



**WORKSHOP ON
ENERGY EFFICIENCY**

NAIROBI, KENYA
22 OCT 2023

Building and Urban design to reduce cooling load and for heat resilience

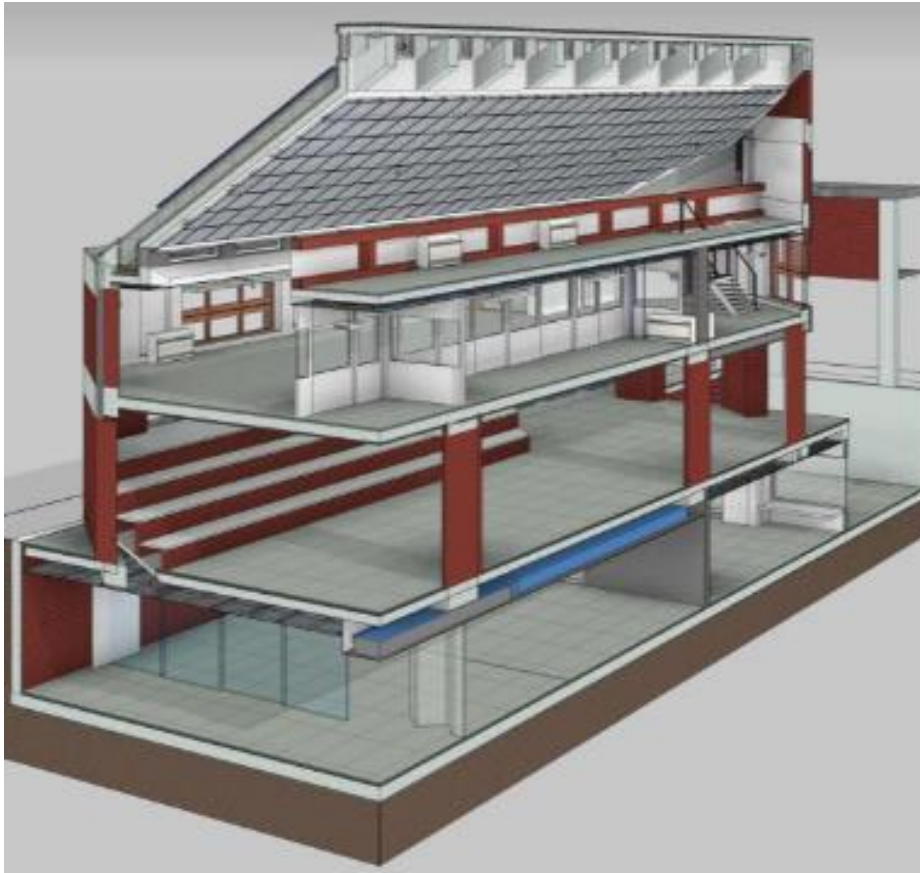
Rajan Rawal
CEPT University, India

Complex interaction between within buildings and between building



Building Design and Operation based on the first principle of science and occupant behaviour

Complex interaction between within buildings and between building



Building Design and Operation based on the first principle of science and occupant behaviour

Complex interaction between within buildings and between building

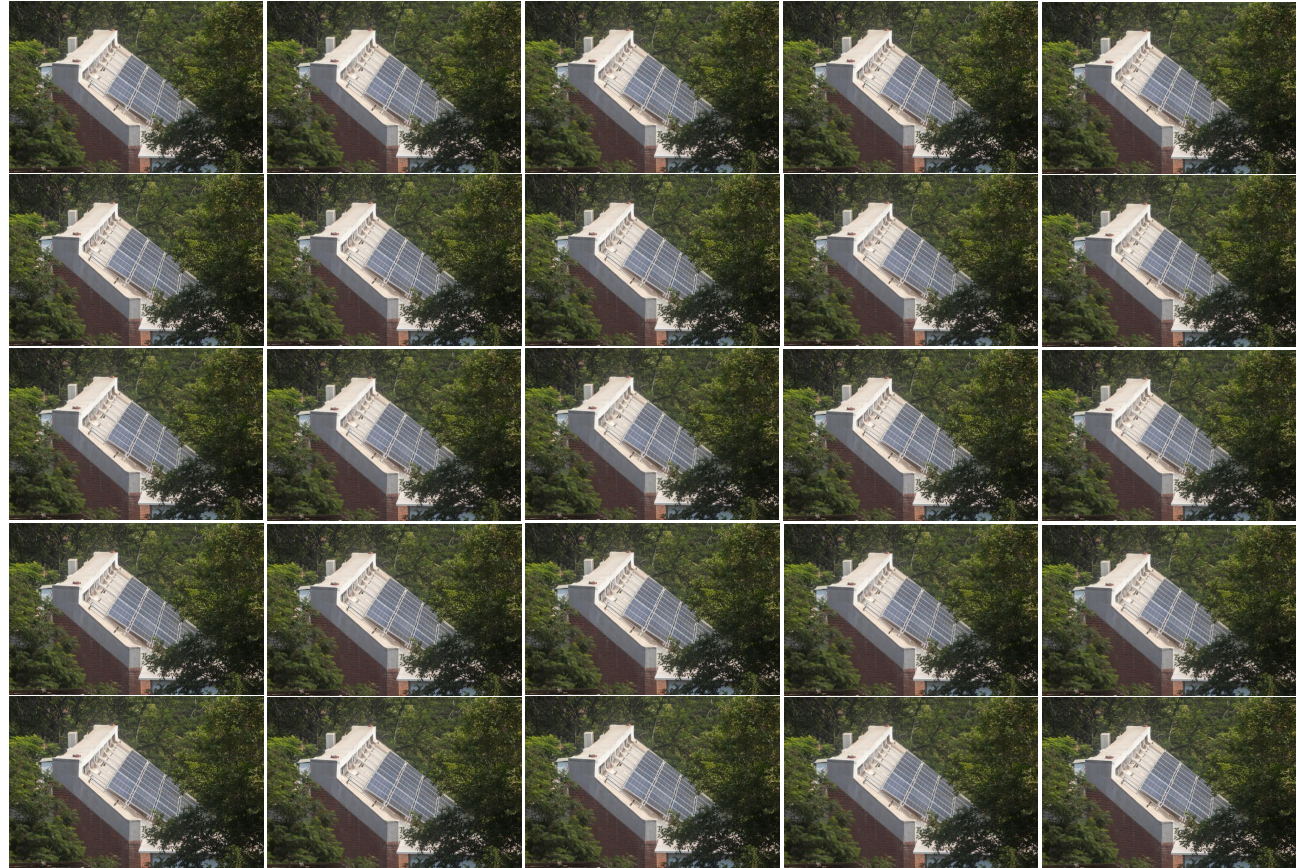
One

Super-Efficient
Net Zero
Healthy building

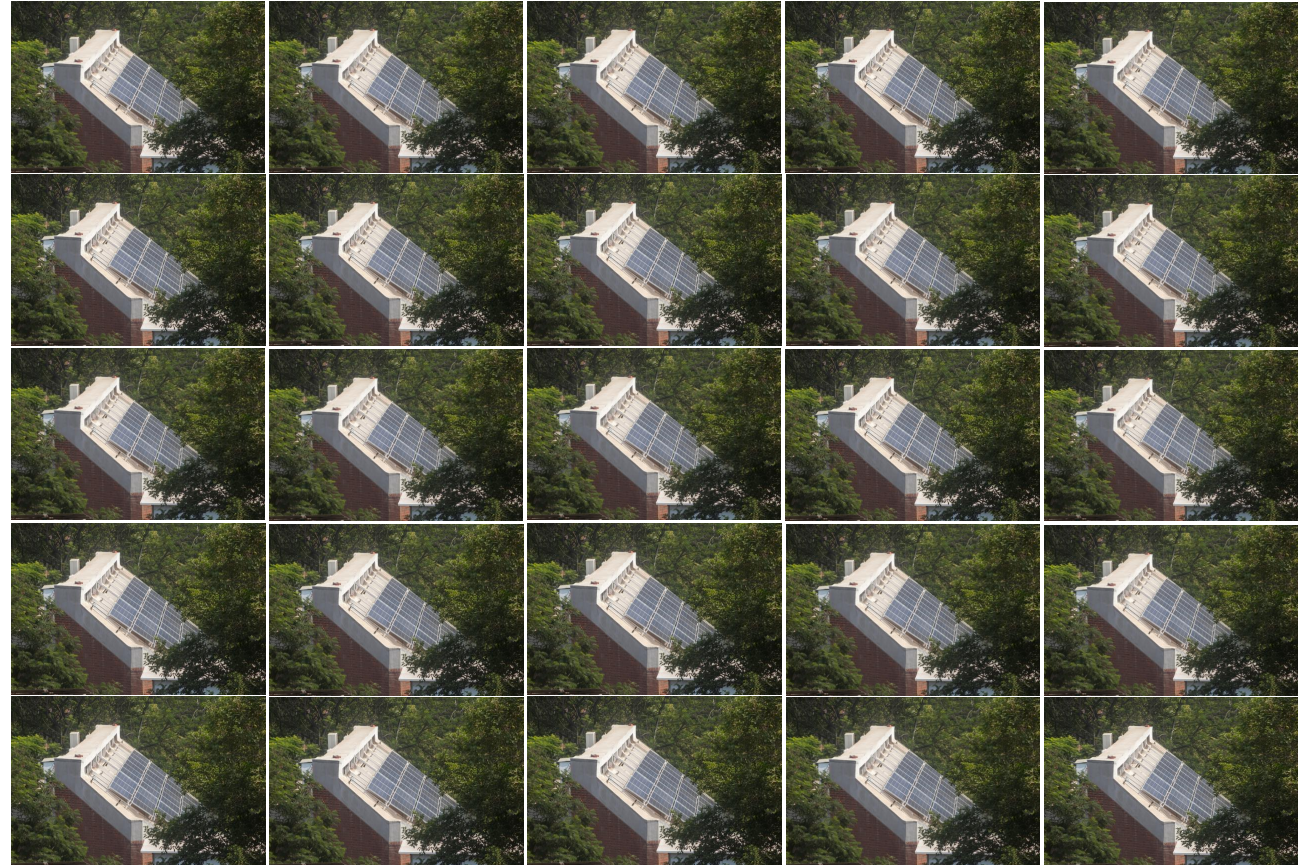
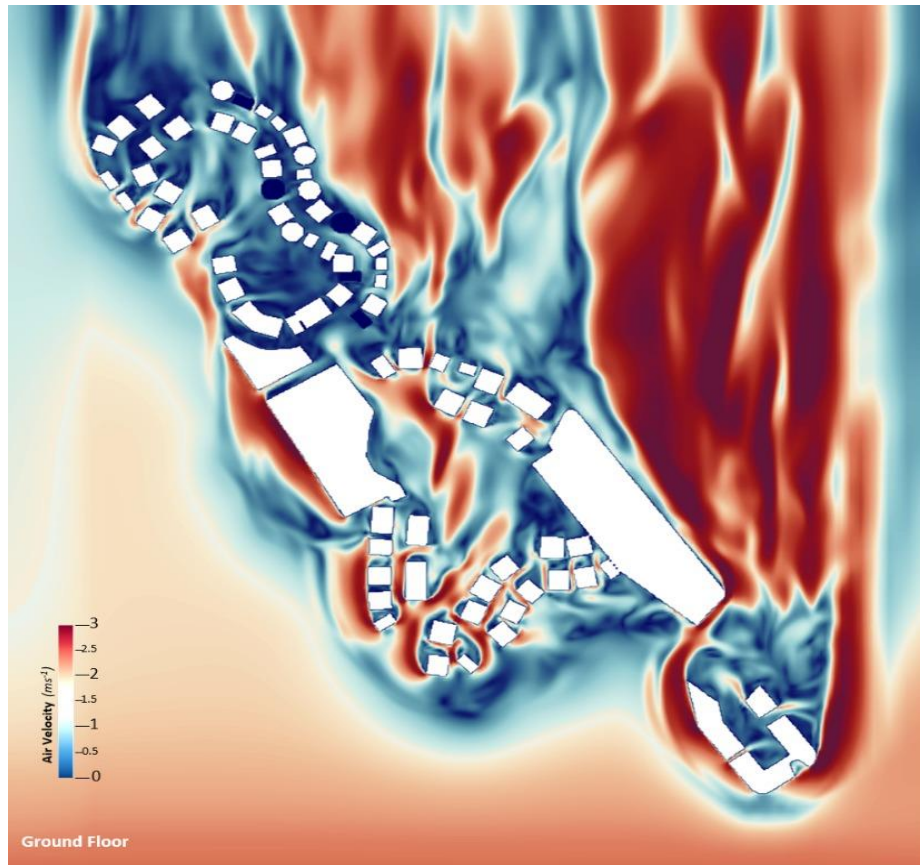
Cannot be replicated '*n*' times to achieve

Super-Efficient
Net Zero
Healthy

Neighbourhood or City

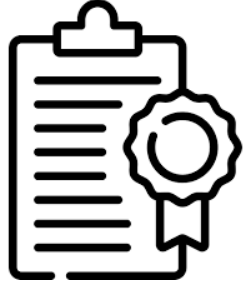
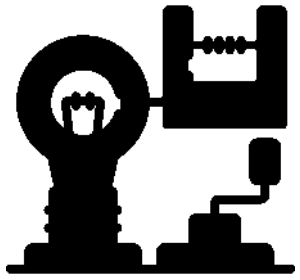


Complex interaction between within buildings and between building



Building Design and Operation based on the first principle of science and occupant behaviour

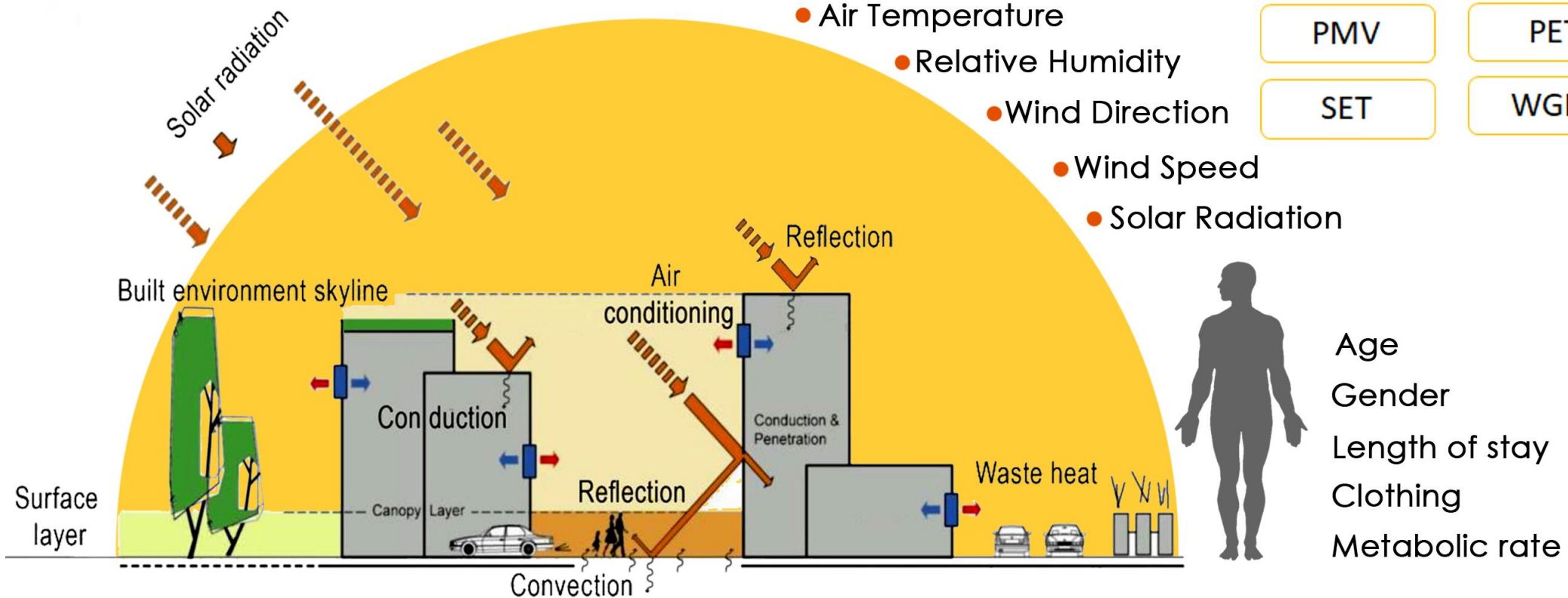
Buildings and Cities: Multi-disciplinary approach to reduce its cooling needs



Integrated approach of Building and Urban Design

Factors impacting outdoor Thermal comfort

Thermal Comfort Models



Integrated approach : Introduction of Transport Infrastructure and UHI Index



Not necessary that Blue and Green Infrastructure will always be helpful in all climate zone for cooling reduction

Highest Air Temperature

Rail + Vegetation = 45.90°C

Rail + Building = 43.90°C

Road + Vegetation = 39.70°C

UHI Index

Rail + Vegetation = 9.30°C max.

Rail + Vegetation = 2.19°C avg.

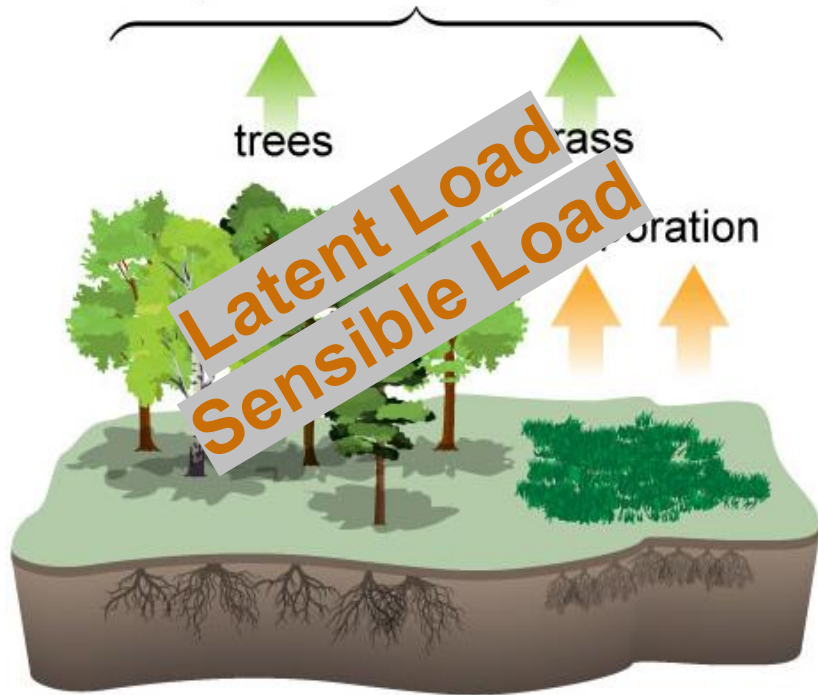
UHI Index

Rail + Building = 6.10°C max.

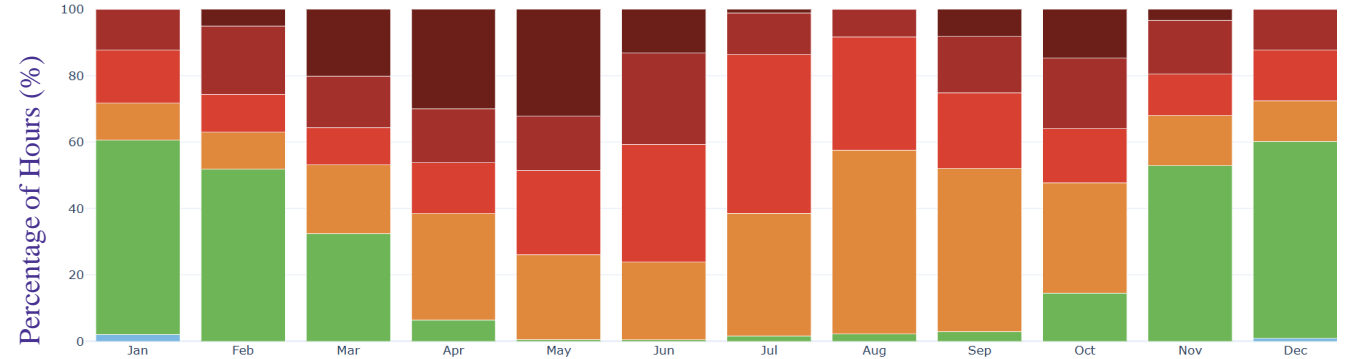
Rail + Building = 0.90°C avg.

Integrated approach : Central Business District, Outdoor Comfort

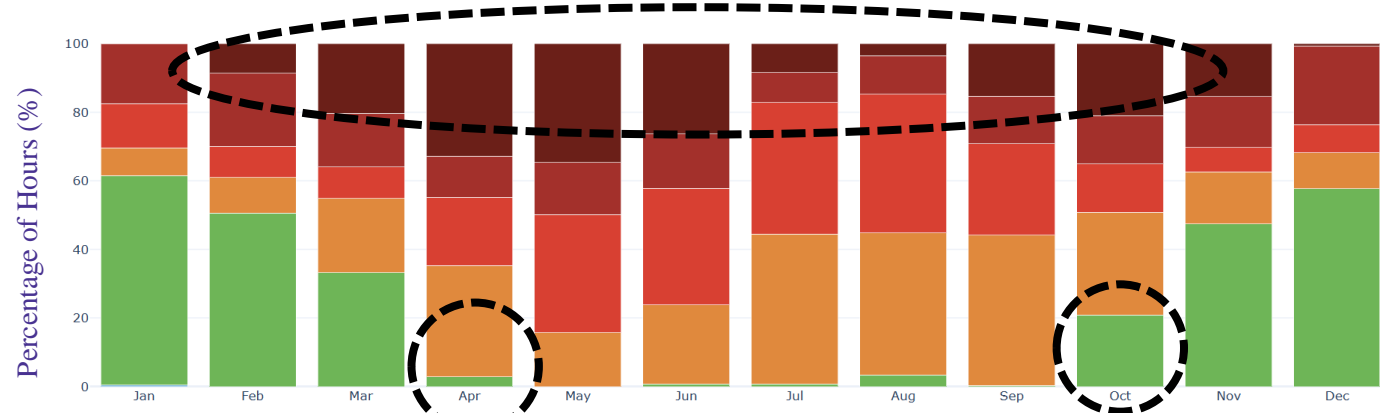
Evapotranspiration =
transpiration + evaporation



Selection of Species and their survival possibilities in future

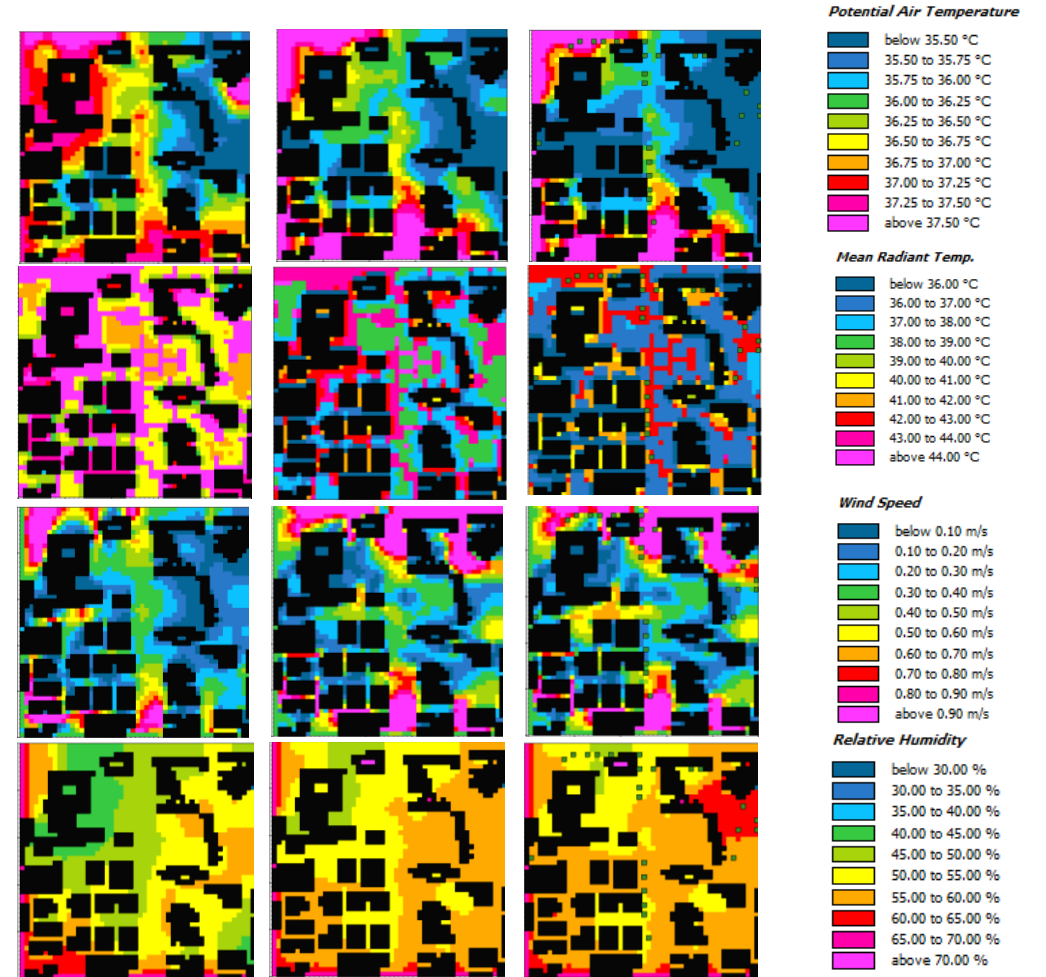
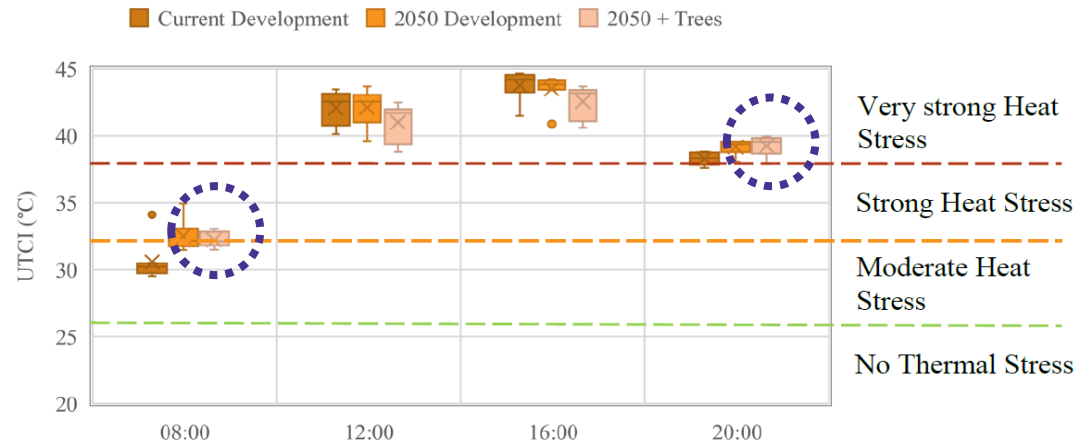
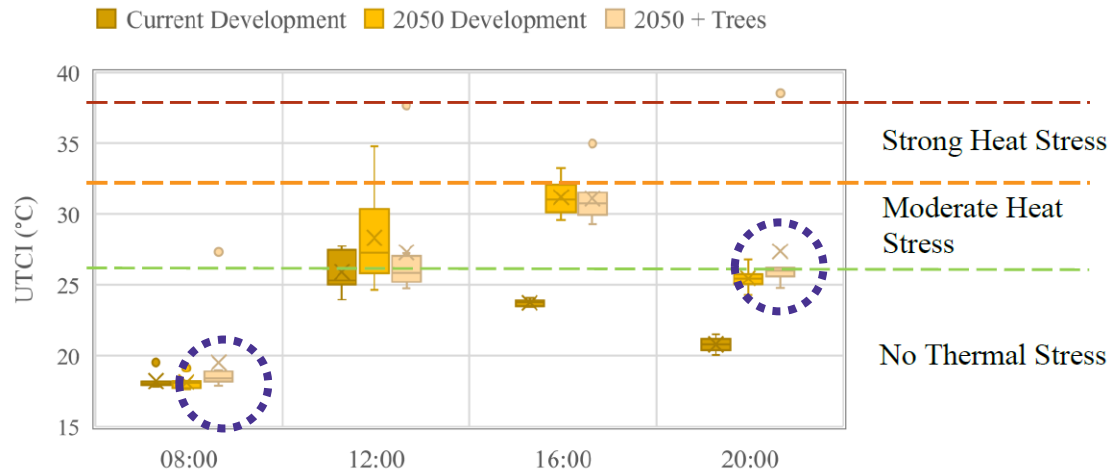


Ahmedabad City Weather 2023



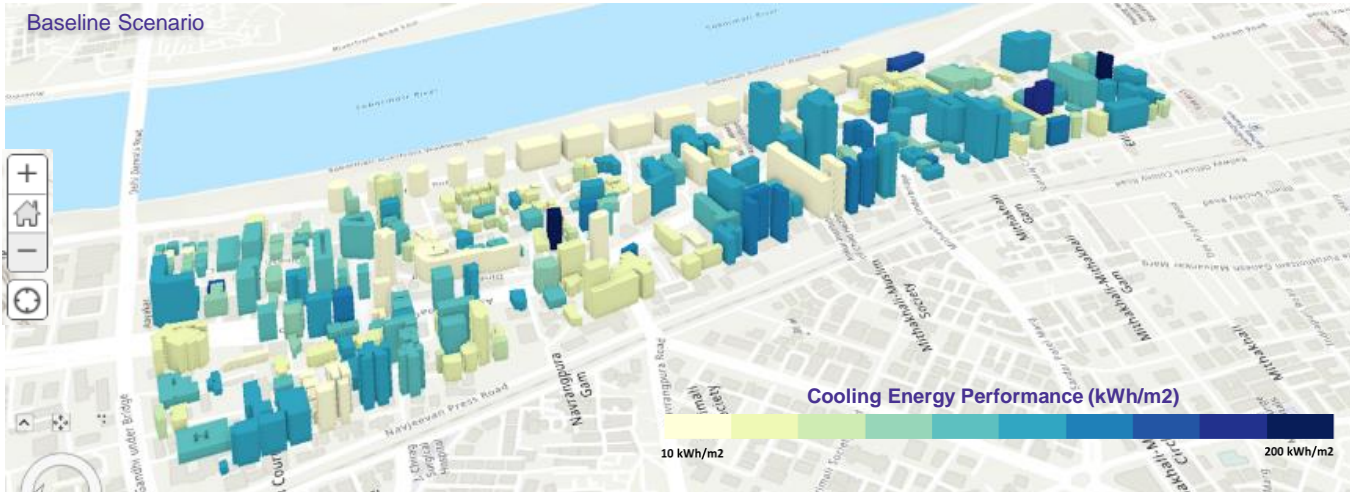
Ahmedabad City Weather 2050 Ref. IPCC Scenario 1.5

Integrated approach : Central Business District, Outdoor Comfort

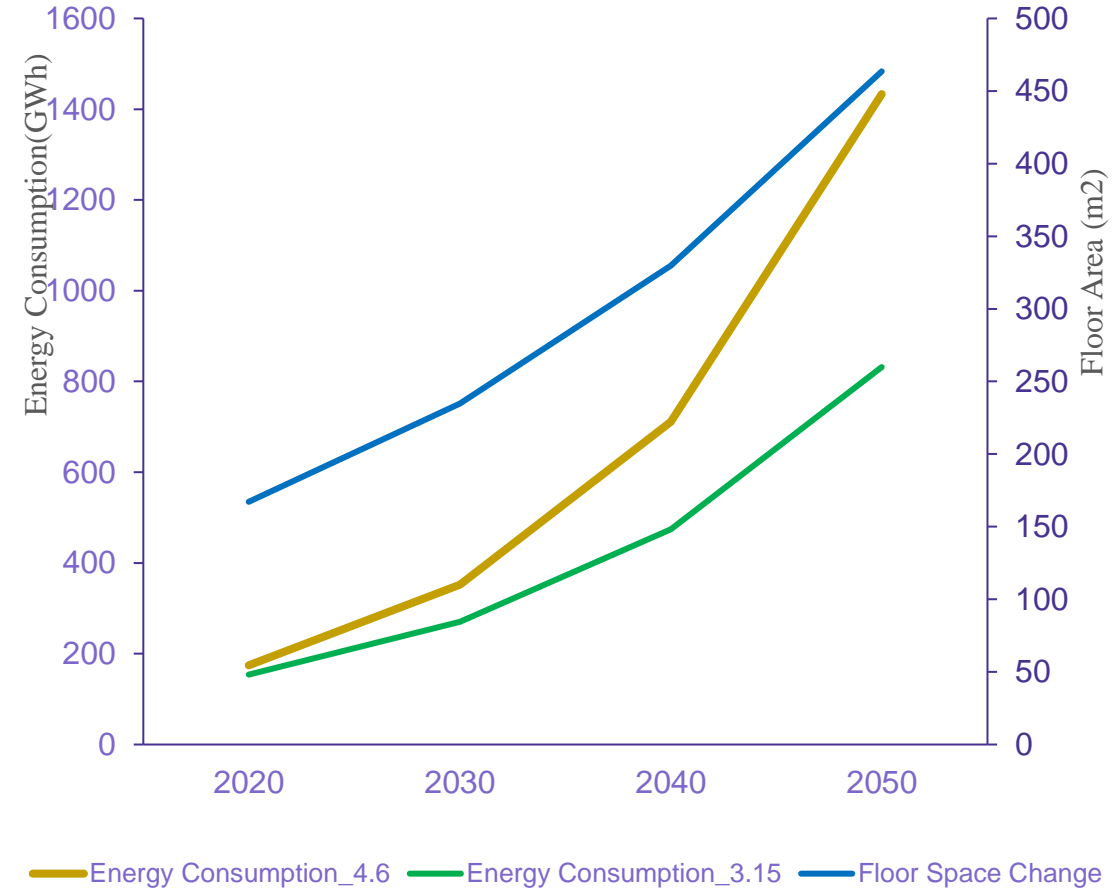


Ahmedabad City Weather 2050 Ref. IPCC Scenario 1.5

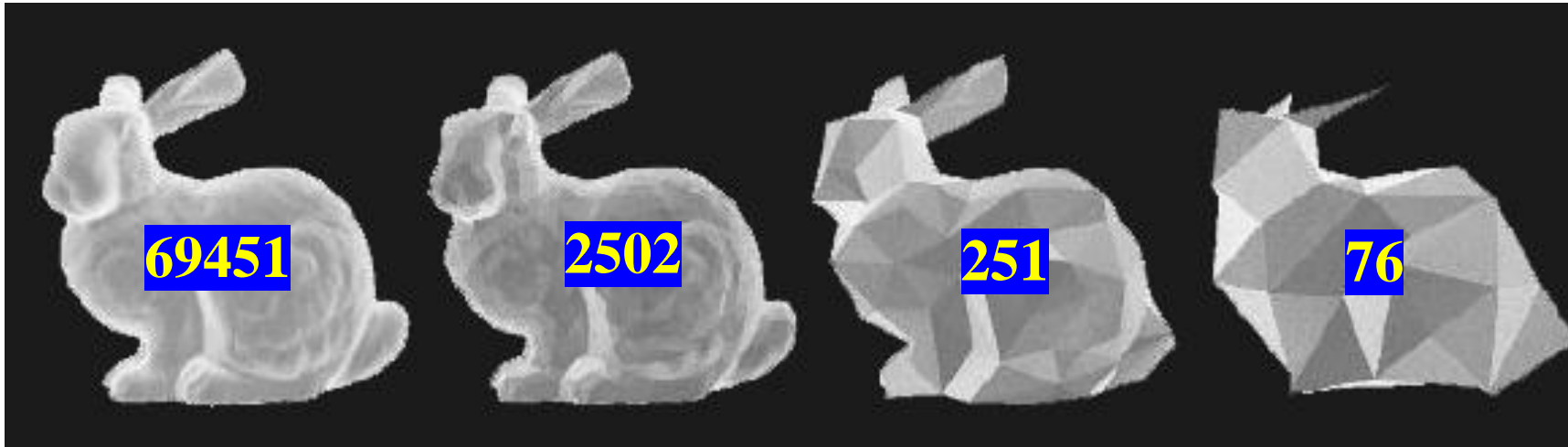
Integrated approach : Central Business District, Energy Consumption



Energy Projection for CBD

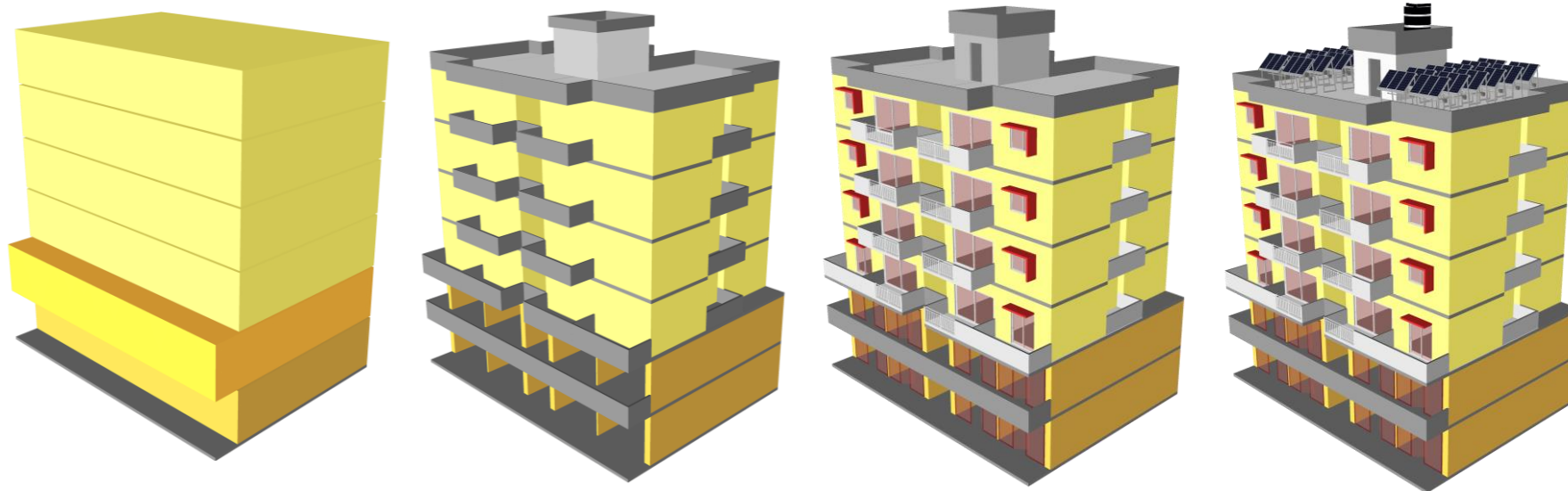


Integrated approach : Level of Details



Geometry

- Block
- Refined Geometry
- Internal Layout

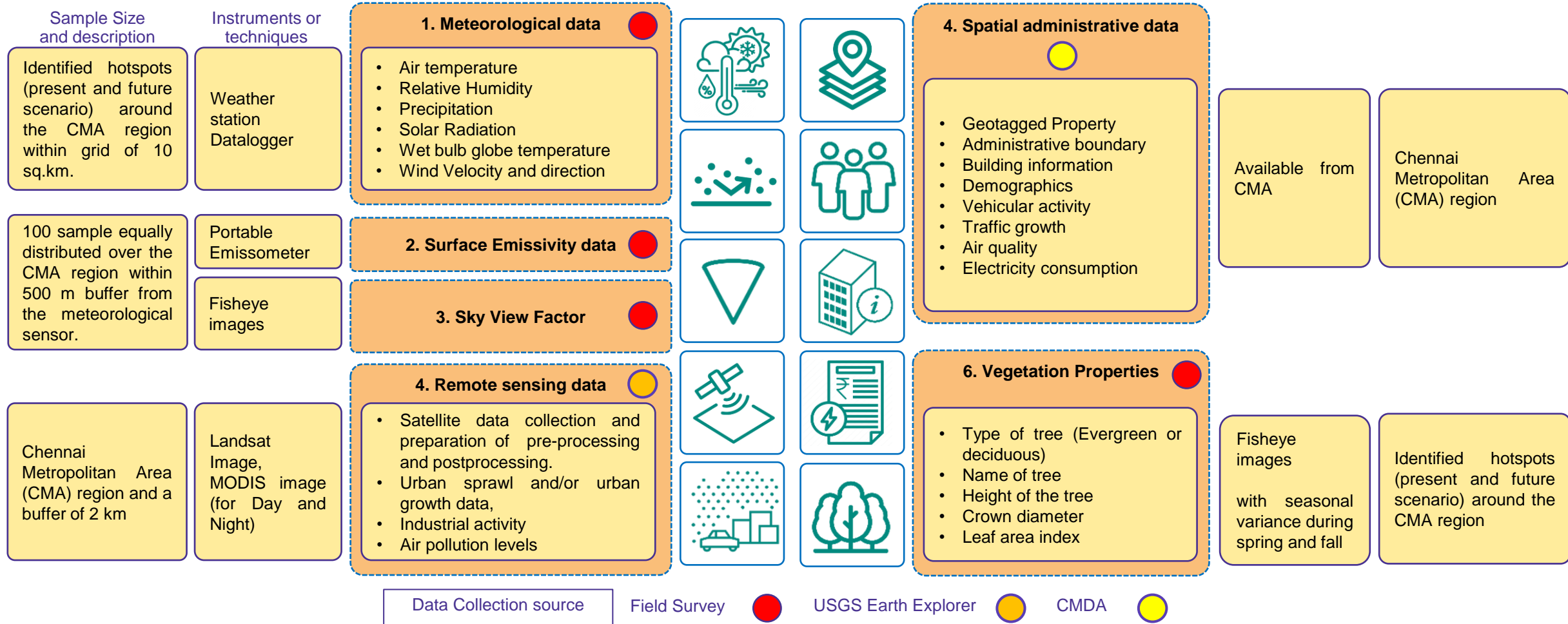


Semantic

- Climate
- Building Use
- Envelop Const.
- Occupancy
- Energy Systems
- RE Systems - SPV

Integrated approach : Level of Details and Fit For Purpose

National Level Methodology to Assess UHI and Reduce GHG Emissions: Chennai



Integrated approach : Building and Urban Design to Reduce Cooling Loads

Level of Resources	Instrumentation / Data				Manpower - Expertise				Timeline			
Level of Details	LoD1	LoD2	LoD3	LoD4	LoD1	LoD2	LoD3	LoD4	LoD1	LoD2	LoD3	LoD4
Development of Heat Action Plan	Low	Medium	Medium	High	Low	Low	Low	Medium	Low	Low	Medium	Medium
Impact due to Urban Planning	Low	Medium	High	High	Low	Medium	High	High	Low	Medium	Medium	High
Improving Outdoor thermal comfort	Low	Medium	High	Very High	Low	High	High	Very High	Medium	High	High	Very High
Reduction in GHG emissions	Low	High	High	Very High	Low	High	Very High	Very High	Medium	High	High	Very High

	Low		Medium		High		Very High
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Thank You

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