Future of the Cities, The Griha Summit, 2016

morphogenesis.

Delhi | Bangalore

Sustainability : Mobility : Affordability : Resilience : Technology

CITIES

TIMES CITY

THE TIMES OF INDIA, NEW DELHI
THURSDAY, APRIL 22, 2010

Power cuts trigger water shortage in Gurgaon

TIMES NEWS NETWORK

Gurgaon: Even as the Millennium City continues to reel under long and unscheduled power cuts, an acute water shortage has made life even more difficult. The situation is bad not only in DLF City, Sushant Lok and Palam Vihar but also in HUDA sectors and old parts of the city.

"In DLF city, about 65% households get water supply through canal water which comes from Basai while the rest get water through their own boring. Now that the supply is erratic, we are facing lot of trouble in this peak summer season," said R S Rathi, president, Gurgaon citizens' council.

"For the last 10 days, we are forced to manage with whatever little water we have. Most of the times we are compelled to buy water from water tankers who have raised the prices in wake of high demand," fumed Mala Verma, a resident of C block, Sushant Lok. Meanwhile HUDA officials claimed that problem had arisen because of damaged Basai pipeline — which is main source of water supply to the city. Officials however claimed that the normal supply of 60 MGD water was badly hit. "We are currently supplying 45 MGD water against the demand of 50 MGD and we do understand that residents are suffering because of the water shortage. Also, due to power outages sometimes pumps do not work hampering the water supply. We hope to overcome the problem in a few days," said a senior HUDA official. He added that the problem was fixed on Tuesday but pipeline broke again on Monday and repair work is going on.

Residents, meanwhile, alleged that the maintenance of the pipeline was poor by the department because of which the people suffer every summer.

"Against the demand of over 80 MGD for the population of 18 lakh, they supply 50-60 MGD and even that is erratic because of lack of maintenance and power crisis. We are victims of government's apathy even after paying so much," Rathi rued.

toireporter@timesgroup.com

HIGH & DRY

HUDA officials claimed that damage to Basai pipeline — which is main source of water supply to the city — has caused short supply

Energy

NIFTY 6,126.25 -9.60 SENSEX 20,683.51 -23.94 DOW JONES 15,837.88 -41.23 NASDAQ 4,083.61 -44.56 ₹/$ 62.51 +0.59 ₹/EURO

hindustanti

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KIWIS CRUSH INDIA IN 4TH ODI TO SEAL SERIES WIN, DHONI BLAMES PACERS ›ht sport p21

JAPAN UNVEILS ELECTRIC BIKE ›ht business p17

'ALAGIRI SAID STA
KARUNANIDHI SAYS THREAT L

Delhi world's most polluted city

TOXIC India slips to 155 among 178 countries on environment performance index, Capital pips Beijing to be city with dirtiest air

Chetan Chauhan
chetan@hindustantimes.com

NEW DELHI: It's no surprise that pollution is a perpetual problem in India. But it's definitely disheartening to hear that India has slipped 32 ranks in the global Environment Performance Index (EPI) 2014 to rank a lowly 155 and its capital Delhi has earned the dubious tag of being the world's most polluted city.

A comparative study of 178 countries on nine environmental parameters released earlier this month by the US-based Yale University shows that one of the world's fastest growing economies is a disaster on the environmental front.

What's worse, India's pollution levels could be playing havoc with the health of its citizens. "A bottom performer on nearly every policy issue included in the 2014 EPI, with the exception of forests, fisheries and water resources, India's performance lags most notably in the protection of human health from environmental harm," said a statement issued by Yale.

The study described India's air pollution as the worst in the world, tying with China in terms of the proportion of population exposed to average air pollution levels exceeding World Health Organisation (WHO) thresholds.

A deeper look at the data gathered by a Nasa satellite showed that Delhi had the highest particulate matter 2.5 pollution levels followed by Beijing. Delhi, with 810 million registered vehicles, has repeatedly beaten the Chinese capital on particulate matter pollution.

The high PM2.5 pollution caused by high vehicle density and industrial emissions is the reason for the dense smog that has been engulfing Delhi during the winter months in the last few years, with adverse health implications. And while Beijing's infamous smog has hogged headlines and prompted government action, even led to the announcement of rewards for cutting back on pollution, the dangers in Delhi have been largely ignored.

According to a study by the Harvard International Review, every two in five persons in Delhi suffer from respiratory ailments. The Lancet's Global Health Burden 2013 report termed air pollution the sixth biggest human killer in India. The WHO last year termed air pollution carcinogenic.

Particles smaller than 2.5 microns in diameter (PM2.5 in shorthand) are fine enough to lodge deep in human lung and blood tissue and cause diseases ranging from stroke to lung cancer, the Yale study said.

CONTINUED ON PAGE 8
» BREATHING POISON IN DELHI, P6

CAPITAL BREATHES UNEASY

Tops global cities with worst air pollution

1. NEW DELHI, INDIA
2. BEIJING, CHINA
3. CAIRO, EGYPT
4. SANTIAGO, CHILE
5. MEXICO CITY, MEXICO

INDIA SLIPS IN RANK TOO

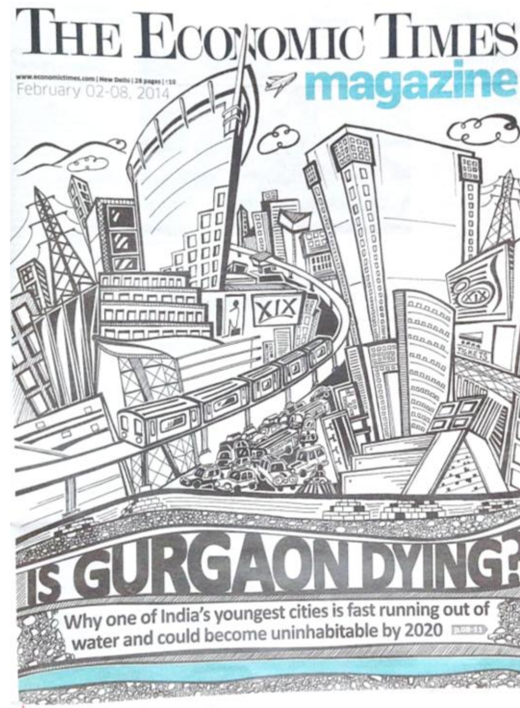
Is second most polluted among its neighbours

	2014	2010
Bangladesh	169	139
India	**155**	**123**
Pakistan	148	125
Nepal	139	38
China	118	121
Sri Lanka	69	58

- **Ranking based on 9 parameters:** Health impact, air pollution, water & sanitation, water resources, agriculture, fisheries, forests, biodiversity & habitat, climate change & energy
- On list of 178 countries, India ranks as low as 174 on air pollution, 127 on health impact

5 CLEANEST COUNTRIES: Switzerland, Luxembourg, Australia, Singapore and Czech Republic

Air



THE ECONOMIC TIMES magazine

February 02-08, 2014

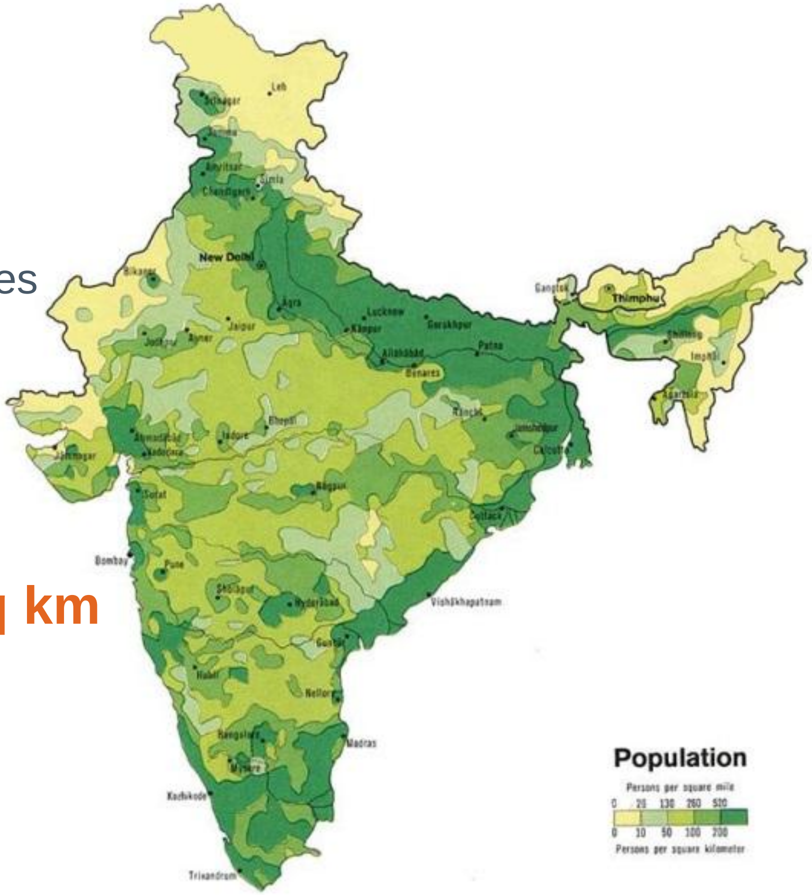
IS GURGAON DYING?

Why one of India's youngest cities is fast running out of water and could become uninhabitable by 2020

Water

Is Population the issue?

Population Density in India



India's population: 1.22 Billion People

No: of people per Family: 5 – Total 244 Million Families

Each Family of 5: 200 sq m of Land
(800 sq m of Land including roads
and Social Infrastructure @25%)

Therefore, total land required: 195,200 sq km

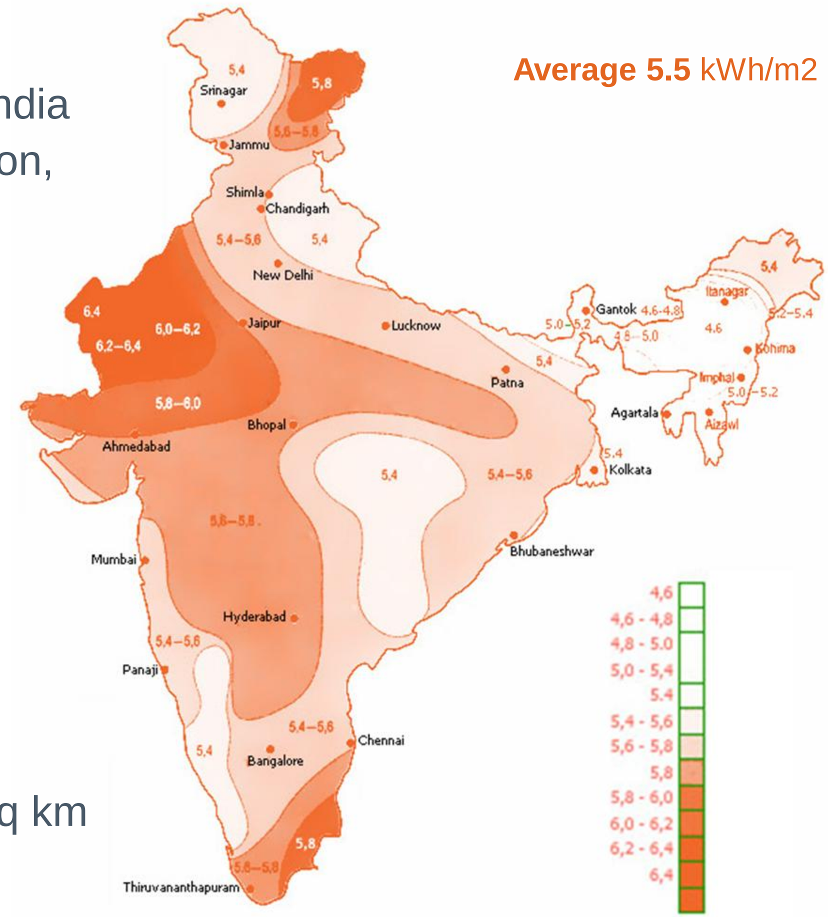
Total Land Area of India: 3,060,500 sq km
(3.06 Million sq km)

Which means Only **6% of India's Land Mass is required to house India's population – Each family with a 200sqm plot of land**

Is Clean Energy the issue?

Daily Solar Radiation in India (KWh/m2)

Average 5.5 kWh/m2



The current yearly per capita energy consumption in India is **680 kWh,** after considering transmission, distribution, transformation losses of 20%, etc (source: World Bank)

India's population: 1.22 billion

Total Consumption: 829600000000 kWh

Average annual solar radiation: 365 * 5.5 = 2000 kWh/m2

Average efficiency of solar unit (inc. transmission losses)**:** 15%

Average output per year: 2000 x 0.15 = 300 kWhr/m2

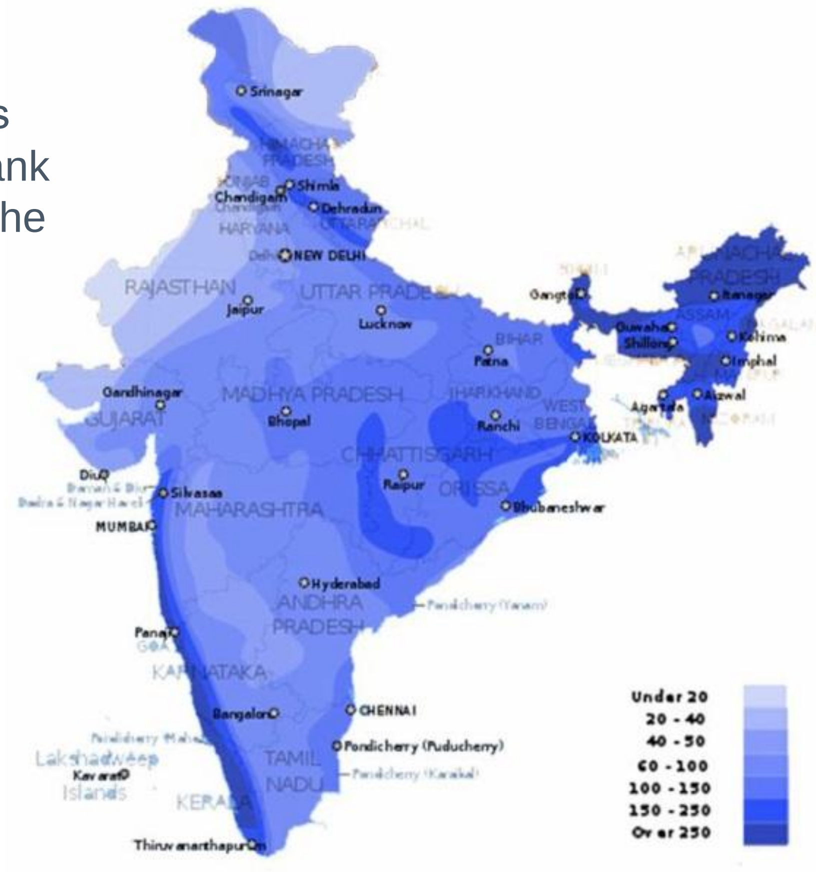
Area of solar panels required to produce required output: 2765 sq km

Land area required: 10,000 sq km

Land area required to house the panels is 0.003% of India's land mass or 2.2% of India's wasteland

Is Water the issue?

India annual rainfall (cm)



Shortfall: Currently only 25% of India's population has drinking water on their premises. According to World Bank estimates, India will exhaust its fresh water by 2050 at the current rate.
(source: Hindustan Times, Aug 26, 2012)

India's average yearly precipitation: 1083mm (source: World Bank)

Total Land Area of India: 3,060,500 sq km
(3.06 Million sq km)

Total Precipitation, therefore: 3,314,500 billion litres

Per capita Precipitation: 2,500,000 litres/person for our population of 1.22 billion.

Even if 2% rainfall could be harvested, each person would have 150 litres a day

- their daily water requirement

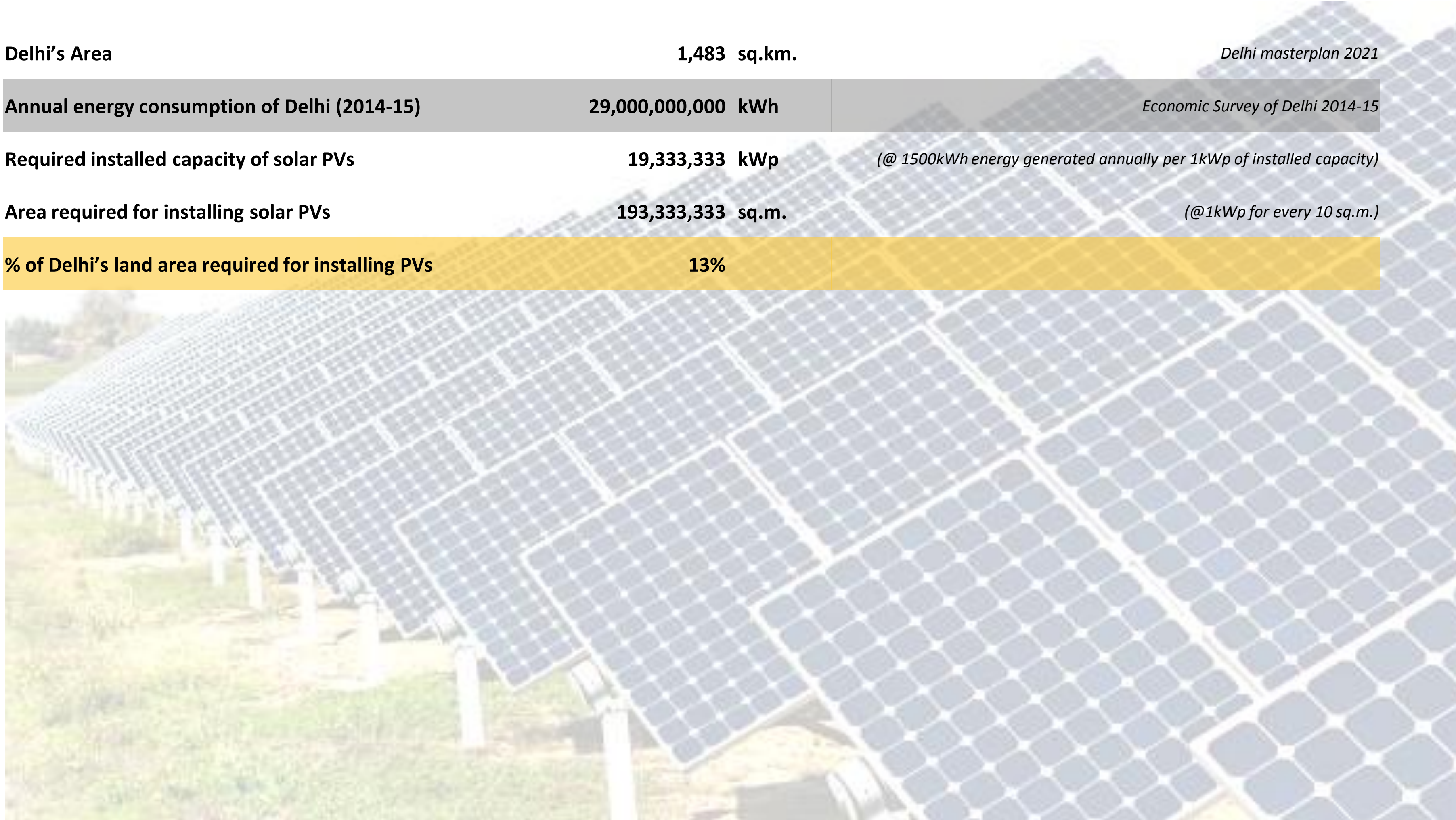
Delhi: Water Carrying Capacity

RAIN-WATER USE FOR LIFE

Delhi’s Area	**1,483**	**sq.km.**	*Delhi masterplan 2021*
Population of Delhi (2011)	**16,787,941**	**ppl**	*Statistical Abstract Of Delhi -2014, Directorate of Economics and Statistics, Government of NCT of Delhi*
Annual fresh-water consumption per person in Indian households	**32.85**	**cu.m./yr.**	*NBC-2005 Recommends 90 lphd*
Annual domestic fresh-water requirement for Delhi's population	**551,483,862**	**cu.m./yr.**	
Annual Rainfall	**0.7554**	**m/yr.**	*http://www.rainwaterharvesting.org/rainfall_htm/delhi.htm*
Run-off factor	**50%**		
Total rainwater collected (including 20% evaporative losses)	**560,129,100**	**cu.m./yr.**	
Carrying Capacity for Delhi	**17,051,114**	**ppl**	

Delhi has the potential to be Net-Zero on domestic fresh-water demand on an annual cycle

Delhi: RE Carrying Capacity



Delhi's Area	**1,483**	**sq.km.**	*Delhi masterplan 2021*
Annual energy consumption of Delhi (2014-15)	**29,000,000,000**	**kWh**	*Economic Survey of Delhi 2014-15*
Required installed capacity of solar PVs	**19,333,333**	**kWp**	*(@ 1500kWh energy generated annually per 1kWp of installed capacity)*
Area required for installing solar PVs	**193,333,333**	**sq.m.**	*(@1kWp for every 10 sq.m.)*
% of Delhi's land area required for installing PVs	**13%**		

Delhi has the potential to be Net-Zero on energy demand by installing solar PVs over 13% of the city's area

Kolkata: Water Carrying Capacity

RAIN-WATER USE FOR LIFE

Kolkata's Area	**1,480**	**sq.km.**	*Kolkata Municipal Corporation* *https://www.kmcgov.in/KMCPortal/jsp/KolkataStatistics.jsp*
Population of Kolkata (2011)	**4,496,694**	**ppl**	Census 2011 http://www.censusindia.gov.in/pca/SearchDetails.aspx?Id=351730
Annual fresh-water consumption per person in Indian households	**32.85**	**cu.m./yr.**	*NBC-2005 Recommends 90 lphd*
Annual domestic fresh-water requirement for Kolkata's population	**147,716,398**	**cu.m./yr.**	
Annual Rainfall	**1.7651**	**m/yr.**	25 years average (1964-2005) http://www.rainwaterharvesting.org/rainfall_htm/kolkata.htm
Run-off factor	**50%**		
Total rainwater collected (including 20% evaporative losses)	**1,306,174,000**	**cu.m./yr.**	
Carrying Capacity for Kolkata	**39,761,766**	**ppl**	

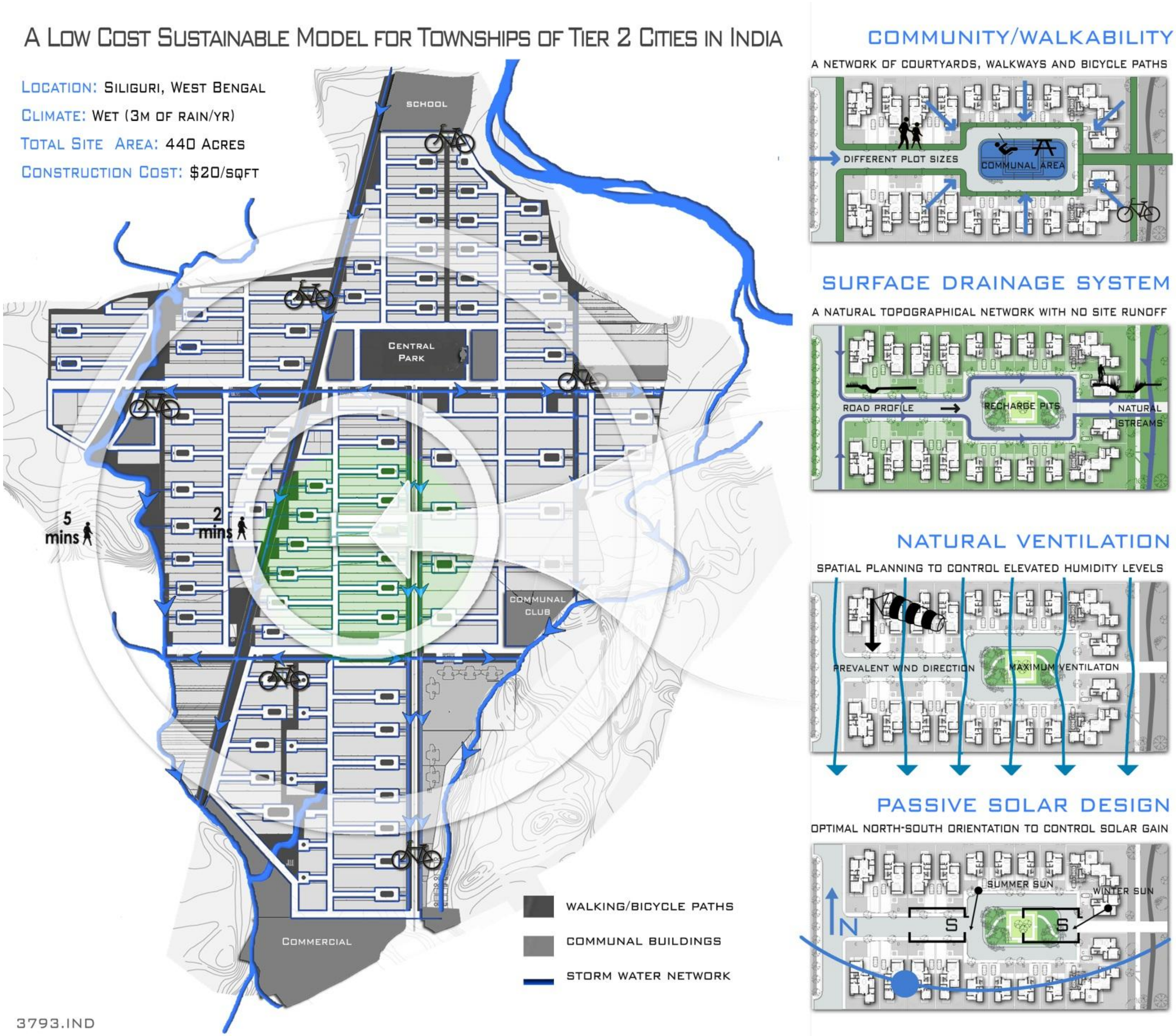
Kolkata has the potential to be Net-Zero on domestic fresh-water demand on an annual cycle

Kolkata: RE Carrying Capacity

Kolkata's Area	**1,480**	**sq.km.**	*Kolkata Municipal Corporation* *https://www.kmcgov.in/KMCPortal/jsp/KolkataStatistics.jsp*
Annual energy consumption of Kolkata (2007-08 to 2009-10)	**7,239,677,340**	**kWh**	*State of India's Cities - An assessment of urban conditions in four mega cities* *Kala Seetharam Sridhar, Nivedita Kashyap* *Public Affairs Centre: Bangalore (2012)*
Required installed capacity of solar PVs	**6,033,064**	**kWp**	*(@ 1200kWh energy generated annually per 1kWp of installed capacity)*
Area required for installing solar PVs	**603,306**	**sq.m.**	*(@1kWp for every 10 sq.m.)*
% of Delhi's land area required for installing PVs	**~4%**		

Kolkata has the potential to be Net-Zero on energy demand by installing solar PVs over 4% of the city's area

Warm Humid (3000mm Rainfall): Uttorayon Township, Siliguri, 400 Acres

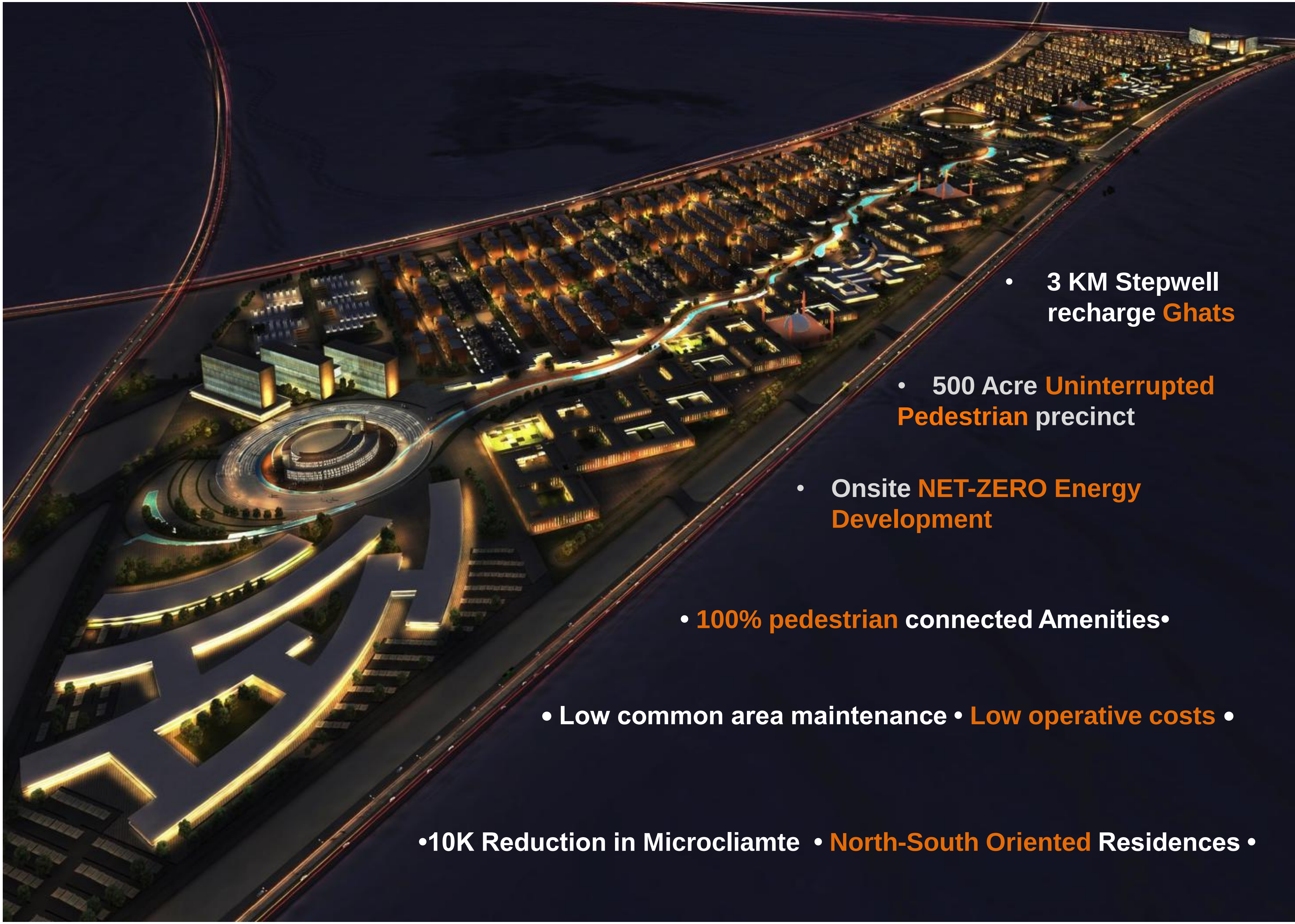








Hot and Dry Climate: Desert Township, Dubai, 532 Acres




© morphogenesis

Composite Climate: Campus for Infosys, Nagpur, 142 Acres

Net Zero Energy for **20,000** people

Zero Water Balance for **20,000** people

Zero Waste Discharge for **20,000** people

Naturally day-lit, Glare-free Workplace

15 acre **Lake** for **Rainwater Harvesting**

Productive Landscape and **Bio-diversity** Park

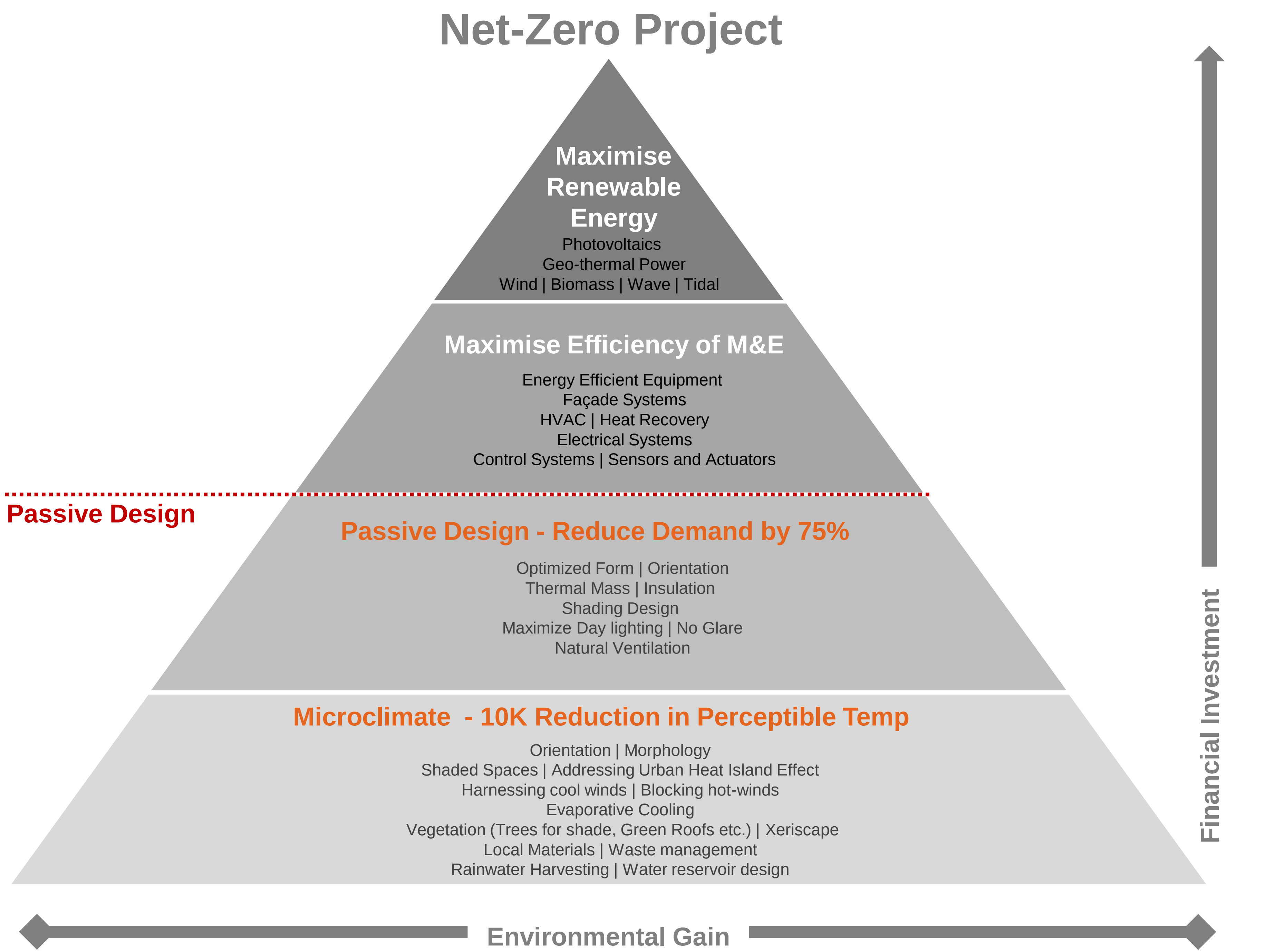
LEGEND

1. Ceremonial Entry
2. Lake
3. Open Courts
4. Amphitheatre
5. Employee Care Centre Block
6. Native Tree Plantation/ Future Development
7. MLCP and Solar Farms
8. Employee Entry
9. Utilities
10. Turnstile Bay
11. Pedestrian Canyon
12. Software Development Blocks
13. Boardwalk

Cold Climate: Amarnath Yatra, 13000ft Altitude

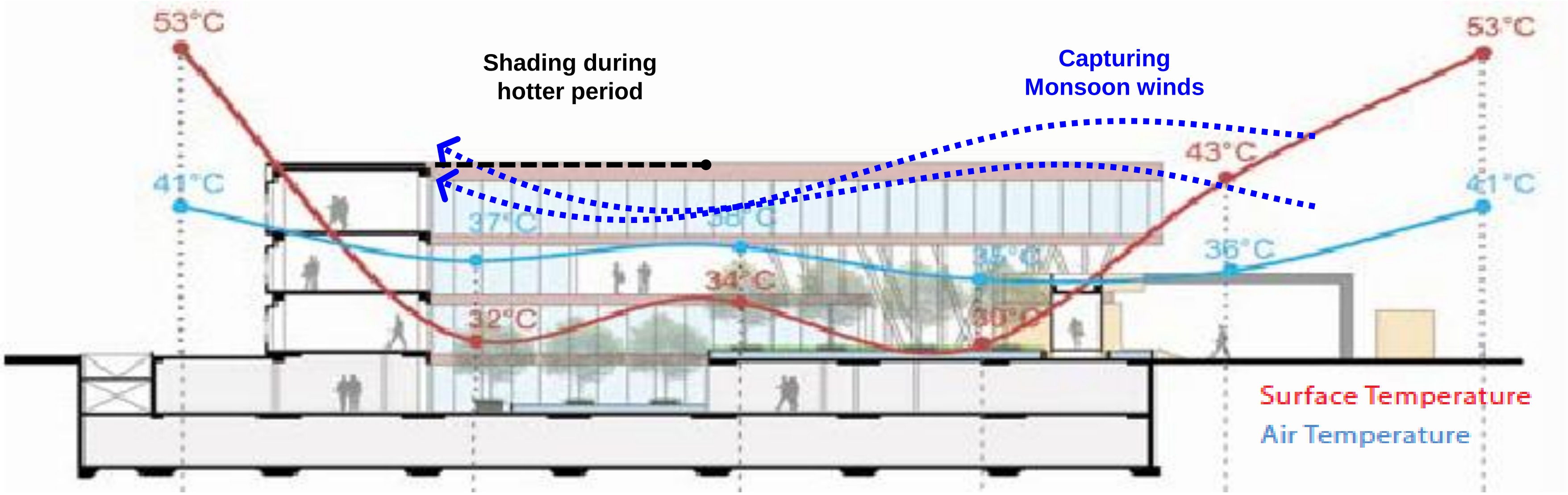
Sustainability | Affordability

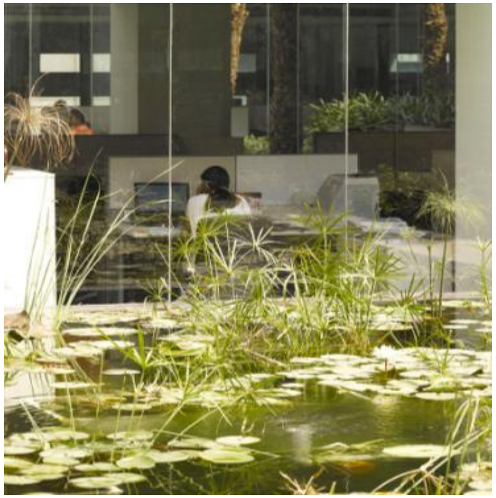
Can buildings be built that consume **75% lesser energy** than green building benchmarks and **Cost Lesser** to Build?


Net-Zero Project
Maximise Renewable Energy
Photovoltaics
Geo-thermal Power
Wind | Biomass | Wave | Tidal
Maximise Efficiency of M&E
Energy Efficient Equipment
Façade Systems
HVAC | Heat Recovery
Electrical Systems
Control Systems | Sensors and Actuators
Passive Design
Passive Design - Reduce Demand by 75%
Optimized Form | Orientation
Thermal Mass | Insulation
Shading Design
Maximize Day lighting | No Glare
Natural Ventilation
Microclimate - 10K Reduction in Perceptible Temp
Orientation | Morphology
Shaded Spaces | Addressing Urban Heat Island Effect
Harnessing cool winds | Blocking hot-winds
Evaporative Cooling
Vegetation (Trees for shade, Green Roofs etc.) | Xeriscape
Local Materials | Waste management
Rainwater Harvesting | Water reservoir design
Financial Investment
Environmental Gain

Microclimate Commercial | 10K Reduction in Perceptible Comfort

Evaporative Cooling| Shading the ground plane | Capturing prevailing winds in Monsoon | Blocking winds in hot & dry season | Vegetation | Green Roofs





Sustainability | Residential: Envelope Optimization

Efficiency Parameters	ECBC	Morphogenesis

Visual Comfort: Efficient Lighting Systems (LEDs)

% Day-lit living spaces (from available daylight hours)	25%	90%

Robust Envelope Design: Optimal Thermal Properties and Element Proportions

Efficiency Parameters	ECBC Baseline Metrics	Design Considerations
U-value of Walls (W/sq.m.K)	0.44	0.624
U-value of Roofs (W/sq.m.K)	0.26	0.345
U-value of Glass (W/sq.m.K)	3.30	1.70
Max. Window : Wall Ratio (WWR)	60%	≤ 20%

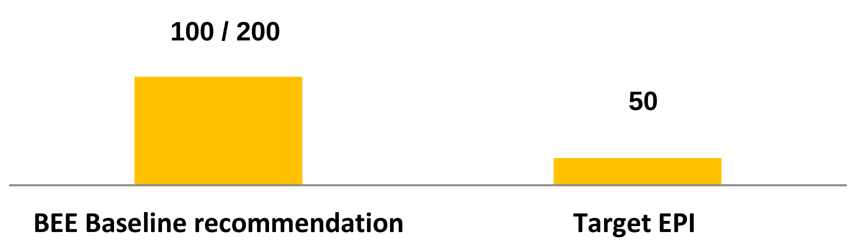
Solar Control: Effective Shading Design

Effective SHGC for Glass (75-90% Shading)	0.20	0.20

Resultant Envelope Load*	≥ 10.0 W/sq.ft.	≤ 2.5 W/sq.ft.

**Envelope Load : Heat loads for HVAC systems*

Energy Performance Index (kWh/sq.m./yr.)



Overall Energy Consumption of residences can be reduced by ~75% over conventional practices through efficient design

Sustainability | Commercial: Envelope Optimization (<1w/sft Envelope Heat Load)

Efficiency Parameters	ECBC	Morphogenesis
Orientation :		
Optimum Orientation for Minimal Solar Exposure		**North-South**

Robust Envelope Design: Optimal Thermal Properties and Element Proportions

Efficiency Parameters	ECBC Baseline Metrics	Design Considerations
U-value of Walls (W/sq.m.K)	**0.44**	**0.44**
U-value of Roofs (W/sq.m.K)	**0.26**	**0.26**
U-value of Glass (W/sq.m.K)	**3.30**	**1.70**
Max. Window : Wall Ratio (WWR)	**60%**	**≤ 30%**

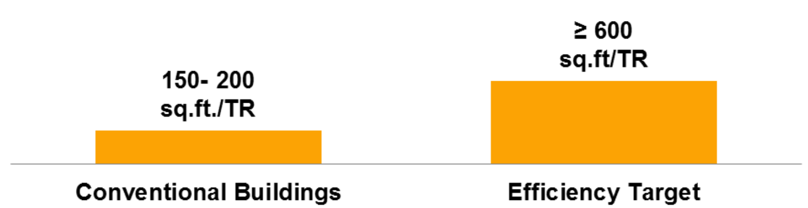
Solar Control: Effective Shading Design

Effective SHGC for Glass (75-90% Shading)	**0.20**	**0.20**

Resultant Envelope Load*	**≥ 4.5W/sq.ft.**	**≤ 1.0W/sq.ft.**

**Envelope Load : Design cooling load for HVAC systems*

Design Cooling Loads for HVAC Systems



Inference:

Electrical consumption for the project can be reduced by ~80% through efficient design of the building envelope

Sustainability | Energy Optimization

S. No.		EPI (kWh/Sqm Yr)	Envelope Load (W/Sqft)	Chiller Sizing (Sqft/TR)	Interior Lighting Savings %
1	BEE Benchmark	140			
2	Conventional Building Parameters	118	3.4	211	0%
3	ECBC Compliance Parameters	86	1.6	320	0%
4	ECBC Compliant + Daylight Sensors	57	1.6	342	65%
5	4 + LPD- 0.5 W/Sqft	49	1.6	362	84%
6	5 + DGU (SHGC- 0.15, U Value- 1.6 W/ Sqm. K)	44	1.1	373	84%
7	6 + WWR 25%	43	0.9	378	83%
8	7 + Chiller COP 6.3	42	0.9	386	83%
9	8 + UFAD	35	0.9	418	83%
10	8 + Radiant Cooling Panels	34	0.9	440	83%

Inference:

- **A benchmark of 43 KWhr/sq.m/yr has be targeted with conventional air-conditioning system.**

Sustainability | Energy Performance Index Metrics : Measure | Manage | Mitigate

Hybrid Building	Air-Conditioned Institutional Buildings				

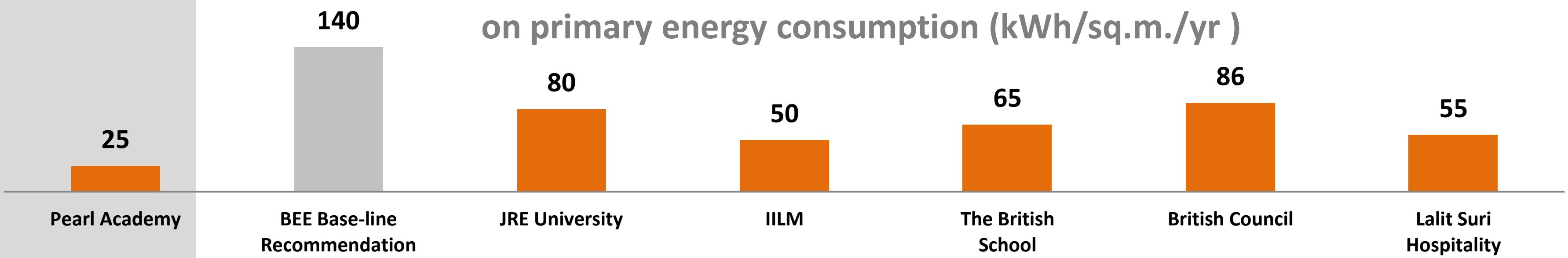




Pearl Academy, Jaipur EPI : 25 kWh/sq.m/yr	JRE University EPI : 80 kWh/sq.m/yr	IILM, Greater Noida EPI : 50 kWh/sq.m/yr	The British School EPI : 65 kWh/sq.m/yr	British Council EPI : 86 kWh/sq.m/yr	Lalit Suri Hospitality Inst. EPI : 55 kWh/sq.m/yr
	Prior to rating systems		GRIHA 5 Star (targeted)	USGBC Platinum (certification)	GRIHA 5 Star (targeted)
2008	2011	2013	2014	2015	2016

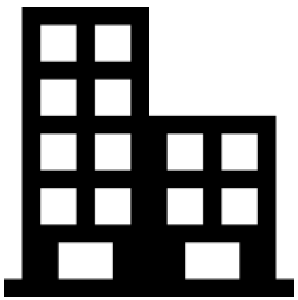
Energy Performance Index (EPI)

on primary energy consumption (kWh/sq.m./yr)



Sustainability | Energy Performance Index

Air-Conditioned Buildings



GRIHA Baseline
EPI : 140 kWh/sq.m/yr

India Glycols Ltd.
EPI : 60 kWh/sq.m/yr

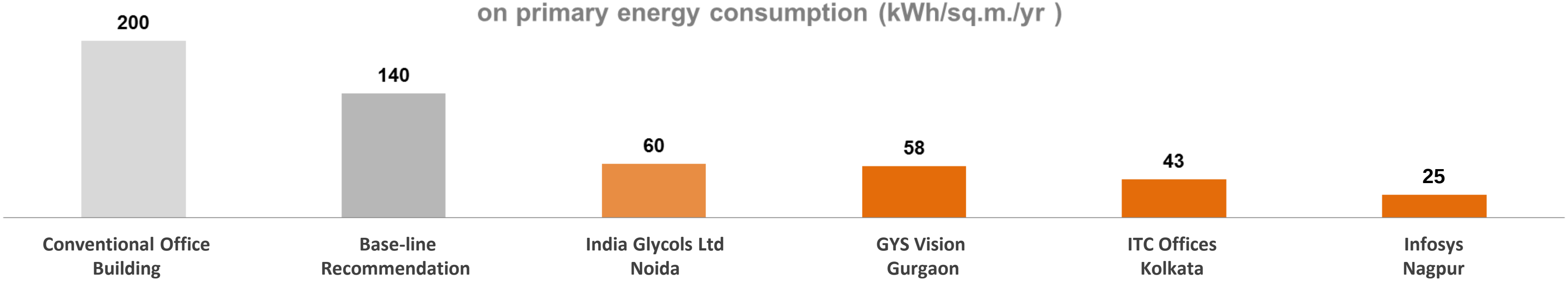
GYS Vision
EPI : 58 kWh/sq.m/yr

ITC Offices, Kolkata
EPI : 43 kWh/sq.m/yr

Campus for Infosys, Nagpur
EPI : 25 kWh/sq.m/yr

2009 2014 2016

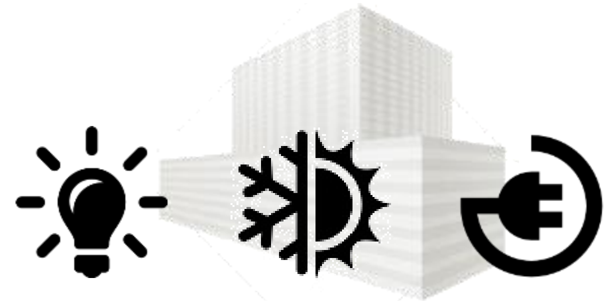
Energy Performance Index (EPI)
on primary energy consumption (kWh/sq.m./yr)



OLDER BENCHMARKS Energy Performance Index Benchmarks (EPI) – (kWh/ m^2 /year)		
Climate Classification	Day time occupancy 5 Days a week	24 hours Occupancy 7 Days a week
Commercial/Institutional/Academic/Hospital buildings		
Moderate	120	350
Composite / Warm and humid / hot and dry	140	450
Residential buildings/Hostels		
Moderate	85	
Composite / Warm and humid / hot and dry	100	

PROPOSED BENCHMARKS for GRIHA V 2015 Energy Performance Index Benchmarks (EPI) – (kWh/ m^2 /year)		
Climate Classification	Day time occupancy 5 Days a week	24 hours Occupancy 7 Days a week
Commercial/Institutional/Academic/Hospital buildings		
Moderate	75	225
Composite / Warm and humid / hot and dry	90	300
Residential buildings/Hostels		
Moderate	50	
Composite / Warm and humid / hot and dry	60	

Affordability | Capital and Operation Cost



Capital Cost

Over-buildability (20%):

Bottom up design to strategize reduction of construction area for parking spaces <35Sqm/Car.

Increase Spatial Efficiency by 20% with Inside Out Design

Structure Optimisation (20%)

Symmetrical Floor Plates, Central Cores, Optimized Grid Spans

Optimising building heights leads to lower structural cost.

M&E Optimisation (25%):

Passive Design, Envelope Optimization along with efficient systems enable an overall reduction in M&E capital cost

Smart Façade (33%):

25% WWR with 90% Daylighting and 90% Shading will enable a substanital reduction in Façade Cost compared to an all glass facade

Operational Cost

Lighting Cost (80%):

Reduction in lighting loads with high Continuous Daylight Autonomy through Passive building design. No lights switched on during the day with a blinds free facade

HVAC Cost (60%):

Reduction in HVAC cooling loads thorough Efficient and Passive building design with an envelope load of <1W/sft

Common Area M&E (60%):

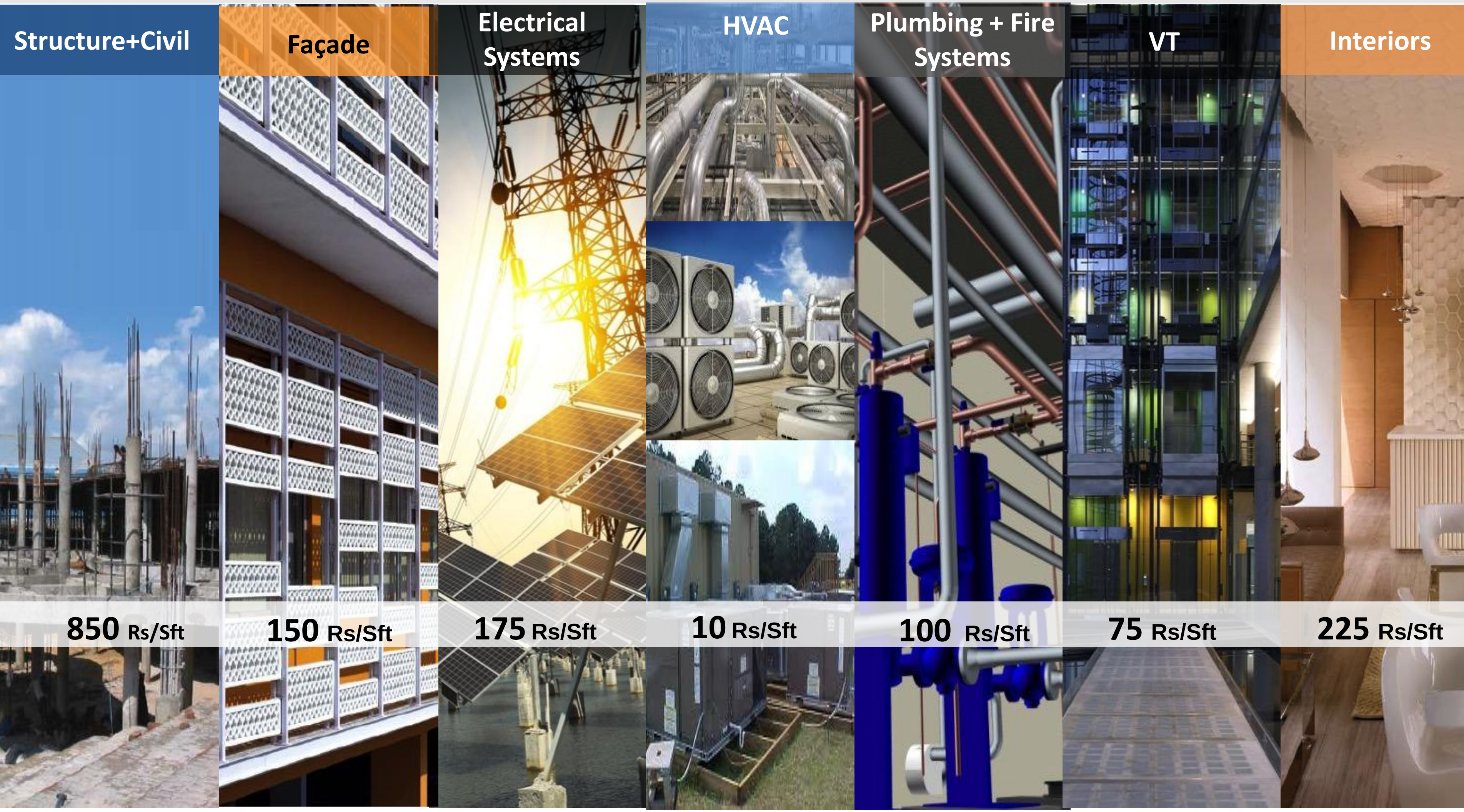
Reduction in M&E common area maintenance costs through passive design

Facility Maintenance (20%):

Reduction expected due to lesser installation of M&E equipment

Affordability | Residential Integrated Project Design

Project Cost Targets – Rs.1,585 / sft (< 25 $/sft)



Optimum Grids Symmetry (45M)	WWR<20%	Envelope Load < 3W/sft	EPI < 50 KwHr/sq.m/yr	Common Stacks / Water saving>50%	Interval < 45s Up Peak > 12%	Green certified Materials

Affordability | Office Integrated Project Design

Project Cost Targets – Rs.2900/sft (<$50/sft)

Structure + Civil	Façade + BMU	HVAC	Electrical + IBMS	PHE	VT	Common Interiors
1,150 Rs/Sft	500 Rs/Sft	325 Rs/Sft	375Rs/Sft	175 Rs/Sft	125 Rs/Sft	250 Rs/Sft
Optimum Grids Symmetry (100M)	WWR<30%	HVAC > 600 sft / TR	EPI < 40 Kwhr/sqm/yr	Common Stacks / Water saving>50%	Interval < 45s Up Peak > 10%	Green certified Materials / Furniture

Towards a Net Zero Future

Sustainability

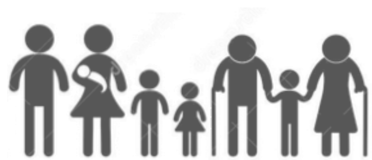
Can buildings be built that consume 75% lesser energy than certified green building benchmarks

Affordability

Can we break barriers of established price benchmarks and reduce consumption of resources through design innovation

Identity

Can architecture be rooted in the Global and the Local, celebrating Diversity over Homogeneity



Livability

Can Smart architecture build resilient communities by putting the user at the center of the design process

Morphogenesis.