Low Carbon Urban Living – Opportunities and Principles

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GRIHA CONFERENCE, Bangalore 3rd Feb 2015

- CONTEXT
- OPPURTUNITIES
- PRINCIPLES
- METRICS
- CASE STUDY

Urban Context

Wealthy 'Global' 5%

Upwardly mobile middle 40%

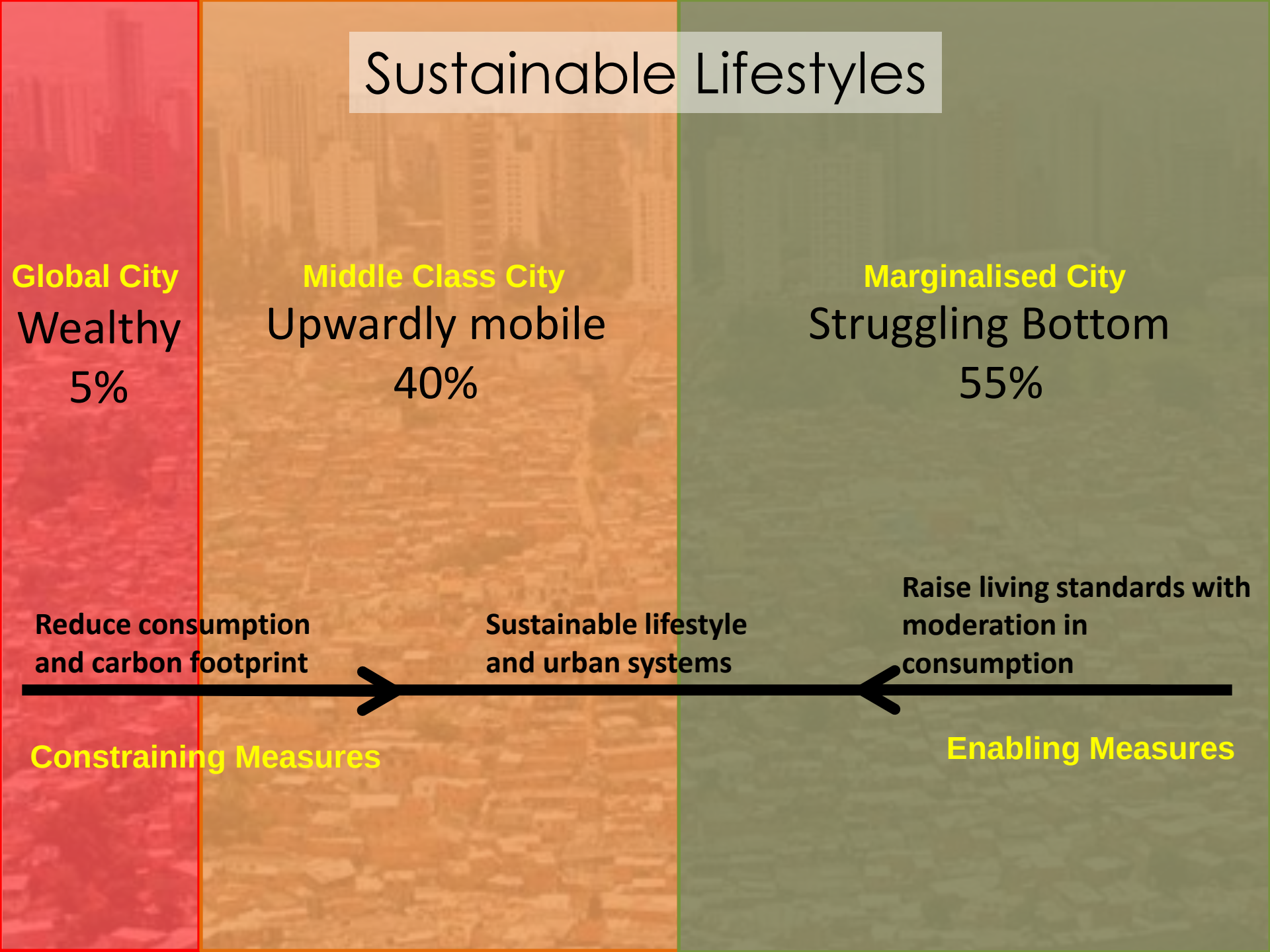
Struggling Bottom 55%

SPATIAL ACCESS, ENVIRONMENTAL SECURITY, DEVELOPMENT ADVANTAGE

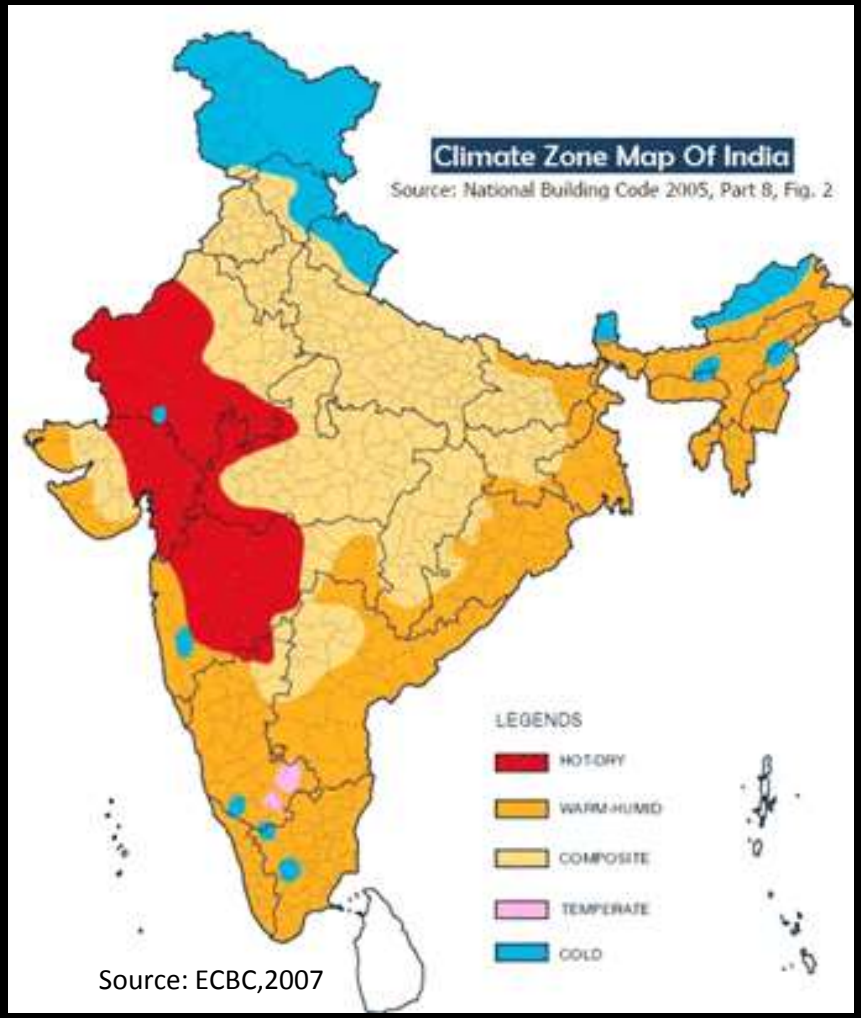
SPATIAL INCLUSION, ENVIRONMENTAL STRESS, DEVELOPMENT OPPORTUNITY

SPATIAL EXCLUSION, ENVIRONMENTAL DISTRESS, DEVELOPMENT DISADVANATGE

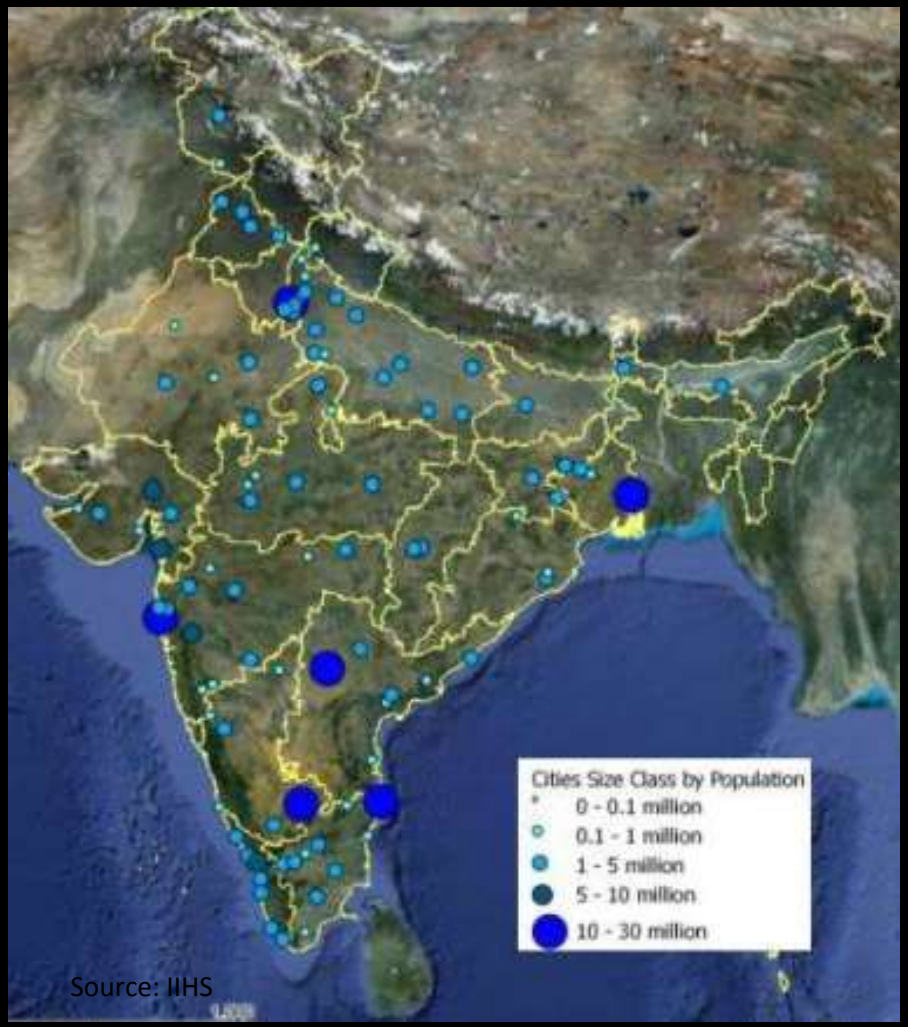
Sustainable Lifestyles



- The urbanization trend in India is showing city expansion with most expansion occurring in the warm and hot climatic belt.

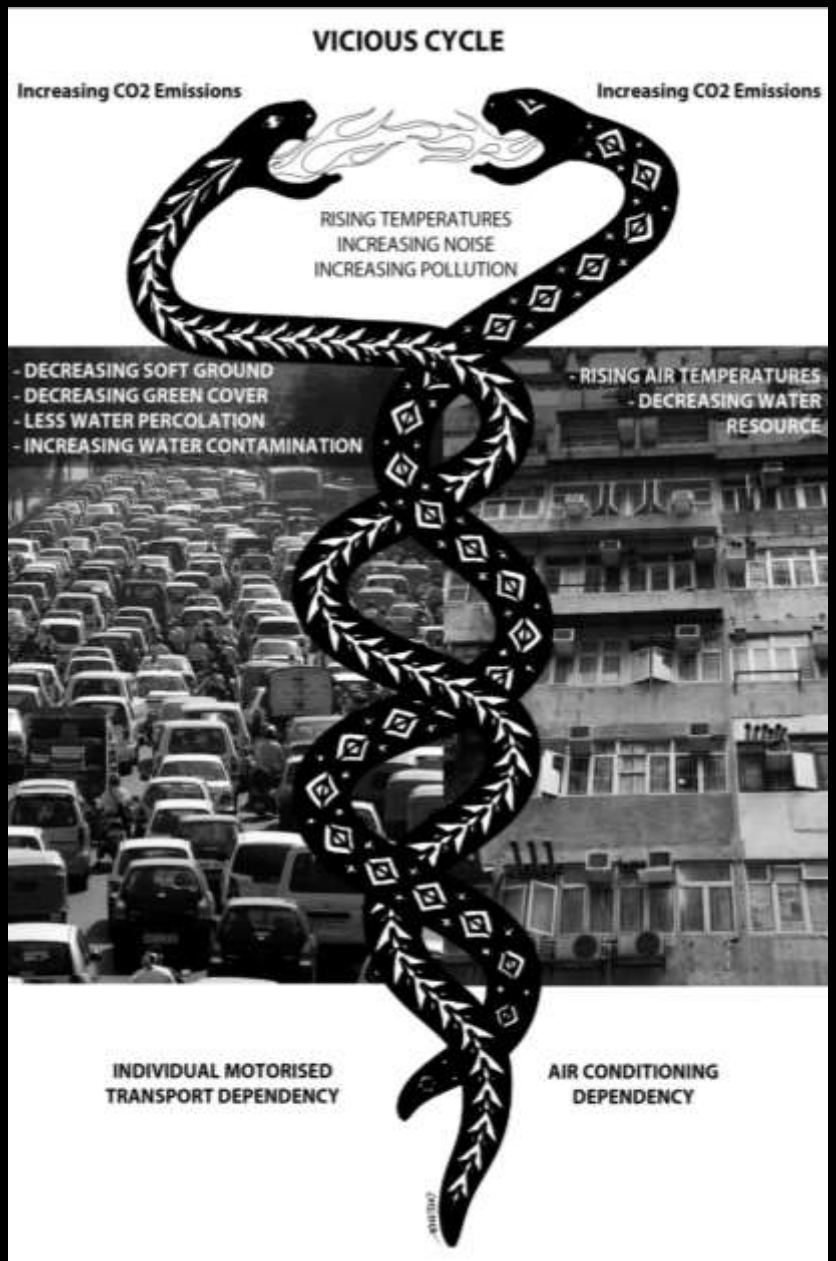


Source: ECBC,2007



Source: IIHS

THREE SINS OF THE UNWISE CITIZEN



Scoping Study for Policy Initiatives to minimize Urban Heat Island Effect for Low Carbon Urban Growth

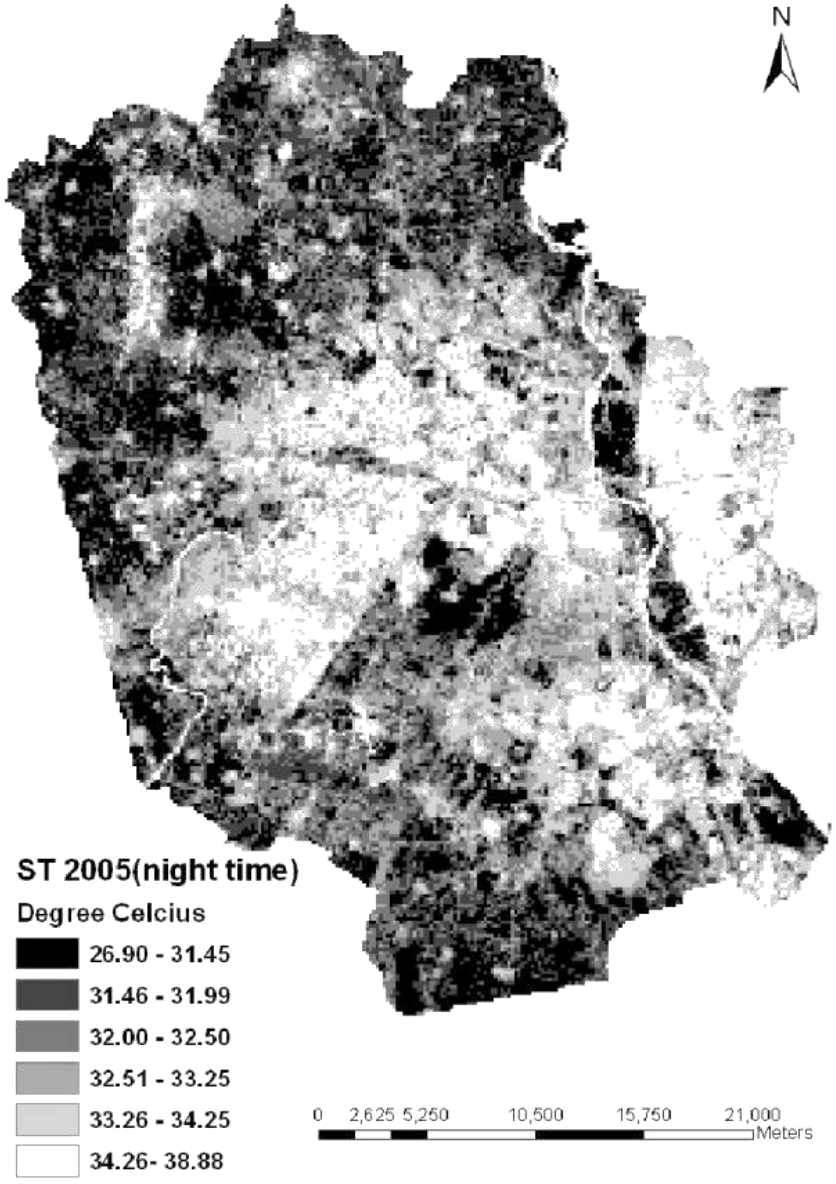
Ashok B. Lall Architects

supported by

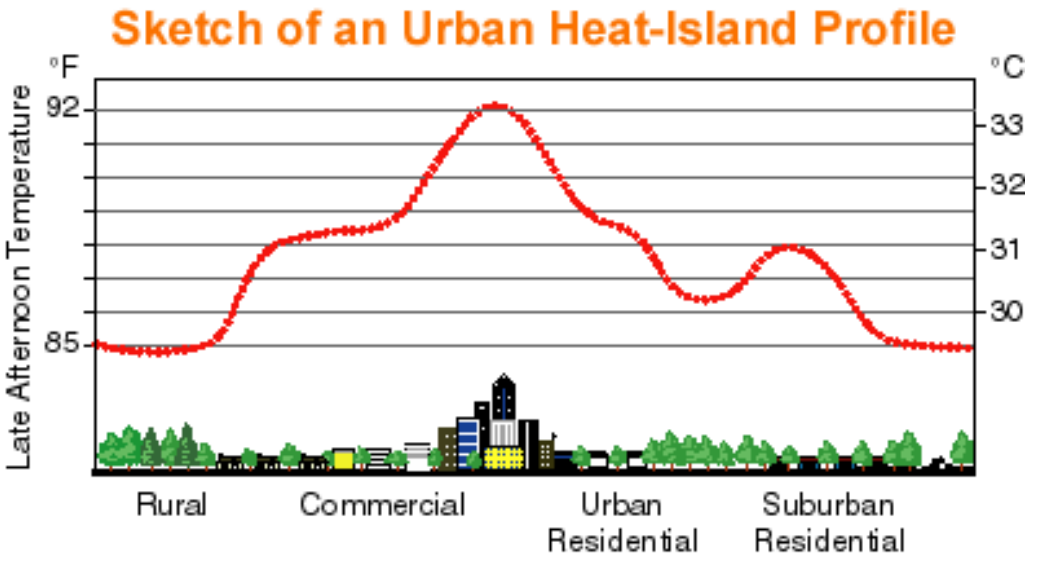
Shakti Sustainable Energy Foundation

SHAKTI
SUSTAINABLE ENERGY
FOUNDATION

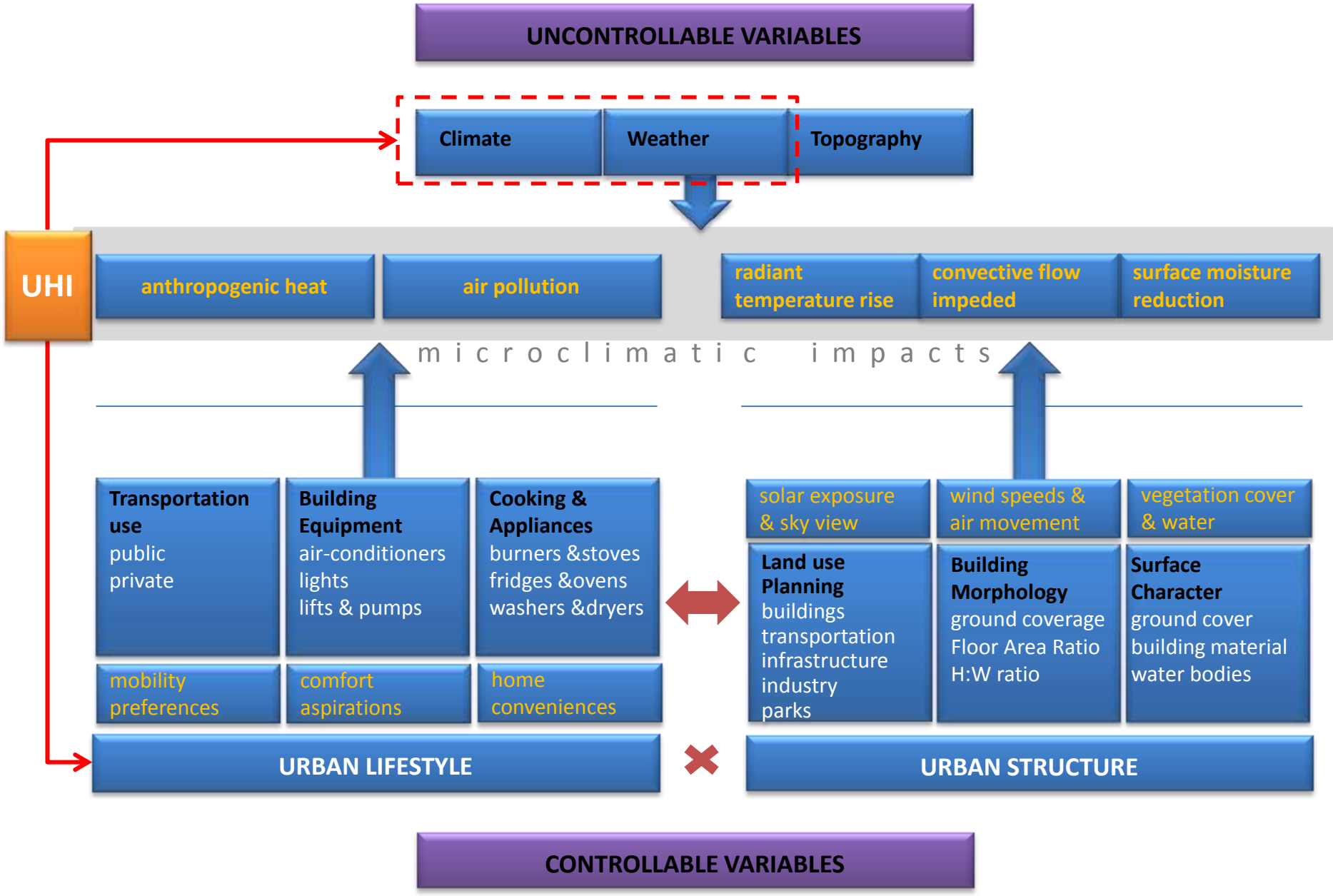
URBAN HEAT ISLAND EFFECT : FUNCTION OF URBAN DENSITY



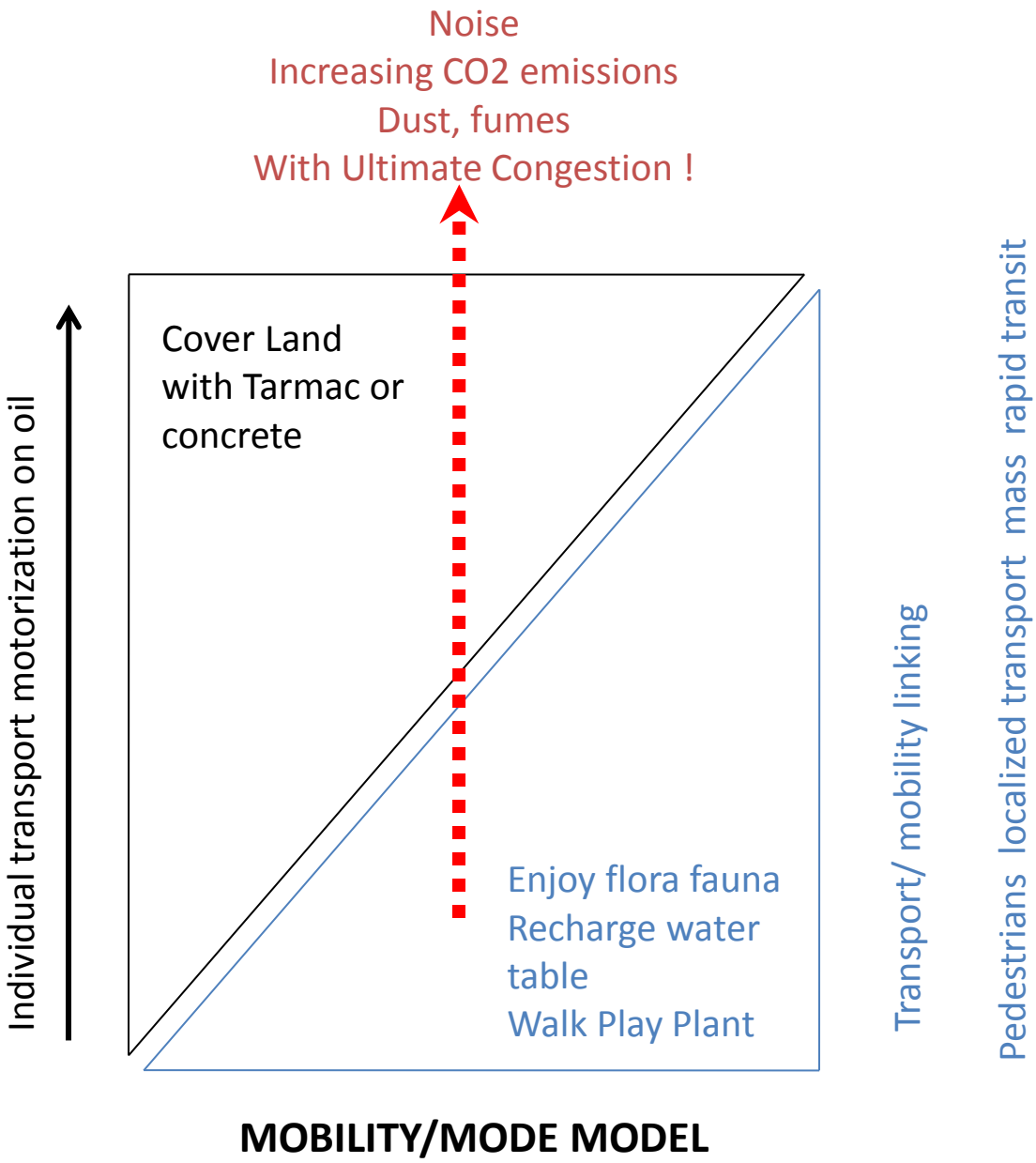
Night time land surface temperatures for Delhi, compiled from ASTER data for 2 October 2005 at 10:35pm, local time.



URBAN HEAT ISLAND EFFECT : ANATOMY



PRINCIPLE : LOW CARBON MOBILITY MODEL



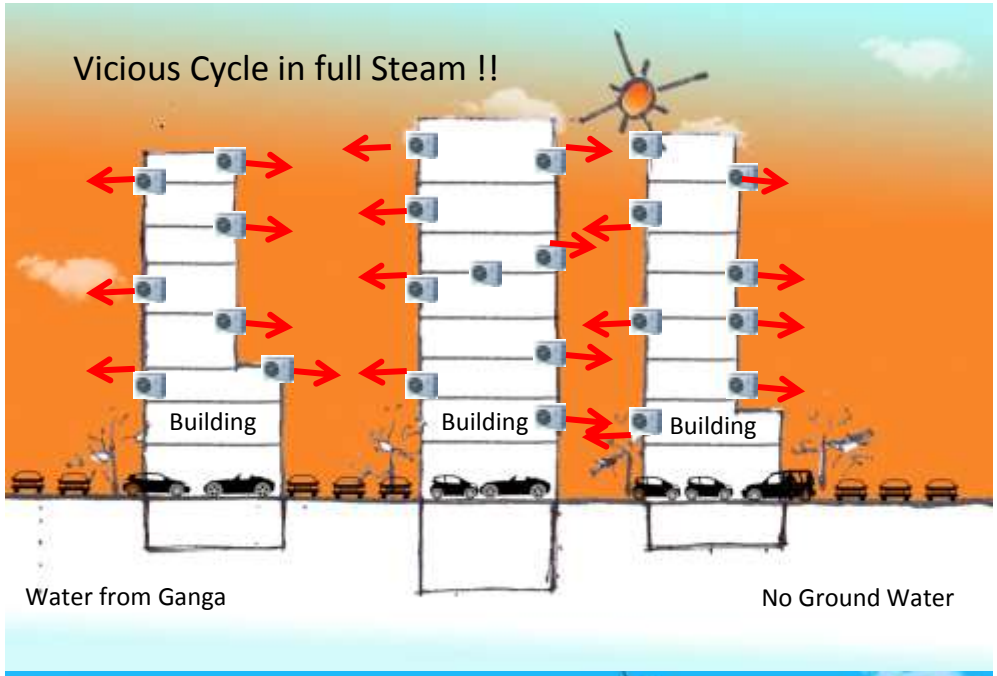
PRINCIPLE : LOW ENERGY INTENSITY URBAN FABRIC

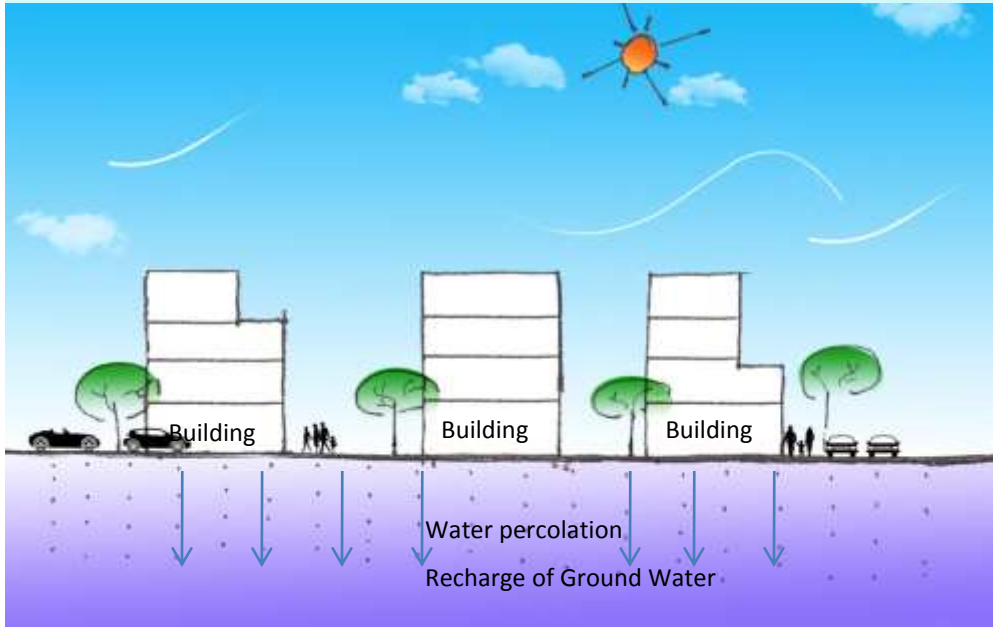
TREND

Increasing Energy Intensity and UHI

Dense

Compact





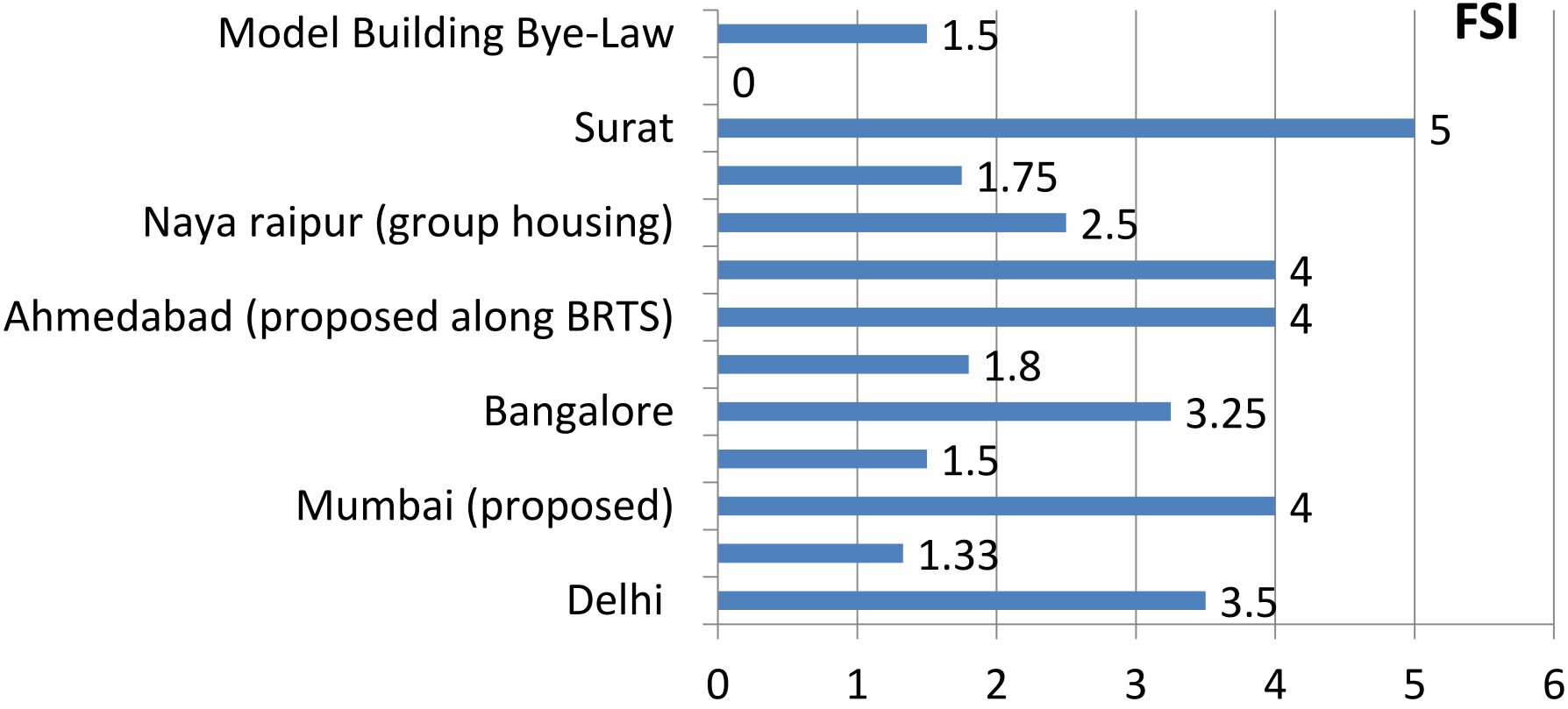
Fully Air Conditioned!

High Density

Two Cars per Household

PRINCIPLE : LOW ENERGY INTENSITY URBAN FABRIC

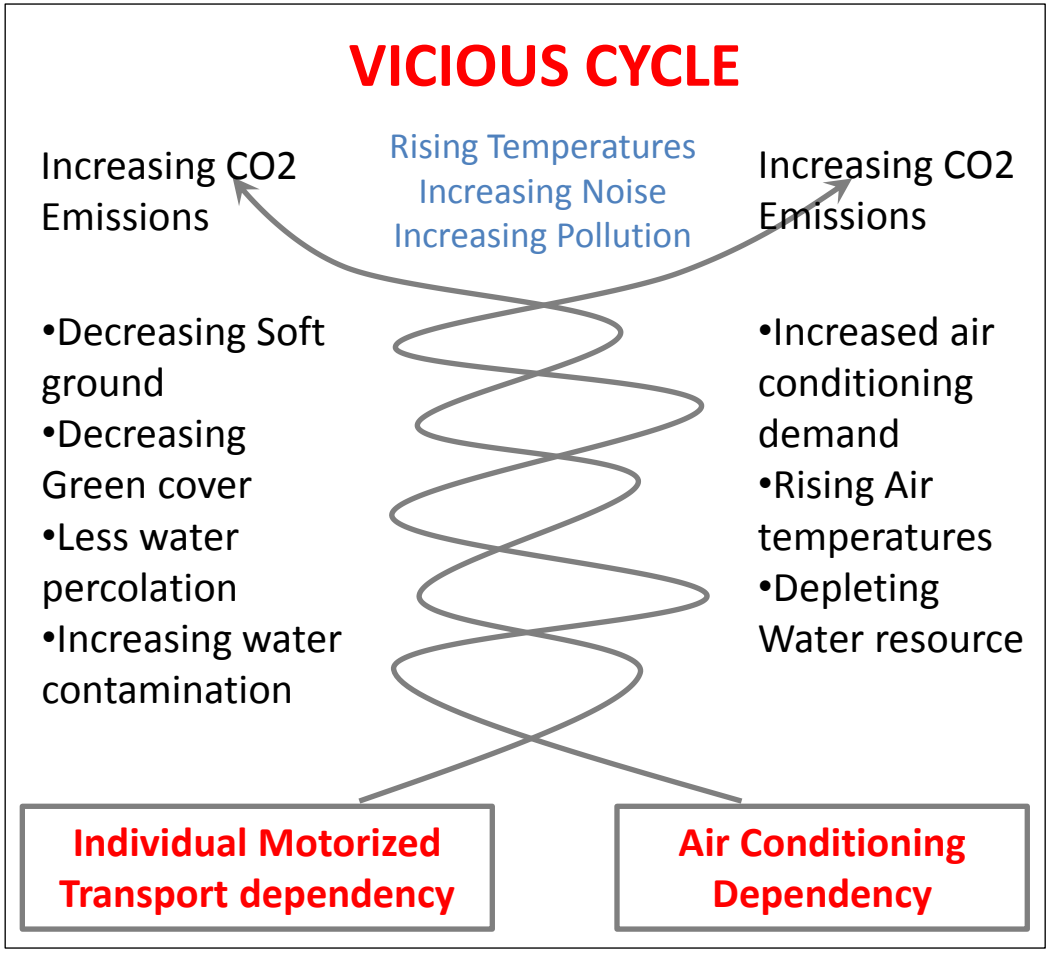
- The urbanization trend in India is showing an expansion in the geographic area of cities as well as a progressive densification of the existing city areas.
- This is accompanied by a progressive increase in prescription of vehicular parking and road surfaces



Source: authors

PRINCIPLE : LOW ENERGY INTENSITY URBAN FABRIC

- Development controls and transportation policy needs to limit the energy intensity of urban fabrics and avoid a vicious cycle leading to 15% increase in energy consumption in buildings.



Development controls and planning regulations today promote the vicious cycle

High density high rise development +
Private motor transport +
Air conditioning

=

Vicious cycle ! Of urban temperature rise and energy consumption

PRINCIPLE : LOW EMBODIED ENERGY BUILDING SYSTEMS

The Multiplier Effect of Embodied Energy in Construction Materials and Methods

50% addition of built-space to existing stock

X

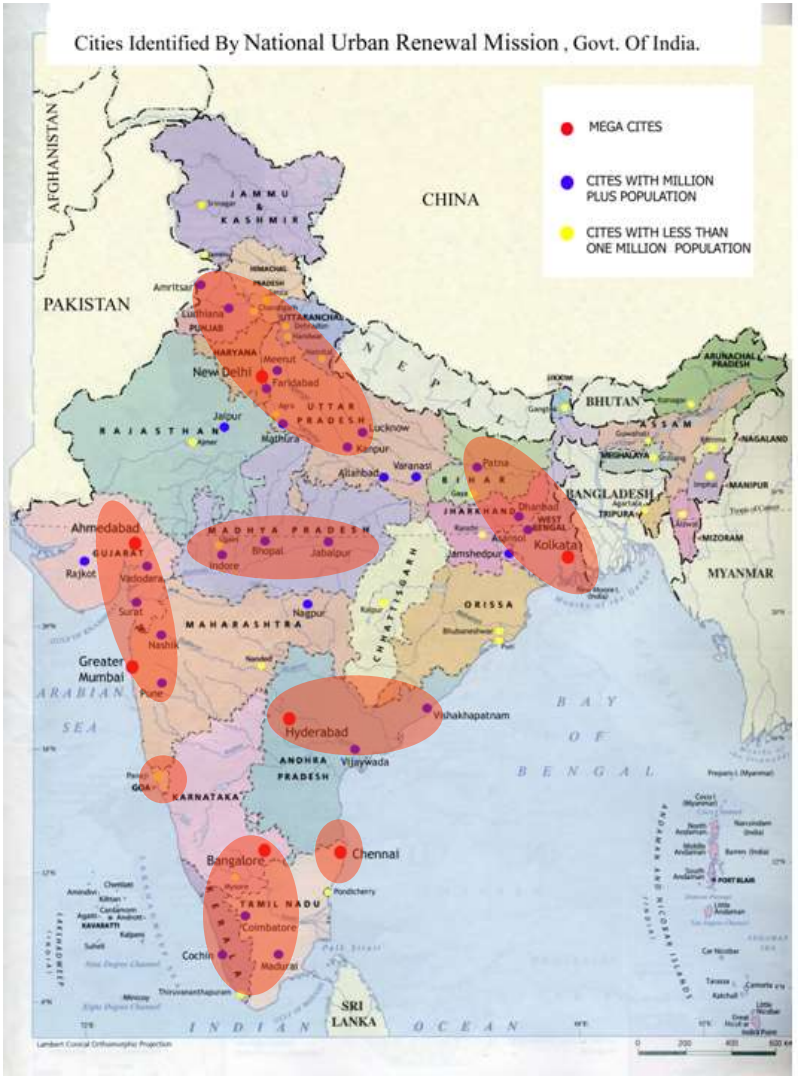
30% increase in embodied energy per unit area

X

over 63 cities of 1 million plus population today

COMPRESSED INTO ONE DECADE!

We can surmise that we have an explosion of CO_2 emission on our hands on account of high embodied energy methods of construction



PRINCIPLE : LOW EMBODIED ENERGY BUILDING SYSTEMS

Embodied Energy: Building Structure & Finishes

	Embodied Energy		Carbon emissions	
	MJ/sqm	GJ/sqm	$KgCO_2/sm$	tCO_2/sqm
Low rise				
DDA (typical)	2028.91	2.03	229.43	0.23
IIPH	1374.43	1.37	177.43	0.18
High rise				
HEWO (typical)	2367.40	2.37	260.03	0.26
IIIT-D	2,615.4	2.6	290.6	0.29

- **For low rise buildings,** considerable reduction in embodied energy might be possible by careful designing and using materials with low embodied energy. The embodied energy of IIPH is 30% lower than that of DDA. The material for wall construction has a major impact on the total EE in load bearing construction.

- **In high rise buildings,** there an indication that EE/sq.m increases with height of building . This may suggest greater efforts required for steel efficient structural design .

- **The range of CO2 emissions** shows that in a well designed low rise building emissions are **30-40% less** than an average high rise building incorporating a RCC frame structure.

Giving preference to low rise buildings (G+4) in residential development and using low embodied energy materials for external walling offers 20 -40 % reduction in EE/Sq. M. of residential space compared to BAU .

PRINCIPLE : SOLAR ACCESS FOR SOLAR CITIES

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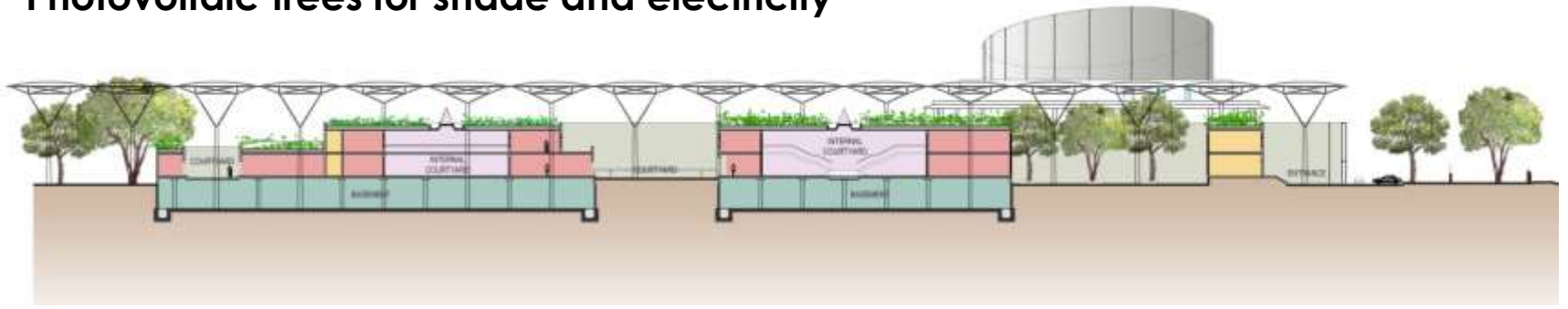
Photovoltaic trees for shade and electricity

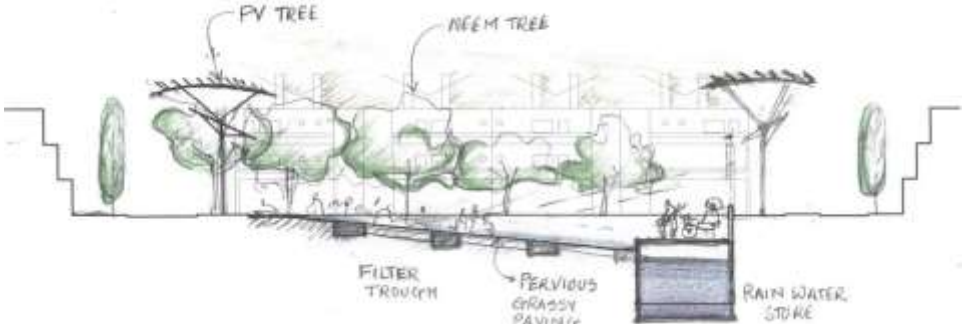


PRINCIPLE : SOLAR ACCESS FOR SOLAR CITIES

Presidential Estate – 5 MW S P P P The Energy And Resources Institute **Ashok B Lall Architects**

PRINCIPLE : SOLAR ACCESS FOR SOLAR CITIES

Open space design combining solar PV and water harvesting.



PRINCIPLE : SOLAR ACCESS FOR SOLAR CITIES

Sunday Market

Open space design combining solar PV and water harvesting.

Night show

PRINCIPLE : SEARCH FOR LOW CARBON URBAN FABRIC

Green Park, New Delhi

Alaknanda , New Delhi

OPTIMAL COMPACT URBAN STRUCTURE

TRANSPORTATION

MINIMUM HARD SURFACE ⟷ LOW CARBON MOBILITY

SOLAR ACCESS — **LOW UHI**

DISTRIBUTION OF SOFT GROUND AND GREEN COVER ⟷ LOW CARBON CONSTRUCTION / LOW ENERGY BUILDINGS

URBAN FORM

MULTI STOREY MUMBAI

THE HIGH- RISE HIGH - DENSITY CITY WIL BE UNSUSTAINABLE; HEAT ISLAND EFFECT WILL RAISE TEMPERATURES; POLLUTION WILL RISE; GREENERY WILL REDUCE; STREETS WILL BE CONGESTED; IT WILL BE AN ANTI-SOCIAL CITY.

THERE ARE TIME TESTED MODELS OF COMPACT, DENSE CITY FORMS. THEY ARE SOCIAL CITIES, AFFORDABLE FOR ALL, ENVIRONMENTALLY SUSTAINABLE...

METRICS : DESIGN STAGE PARAMETERS

A. OPTIMISING COMPACTNESS

- **Land Consumption: Land area / Capita**

- **Building Consumption: Built Area/ Capita (resident)**
  Built area / Capita (direct employee)

B. ROBUSTNESS

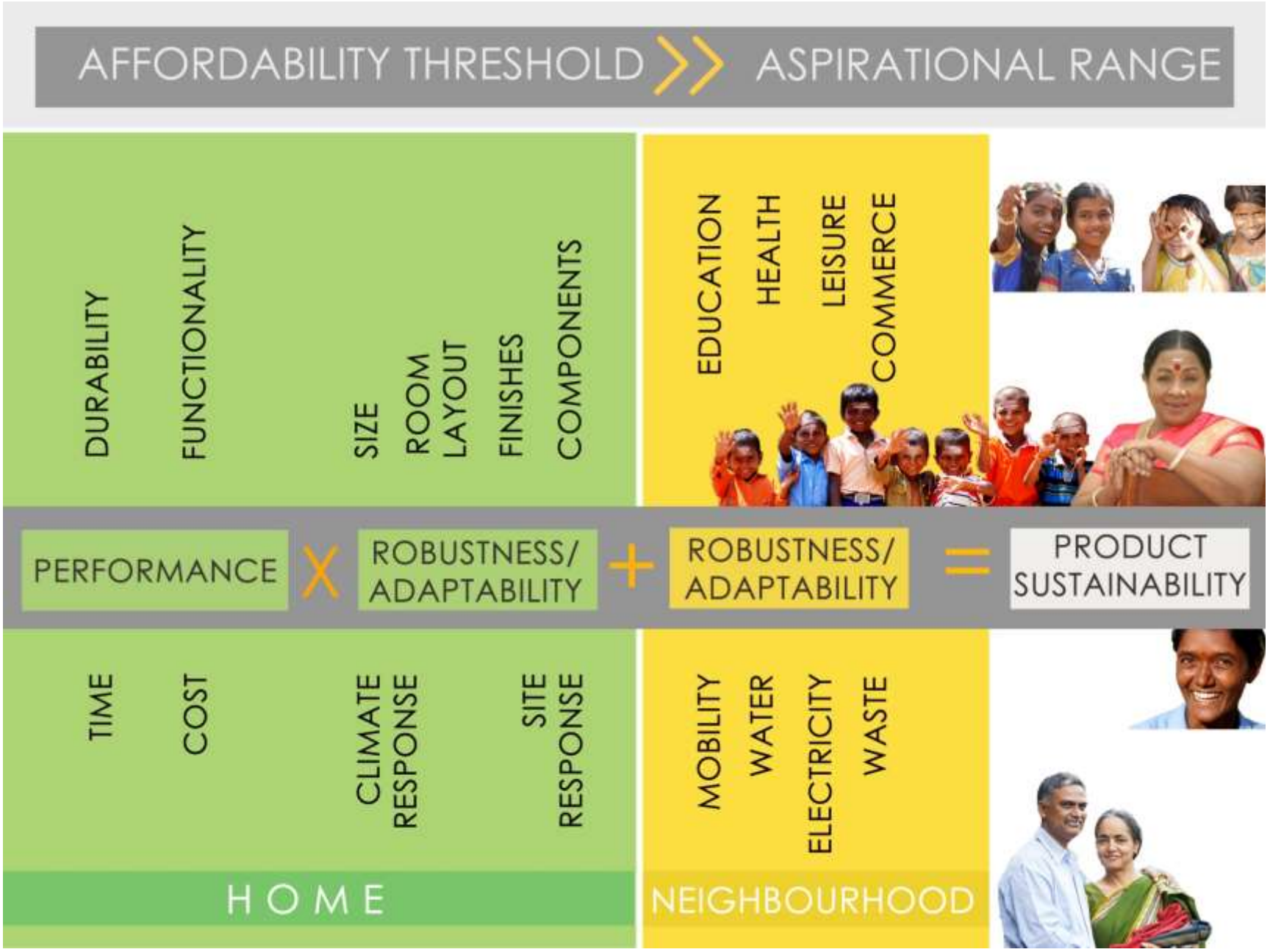
- **Energy resource dependency: Backup generation capacity/Capita**
- **Solar access potential : Solar access roof /per unit floor area**
- **External water resource dependency: Water demand as a factor of natural precipitation**
- **Energy intensity : Anthropogenic heat dissipated (transport and buildings) peak summertime/ unit area of developed land**

METRICS : DESIGN STAGE PARAMETERS

- **CO2 Emissions / capita (gross)**
- **CO2 Emissions for city infrastructure/ capita**
- **CO2 Emissions in local city level mobility and transportation/ capita**
- **CO2 Emissions from embodied energy in buildings/ capita (gross)**
- **CO2 Emissions from operational energy in buildings/ capita (gross)**

OPPORTUNITIES FOR COLLECTIVE LIVING

AFFORDABLE HOUSING



PRODUCT SUSTAINABILITY

- **The standardized product of house types will need to be robust.**
- **It must anticipate the lifestyle change as buyers become middle class and form a community.**
- **It must be adaptable to respond to different climatic locations.**

AFFORDABLE HOUSING

OPTIMAL COMPACTNESS : HIGH DENSITY, LOW RISE

TYPICAL FLOOR PLAN

G.C. ACHIEVED = 17985 SQM (33.6%)
FSI = 1.35

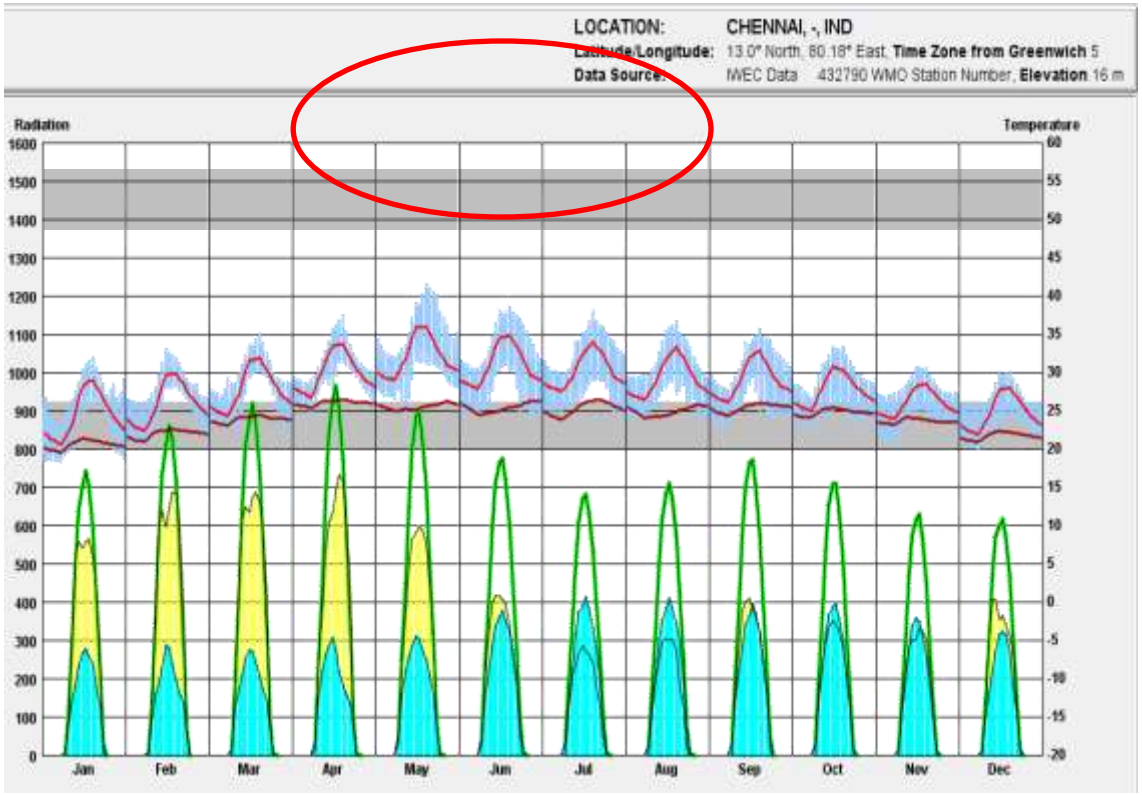
LAND UTILIZATION SATURATED

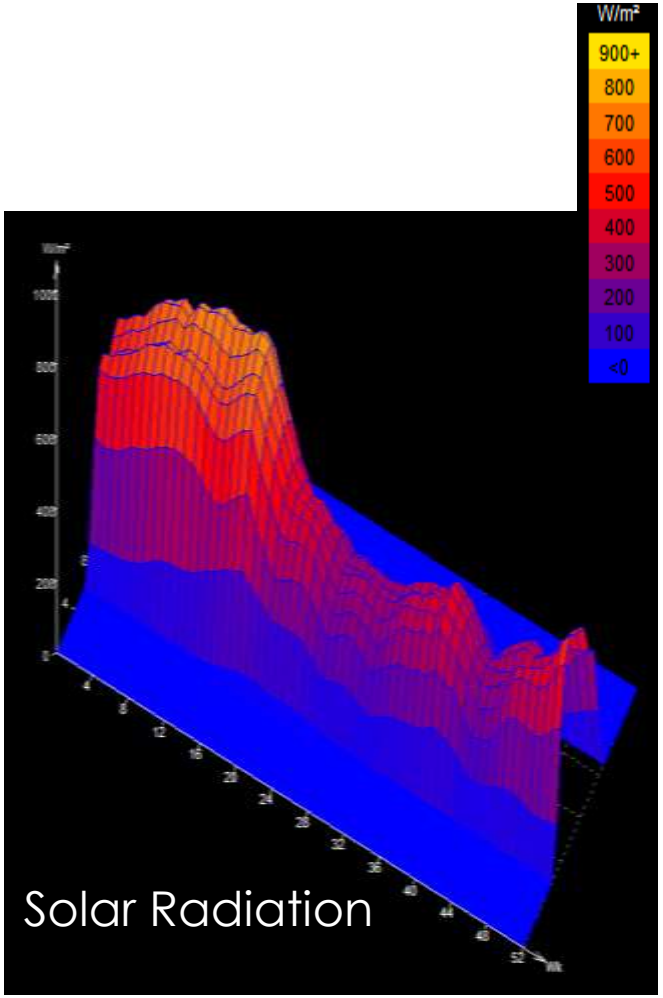
Dwelling Unit Configuration

1BHK – 29 sqm	= 176
1BHK – 34 sqm	= 460
1BHK – 41 sqm	= 32
2BHK – 46 sqm	= 612
Total Units	=1280

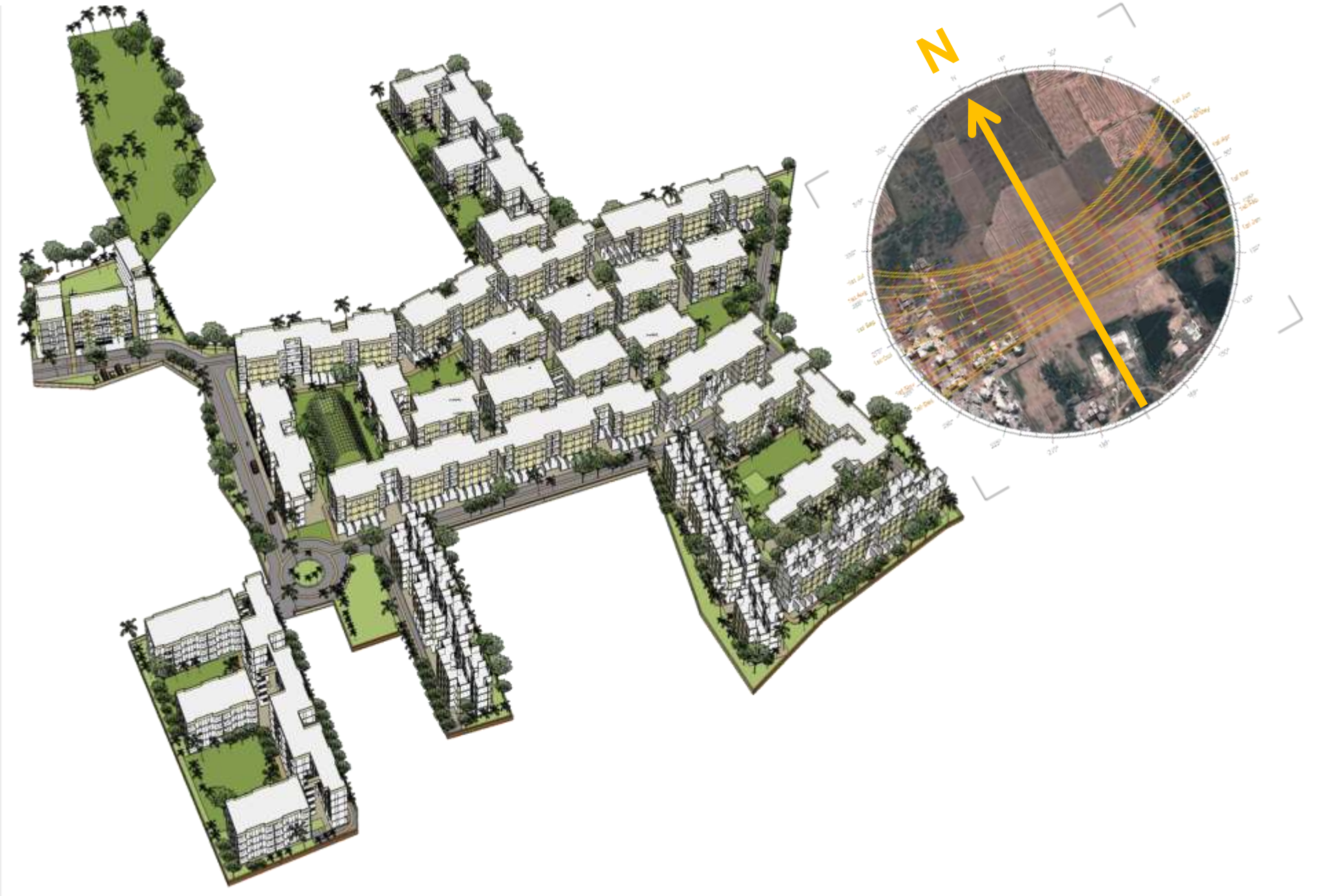
- 32 Local Shops
- 126 nos cars and 1280 two wheelers
- Bus Stop / taxi stand

CLIMATIC CONTEXT: HOT AND HUMID





SITE LEVEL STRATEGY : ORIENTATION



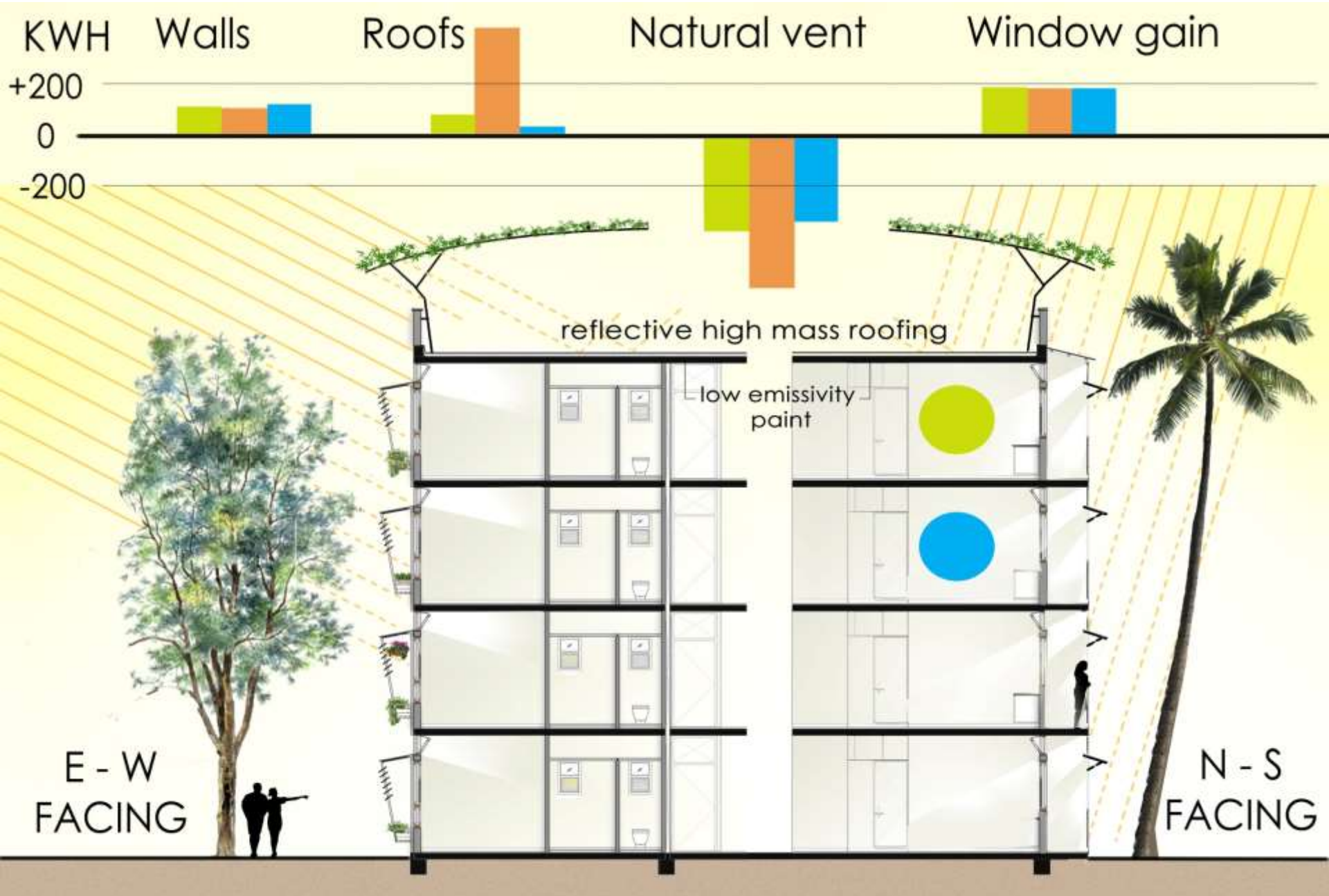
SITE LEVEL STRATEGY : MICRO CLIMATE

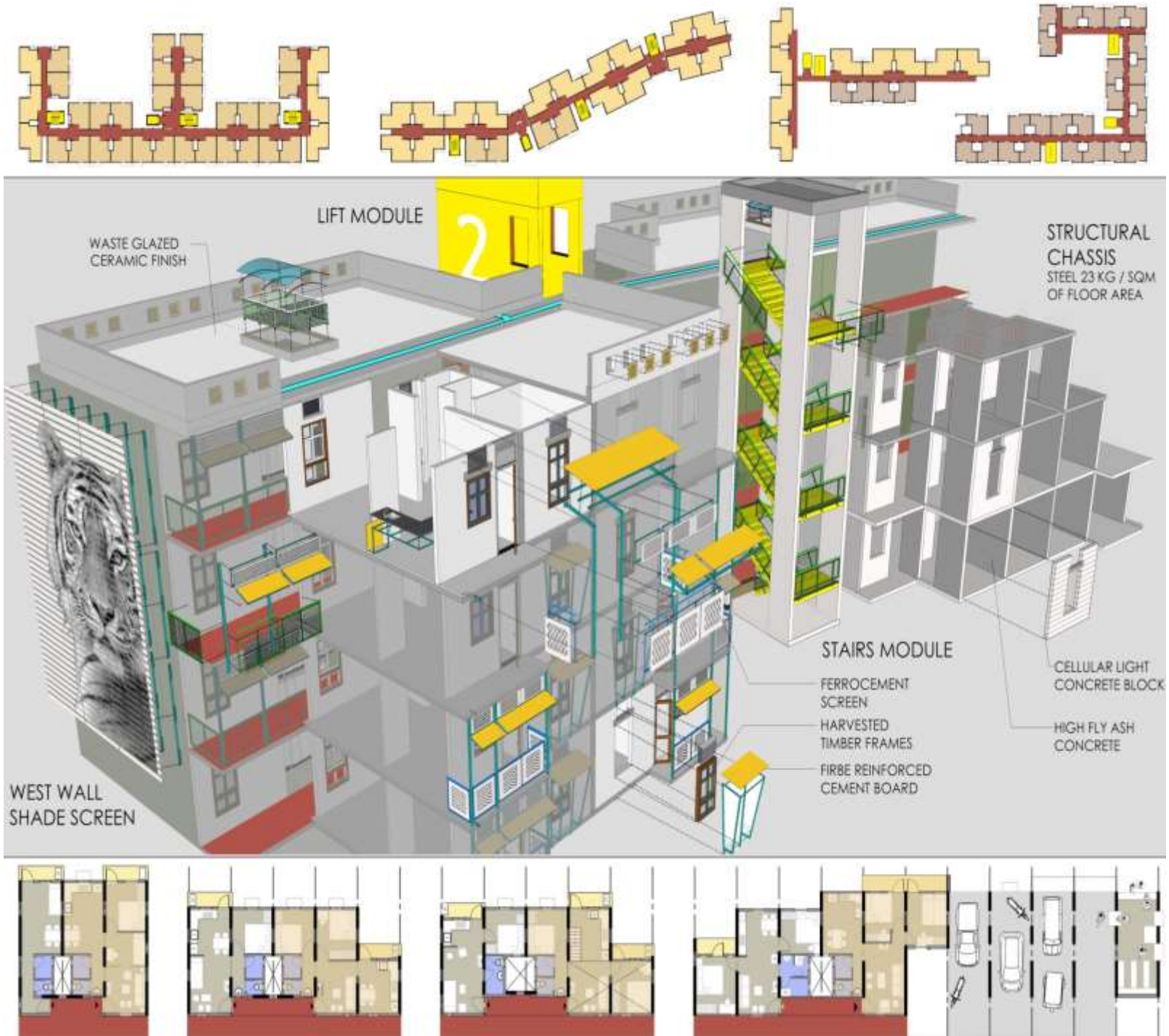
- Vehicular movement (hard paved) restricted to periphery
- Soft ground with shady trees interspersed – shaded outdoors.
- Breaks for breeze.

SITE LEVEL STRATEGY : OPERARIONAL ENERGY

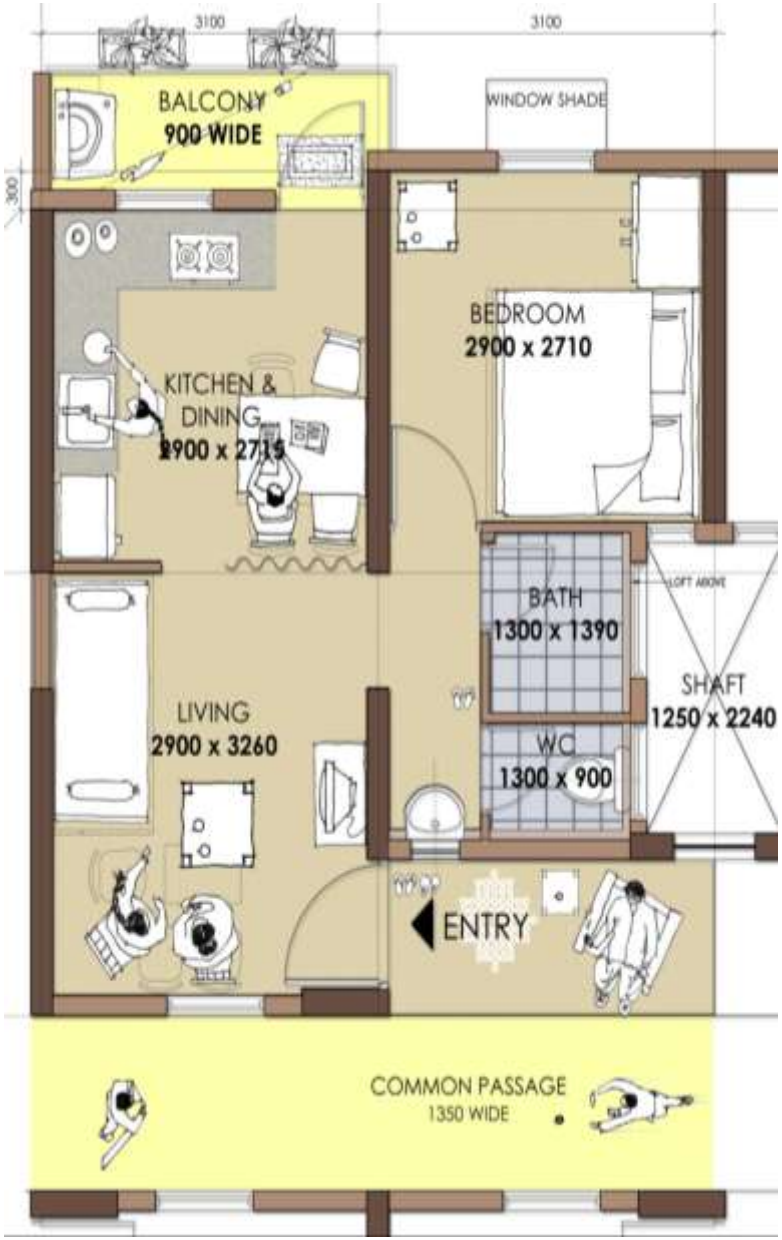
- Four storey height – minimum dependence on lifts.
- Minimum pumping energy for conveying water.
- Encouraging pedestrianization and public transport use
- Recycling of treated waste water to reduce ground water pumping.

BUILDING LEVEL STRATEGY : SOLAR PROTECTION AND THERMAL INSULATION



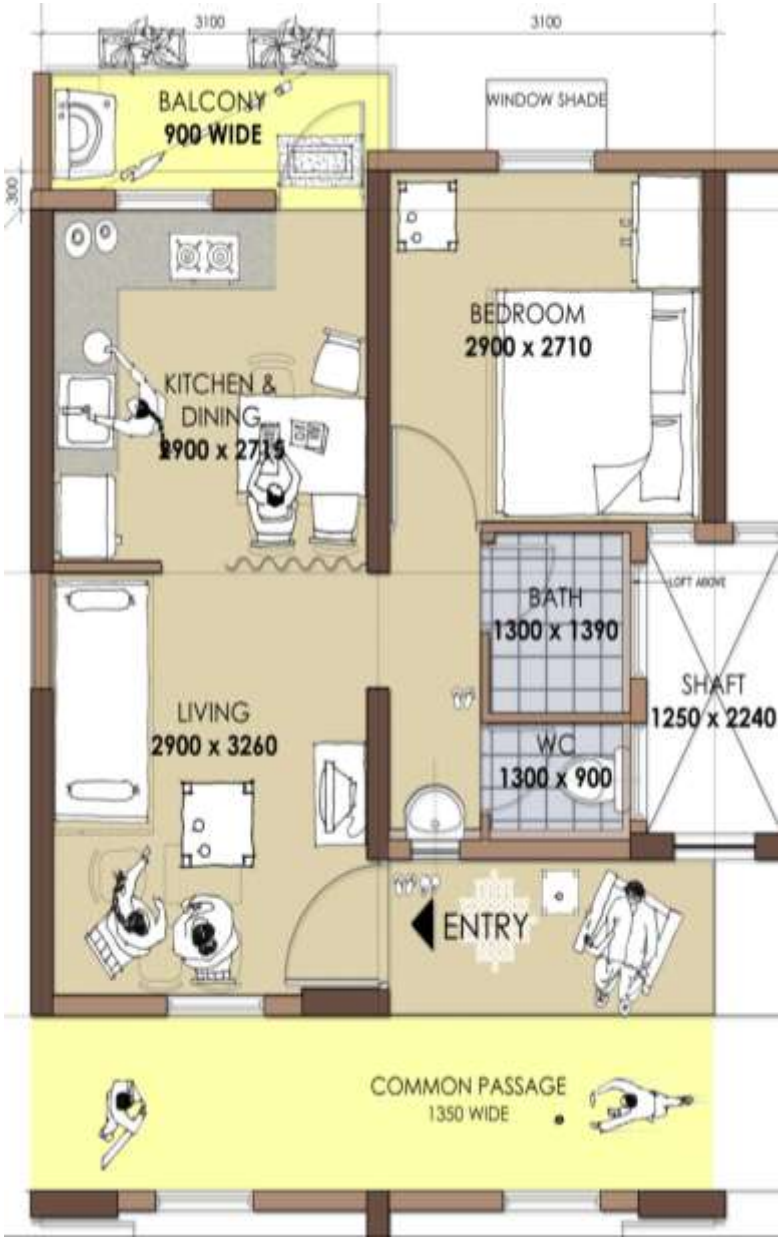

LIFT MODULE
WASTE GLAZED
CERAMIC FINISH
STRUCTURAL
CHASSIS
STEEL 23 KG / SQM
OF FLOOR AREA
STAIRS MODULE
FERROCEMENT
SCREEN
HARVESTED
TIMBER FRAMES
FIRBE REINFORCED
CEMENT BOARD
CELLULAR LIGHT
CONCRETE BLOCK
HIGH FLY ASH
CONCRETE
WEST WALL
SHADE SCREEN

BUILDING LEVEL STRATEGY : PASSIVE DESIGN



- Heavy thermal mass shielded from external temperatures
- Autoclaved Aerated Concrete blocks as an insulating envelope
- End concrete walls shaded by external louvers

BUILDING LEVEL STRATEGY : PROSPECTIVE DESIGN

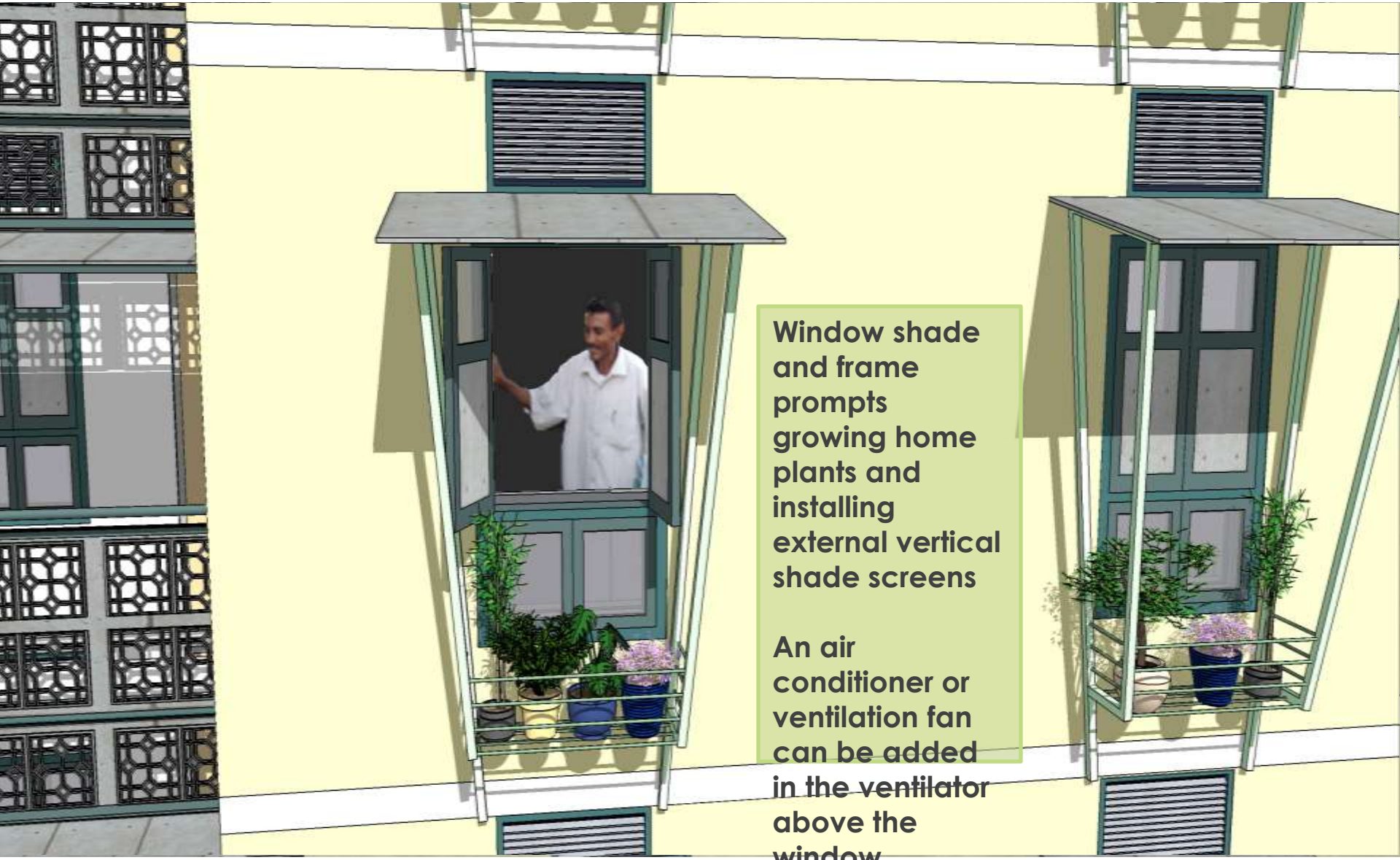


- For homes to be affordable minimum essential provisions are provided.
- Improvements and additions to these provisions are to be anticipated as income and aspirations rise.
- Consumption is to be disciplined!
- Electric connection limited to 5 kW supply per home.
- Water supply is metered.

Kitchen

Mechanical exhaust may be added.

BUILDING LEVEL STRATEGY : WINDOWS AND BALCONIES



Window shade and frame prompts growing home plants and installing external vertical shade screens

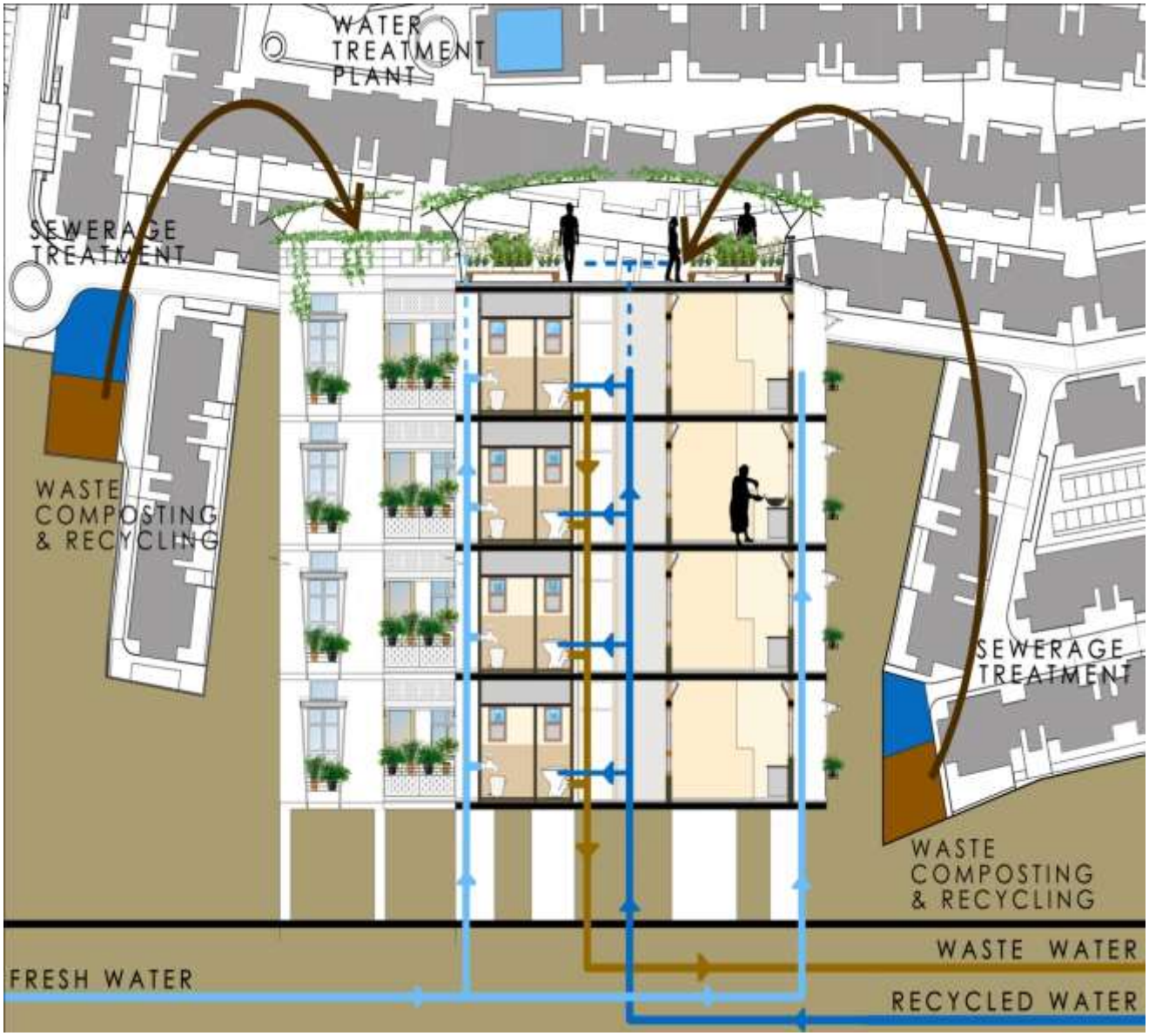
An air conditioner or ventilation fan can be added in the ventilator above the window.

BUILDING LEVEL STRATEGY : COMFORT ASPIRATIONS!

Today

Two years later – mechanical ventilation / air conditioning (April to August – part time)

WATER AND WASTE MANAGEMENT



OPPORTUNITIES OF COLLECTIVE LIVING : COMMUNITY PARTICIPATION

•RECEPTION
Resident Welcome
Orientation
Property Exchange
Bills

•HOME SUPPORT
Solar Kitchen
Laundry
Organic Food Services

•INFORMATION AND COMMUNICATION
VIRTUAL NOTICE BOARD
I. Community TV
II. Telephony
III. Internet

•TRANSPORT CONNECTIVITY
Bus Stop
Rickshaws/Taxi Bay
Rentable Bikes
Parking facility for personal vehicles

•TRADE AND EXCHANGE
Home Improvement Services
Second Hand Home Appliances
Furniture
Repairs
Grocery
Beautician
Hairdresser Etc.

OPPORTUNITIES OF COLLECTIVE LIVING : COMMUNITY PARTICIPATION

•EDUCATION AND TRAINING

VERANDAH	VIHARA
Yoga	Tuition
Martial Arts	Craft
Dance	Music
	Theatre

•RECREATION AND CELEBRATION

Large Open Pandal for Celebration
Catering Corner
Smaller sheltered spaces for recreation

ENVIRONMENTAL CONCERNS : DEVELOPER'S RESPONSIBILITY

WATER EFFICIENCY

- During Construction
  Minimizing water for curing
- Post Construction
- Rain Water Harvesting
  Ground water recharge
- Water Recycling
  For flushing and irrigation
- Low Flow Fixtures
- Metered fresh water supply
  Individual home meters

ENERGY EFFICIENCY

- Day lighting
  All rooms and passages day lit
- Reducing cooling load
  Natural ventilation, shading,
  kitchen exhaust
- Efficient Light Fixtures
- Minimum building height
  Reducing dependence on lifts, reducing pumping energy
- Low embodied energy structural system

MAINTENANCE AND REGULATION OF SERVICE INFRASTRUCTURE

- Water
  Centralized pumping, storage and treatment
- Sewage Treatment – decentralized
  Basic level treatment by 'natural' system, Treatment for recycling by low energy system
- Waste Disposal
  Sorting at home, composting, recycling
- Shared Spaces
  Low maintenance landscape
- Electricity
  Minimum diesel gen back-up

ROOF AS COMMUNITY ASSET

LEISURE AND BIO-MASS

COMMUNITY LIVING : HABITABLE OUTDOORS

COMMUNITY LIVING : IDENTITY AND EXPRESSION

Research & Development Project - A special collaborative unit to be set up between:

- **Developer**
- **Bureau of Energy Efficiency, India**
- **Research Consultants, and**
- **Residents Association**

TRACKING PROGRESS

- Obtain electricity expenditure history of prospective buyers in their present accommodations.

- Obtain information on electricity consumption according to use – lighting, electrical gadgets, appliances etc.

- Map electrical consumption individually and collectively in new occupied homes.

- Develop community level exchange of information on household wise electricity consumption – creating awareness and setting bench marks for efficient use of electricity.

- Share data on electricity consumption for support infrastructure – lifts, external lighting, sewerage treatment and pumps.

- Encourage escalating tariff structure for water consumption.

- Celebrate exemplary achievements

PROPOSE ENERGY EFFICIENCY BENCHMARKS, GOALS AND MANAGEMENT SYSTEMS FOR ENVIRONMENTAL RESPONSIBILITY