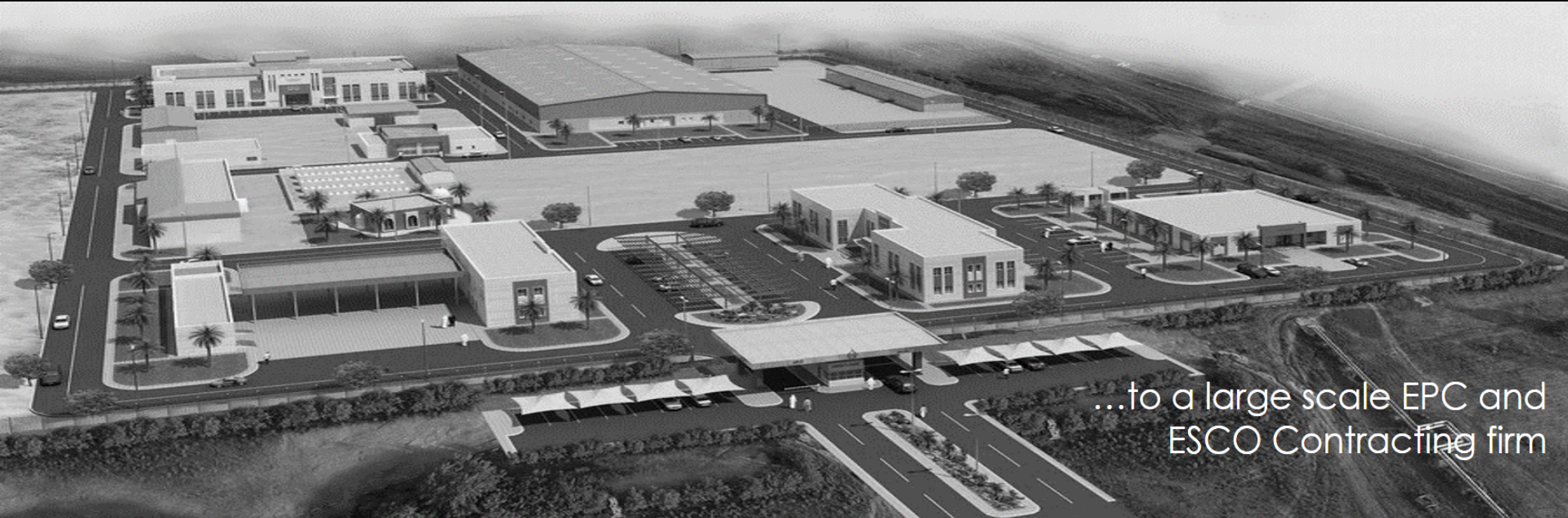
250₊ Projects

6 Counties' work experience



...to a Green Buildings
Certification & Sustainability
Design Firm

MEMBER
GRHA
U.S. GREEN BUILDING COUNCIL
MEMBER
ENERGY IS LIFE
BEE
CONSERVE IT
استدامة
estidama
greenstar Exige
Excellence In Design
For Greater Efficiencies
INTERNATIONAL
WELL
BUILDING
INSTITUTE



...to a large scale EPC and
ESCO Contracting firm






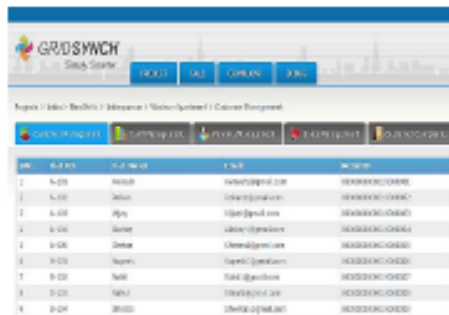
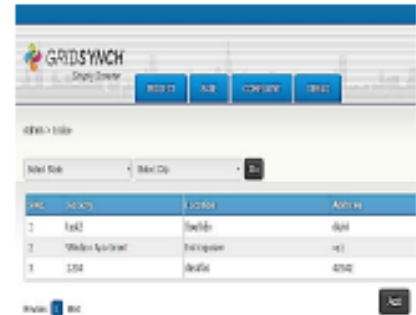
...to a Smart Meter Solution Company

Phase -1
 HARDWARE
 Assembly & QA



Cloud Hosted Vending
 Software

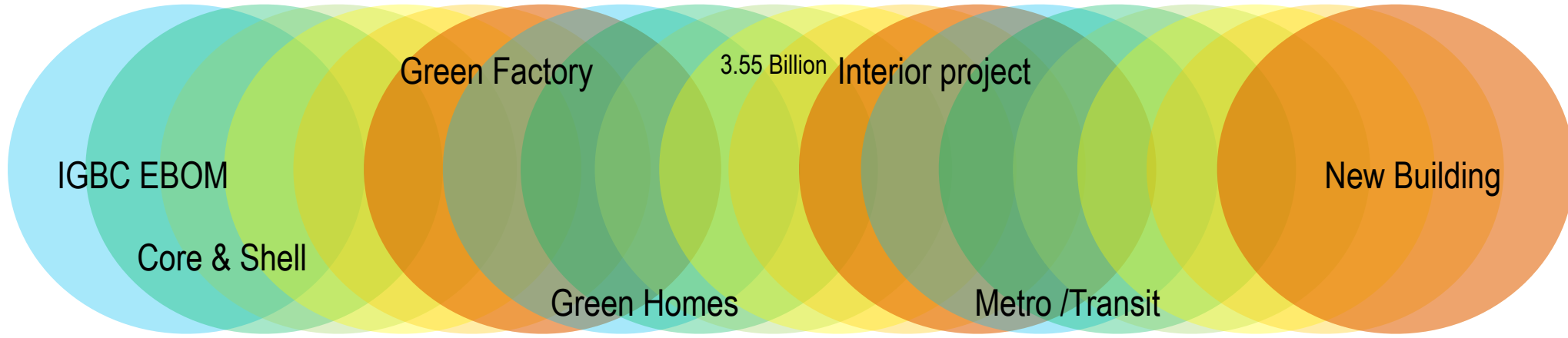
Vending Software  Live Cloud Hosted on  Asia's Largest Tier 4 Datacenter

SN	DATE	TIME	USER	IP
1	4-20	10:00	admin@grid.com	10.10.10.10
1	4-20	10:05	admin@grid.com	10.10.10.10
1	4-20	10:10	admin@grid.com	10.10.10.10
1	4-20	10:15	admin@grid.com	10.10.10.10
1	4-20	10:20	admin@grid.com	10.10.10.10
1	4-20	10:25	admin@grid.com	10.10.10.10
1	4-20	10:30	admin@grid.com	10.10.10.10
1	4-20	10:35	admin@grid.com	10.10.10.10
1	4-20	10:40	admin@grid.com	10.10.10.10
1	4-20	10:45	admin@grid.com	10.10.10.10

Consumer Mobile
 APP





As on Jan 2017

135 MILLION

Square Feet registered to IGBC/GRIHA /LEED/Green Mark since 2008

As per internal calculations of GreenTree India

People.

Built Environment.

Economics.

Re-Imagination of Connectivity...

THEN...



NOW...



Re-Imagination of Computing Devices...

THEN...

(Desktops / Notebooks)



NOW...

(Tablets / Smartphones)



Re-Imagination of Drawing...

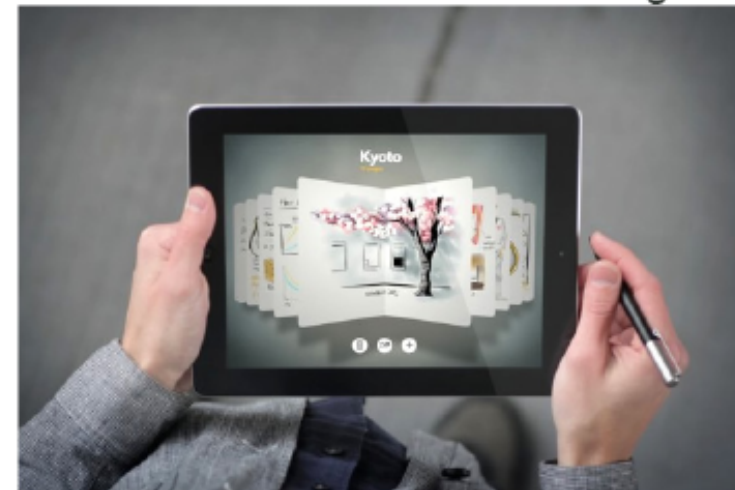
THEN...

Dedicated Canvas / Paint Supplies / Studios
/ Limited Distribution



NOW...

(Paper by Fiftythree...)
Reusable Canvas (Screen) / Creating Art
Anywhere Anytime / Digitally Enhanced
Creation Tools / Instant Sharing



Re-Imagination of Government Subsidies...

THEN...

Gather in Town / Wait in Line
to Receive Subsidies



NOW...

200MM+ Farmers in India Receive
Government Subsidies Via Mobile Devices*



Changing Face of Indian Architecture



TRADITIONAL/VERNACULAR BUILDINGS

Selective use of HVAC | Climatic responsive architecture | Passive heating/cooling | Low Energy Use



MODERN BUILDINGS

Climate controlled | Hi-Tech | Energy Intensive | Emulates western modern architecture

Mumbai



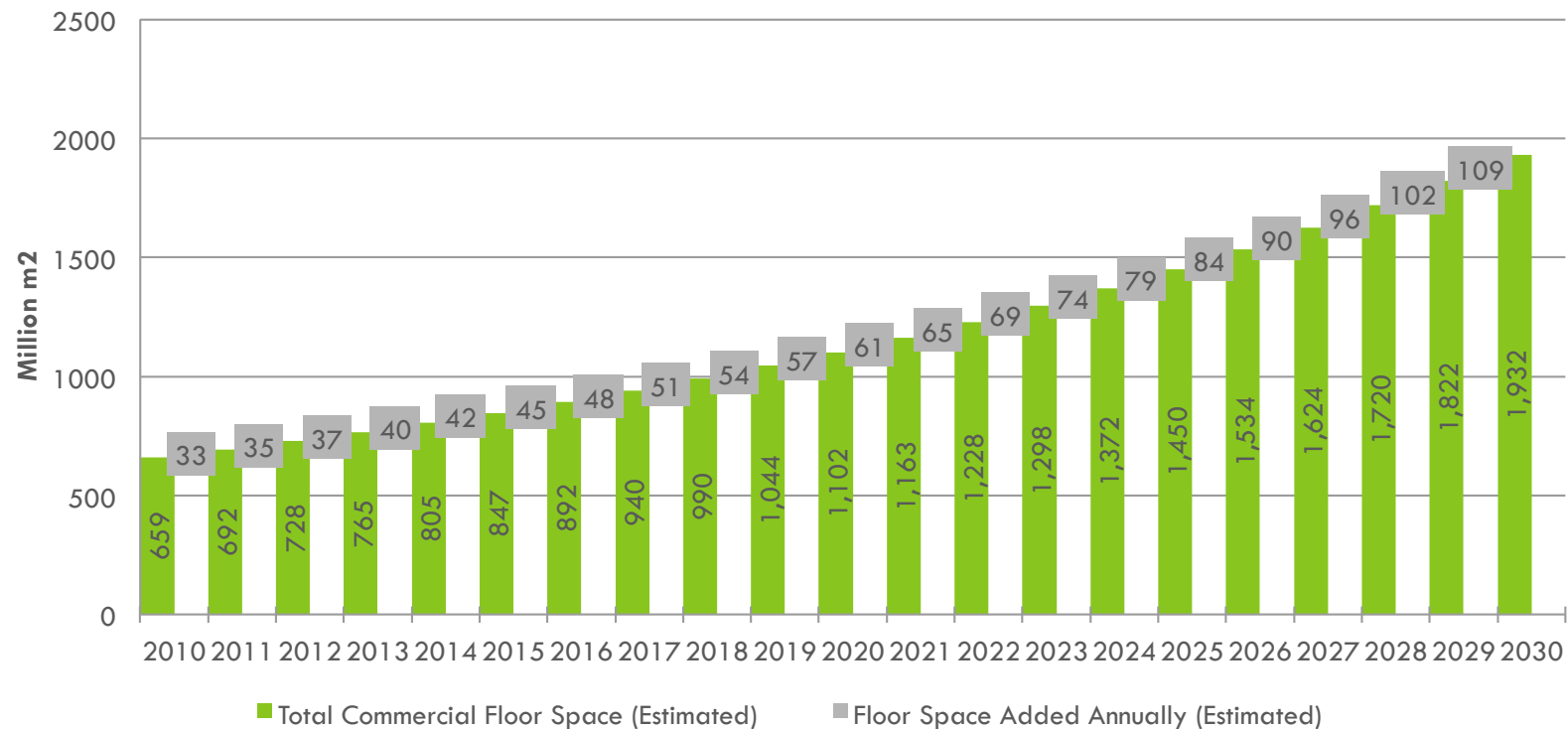
Gurgaon

15



Commercial Buildings Growth Forecast

16



Commercial Floor Space Projection for India (Assuming 5-6% Annual growth)



Urban Growth Pattern

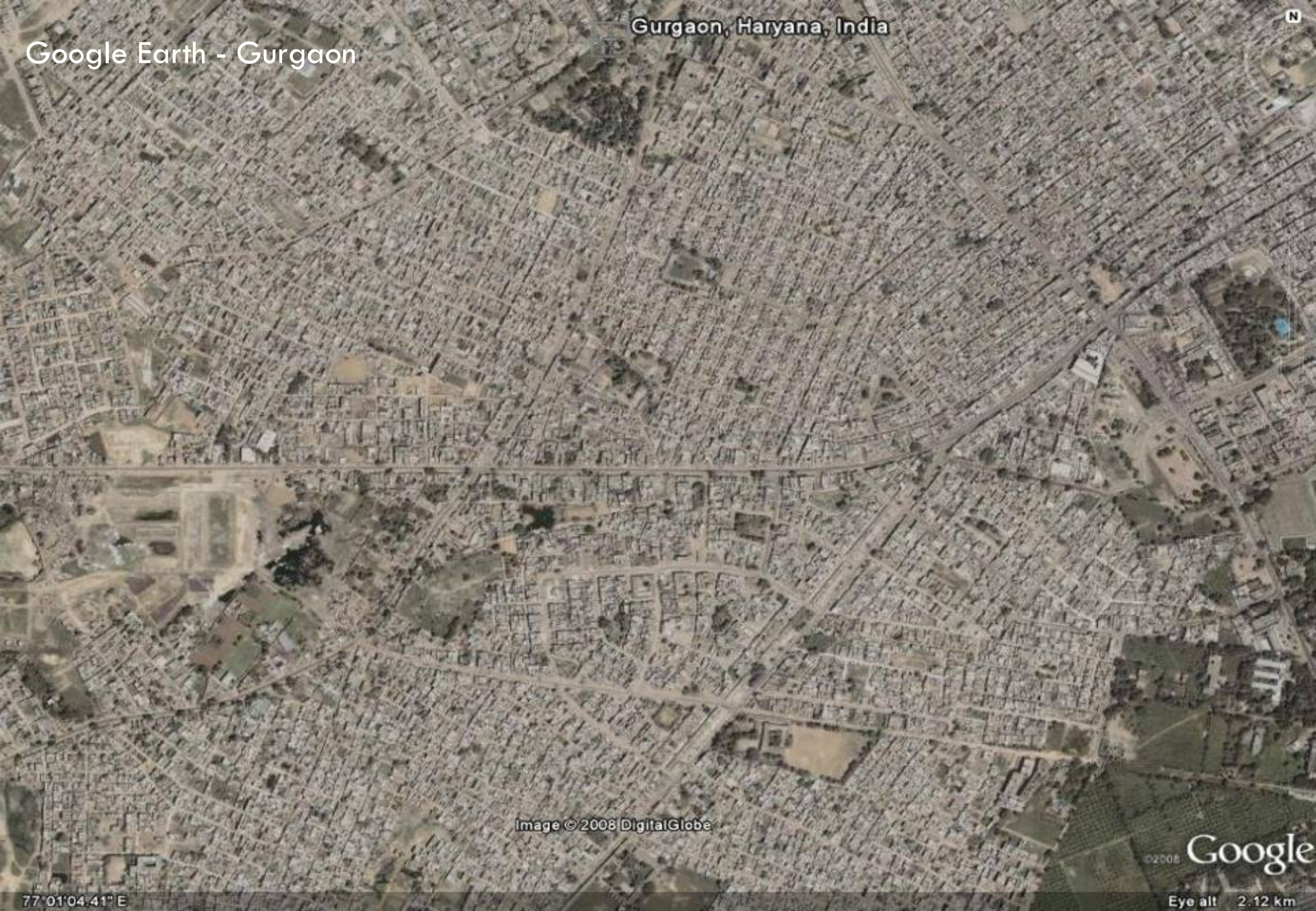


Image © 2008 DigitalGlobe

©2008 Google

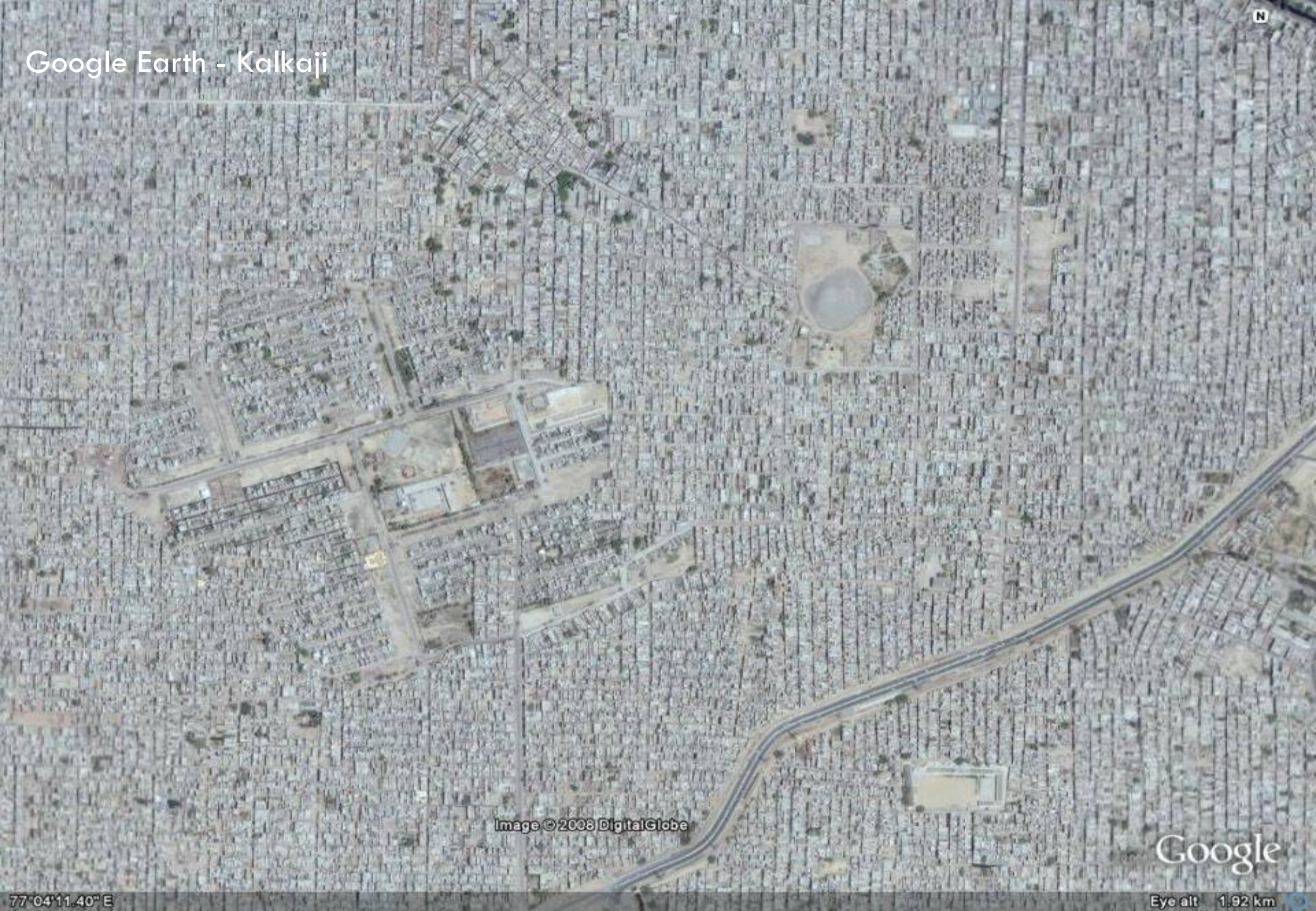


Image © 2008 DigitalGlobe

Google

Google Earth - Ambedkar nagar



Image © 2008 DigitalGlobe

Google

3° N 77° 14' 25.47" E

Eye alt 1.83 km



Image © 2008 DigitalGlobe

Google

Second Tier City- Rohtak, Haryana



Rohtak, Haryana, India

Google

Image © 2009 DigitalGlobe

Mar 8, 2007

Eye alt 7.75 km

28°53'33.06" N 76°34'55.48" E



Image © 2009 DigitalGlobe

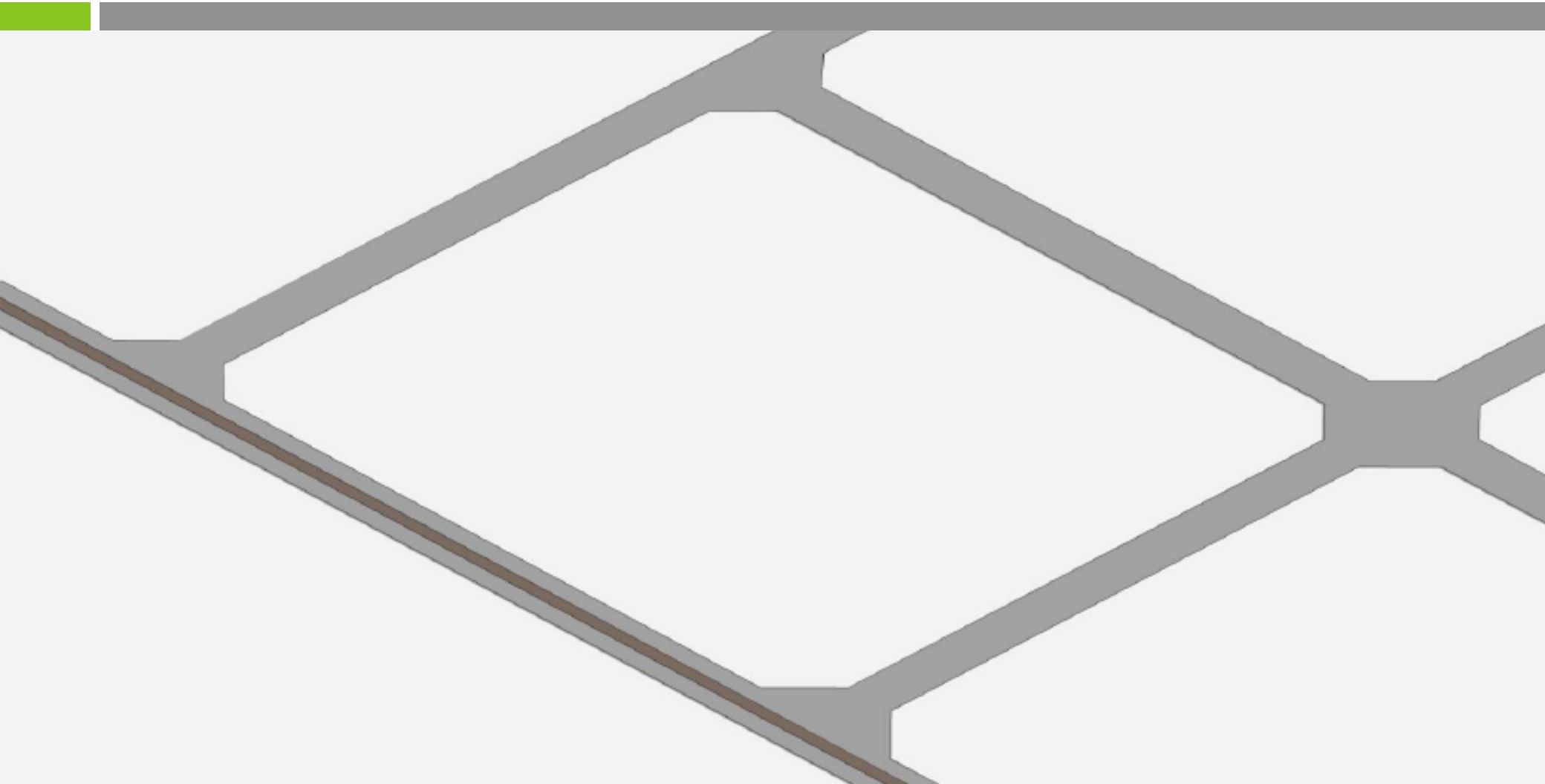
Google

28°52'24.27" N 76°34'18.75" E

Mar 8, 2007

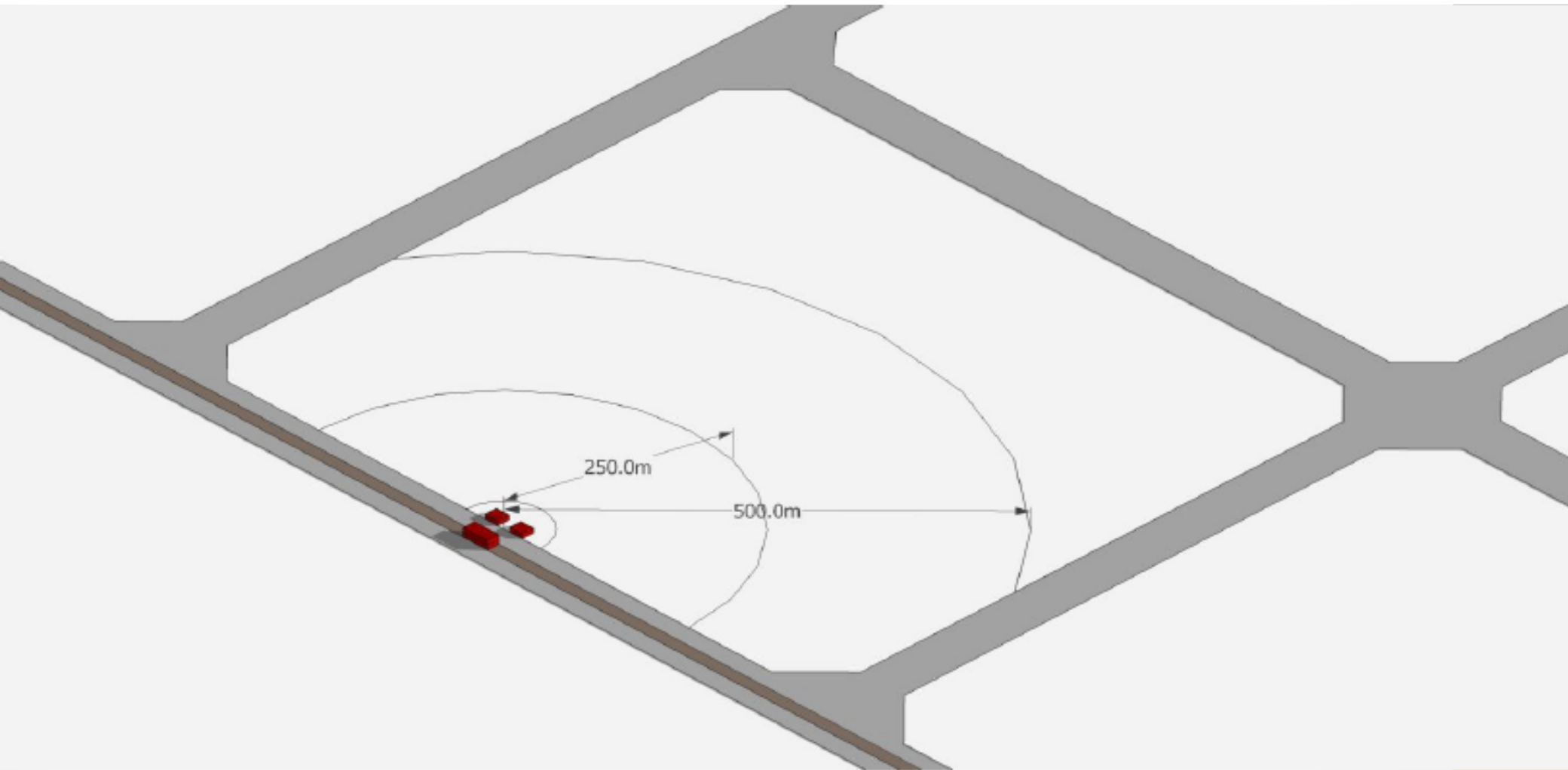
Eve alt 2.03 km

Urban Development – Best Case Scenario



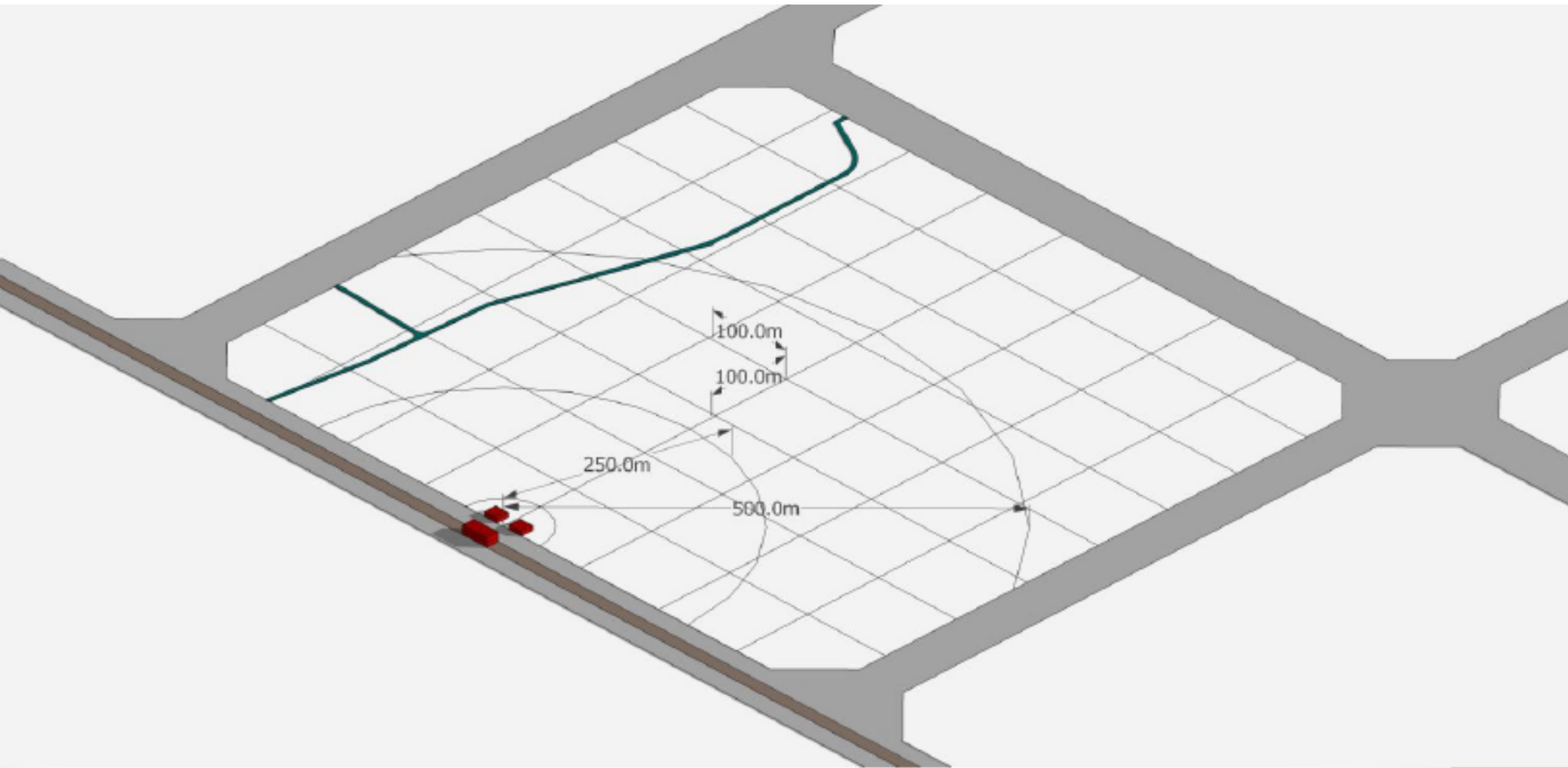
EXISTING SECTORAL DIVISION

Urban Development – Best Case Scenario



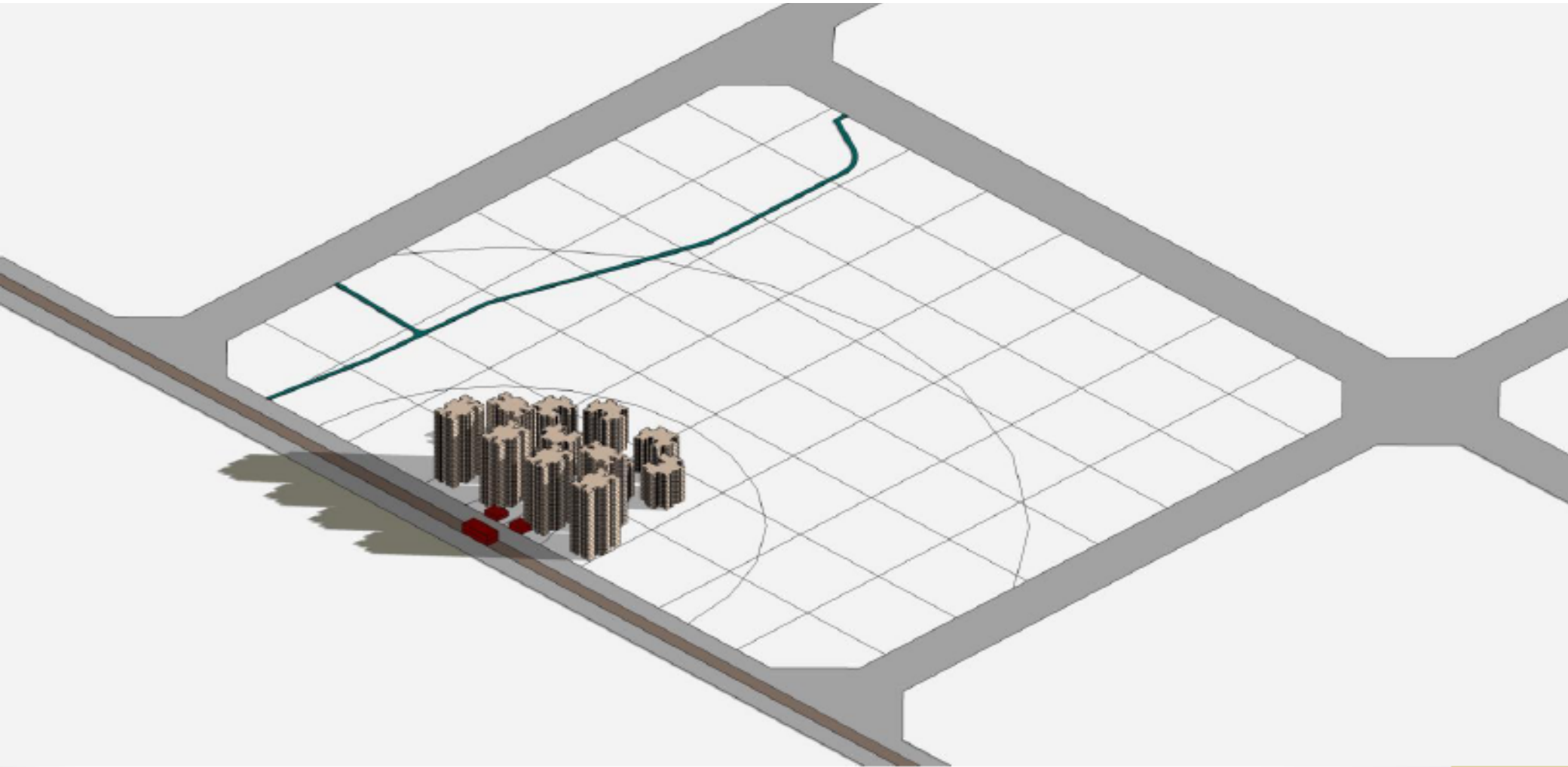
LOCATION OF BRT STATION WITH RANGE OF PROXIMITIES

Urban Development – Best Case Scenario



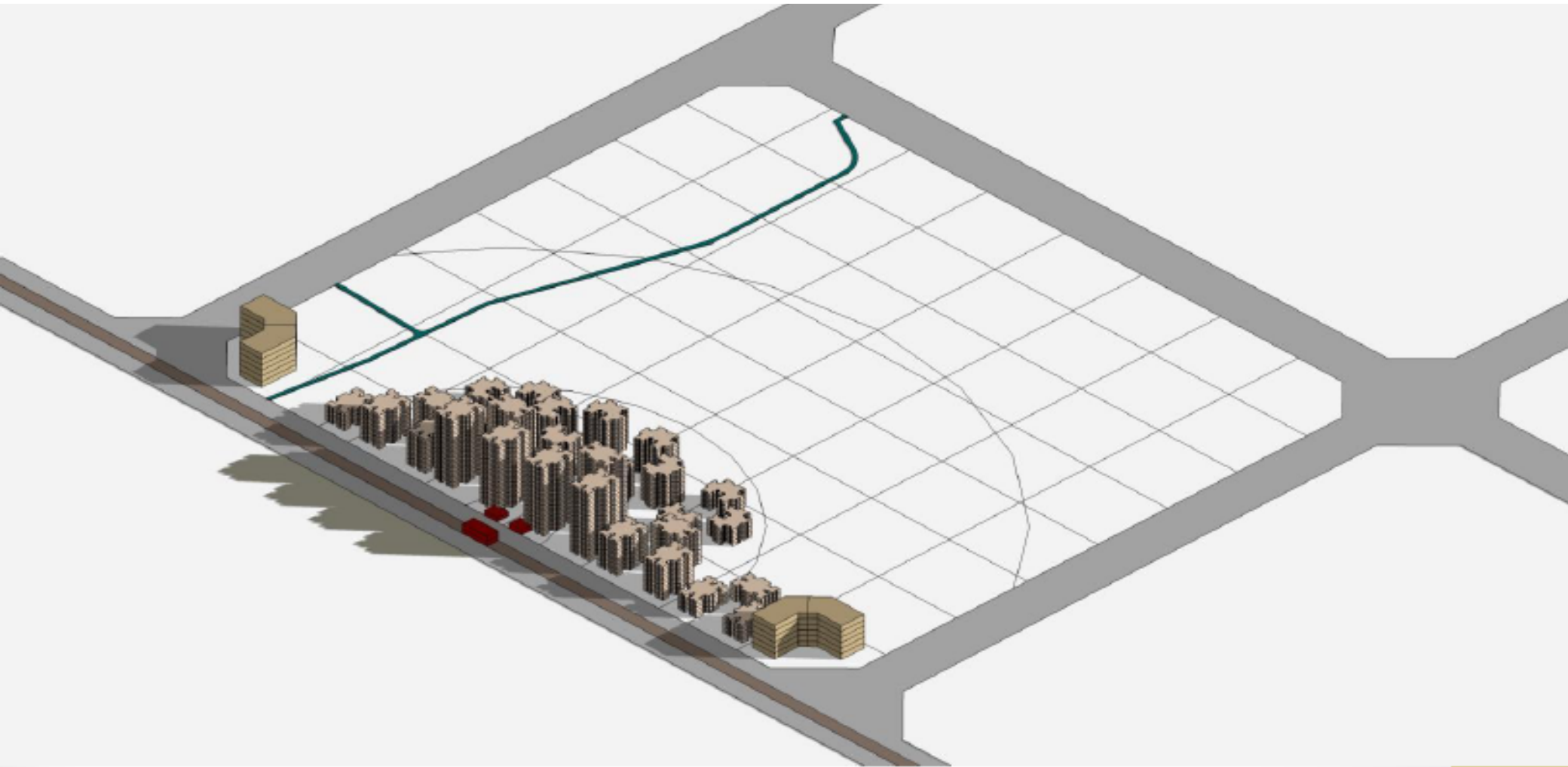
LAYING THE PEDESTRIAN GRID AND EXISTING NATURAL FEATURES

Urban Development – Best Case Scenario



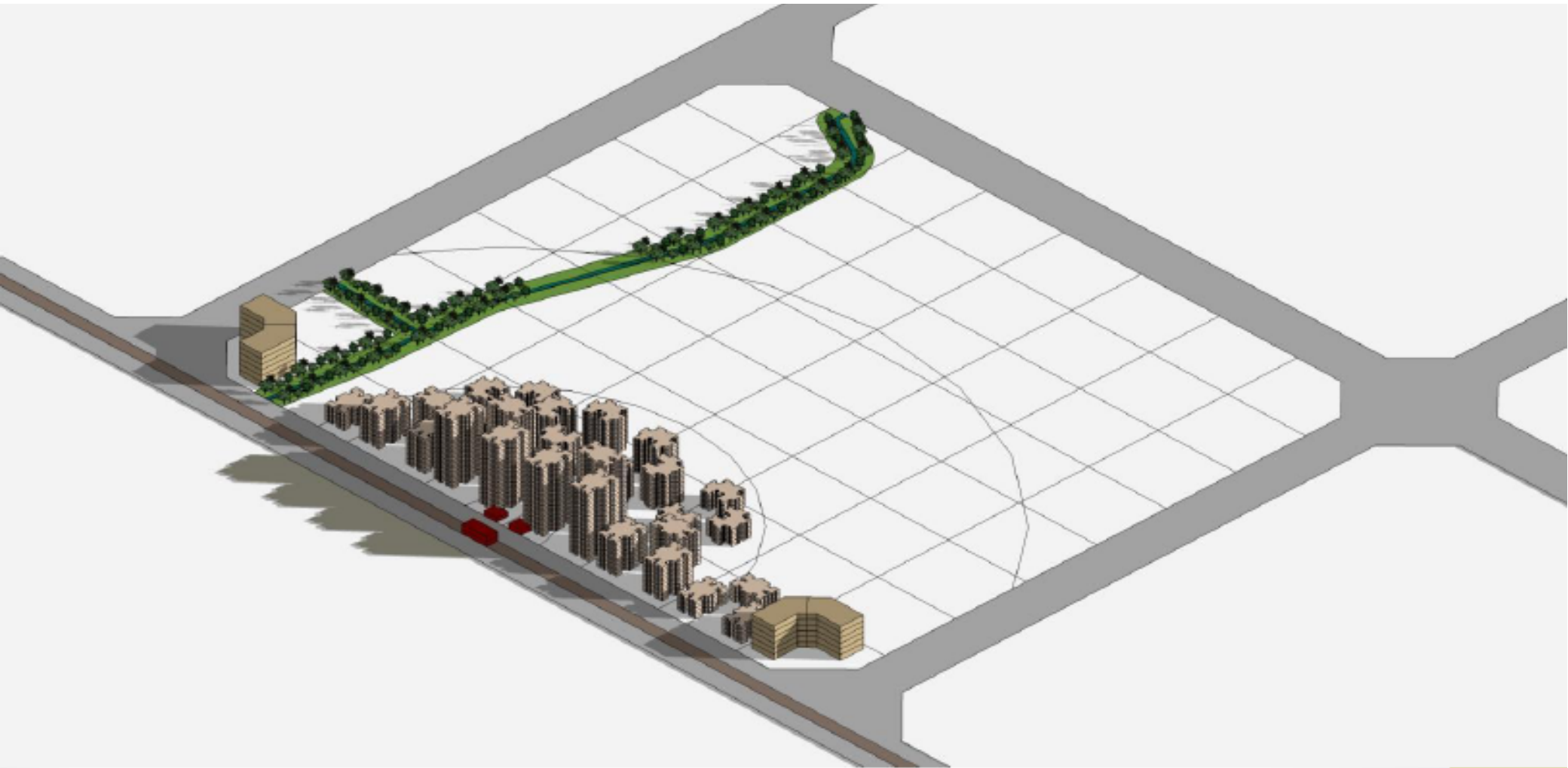
HIGHEST DENSITY CLOSEST TO BRT STATION

Urban Development – Best Case Scenario



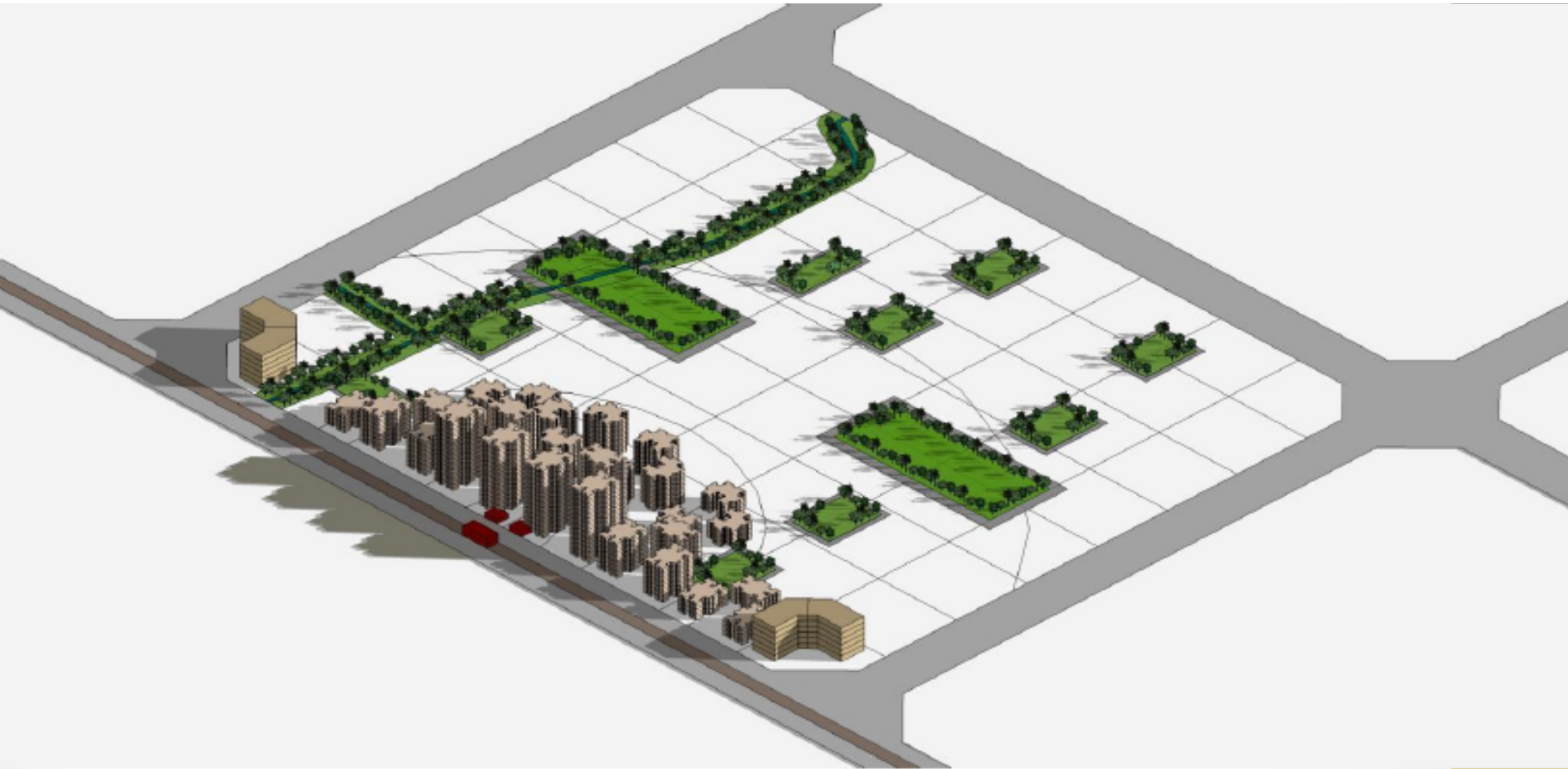
GRADATION OF DENSITY FROM THE TRANSIT POINT

Urban Development – Best Case Scenario



GREEN CORRIDOR ALONG NATURAL FEATURES

Urban Development – Best Case Scenario



DEMARCATING OPEN SPACE HIERARCHY AS PER NATURAL FEATURES

Urban Development – Best Case Scenario



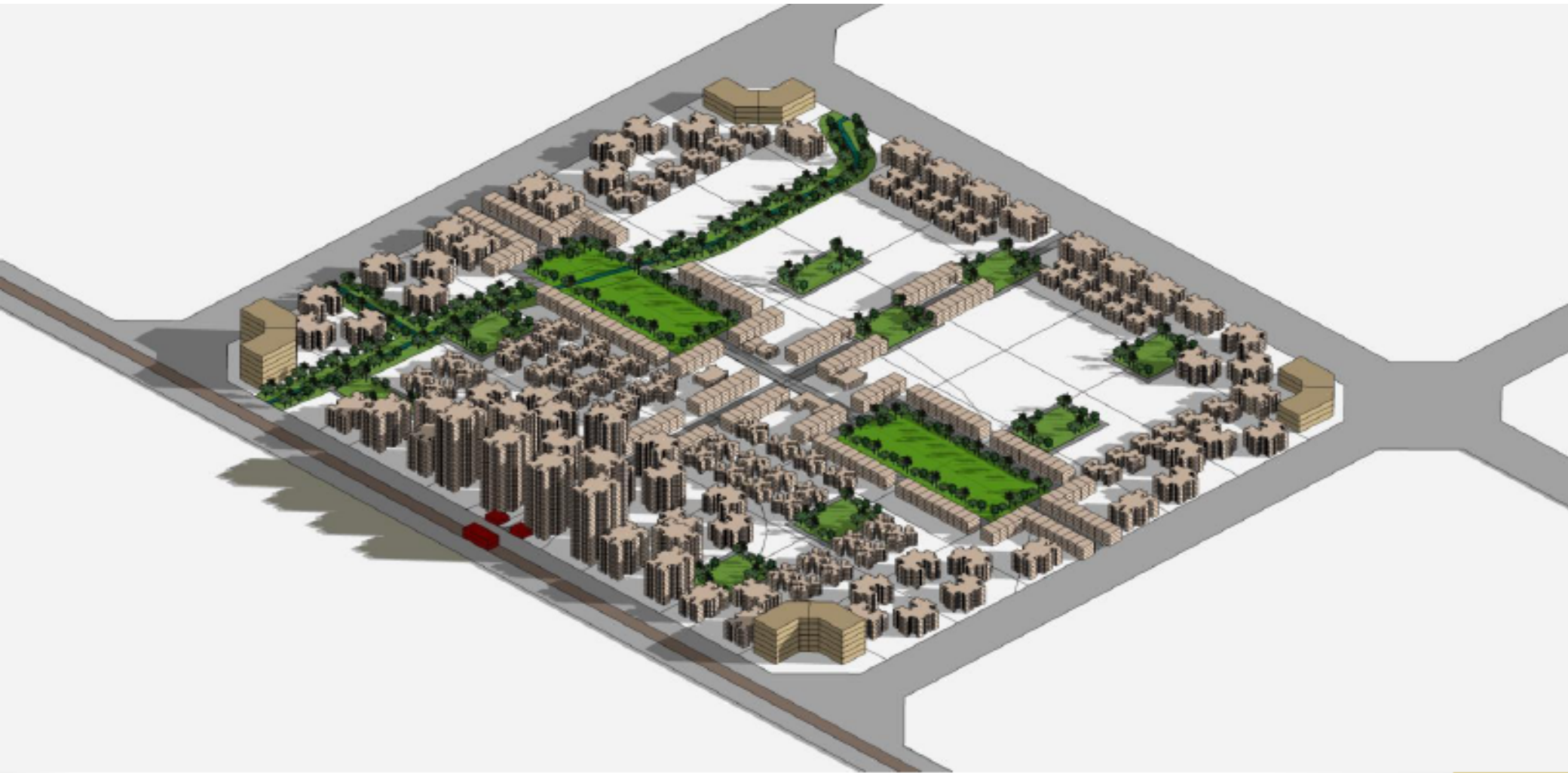
DEMARCATING SECTOR EDGES AND CORNERS WITH MEDIUM DENSITY

Urban Development – Best Case Scenario



DEMARCATING SECTOR EDGES WITH MEDIUM DENSITY

Urban Development – Best Case Scenario



MEDIUM DENSITY RESIDENTIAL TOWARDS THE BRT CORRIDOR

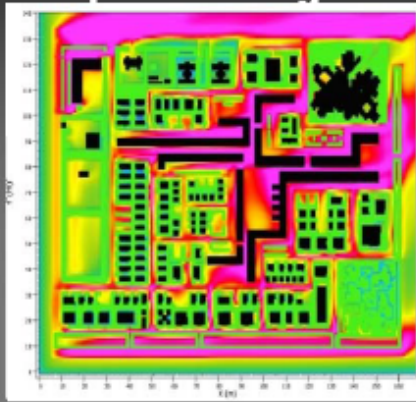
Urban Development – Best Case Scenario



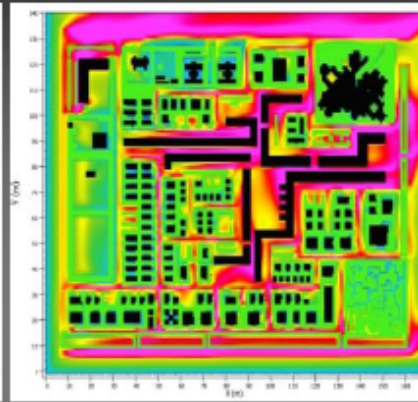
LOWEST DENSITY RESIDENTIAL AWAY FROM THE BRT CORRIDOR

Urban Landscape Planning

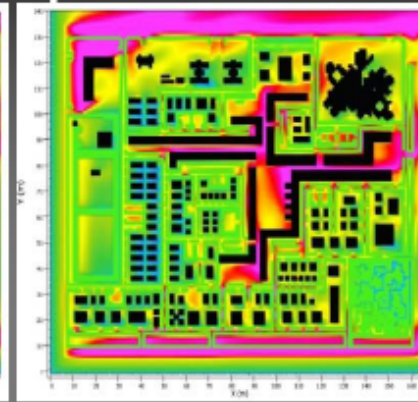
Impact of Vegetation on Ambient Air Temperature



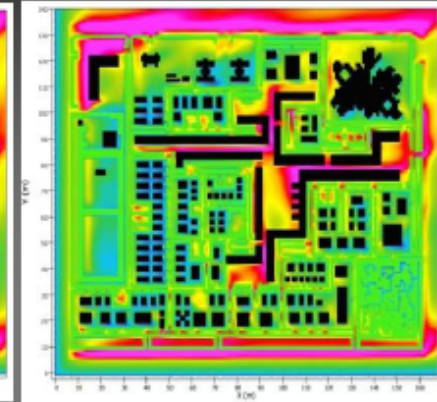
Case 1 (Plot plantation)



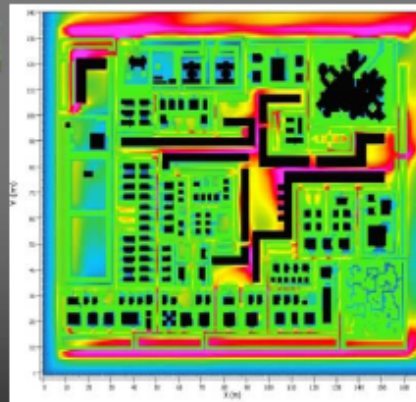
Case 2 (Plot plantation)



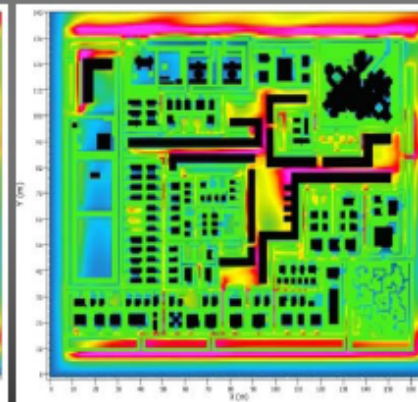
Case 3 (Road plantation)



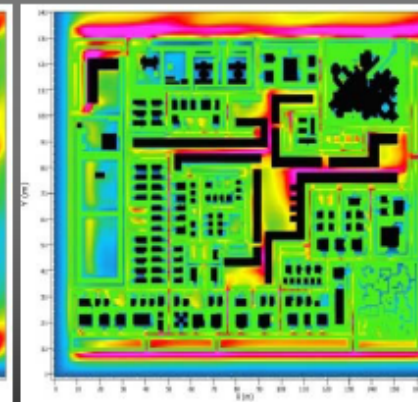
Case 4 (Road plantation)



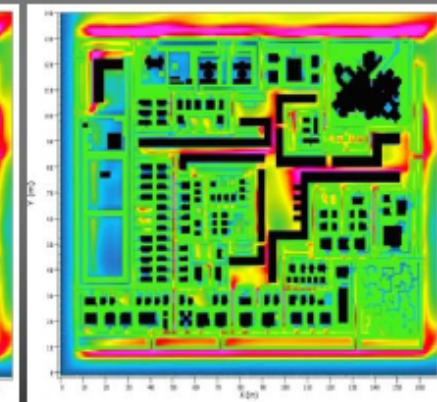
Case 5 (Combination plantation)



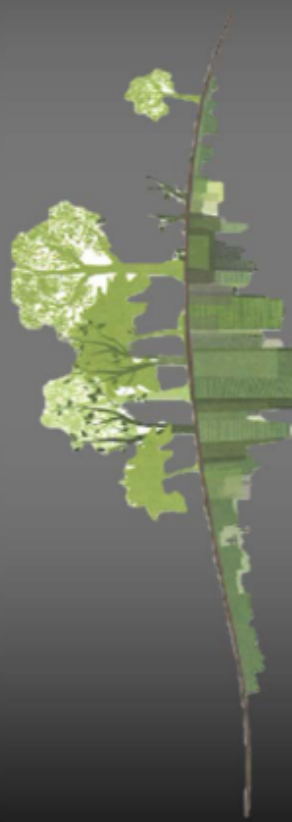
Case 6 (Combination plantation)



Case 7 (Combination plantation)

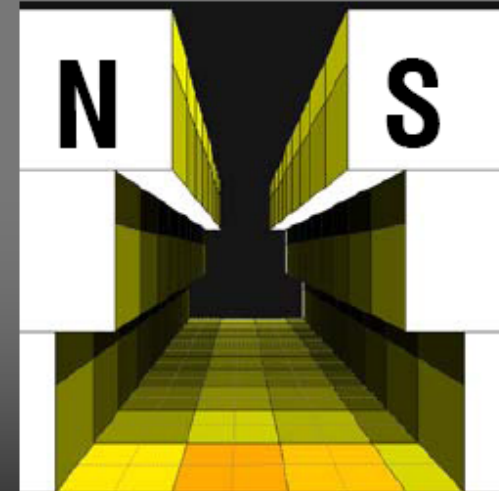
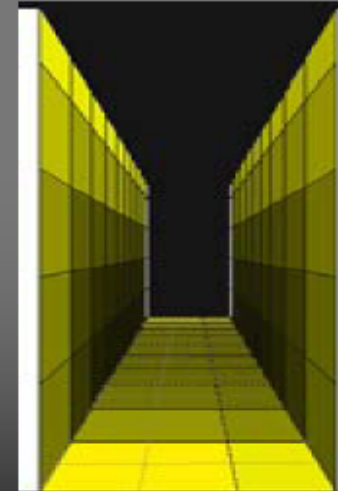
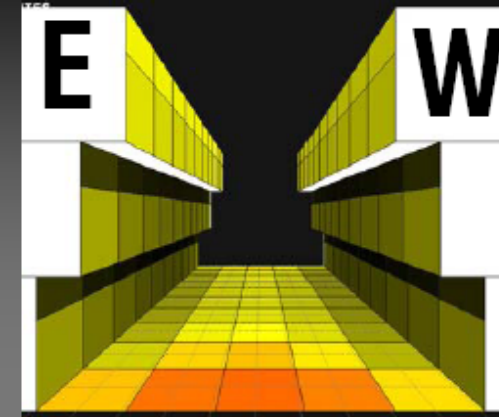
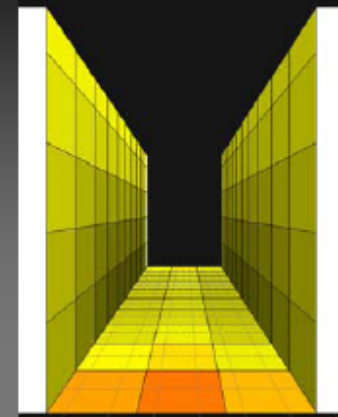


Case 8 (Combination plantation)



Street Planning

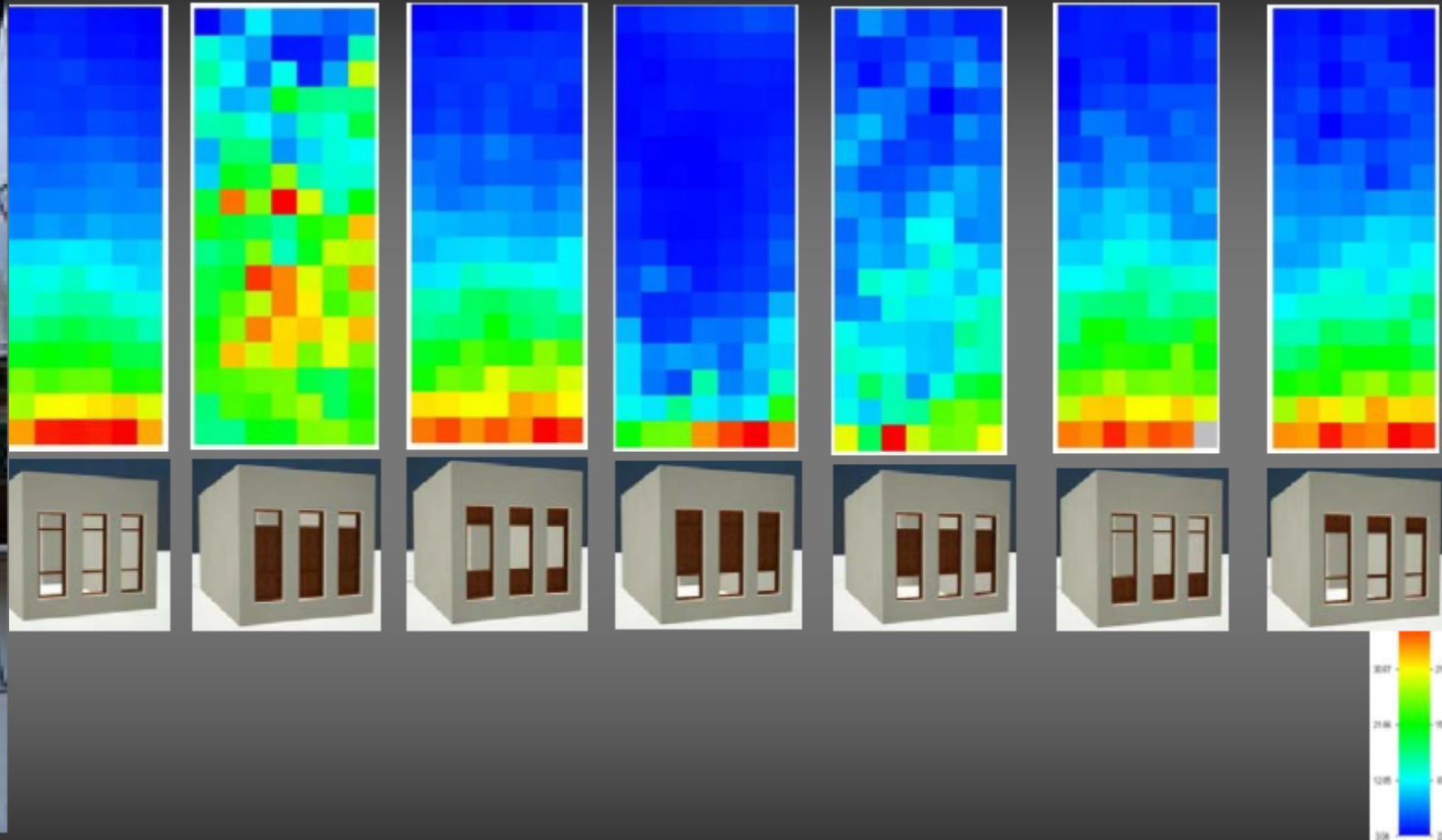
	Obstruction angle 50°, H/W ratio 1.2	Obstruction angle 60°, H/W ratio 1.7	Obstruction angle 70°, H/W ratio 2.6	Obstruction angle 80°, H/W ratio 5.7
N-S	74% shaded	81% shaded	87% shaded	94% shaded
E-W	52% shaded	61% shaded	71% shaded	82% shaded
NW-SE NE-SW	68% shaded	76% shaded	84% shaded	93% shaded
Street Hierarchy	Main road	Secondary	Inner Street	



Incident Solar radiation received on street



Opening / Windows





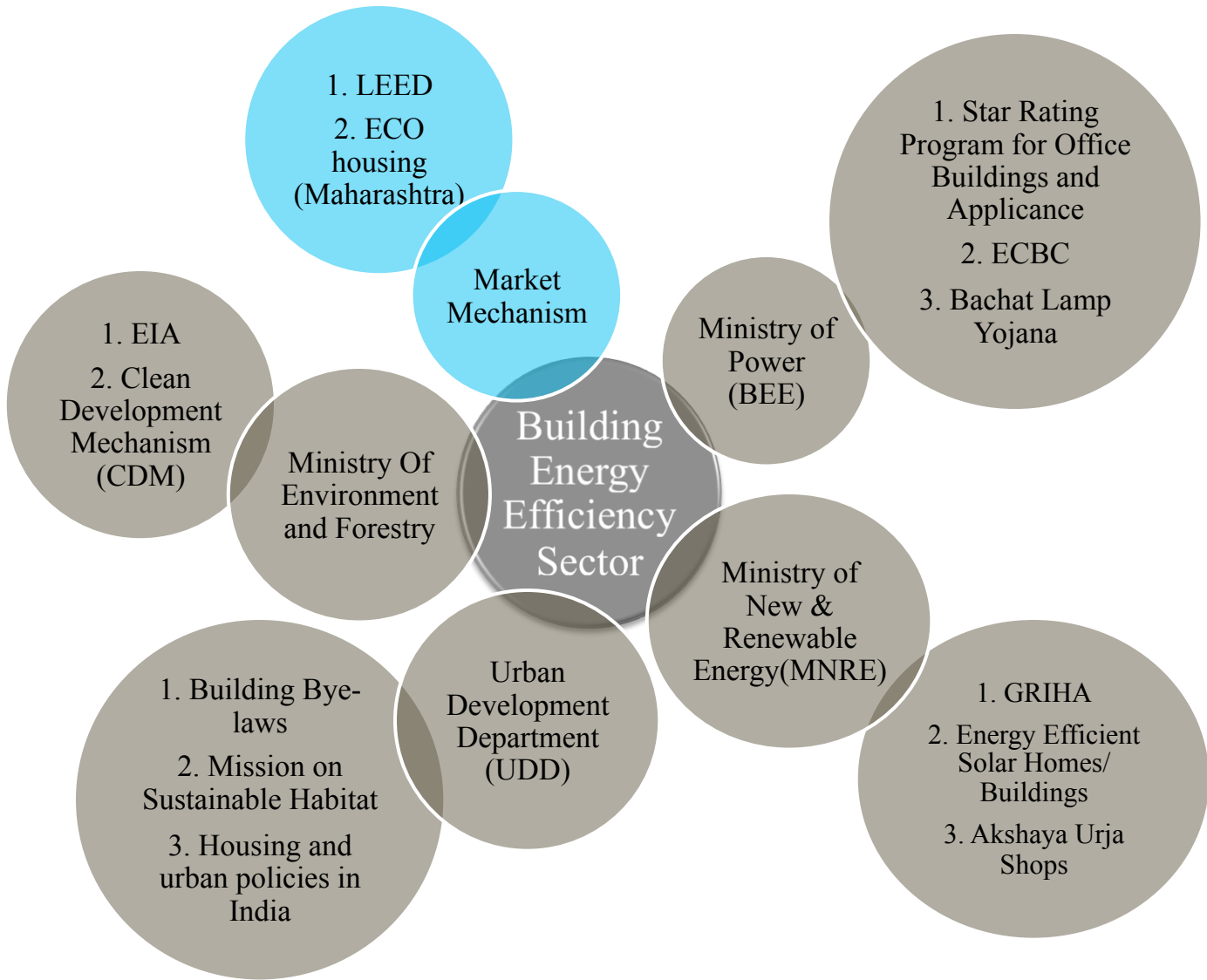
What lies in Government's basket...

Government's Initiatives

National Action Plan on Climate Change



Building Energy Efficiency Initiatives



2.

ECBC Introduction

- i. Life Style Changes and Urban Growth Pattern
- ii. Energy Scenario in India & Government Initiatives**
- iii. ECBC Approach – Envelop, HVAC, Lighting, SHWP, Electrical: ECBC Compliance
Case Study

Introduction to ECBC

- ECBC sets minimum energy efficiency standards for design and construction of commercial buildings
- ECBC encourages energy efficient design or retrofit of buildings so that
 - ▣ Does not constrain the building function, comfort, health, or the productivity of the occupants
 - ▣ It has appropriate regard for economic considerations
- Addresses local design conditions and helps improve existing construction practices
- Emphasis on Integrated Building Design approach
- First generation code – ease of use and continuous improvement

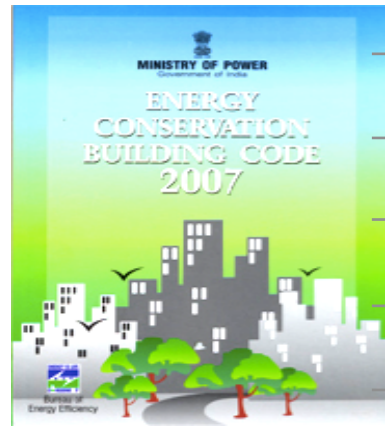
ECBC Scope

- New Buildings with
 - ▣ Connected load in excess of 100kW
 - or
 - ▣ Contract demand in excess of 120 kVA
- Also applies to Additions and Major Renovation
 - ▣ When addition + existing building area $> 1000 \text{ m}^2$
 - ▣ Renovated portions and systems of a 1000 m² or larger building

ECBC CODE

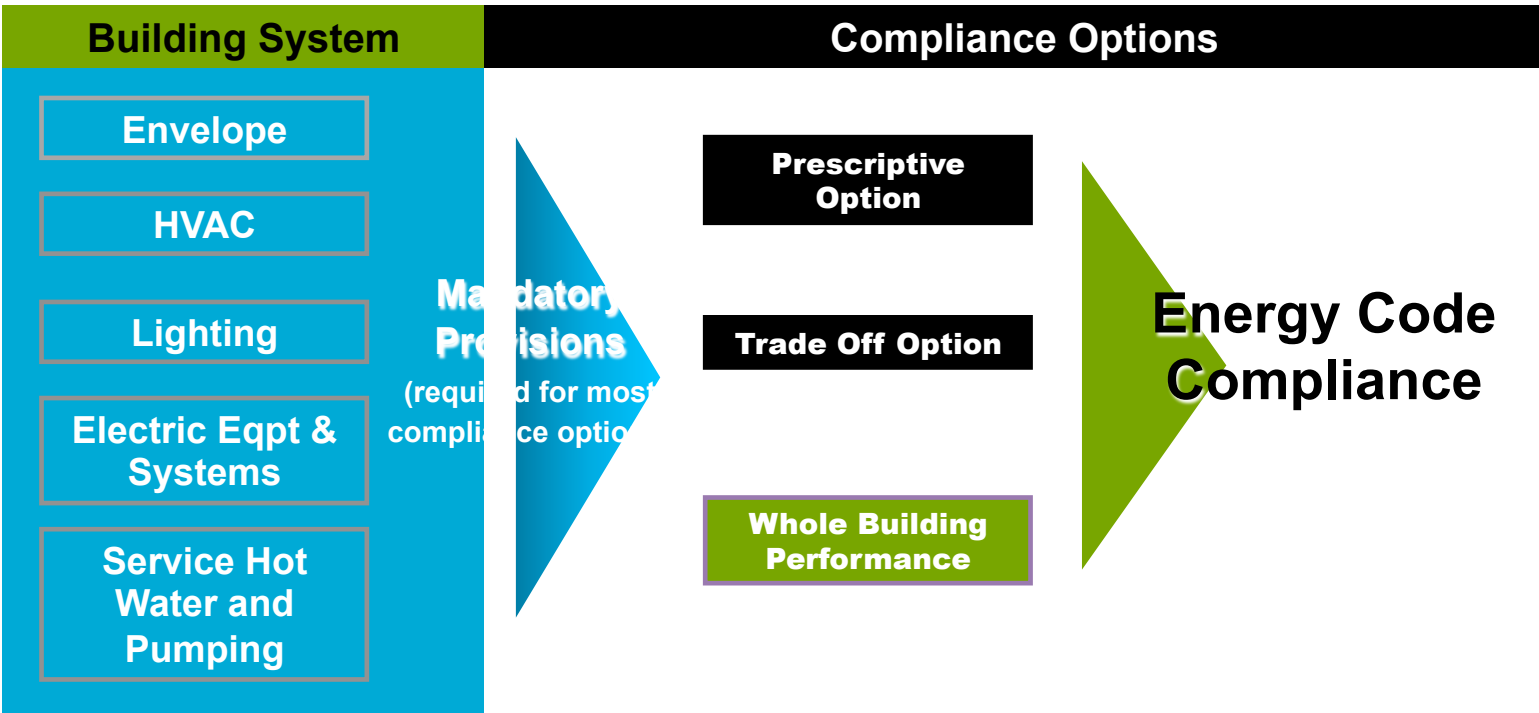
Energy Conservation Building Code (ECBC)

User Guide



- Administrative Guidance →
- Technical Guidance →
- Compliance/ Checklist →
- Case Studies/Examples →
- References →

- ECBC Compliance –
1. ECBC Will Become Mandatory VERY SOON!!!
 2. Greentree Has Developed ECBC Compliance Software
 3. Involved In Framing Of Uttaranchal, Uttar Pradesh And Other States' ECBC Norms



ECONirman – ECBC Conformance Tool



Building Energy Tools



ECBC Conformance Check Tools

Energy Benchmarking



Online ECBC Conformance Check using the Prescriptive and Whole Building Performance Methods

Building Energy Benchmarking

These web tools are made possible by the support of the American People through the United States Agency for International Development (USAID), under the terms of Award No. 386C-00-06-00153-00. The contents of these web tools are the sole responsibility of International Resources Group (IRG) and do not necessarily reflect the views of USAID or the United States Government.

ENERGY CONSERVATION BUILDING CODE (ECBC)



Conformance Check Report

Envelope Summary

Date of Report Generation	21/02/2012
General	
Building ID generated by tool	359
Building Name	BT DELHI
Location	
State/Union Territory	NCT
City	DELHI
Climatic Zone	Composite
Latitude/Longitude	28° 58' / 77° 21'
Project Details	
Building Type	School/University
Building Use	24 Hour
Connected Load	541.00 kW
Project Type	New Building
Build-up Area	37236.5 m ²
Conditioned Area	15470.3 m ²
Conformance Checked For	
% Vertical Fenestration Area (WWR) Calculation	Total Vertical Fenestration Area divided by Gross Exterior Wall Area times 100 equals % Vertical Fenestration Area (WWR)
Note: % Vertical Fenestration Area (WWR) cannot exceed 80% for Prescriptive Conformance	1907.2201 / 5918.4 x 100 = 32.23596
% Skylight Area (SRR) Calculation	
Note: % Skylight Area (SRR) cannot exceed 5% for Prescriptive Conformance	Total Skylight Area divided by Gross Roof Area times 100 equals % Skylight Area (SRR)
	101.81 / 8436.79 x 100 = 1.2064526

Envelope Conformance Summary			
Envelope Component	No. of Conforming	No. of Non-Conforming	Conformance Status
Walls	4	0	Conforming
Roof	1	0	Conforming
Vertical Fenestration	4	0	Conforming
Skylights	1	0	Conforming

Building Conformance as per the ECBC **Conforming**

Tools are available on URL: www.eetools.in

GRIHA Rating System

□ Facilitation for **Green Rating for Integrated Habitat Assessment (GRIHA)** that assesses a building on the basis of:

- Energy passive Design
- Energy System Design
- Site
- Water
- Waste
- Health
- Operation and Maintenance (O&M)

□	51 - 60	★
□	61 - 70	★ ★
□	71 - 80	★ ★ ★
□	81 - 90	★ ★ ★ ★
□	91 - 100	★ ★ ★ ★ ★



LEED Rating System

- Complete facilitation of Green Building Design in accordance with the LEED rating system.
- Advice and guidance in the following areas.
 - Sustainable sites – Locations and Linkages
 - Water efficiency
 - Energy & Atmosphere
 - Material & Resources
 - Indoor Environmental Quality
 - Innovative Design
 - Regional Priority
- Rating Levels: Certified > Silver > Gold > Plc





High Performance Building Design

Envelop Performance

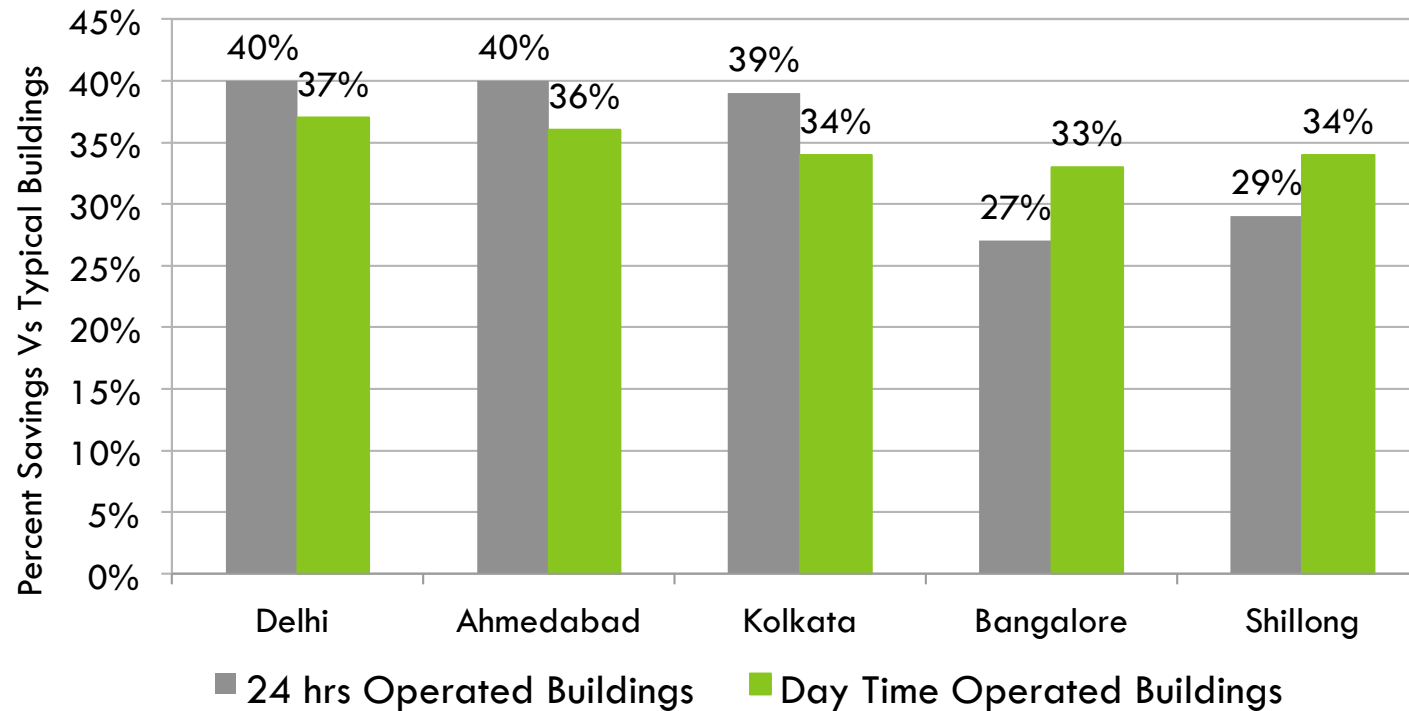
HVAC Performance

Lighting Design Performance

Whole Building Performance and Energy Monitoring

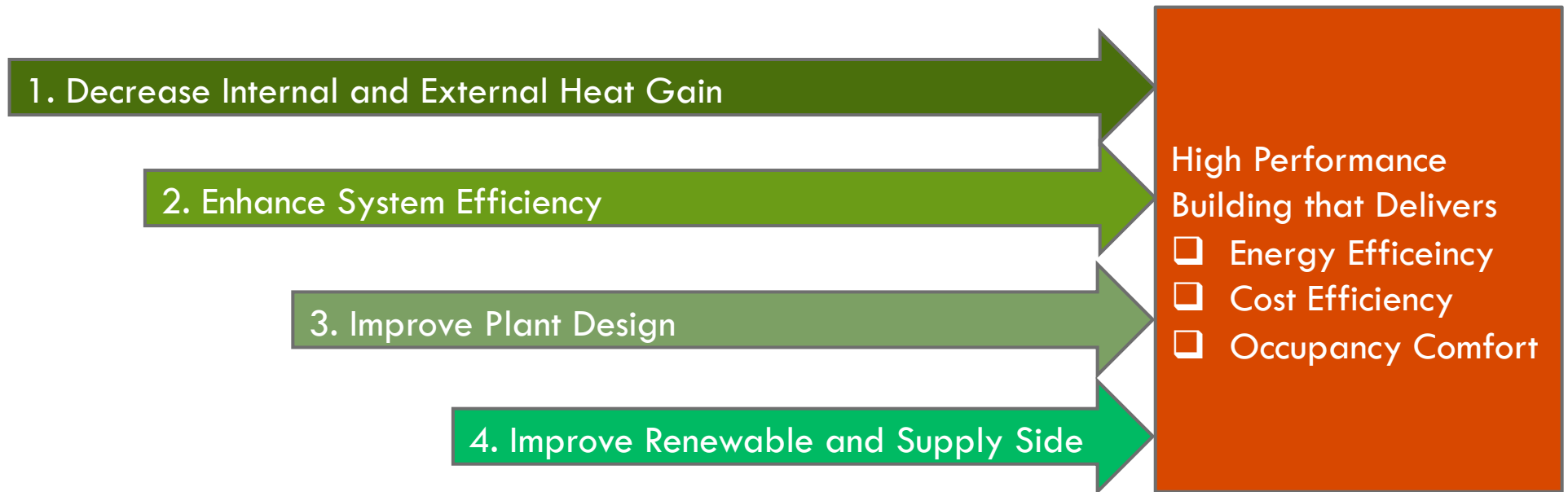
ECBC Implementation Potential

48



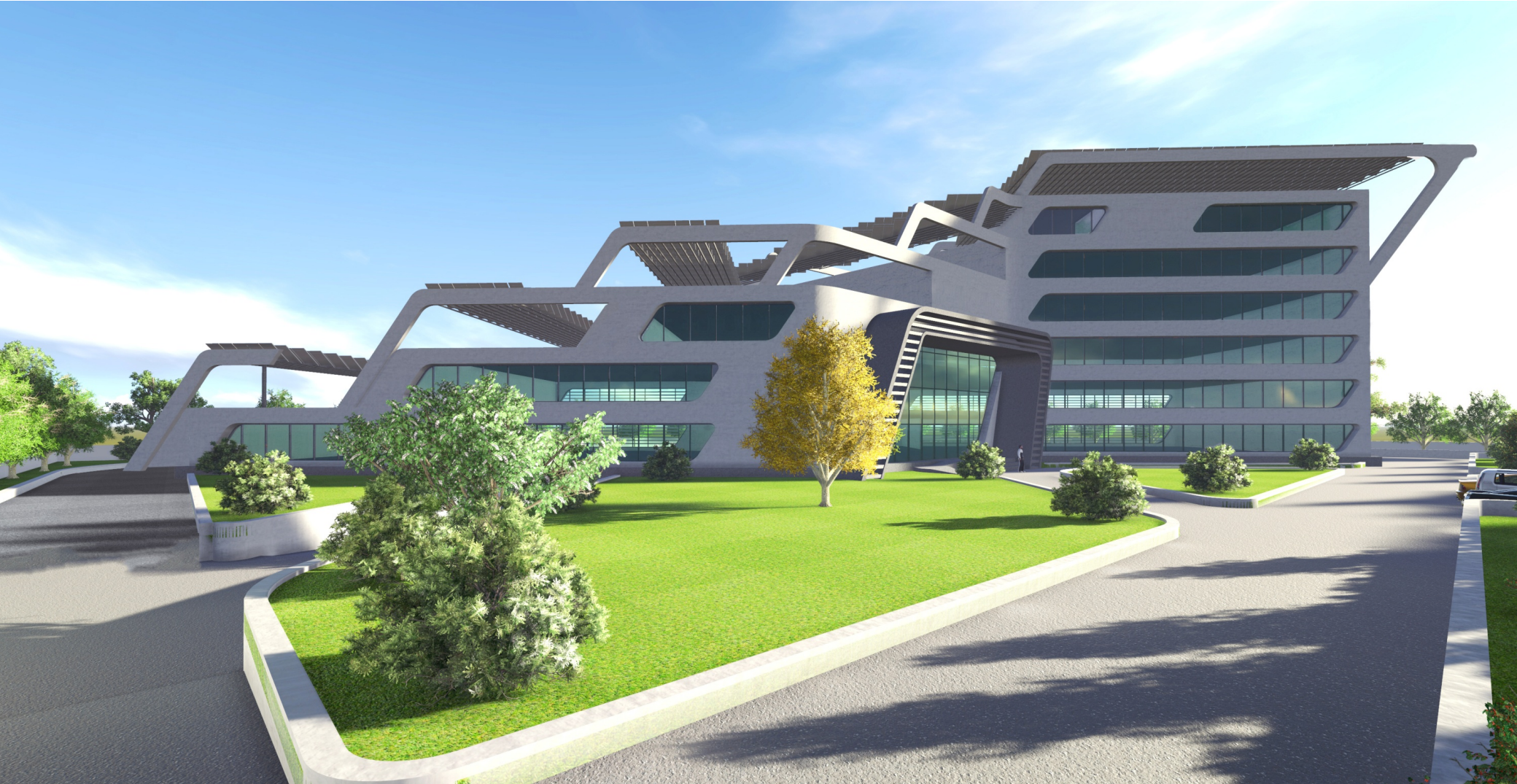
NATIONAL ENERGY SAVINGS = CODE STRINGENCY x LEVEL OF COMPLIANCE x ADOPTION RATE

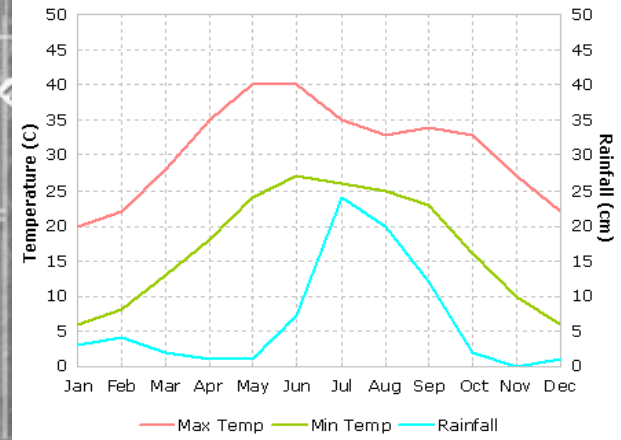
Building Energy Performance



Sequence of approach to create a set of integrated energy conservation measures (ECMs)

UHBVN initiative – ECBC & Above



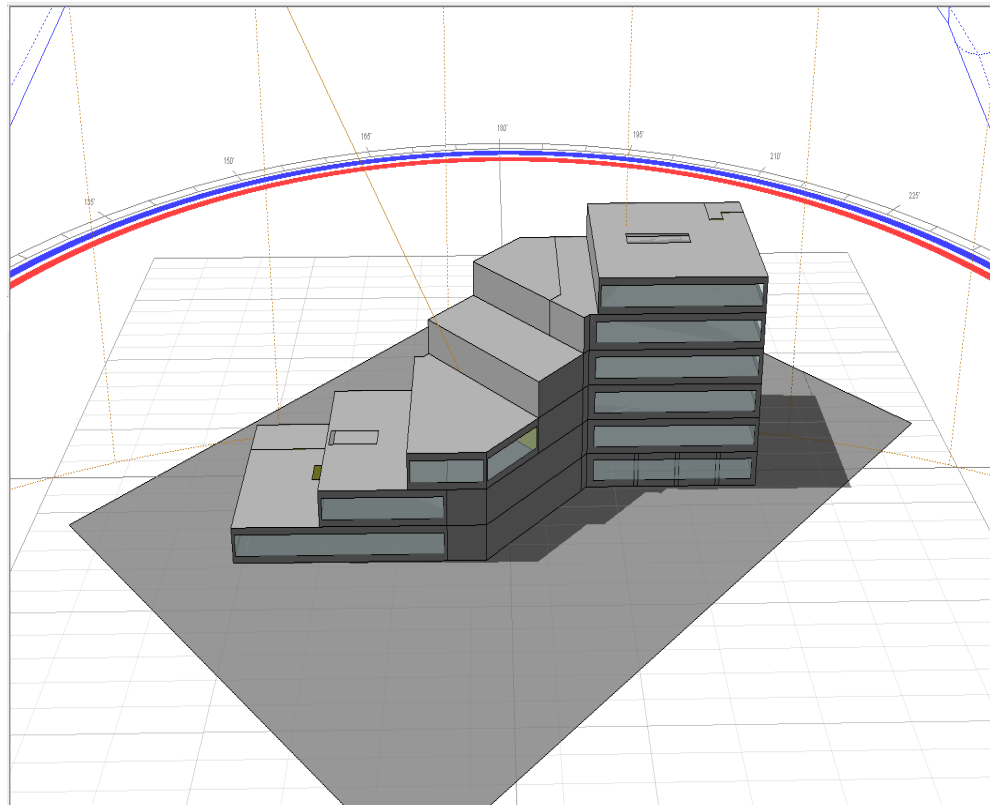


- Possibility of N-S Orientation to reduce insolation.
- Promote Cross Ventilation with wind flows running parallel to the Himalayas

Possible Views of Himalayas from Upper Storeys on North Side

SITE ANALYSIS: SUN PATH & WIND POTENTIAL

Building Orientation



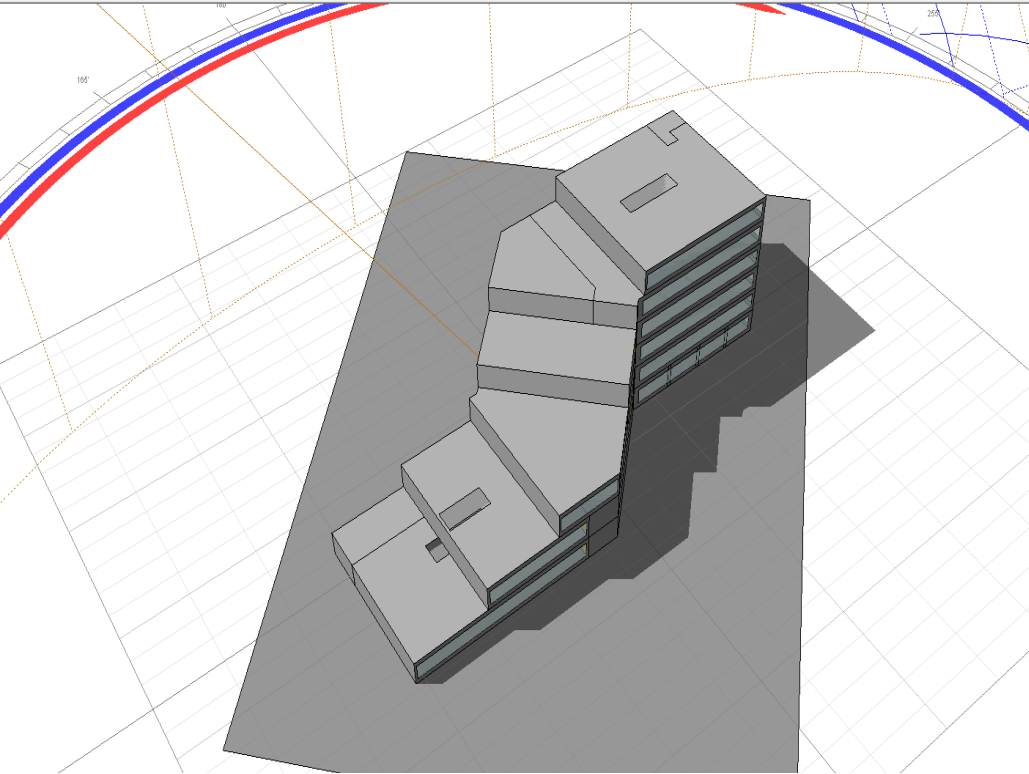
Shadow Analysis –
21st June

NORTHERN
FACADE

Analysis carried out at 10 am

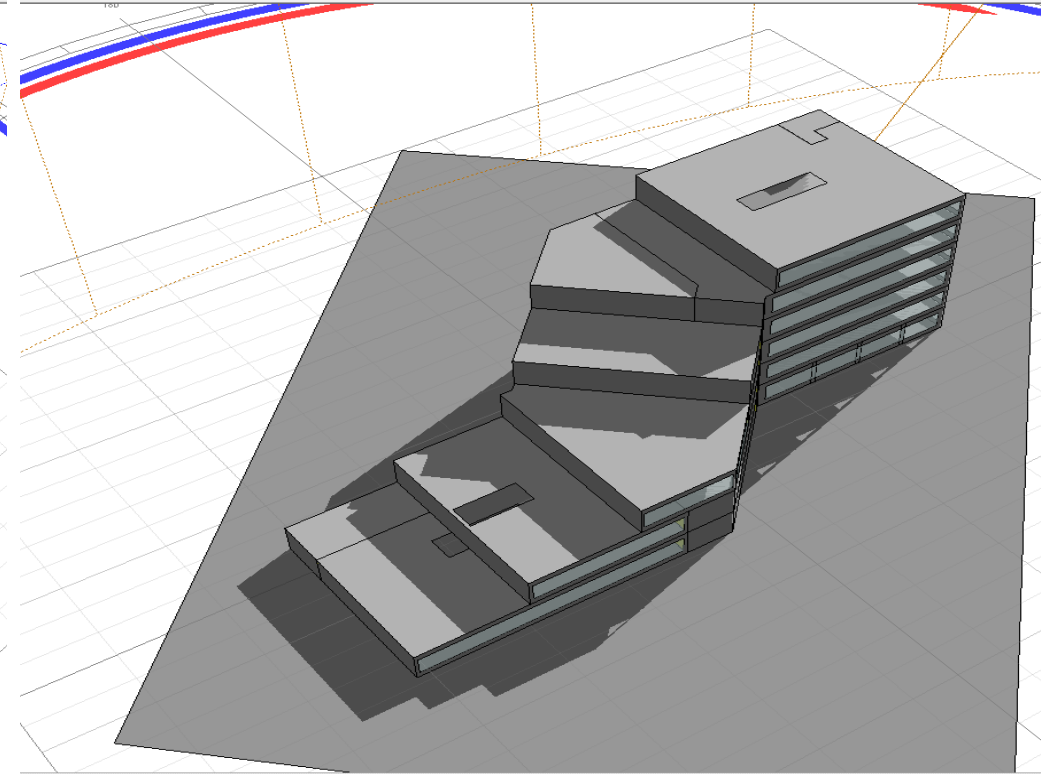
- Range of Open Spaces & Terraces, for Summers and Winters at Various levels
- Office Spill outs at all levels

Building Orientation



All the terraces receive solar radiation during the morning time (Analysis carried out at 10 am)

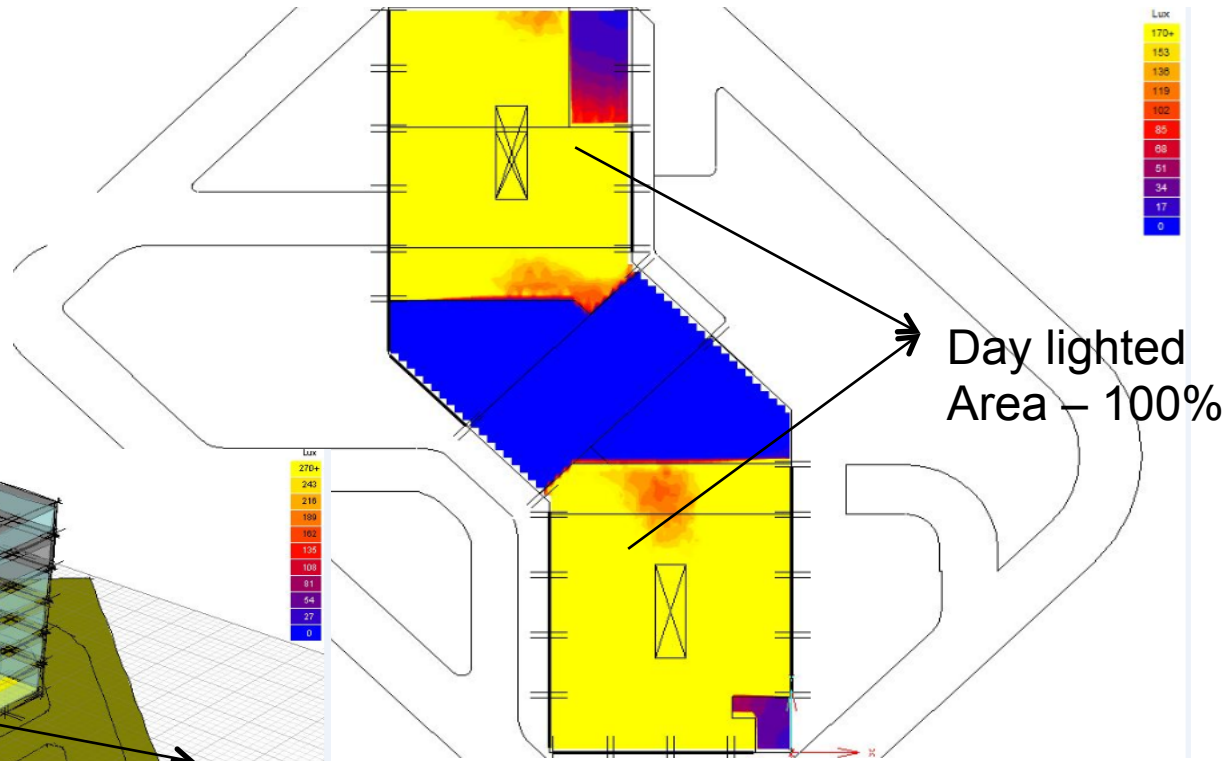
Shadow Analysis – 21st Sep



All the terraces remain shaded during evening time (Analysis carried out at 4 pm)

High Performance Envelop Description

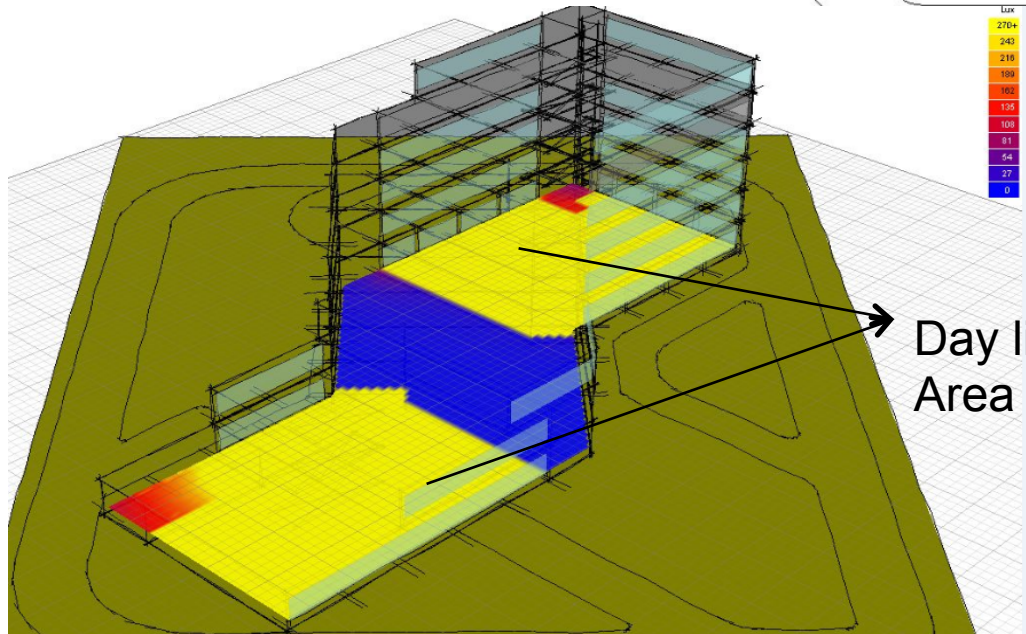
Day Light-requirement - GRIHA



Day lighted Area – 100%

LUX Requirement - 250

Day Light-requirement - LEED



Day lighted Area – 100%

LUX Requirement - 270

Building Input Parameters

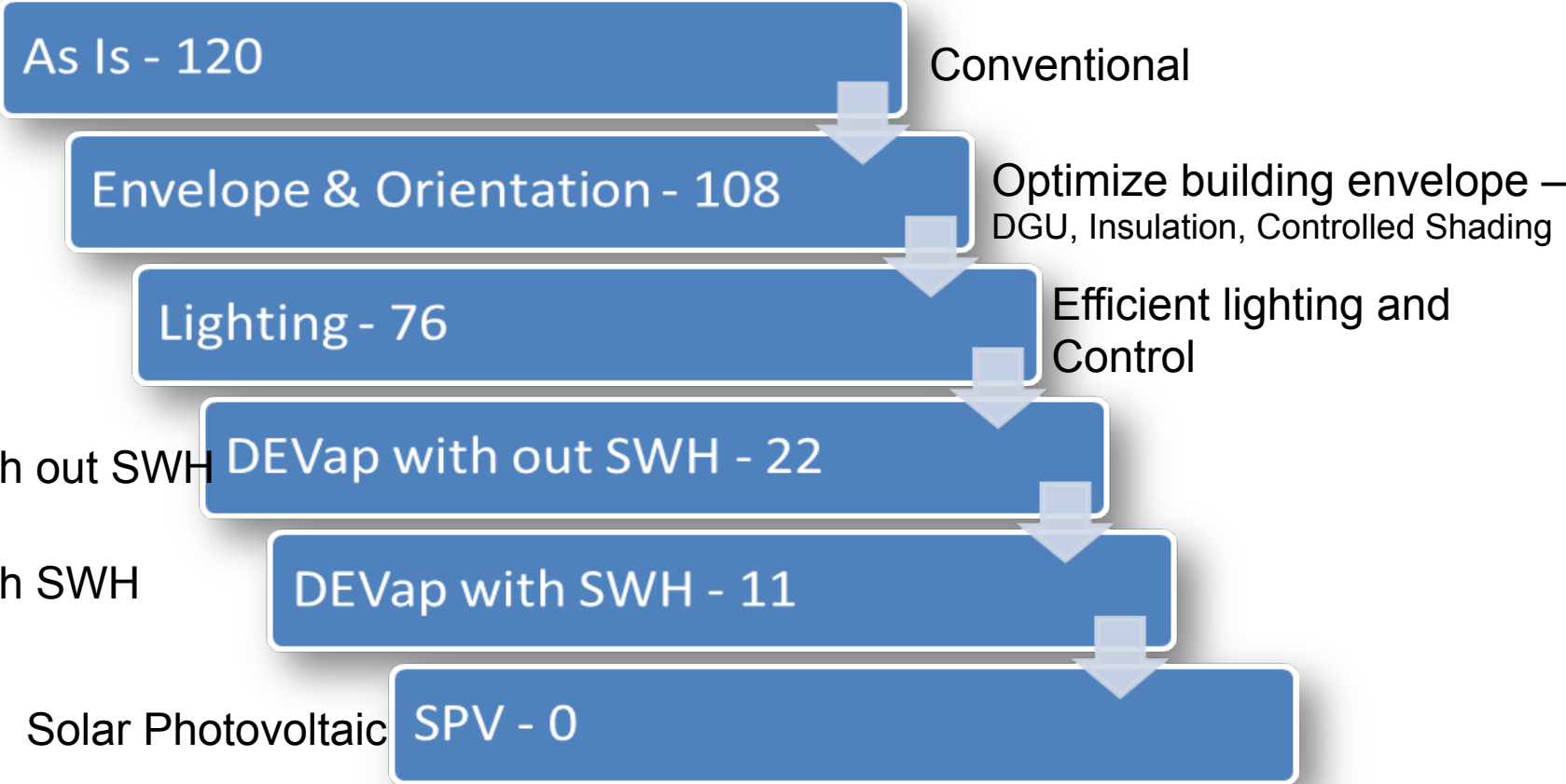
Wall & Roof	
Wall Overall U-value	
Wall Minimum Insulation	TRIC Eco Wall= 0.44 W/m2K
Roof Overall U-value	RCC 150mm+Brick 75mm+50mm foam spray+40mm cement creed = 0.34 W/m2K
Roof Minimum Insulation	50mm foam spray insulation = 0.42 W/m2K
Roof Reflectivity	0.9
Fenestration	
SHGC	0.26
U-value	1.5 W/m2K
VLT	0.5
Shading	Automatic Control
Internal Loads	
Lighting	Office - 4 W/m2; Parking - 1 .2 W/m2; Residential - 3 W/m2
Dimmable Ballast	Yes
Daylight Sensor	Yes
Occupancy Sensor	Yes
Programmable Timers	Yes
Receptacle Equipment	5 W/m2
HVAC	
Cooling System Type	DEVap
DEVap System Capacity	215 Tr
Cooling Set Point	25 deg C
Regenerator Heat Source	Solar Water Heating
Heating System Type	Solar Water Heating
Heating Set Pt	21 deg C
Fan Control	Variable Speed
Outside Air	30% extra over ASHRAE 62.1-2007 minimum acceptable rates
Renewables	
Solar Photovoltaic	100 kW

Free Area Utilization

S.No	Description	AREA IN SQM
1	Solar PV	1200
2	Solar Water Heating Collectors	500
3	Green Area	360
	Total	2060

High Performance Envelop Description

EPI (kWh/m²/yr) Summary



ENERGY EFFICIENCY IMPROVEMENT

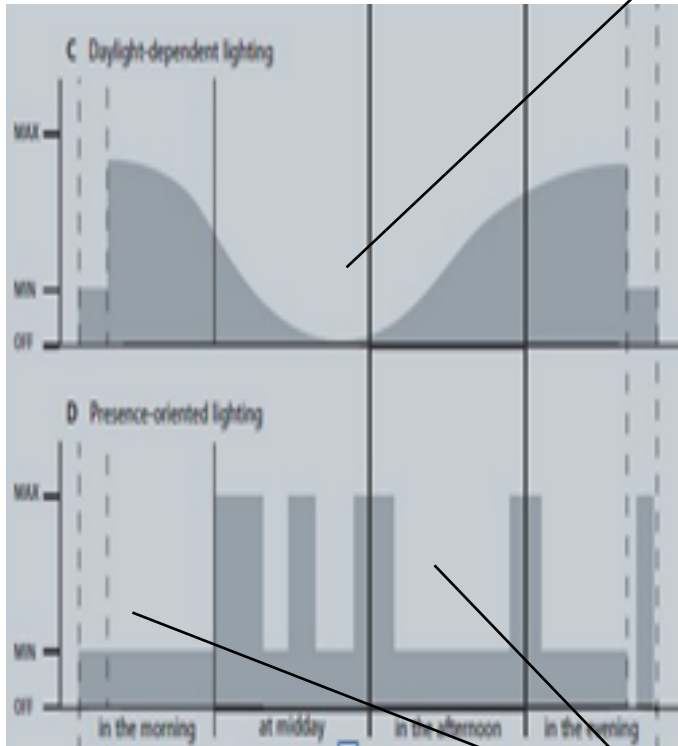
LEED / GRIHA Summary

Criteria/ Credit	GRIHA		LEED	
	Max. Points	Possible points	Max. Points	Possible points
Outdoor lighting system efficiency	1	1		
Optimized Building Design	8	8		
Optimize Energy Performance	16	16	19	19
Renewable Energy Utilization	8	8	9	9
Mandatory use of CFC free insulation & Refrigeration equipment and halon free fire suppressant systems	1	1	2	2
Audit & Validation	Mandatory & no points	Mandatory & no points	3	3
Operation and Maintenance	2	2	2	2

POINTS ACHIEVING UNDER GRIHA = 94
 POINTS ACHIEVING UNDER LEED = 92

Efficient Control - Lighting

Savings Due to Day-light Controls



Typical Lighting Control Applications

Type of Control	Private Office	Open Office - Daylit	Open Office - Interior
Occupancy Sensors	++	++	++
Time Scheduling	+	++	++
Daylight Dimming	++	++	0
Bi-Level Switching	++	+	+
Demand Lighting	+	++	++

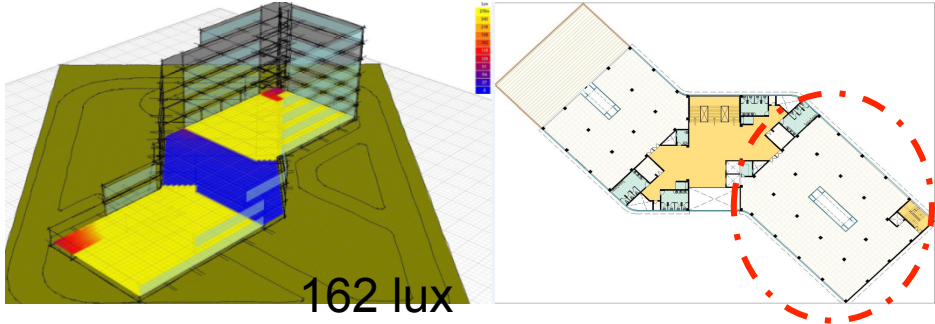
++ = good savings potential

+ = some savings potential

0 = not applicable

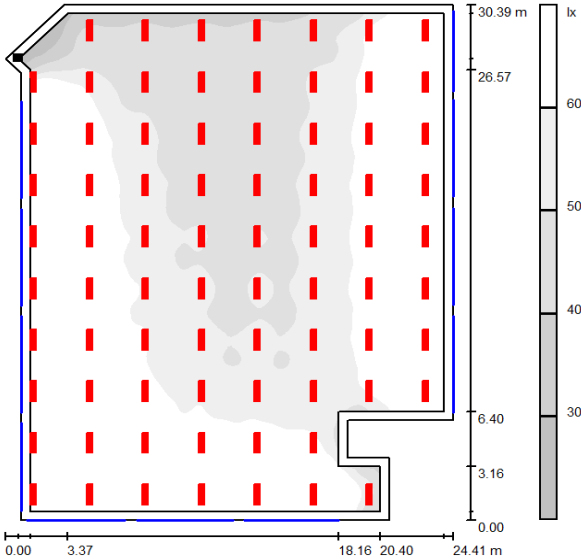
Savings Due to Occupancy Based Controls

Efficient Control - Lighting

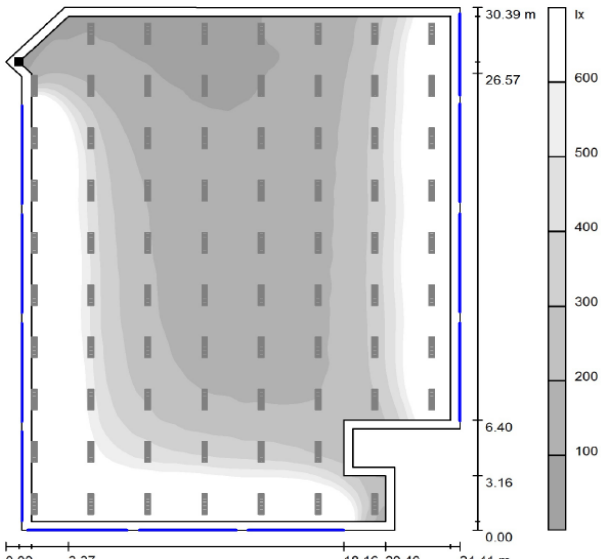


162 lux

Savings Due to Day-light Controls

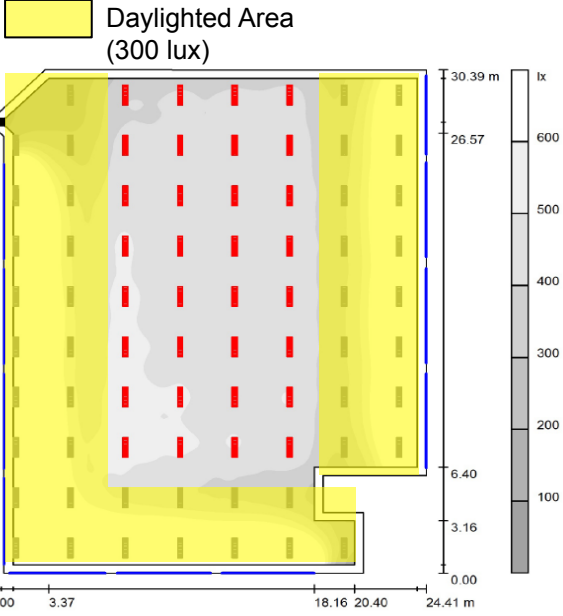


Artificial Lighting



Use of Daylight

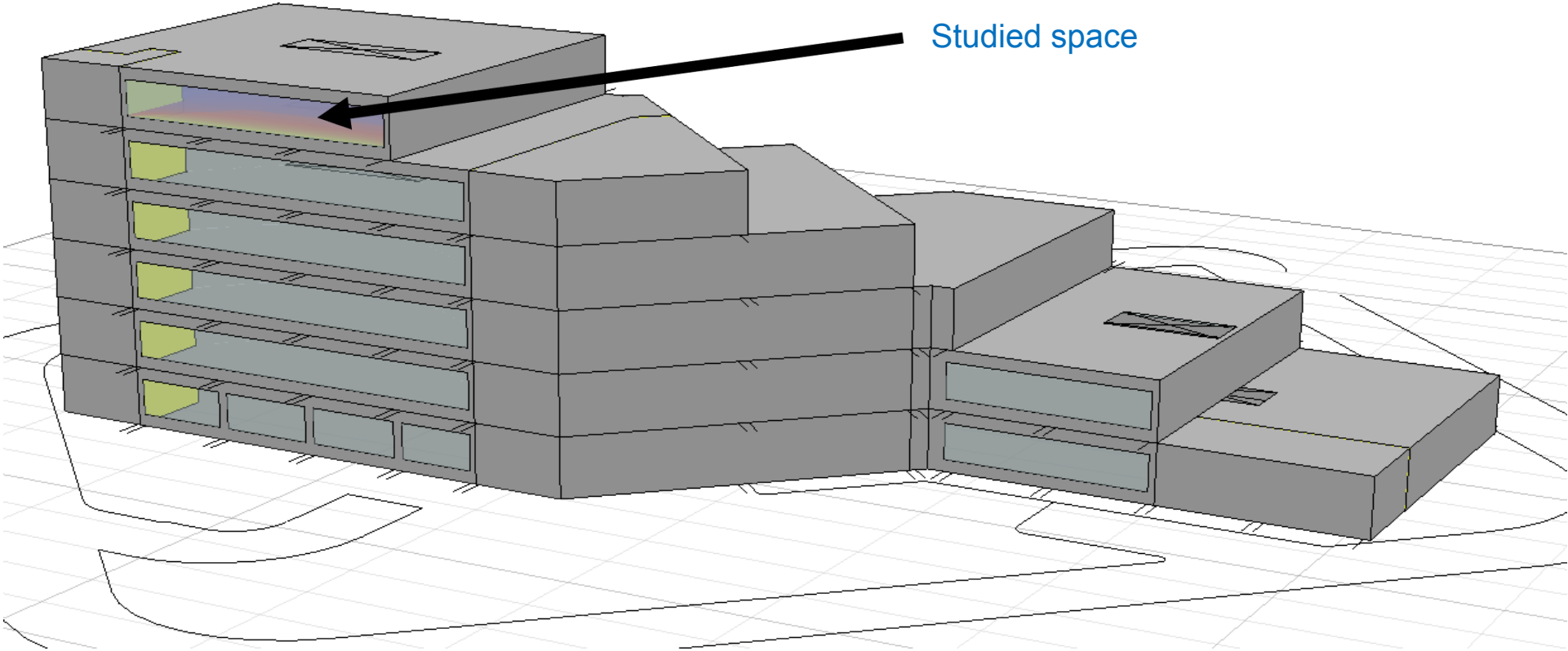
Integrated artificial lighting arrangement with daylight



Combination of Artificial lighting and use of daylight



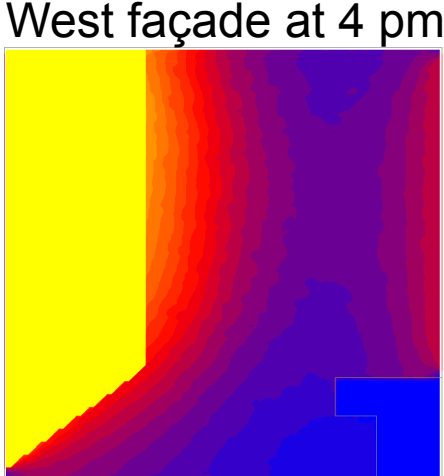
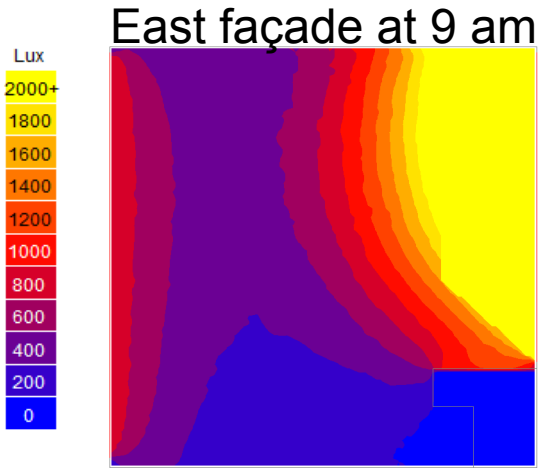
Solar adaptive shading



Façade Optimization – Automatic Shading Control

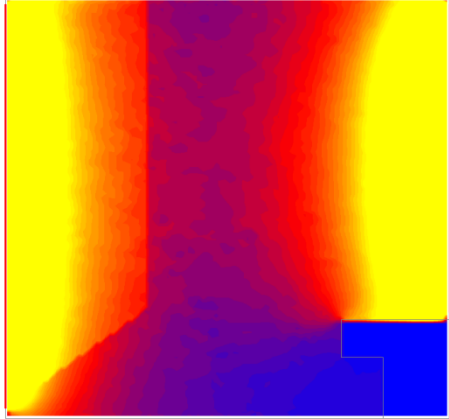
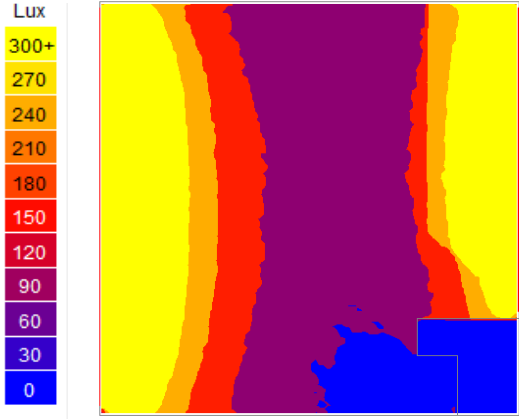
Solar adaptive shading

Light Levels analysis



Without shading devices
Light Levels : higher than 2000 lux
Visual discomfort

Average Light Level : around 2000 lux



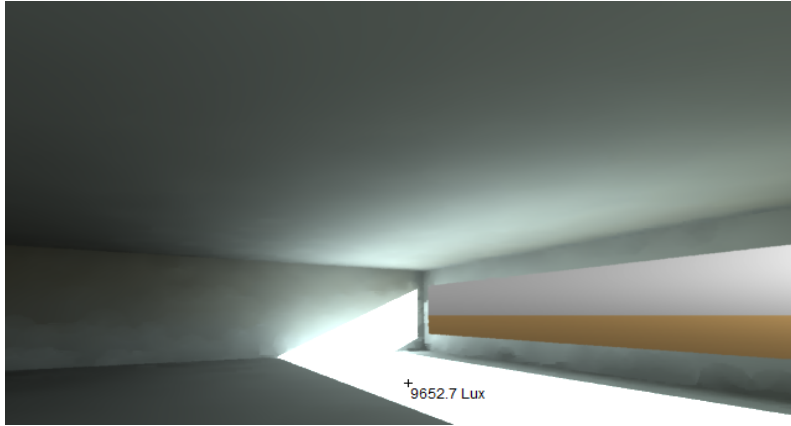
With solar adaptive shading
Light Levels : < 500 lux
Visual comfort

Average Light Level : around 250 lux
A combination with artificial lighting is needed

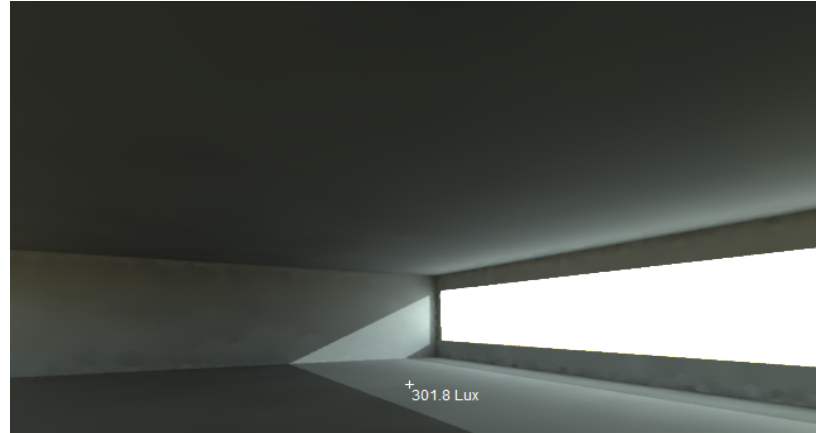


Solar adaptive shading

Radiance Views of an East façade at 9 am



Without shading devices



With solar adaptive shading

Benefits of the solar adaptive shading

- Create a visual comfort in the room
- Homogeneity of light level
- Optimization of the daylight

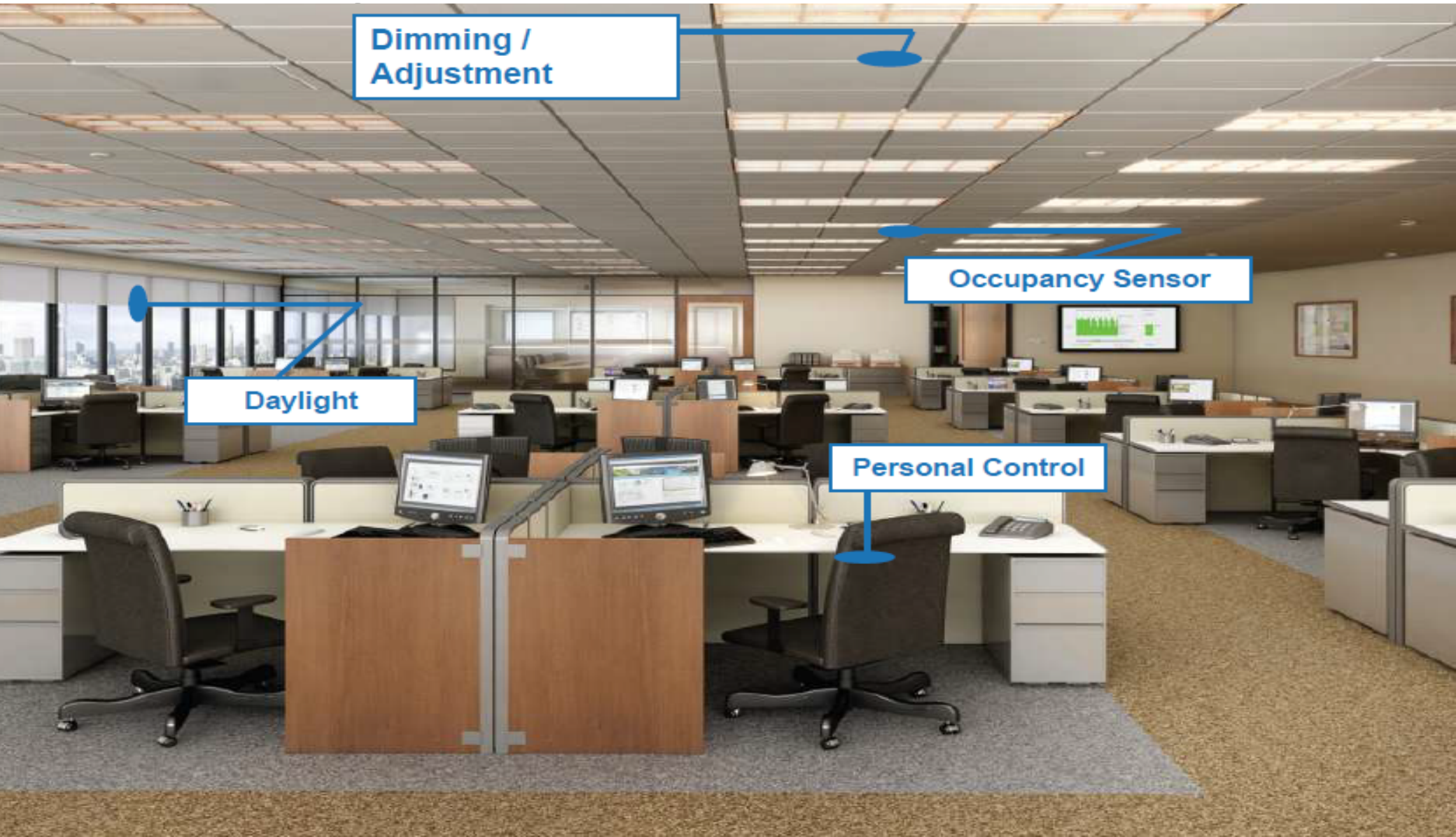


**Dimming /
Adjustment**

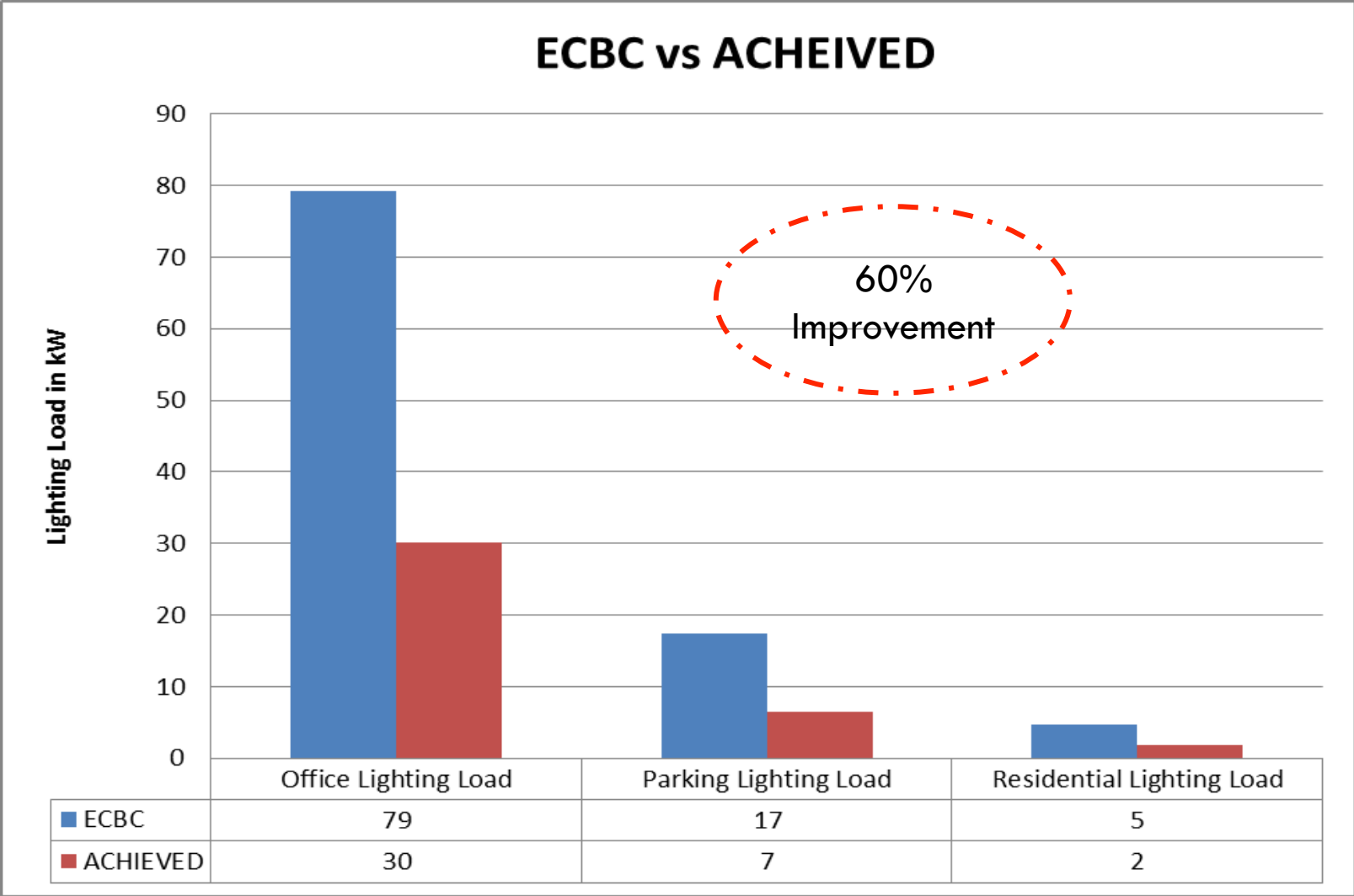
Occupancy Sensor

Daylight

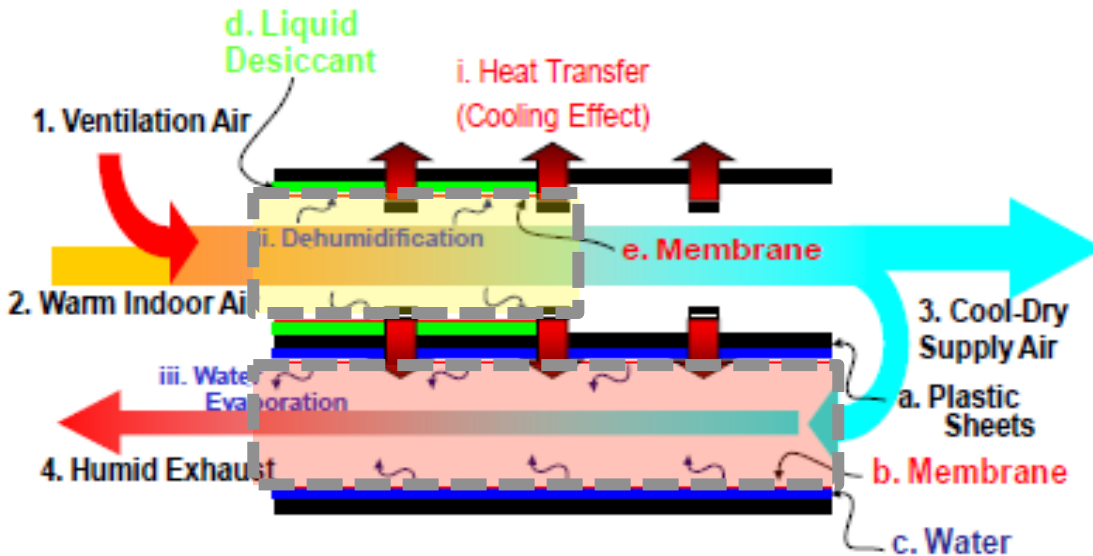
Personal Control



ECBC vs ACHIEVED - Lighting

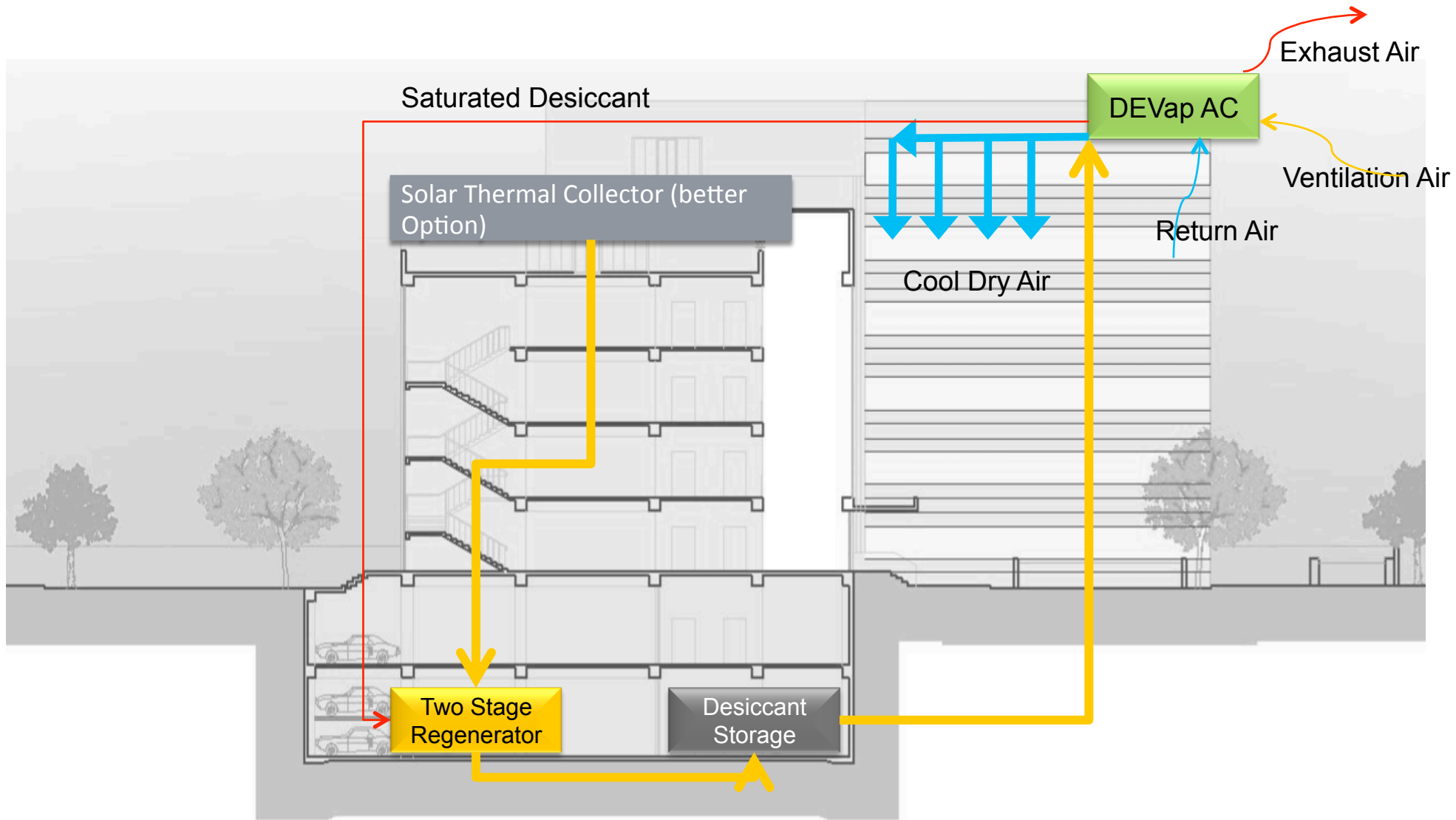


100% Passive Cooling is Possible

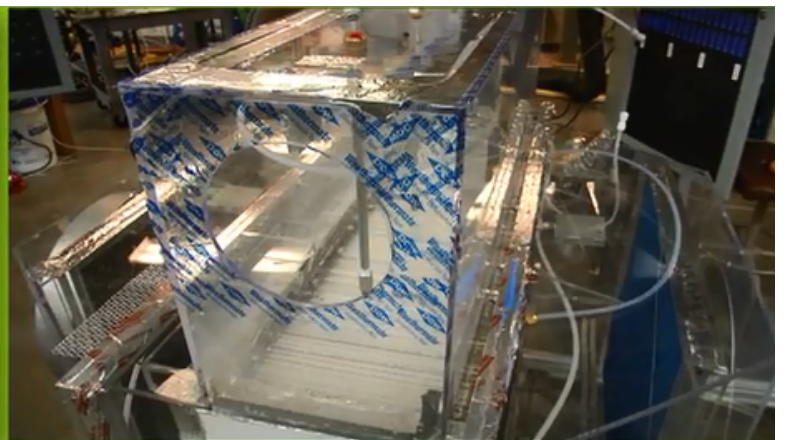
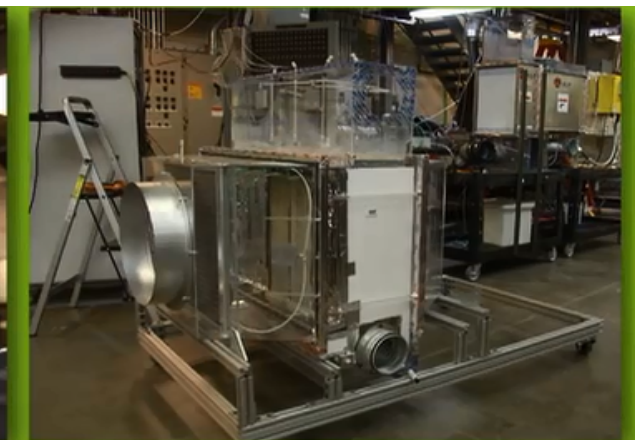
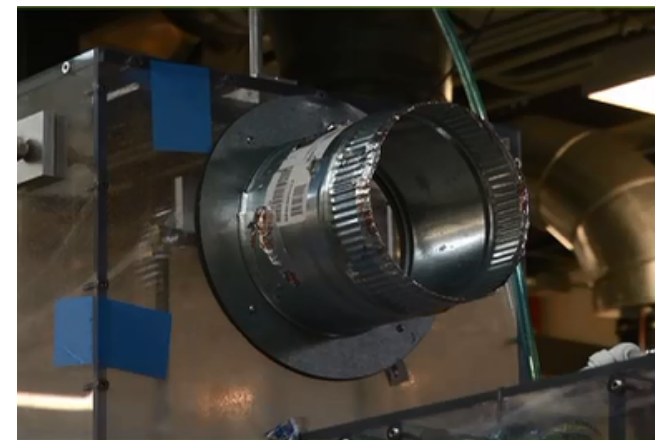
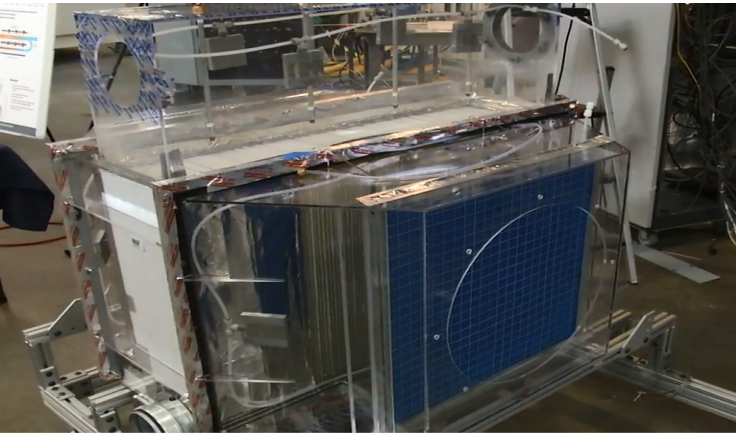


FEATURES:

- Combine membranes,
- evaporative coolers and desiccants (AKA salt solutions) into a single device
- Desiccants' capacity to create dry air using heat
- evaporative coolers' capacity to take dry air and make cold air.
- Replaces the refrigeration cycle with a thermally activated absorption cycle
- Capable of being powered by natural gas and solar energy
- Use of salt solutions means none of the harmful carbons associated with refrigerants are being released into the air
- using far less electricity leads to a lower monthly energy cost

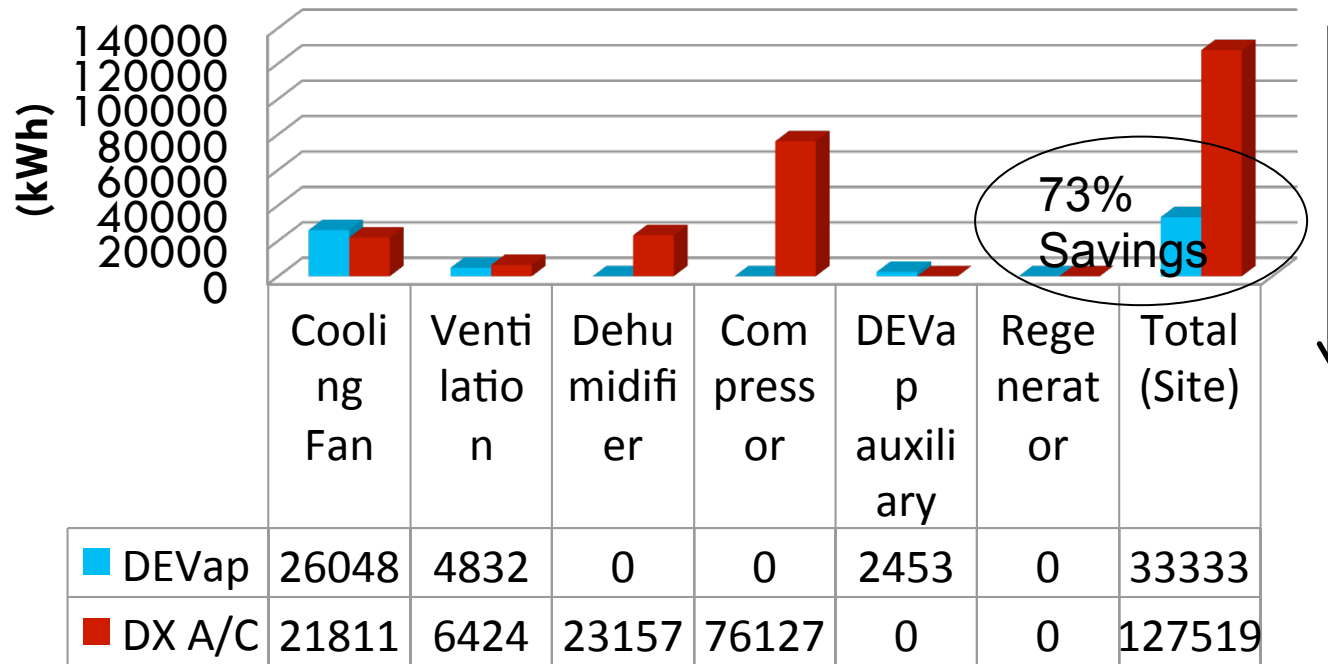


Passive Cooling - DEvap



Passive Cooling - DEVap

Energy Consumption Comparison



Resulting a INR 7.50 Lacs savings per annum only for cooling
 Solar Water Heating system can be integrated to serve the heating energy requirement during the winter season

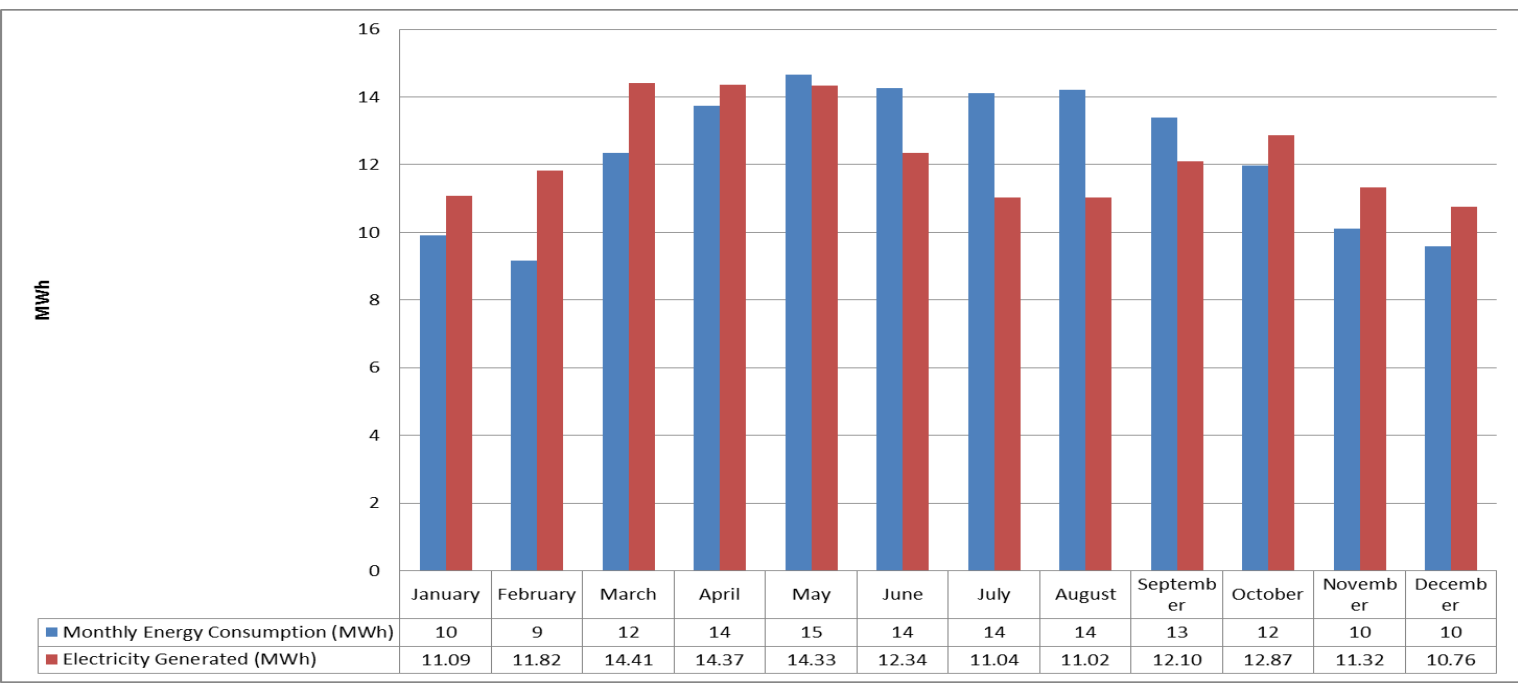
There by meeting, 100% of the comfort hours through passive strategies

System Sizing - RENEWABLES

- Solar PV Capacity Required = 200 kW
- Area Required for Solar PV = 2000 Sq.mt
- Area Available for Solar PV = 2060 Sq.mt
- Energy Consumed by Building = 300 MWH (Annually)
- Energy Generated by Solar PV = 300 MWH+ (Annually)

- All the energy required for regeneration and winter heating is supplied by Solar water heating System
 - Could Run on “Net-metering” model till “Feed-in-tariffs” implemented when complete grid connected system viable.
 For UHBVN, small battery bank proposed for emergency requirements & to reduce DG usage

Consumed vs Generated - RENEWABLES



RENEWABLE ENERGY

Convergence in Practice....



THANKS

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