Position paper on :

Low Carbon Resource-Efficient Affordable Housing

Based on the context of urbanization in Gujarat, particularly that of Rajkot

Commissioned by:

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The Broader Context

CapaCities PROGRAM IN FOUR CITIES IN INDIA

This paper seeks a strategy to achieve **affordable Housing for All,** in tune with **Sustainable Development Goals** and **Climate Change** agenda of COP21.

INDIA IS SIGNATORY TO COP 21 PARIS AGREEMENT ON CLIMATE CHANGE

Sustainable Development Goals

Affordable homes at locations of employment and economic opportunity with access to public transport and social amenities. Livelihoods in an inclusive construction economy

Resilience of urban living in cases of infrastructure breakdown and disasters, with sufficiency of habitable space and environmental security – water, air, recycled waste.

Use of low-carbon and resource-efficient modes of production for construction of housing and selecting building types for minimum operational energy.

Build-in resilience against extreme events, shade and green for a habitable outdoors against heat waves, aggregate rain harvest and water efficiency, minimize hard ground and motor vehicles for low UHI

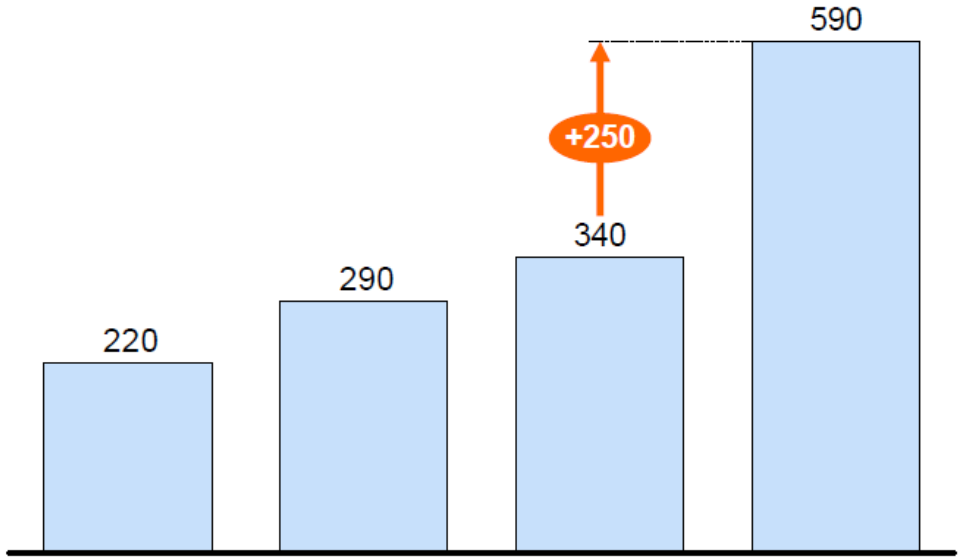
Housing for all
Ministry of Housing & Poverty Alleviation

SUSTAINABLE DEVELOPMENT GOALS

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Urbanization in India

Urban population
Million



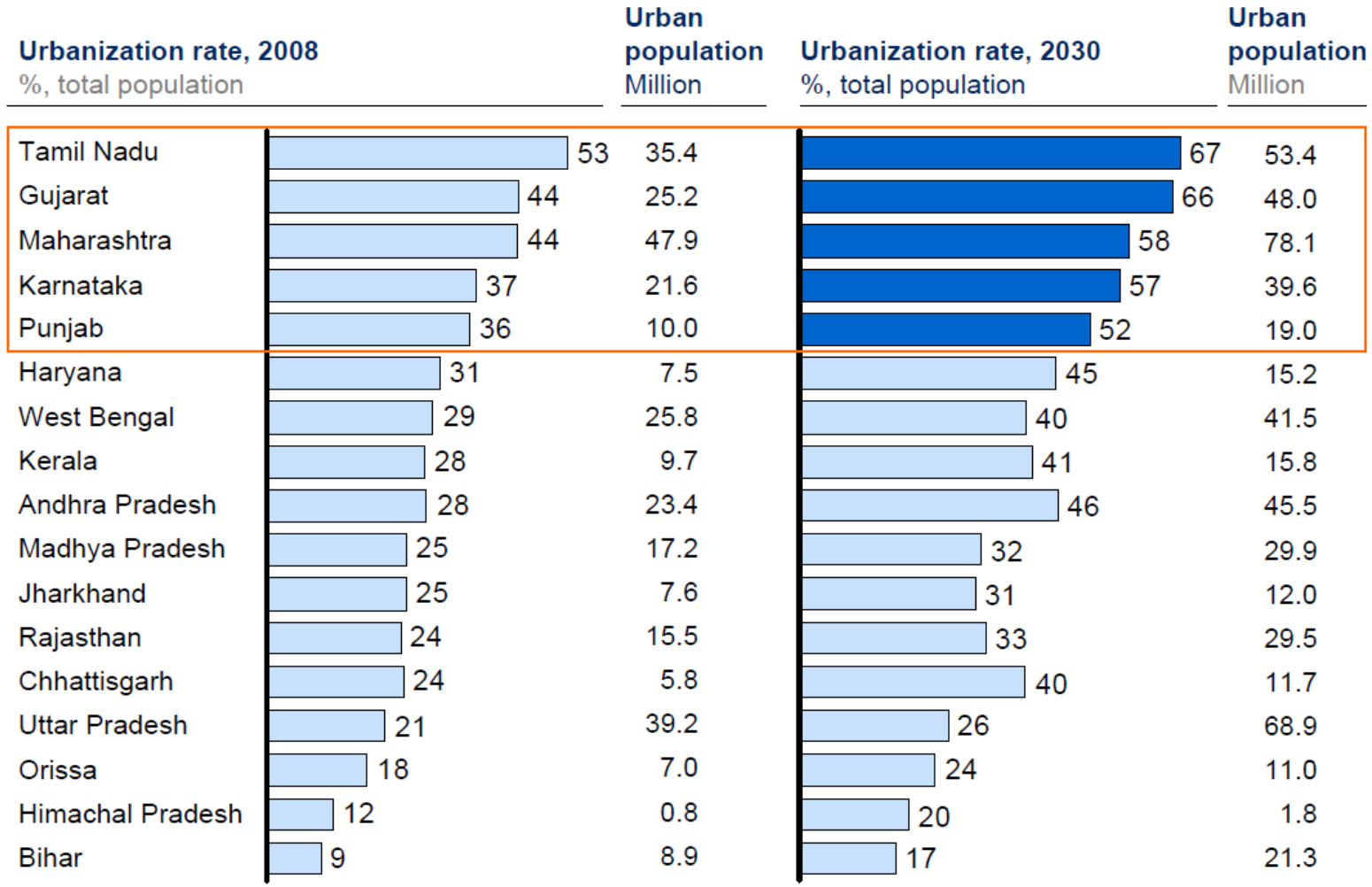
	1991	2001	2008	2030
Total population Million	856	1,040	1,155	1,470
Urbanization rate[1] %	26	28	30	40

1 Defined as the ratio of urban to total population based on the census definition of urban areas; population >5,000; density >400 persons per square kilometer; 75 percent of male workers in nonagricultural sectors; and other statutory urban areas.

SOURCE: India Urbanization Econometric Model; McKinsey Global Institute analysis

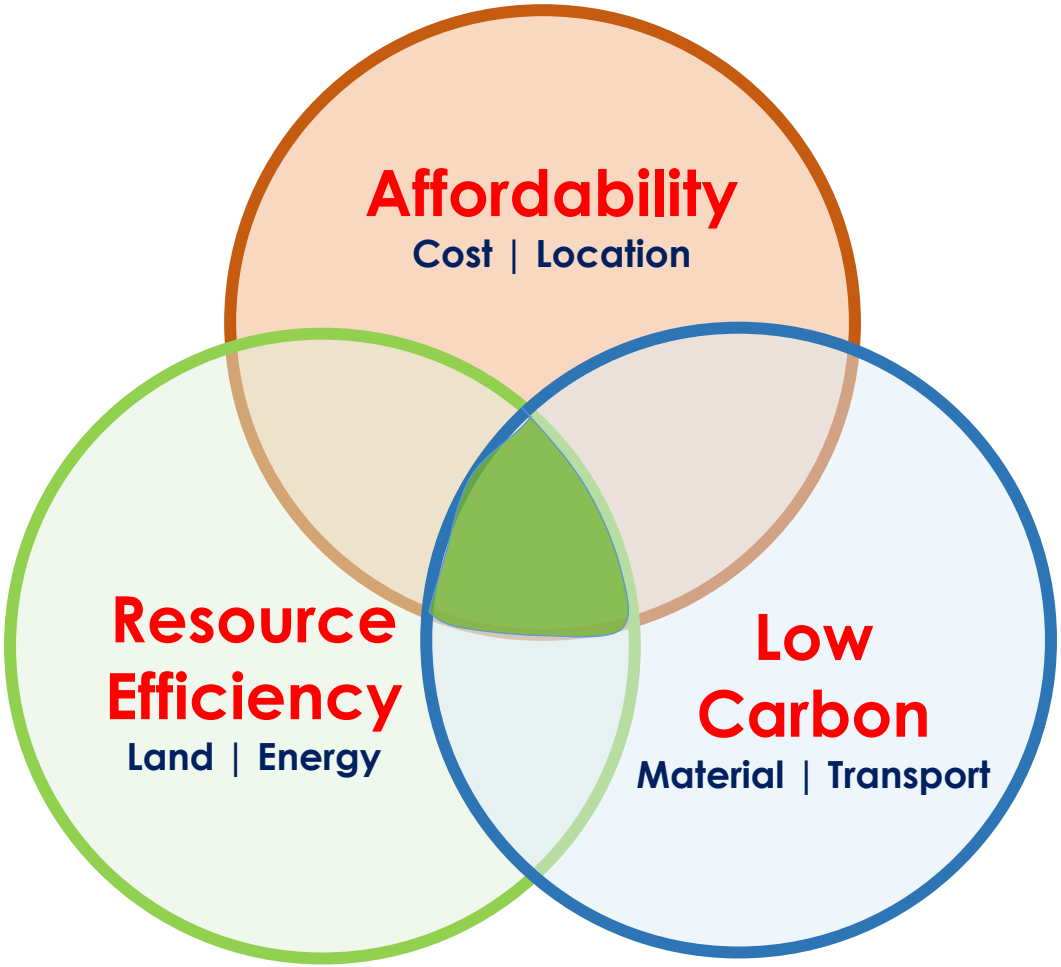
Urbanization in India

Five states are likely to be more than 50 percent urbanized



SOURCE: India Urbanization Econometric Model; McKinsey Global Institute analysis

Affordability and Sustainability

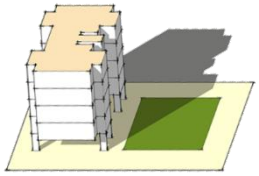


"A combination of resource-efficient and low-carbon construction with compact urban morphology and low-carbon city transport produces low carbon and affordable urban systems. "

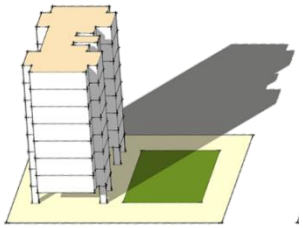
EVALUATING BUILDING OPTIONS

Methodology for Evaluation

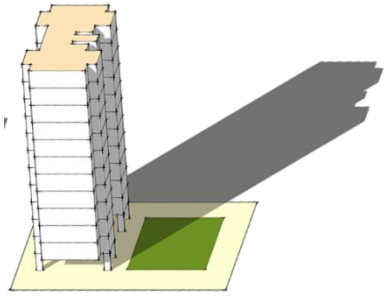
In this study, the buildings are classified in 3 typologies :



Low rise(<16.5m),



Medium rise(16.5-25m)



High Rise(>25m)

This study has evaluated the potential of Low Carbon resource-efficient affordable housing on various parameters over 3 scales:

Building Level

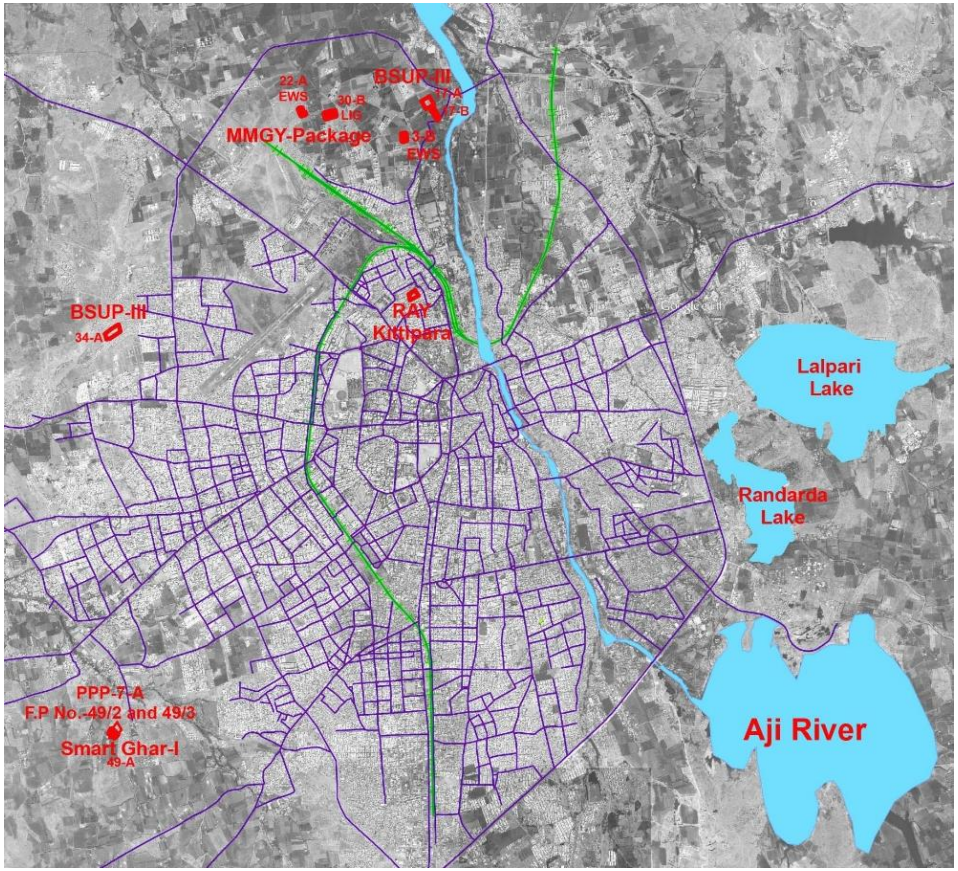
Neighbourhood Level

City Level

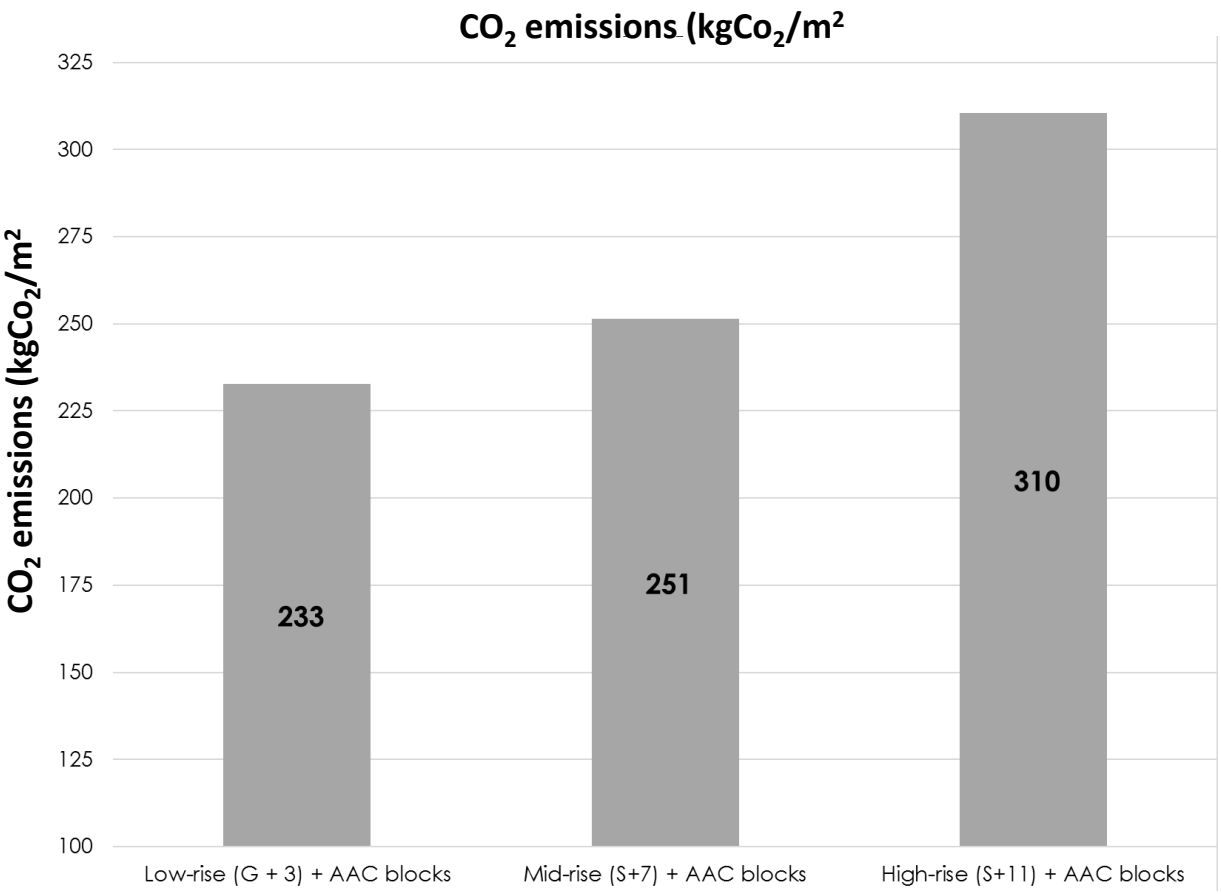
RMC Projects studied for Evaluation

Empirical data from the following projects of Rajkot was collected from RMC and analysed on the parameters of embodied energy, operational energy, maintenance costs, space efficiency, solar roof potential etc. The data was then compared and recommendations for a low carbon, resource efficient and affordable scenario are suggested.

Type		Project Name	Name Of Scheme/Programme
Low Rise	G+3	Kittipara, NR. Refyuji Colony	*RAY*
		MMGY 22A,Popatpara Rajkot	*MMGY*
		Raiya Dhar 17A,17B,34A	*BSUP-III*
	S+4	Nr. Bishop House FP 95B	*MMGY*
Medium Rise	S+7	MMGY 30B	*MMGY*
		MMGY 3B	*MMGY*
		Nr. Bharat Nagar, TP 28 Mavdi, FP 12A	*PMAY PPP*
High Rise	S+10	Bharat Nagar, 7A	*SMART GHAR I, PMAY*
	S+11	Nr. Bharat Nagar, TP 28 Mavdi, FP 49/A (Smart GHAR I)	*SMART GHAR III, PMAY*



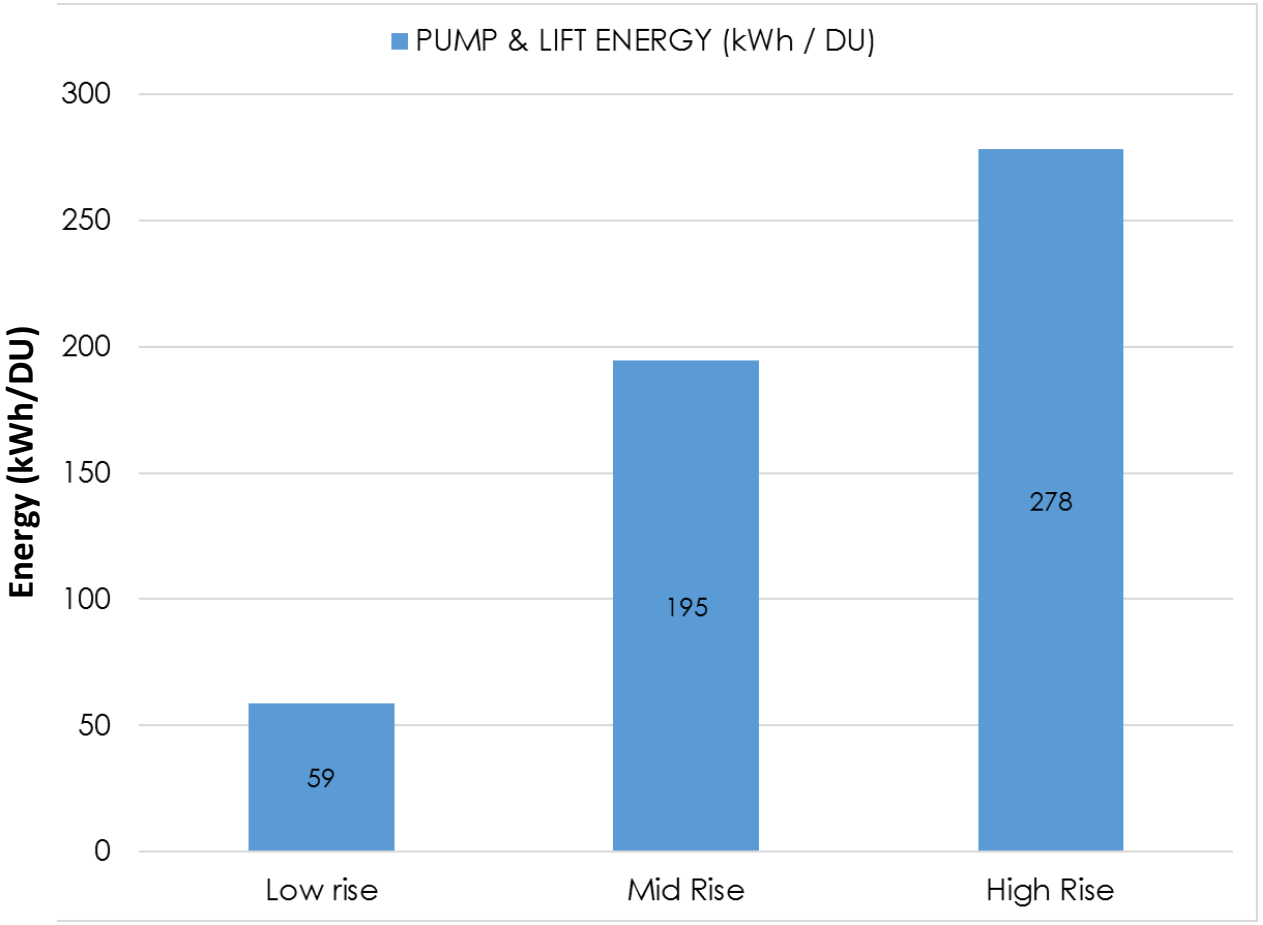
Embodied Energy Efficiency

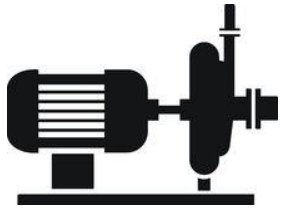


- Given the same walling material, the taller our buildings are, greater will be the CO_2 emissions, due to higher steel and cement content.
- As we go from low-rise to mid-rise and high-rise buildings, CO_2 emissions will increase around 15% and 35% respectively.
- The CO_2 emissions are higher if we use brick and monolithic concrete instead use AAC/Hollow-core/Fly ash bricks/ Hollow-core/ Hollow burnt- clay brick

Hollow Core Blocks | AAC Blocks | Flyash Bricks | Hollow burnt-clay brick

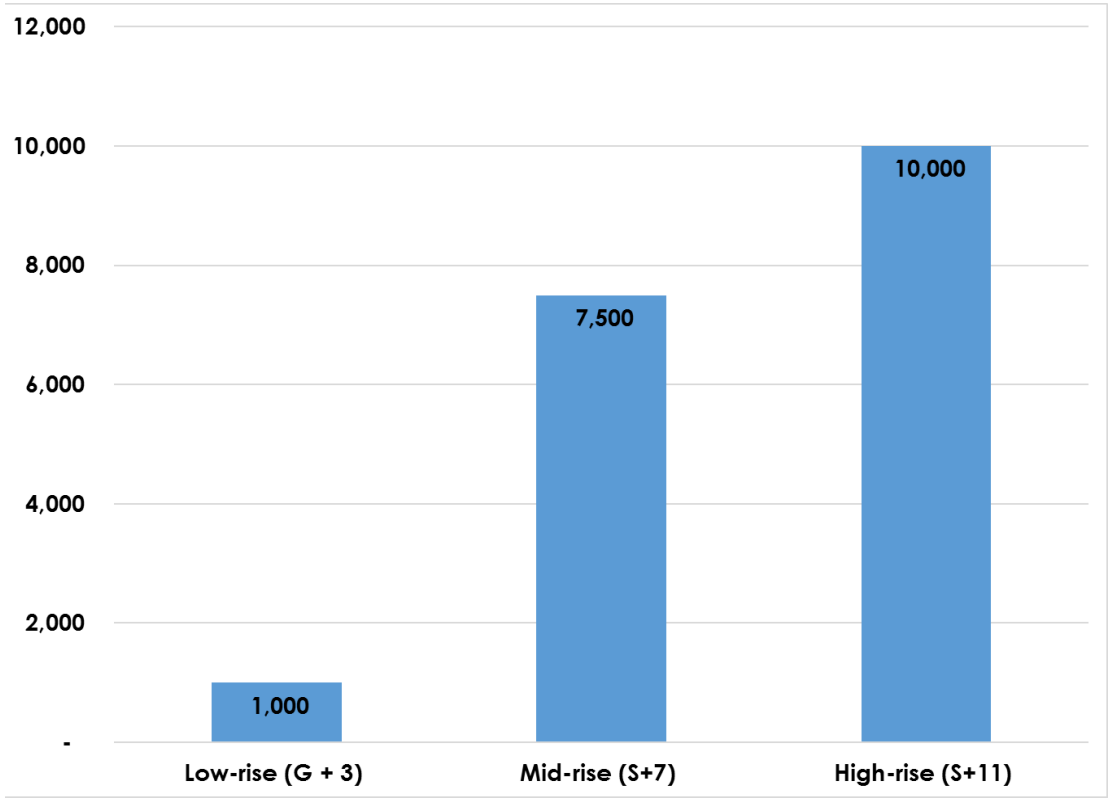
Operational Energy Efficiency





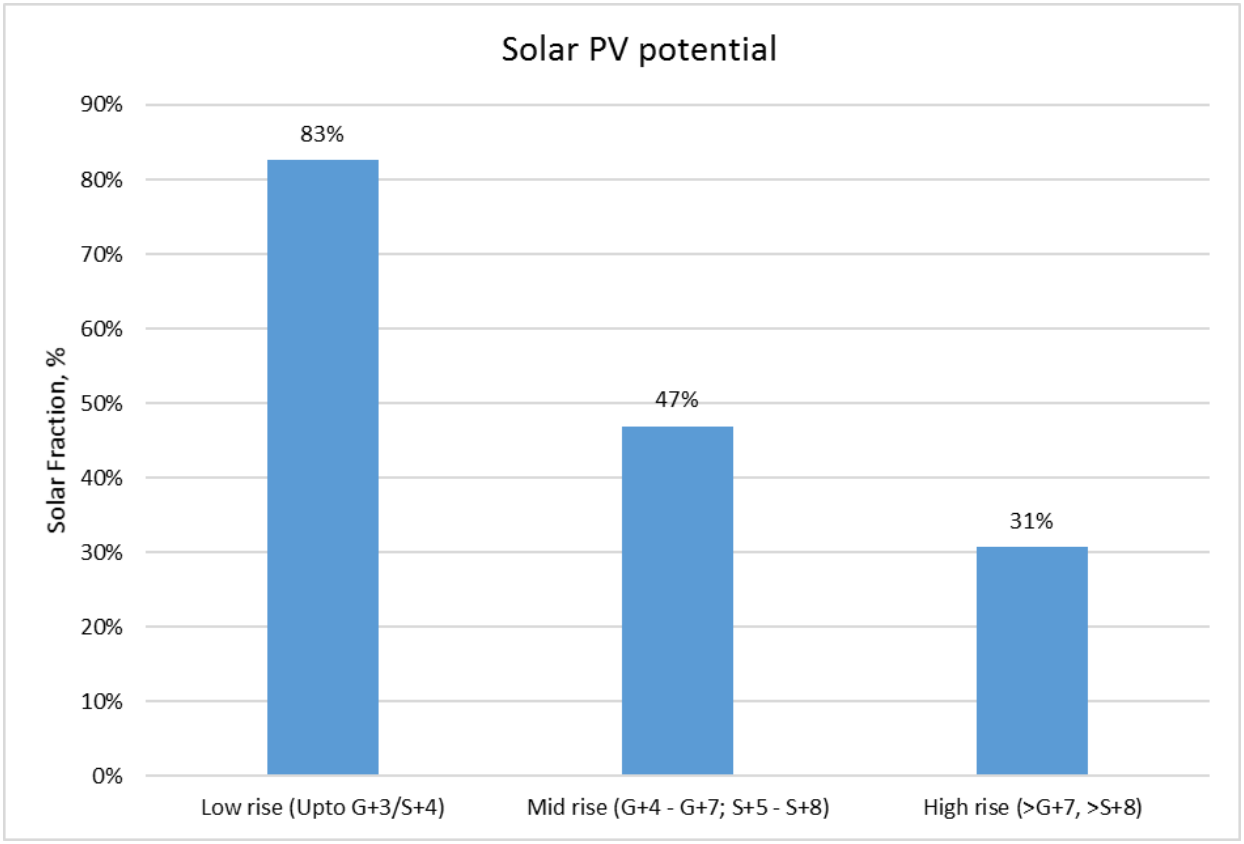
- **Increase in common service energy (pump + lift) by 4 to 5 times as we go from low-rise to high rise**

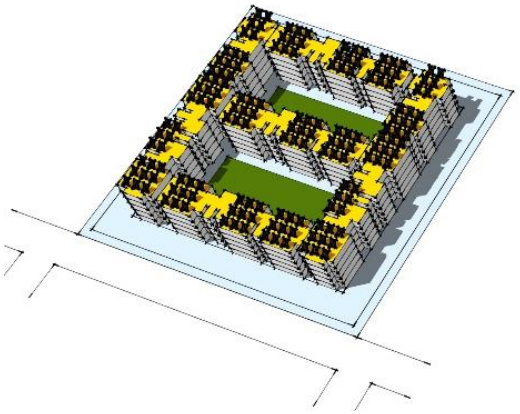
Maintenance Cost Comparison



Evaluated over their lifecycle the maintenance & operation costs of High rise buildings is 10 times the cost incurred in Low rise buildings.

Rooftop Solar Potential





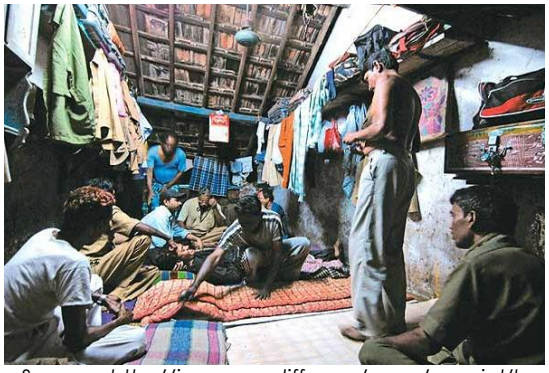
- **80% of the energy requirement in a low-rise building can be met by rooftop solar energy. Low rise buildings have the potential to be Net Zero due to better Rooftop Area to Electricity Demand Ratio.**

- **Building higher decreases Solar potential.**

BUILDING UNIT LEVEL

Quality of Life and High density living

Lack of Space inside a House



Source : http://inwww.rediff.com/news/special/how-mumbai-once-lived/20150114.htm

Spill over space

Dearth for open Space

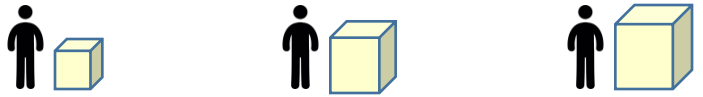
Source:http://2.bp.blogspot.com/Aq4UkDW89A/UheBt1aT09I/AAAAAAAAA2A/TOsFK5Lrzbg/s640/Mumbai+Chawl+6.jpg

Space inside a house is a direct indicator of quality of life.

Quality of Life and High density living

-Space within a House

	Low-Income Housing			Middle-Income Housing	
Size of DU(sqm) (Carpet Area)	25-30	40-45	55-60	70-75	105-110
Space(sqm)/ **Person**	6.1	9.4	12.7	16.1	23.8



Inadequate per person Space inside a home

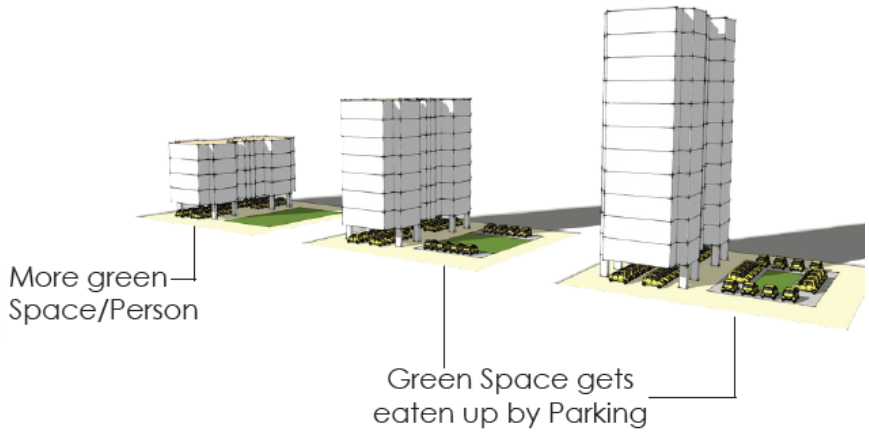
Greater Need for **Compensatory Open/Spill over Spaces** in immediate proximity of the home

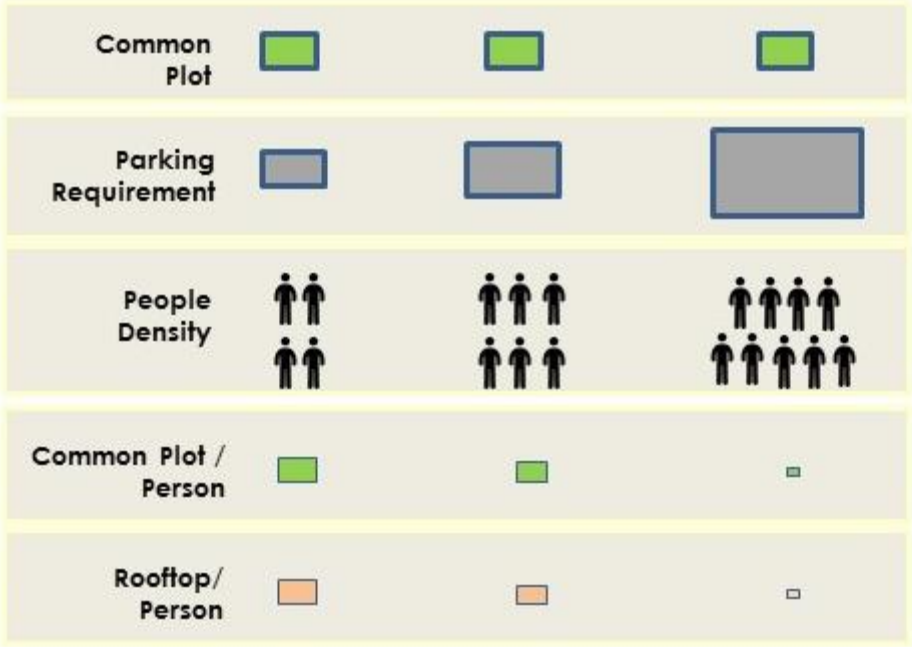
- **Open Spaces on Ground**
- **Accessible Rooftop Spaces**

People/DU 4.5

If no. of people increase, as some houses even have 8-10 people per house, then the per person size decreases even further

-Space in immediate proximity of a house (Open Area/Person)

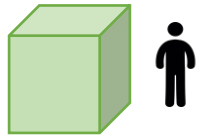




Open space is a function of plot area

Parking is a function of Built up area

Common Plot is a function of Plot Area

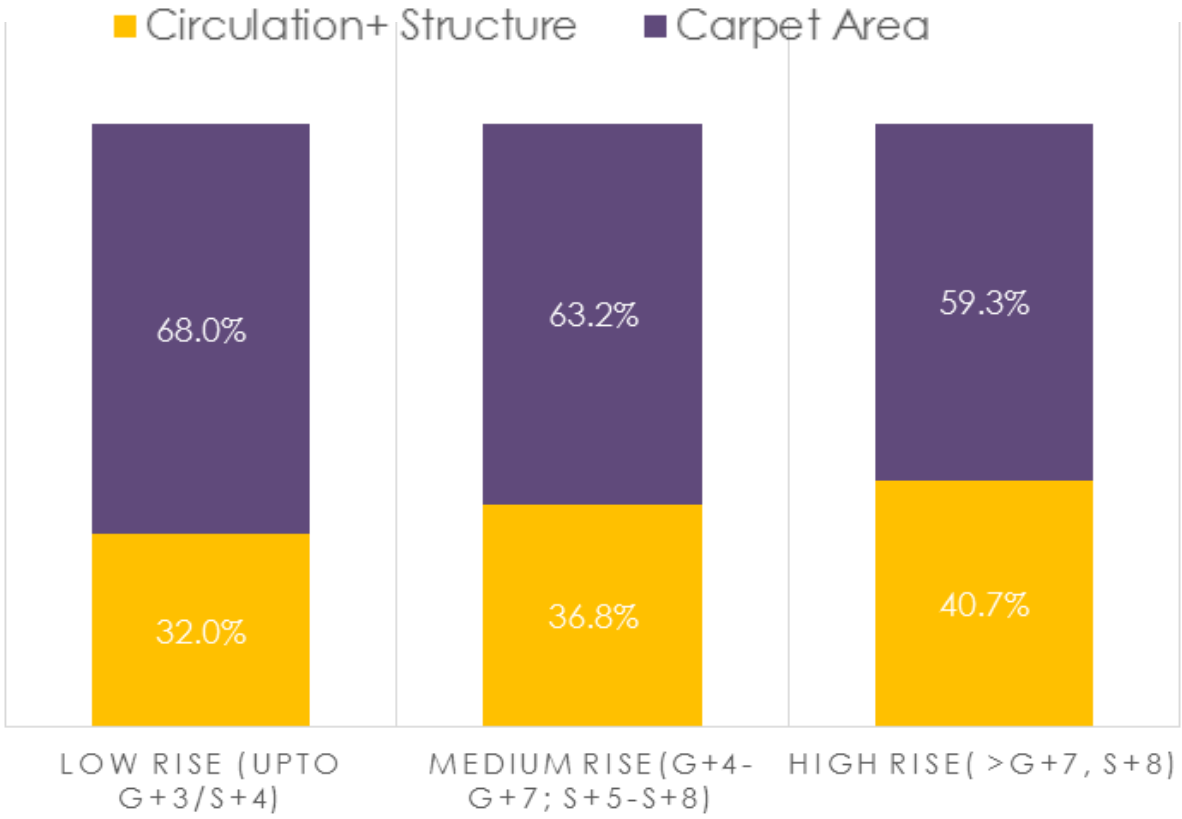


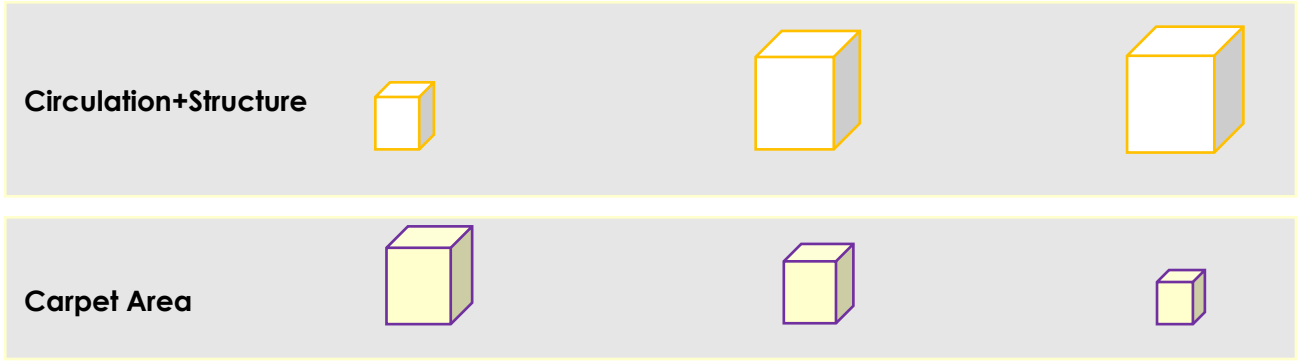
The recreation space requirement for Affordable Housing Schemes with DU size less than 45sqm, needs to be determined by People -Density rather than Plot Area

Carpet Area/ Built Up Area

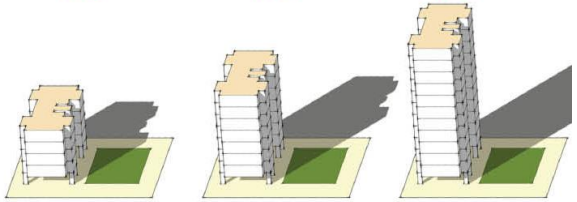
- Building higher increases the area taken by Circulation (Corridor, Stair etc.) and the Structure also becomes thicker.

- Thus for getting the same Carpet Area the Built Up area increases, thus decreasing Space Efficiency and making the per sqm Construction Costlier





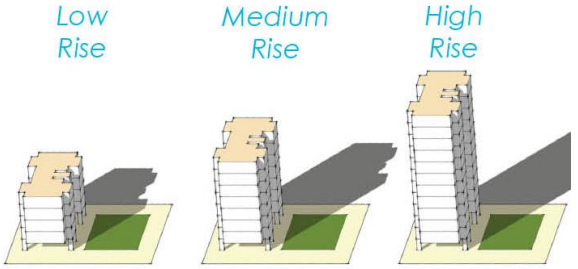
Comparison of Building Typologies



Criteria of Comparison	Low Rise	Medium Rise	High Rise
Sustainability	**High**	**Medium**	**Low**
Environmental Impact	**Low**	**Medium**	**High**
Suitability for Housing Category	**EWS/LIG** (<50m²)	**LIG/MIG** (50-90m²)	**MIG/HIG** (>90m²)
Demand	Maximum ***70%***	Moderate 20%	Least 10%

The high rise development is least suitable from a Low Carbon perspective and thus should be avoided.

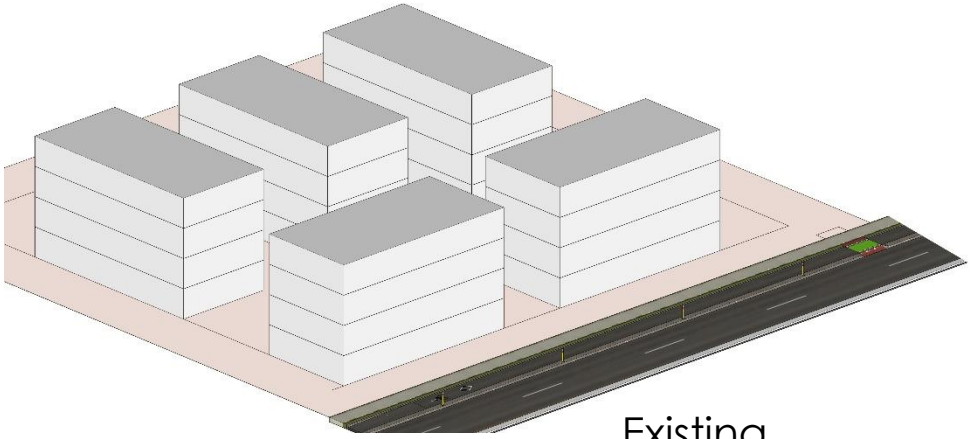
The preferred typology should be Low rise but if Land Cost are very high one may go for a Medium Rise.



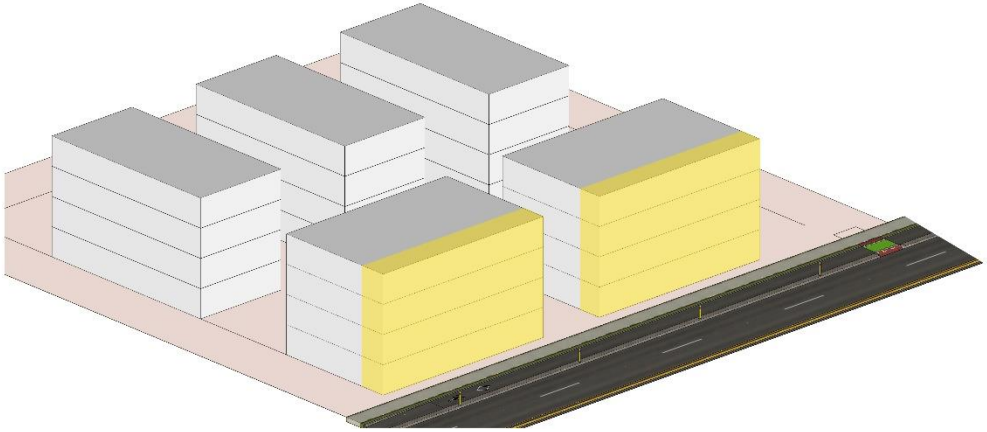
Criteria of Comparison	Low Rise	Medium Rise	High Rise
Affordability	**Most**	**Less**	**Least**
Open Area per Person	●	●	●
Embodied Energy efficiency	●	●	●
Operational Energy efficiency	●	●	●
Solar-Roof Potential	●	●	●
(Carpet Area)/ (Built Up area)	●	●	●
Construction Cost affordability	●	●	●
Quick Construction Time	●	●	●
Maintenance affordability	●	●	●
Disaster/ Break-down resilience	●	●	●

NEIGHBORHOOD LEVEL

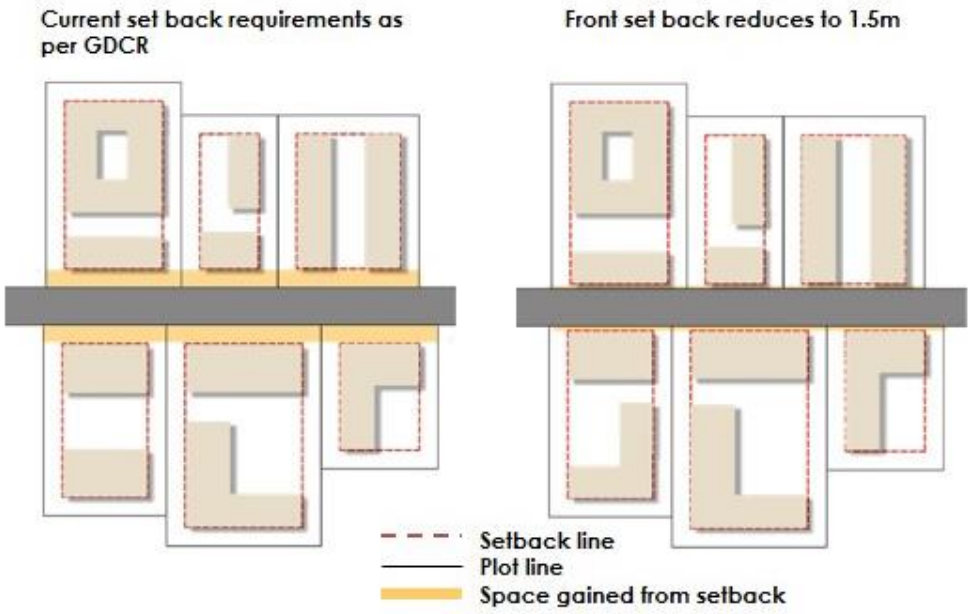
Optimizing Land by reducing Front Margin



Existing



Proposed



1. **Reduce front Margin** *from 4.5m to 1.5m. Promote Build to Line typology. This helps in:*

a) ***Increasing Buildable area*** *and thus ground coverage.*

b) Creating ***safer neighbourhood****, with '****eyes on the street****'*

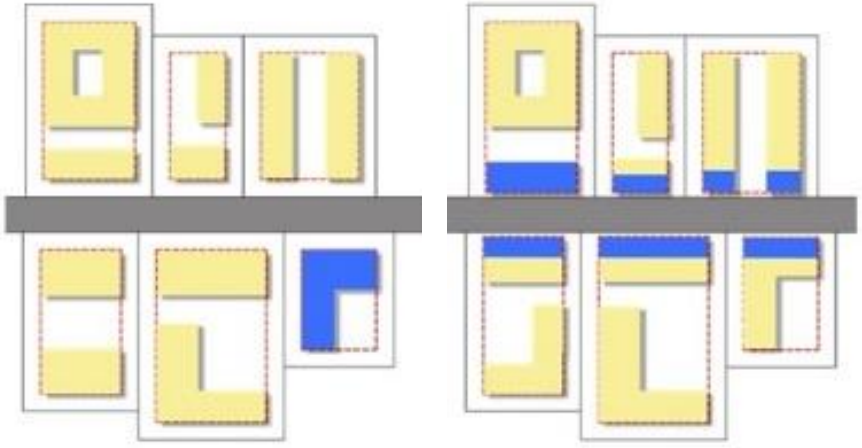
Optimizing Land by promoting Mixed Use

Promote **Mixed-use**,

a)Reduces need for motorised travel - basic amenities & livelihoods integrated with housing

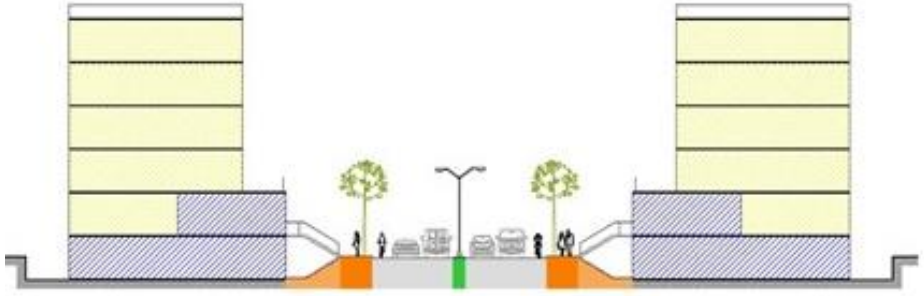
b) Ensures ***Pedestrian friendly streets*** *and vibrant streetscape.*

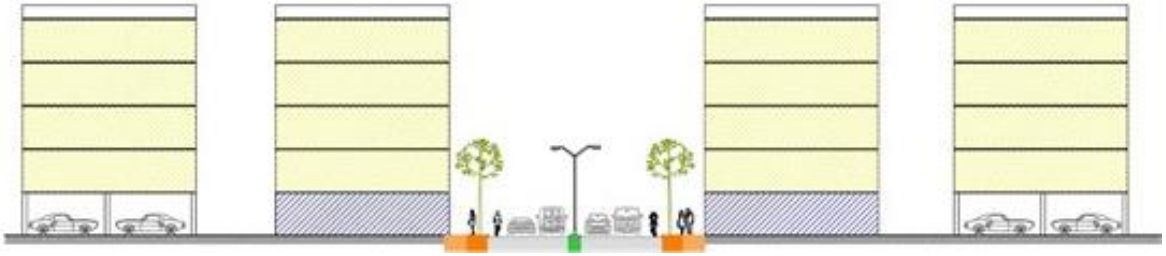
New Mixed use typologies



Existing

Proposed





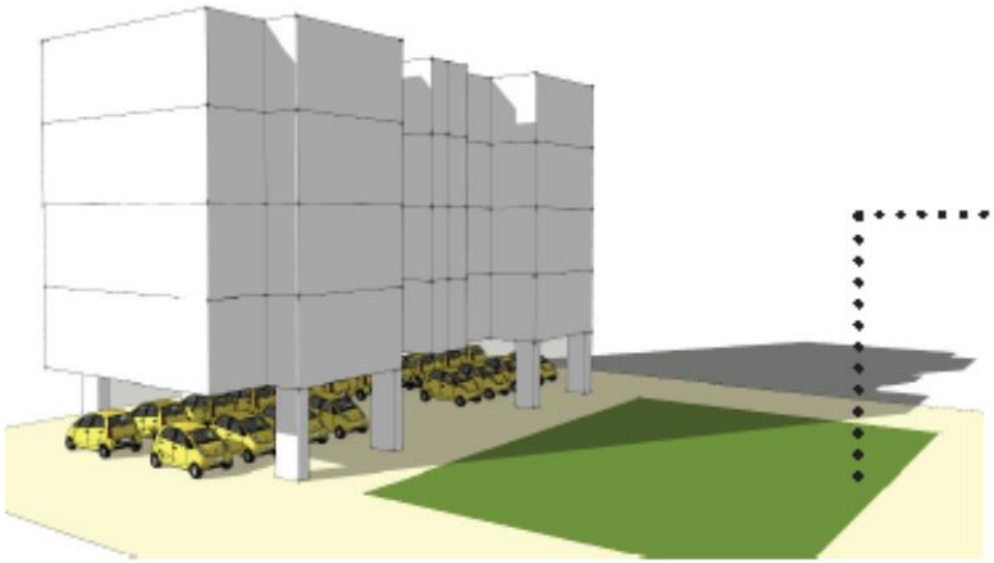
Sustainability at Plot level

*'**Maximize Soft ground**'* in order to :*

*a) Have **Maximum Water percolation.***

*b) Provide **space for plants** and vegetation.*

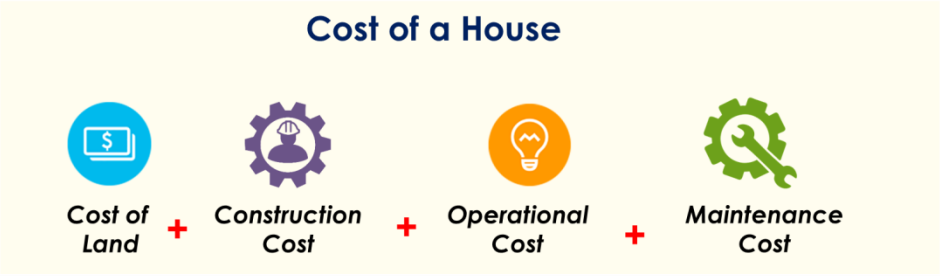
*c**) Minimize Urban Heat Island Effect.***

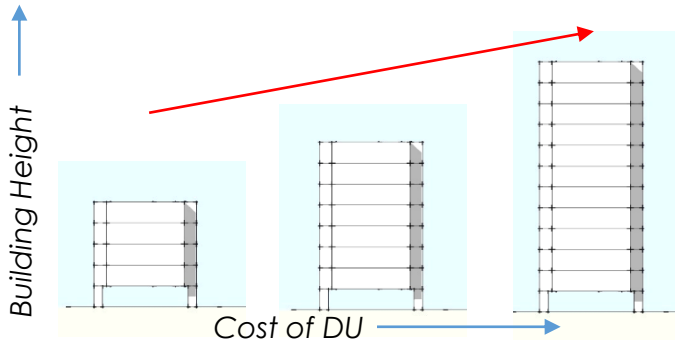


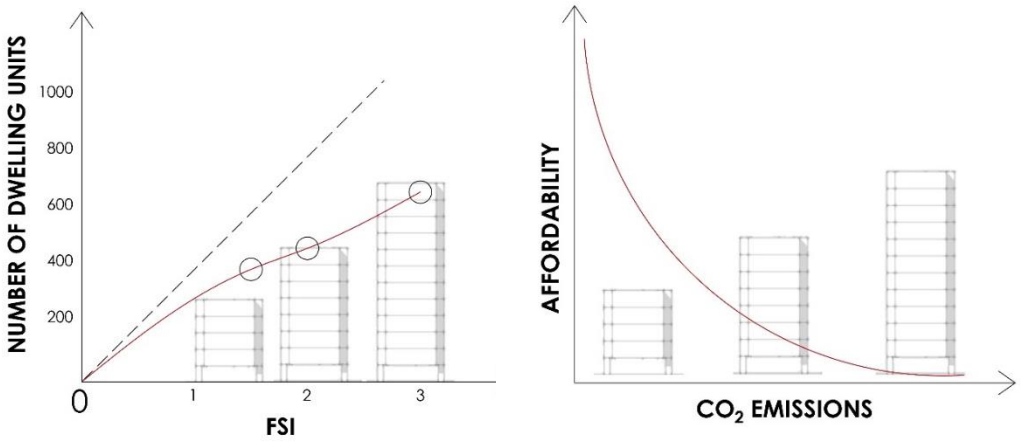
** The S+4 typology, accommodates all the required parking under the building footprint, and thus gives maximum soft ground.*

Optimizing Land and density

Land Cost, FSI and Density







Increase in FSI does not yield proportionate increase in number of houses

Land and development policy needs to aggressively address the causes of high Land Cost*:

- **Speculation and investment of unaccounted wealth** in real estate markets
- **Land hoarding**
- **High stamp duty**

And fast-track

- **Allocation/release of public land for affordable housing**

* Source: Three year Action Agenda 2016-17 to 2019-2020,NITI Ayog, GOI

CITY LEVEL

Transit & Location

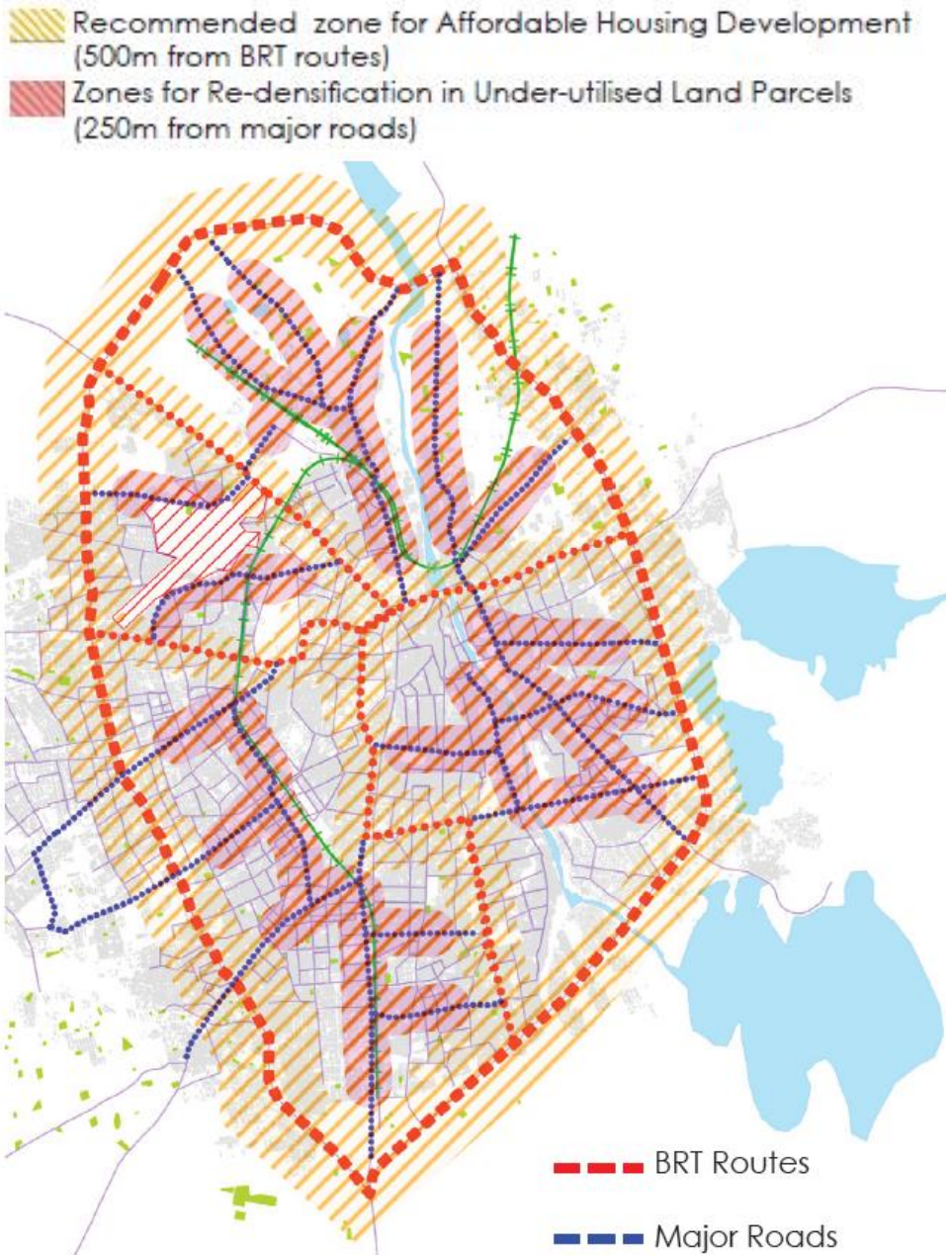
Locate **maximum affordable housing within 500m of the mass transit routes** like the proposed BRT route and **200m from the major roads**, allow ing easy access to affordable public transport.

This locational advantage for affordable housing helps ensure:

a) Reduced need and dependence on private transport, therefore **reduction in the carbon footprint of mobility in the city.**

b) **Spatial equity** for all citizens.

c) ***Quick economic integration and progress for the new migrant and the young aspirant.***



Pedestrian friendly Urban Grid

Ensure **walkability** (<500m) to the **Public Transit Routes.**

Frequent **pedestrian connections** at every 50m in the city blocks **encourages walkability** and **enhances liveability**.

Pedestrian friendly Urban Grid

Ensure **walkability** (<500m) to the **Public Transit Routes.**

Frequent **pedestrian connections** at every 50m in the city blocks **ensures walkable access to Public Transport Routes**, **encourages walkability** and **enhances liveability.**

RUDA GDCR Recommendations

GDCR Recommendations

OBJECTIVE

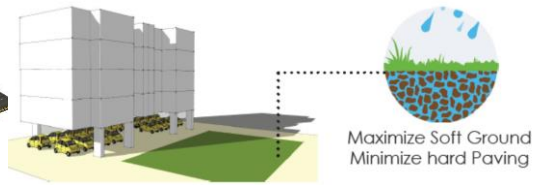
Development Control Regulations must be designed to **promote a low-carbon urban fabric considering a 50 year perspective.** This is imperative to meet the commitment made by India to reducing carbon intensity of development by 30% by 2030.

Synergies have to be found between the quantitative demand for shelter, demand for land and urban fabric that is **affordable and sustainable.**

The research shows that the solution lies in **low-rise high density** urban fabrics for **'affordable housing' for majority of our citizens**.

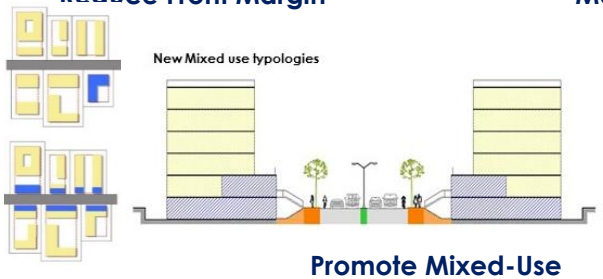
Land policy and development controls need to **INCLUDE AND ADDRESS** these priorities

NEIGHBOURHOOD LEVEL



Reduce Front Margin

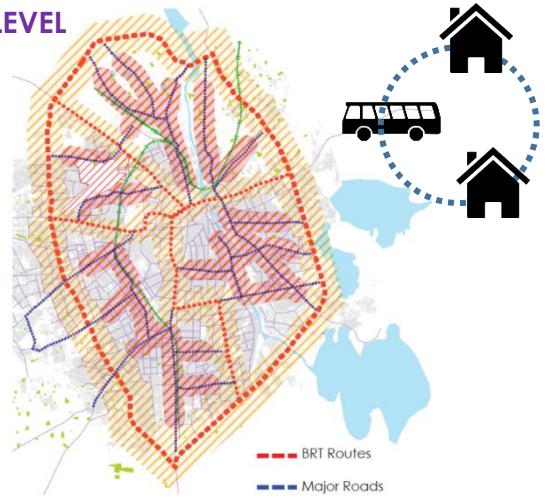
Maximize soft ground



Promote Mixed-Use

CITY LEVEL

Pedestrian friendly Urban Grid



Affordable Housing along Public Transit

DNA of Low Carbon Affordable Cities

Density proposed in RUDA-GDCR **250-600 DU/Ha**

LOW RISE -HIGH DENSITY

DU/Ha – ***400***

Open Space/DU- **15m²**

Construction Cost- Rs.**900-1100**/sqft

80% Solar Potential *for renewable energy from rooftops*

3 million tonnes less of CO_2 emissions, if Low rise format is used instead of High Rise

Quick construction time *with rationalized simple building technologies*

Best opportunity for wealth distribution through construction process

Low-Carbon Affordable City

Best* **Case** Scenario for Affordable Housing:

LOW RISE-HIGH DENSITY

For all Tier 2 and Tier 3 towns and urban extensions of Metros the preferred typology is Low rise

Where land cost is very high the Medium rise option may be an acceptable compromise

High rise development is least suitable from a Low Carbon perspective and thus should be avoided.

* Optimising Affordability, Resource Efficiency, Sustainability and better quality of Life