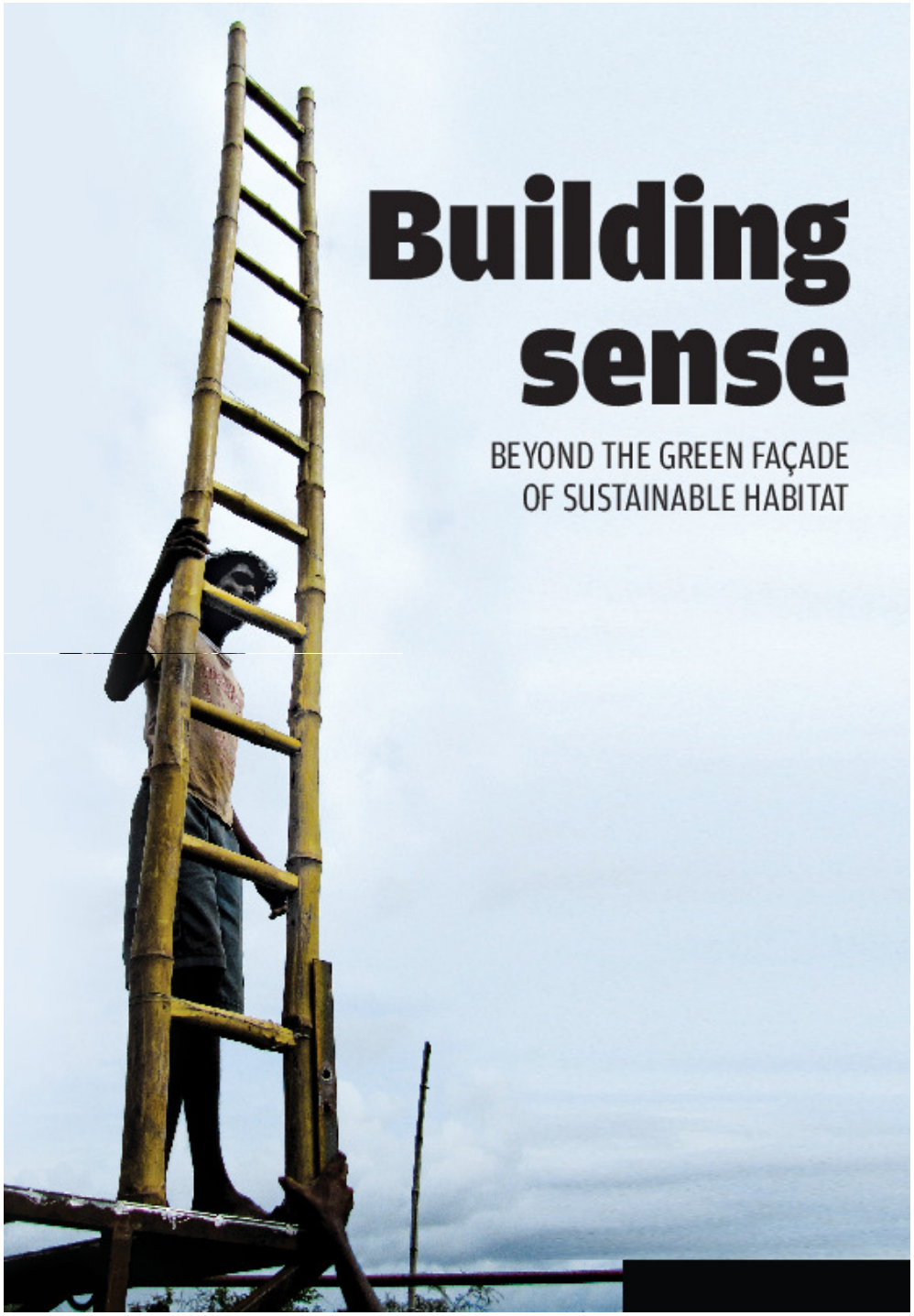
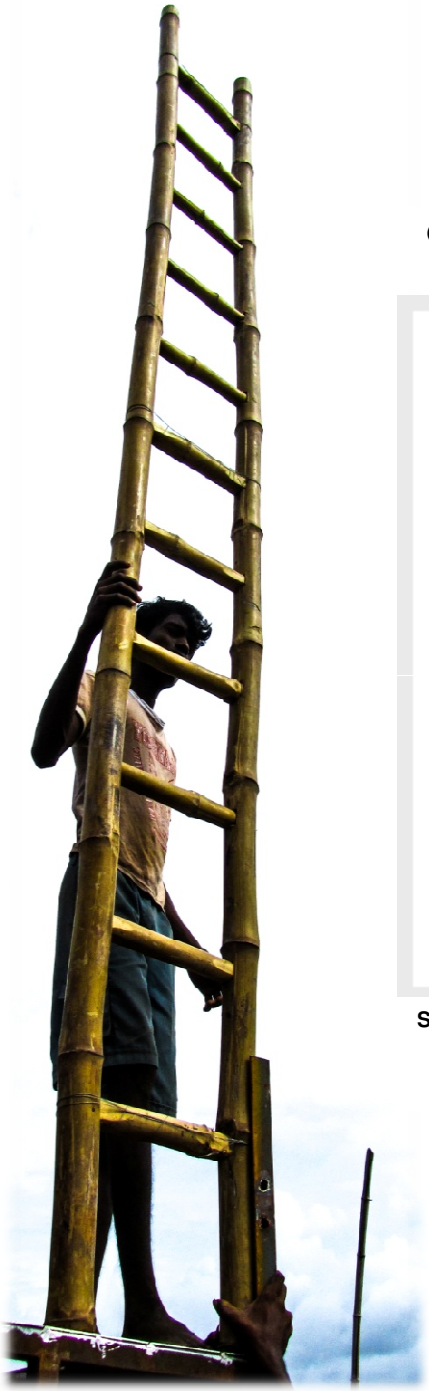


Anumita Roychowdhury
Centre for Science and Environment

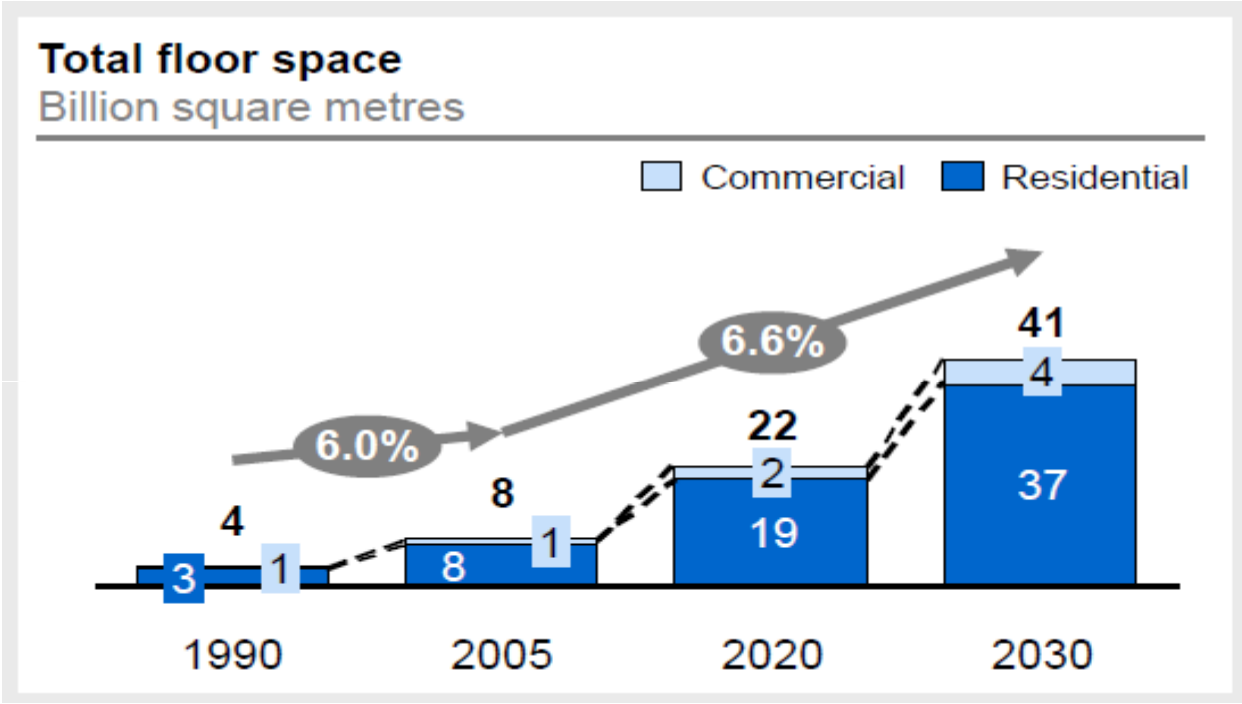
Orientation Workshop on Sustainable Building Approaches and Practices

Centre for Science and Environment
Hyderabad, October 25, 2016



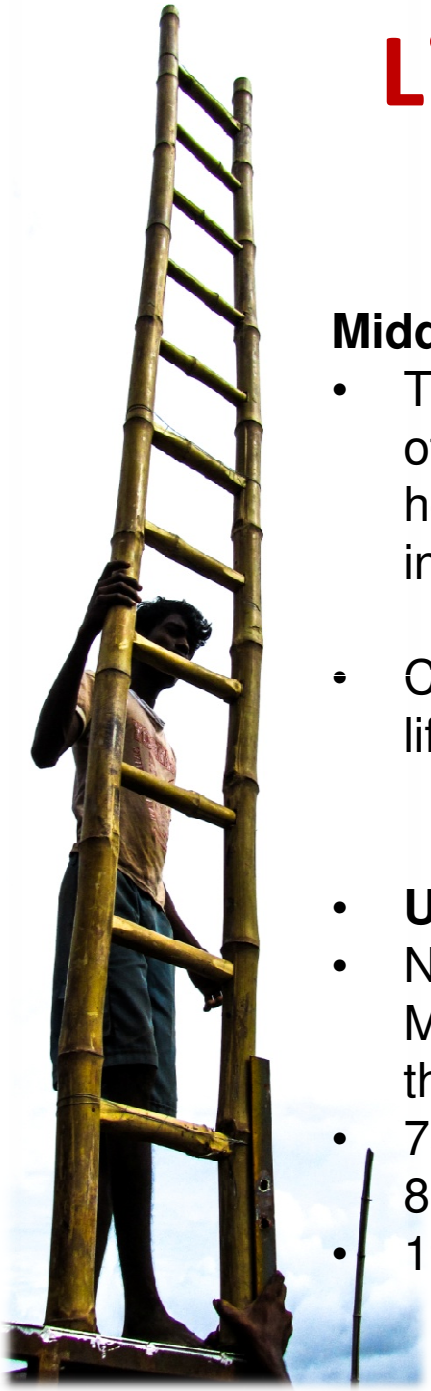
Building construction: explosive

Graph 5: Explosive growth of building stock in India



Source: Environment and energy sustainability: An approach for India, McKinsey & Company

Explosive trend-- About 60% of building stock of 2030 yet to be built. In contrast, 70-80 per cent of the future stock in the US and UK already built. In France, buildings constructed before 1975 thermal regulations will represent over 50% of the building stock in 2050



Lifestyle pressure amidst poverty

Middle class growing rapidly:

- The 2010 McKinsey study: the seeker class (with household income of 200,000 – 500,000 per annum) is expected to be half of all urban households by 2025. About 16% households fall in mid-high to rich income class. (Jones Lange 2010)

- Cities will see more concentrated buying power, transformation of lifestyle and aspiration for high end resource intensive comfort level.

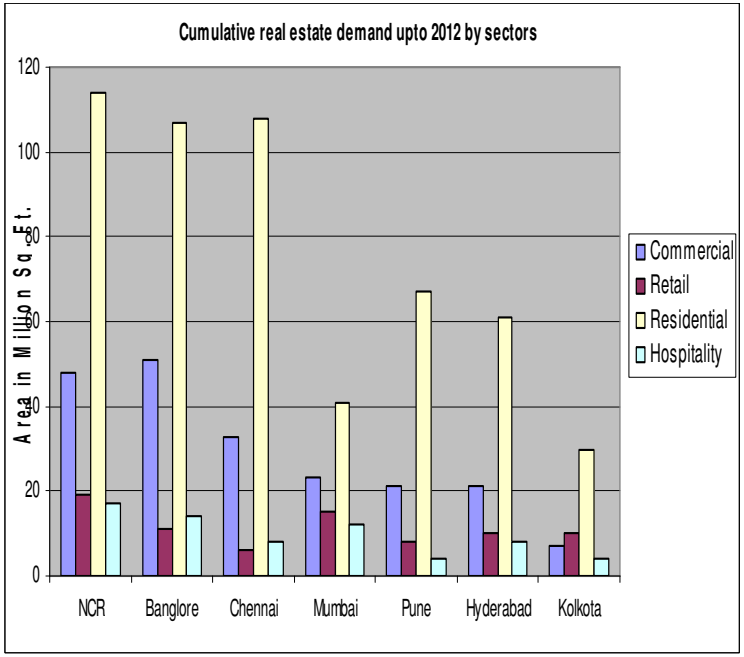
- **Urban poverty remains high:**
- Nearly 21% of urban population -- but 40% to half in Delhi and Mumbai in slums…... All low income groups are not necessarily in the slums.
- 75% of the urban population in the bottom rung of income level – Rs 80/day (USD 1.8). (Mckinsey 2010)
- 19% households cannot afford any housing (Jones Lange 2010)

Clamour for homes

Residential space:
Enormous deficit – Official estimate for affordable housing 18.6 million units;

Unofficial estimate – 40 million! Demand growing at 10% annually. Demand for residential space dominate at 63% of all spaces

Pune: Housing deficit of 5 million



Source Anon, 2008, The metamorphosis, changing dynamics of Indian realty sector,
Cushman & Wakefield, May

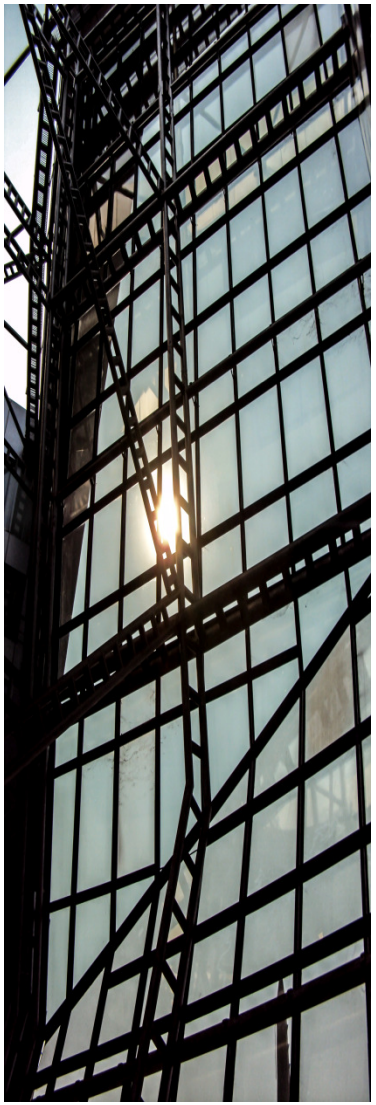
Offices and retail

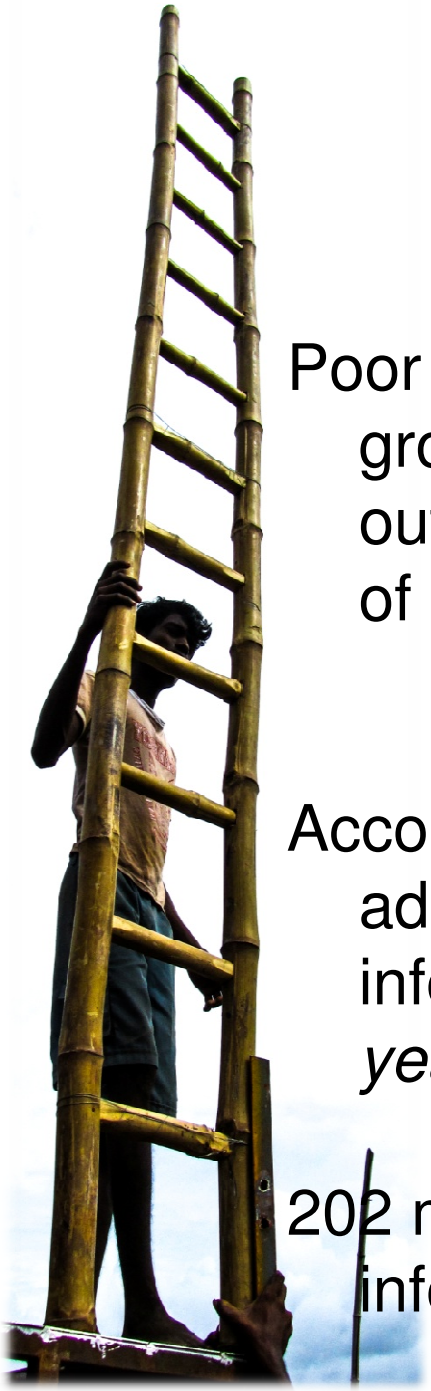
Nationally commercial floor space to increase 5-6% a year: BEE estimates space of shopping malls at 79 million sf in 257 urban centers in 15 largest cities of India

Mckinsey estimates **four fold increase in commercial space** between 2009 and 2030

Retail and hospitality sector to see very rapid growth rate – CAGR 8-9%. By 2030 it will be 7-11 times the level of 2009. In the 15 largest cities of India 7.3 million sq m of space is expected to come up as sites for shopping mall.

New growth in suburbs -- resource conflict areas
95% of new residential projects in suburbs
60% of operational office spaces in suburbs around metro cities. More than half of retail spaces in suburbs (J Lange)



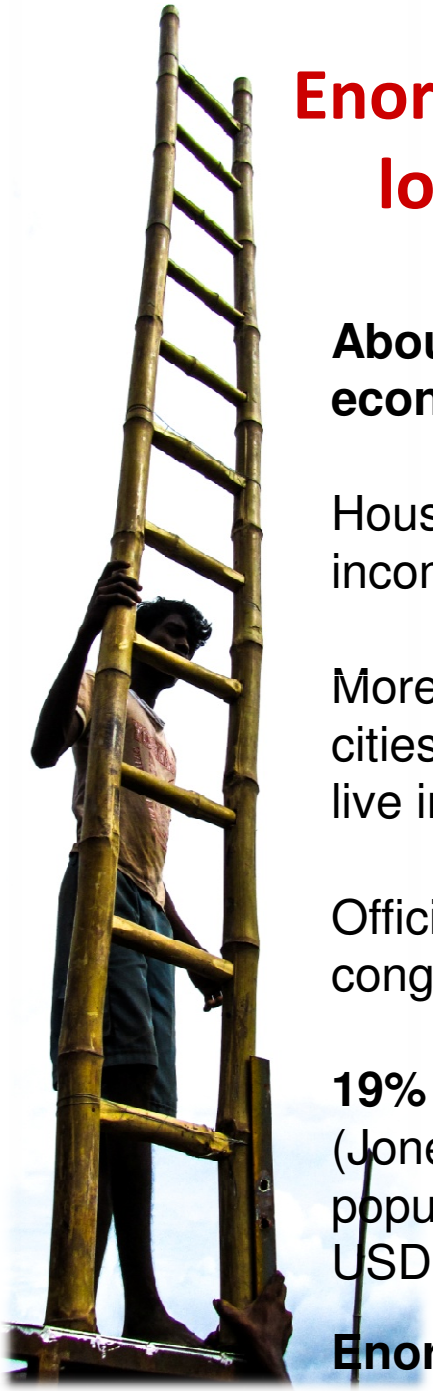


Informal economy and non-planned settlements

Poor people's settlements growing at 6% annually – outstripping urban growth rate of 3.4%.

According to UN Habitat India is adding 4.4 million people to informal settlements *every year.*

202 million Indians will be in informal settlements in 2020.



Enormous housing deficit in low income categories

About 95% of housing shortage in economically weaker sections.

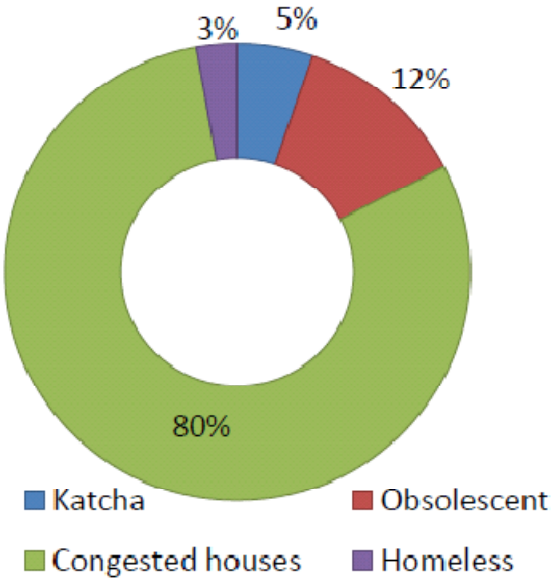
Housing shortfall in middle income and higher income group is only **4.38%**

More than **40%** of low income households in cities with more than a million population each, live in self constructed homes.

Officially **80%** of houses have been declared congested houses – over crowded

19% households cannot afford any housing (Jones Lange 2010). 75% of the urban population in the bottom rung of income level – USD 1.8 (Mckinsey 2010)

Enormous health burden



Source: Ministry of Housing and Poverty Alleviation – Housing for All by 2022,

The paradox: Housing shortage vs vacant houses

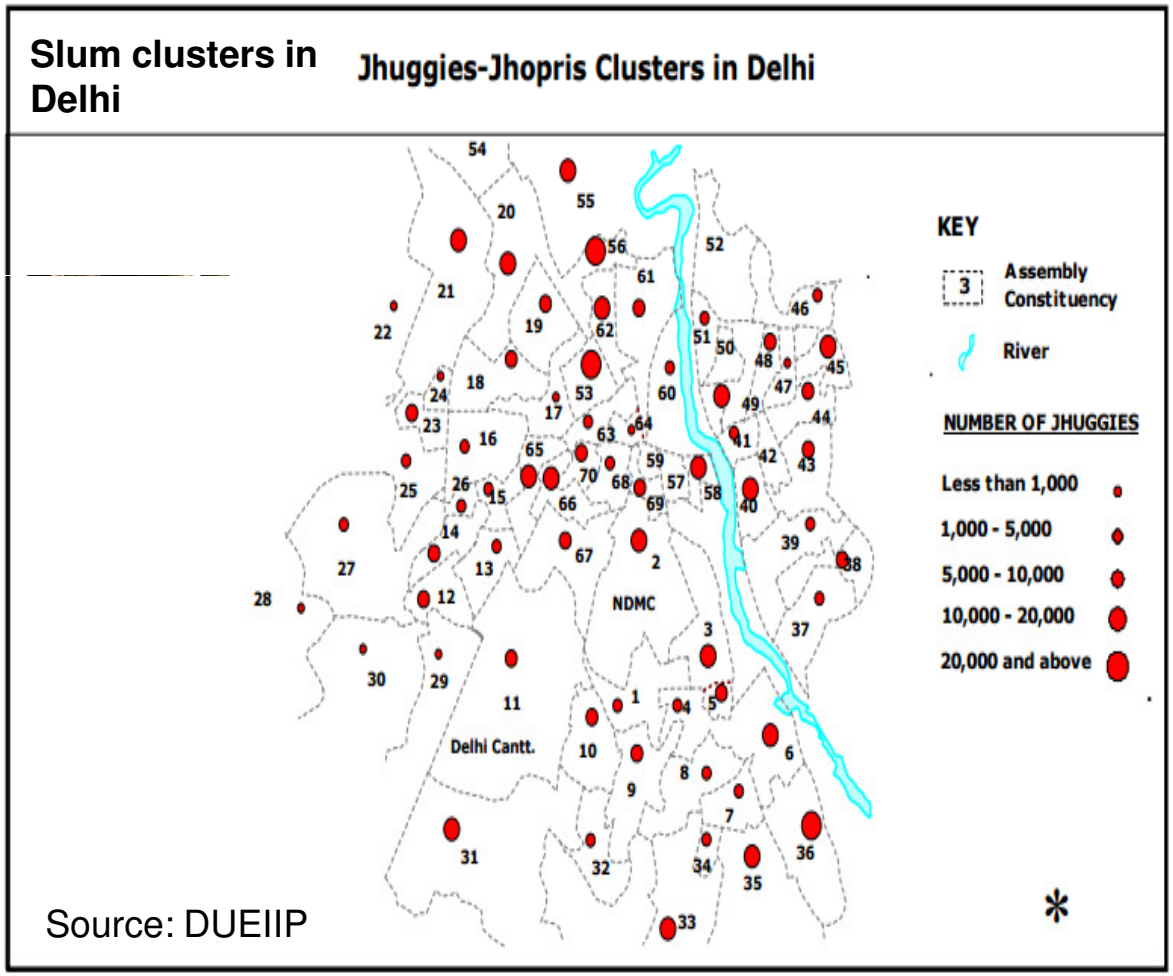
India 2011 census: In urban India 11.09 million housing units are lying vacant.
Housing shortfall is 18.6 million.

Delhi has 4.5 million houses but 11% are vacant.
Subsidy going to relatively higher income category.
Misuse of subsidy for speculation
Ensure poor get access to existing and new housing to lessen the burden to build newer units.

Ensure people get access to existing and new housing to lessen the burden to build newer units.

No space for poor in cities

Slum clusters in Delhi



Source: DUEIIP

Urban sector accounts for 60% of national GDP.

The contribution of informal sector to urban GDP is 7.58% and to the country's GDP 4.5%. (PRIA 2013) But no space for them

Slums are 3% of Delhi's area that houses 30% of Delhi's people

Central core of Delhi is 3% of Delhi's area with only 1% of Delhi's people

Car parking 10% of Delhi's area

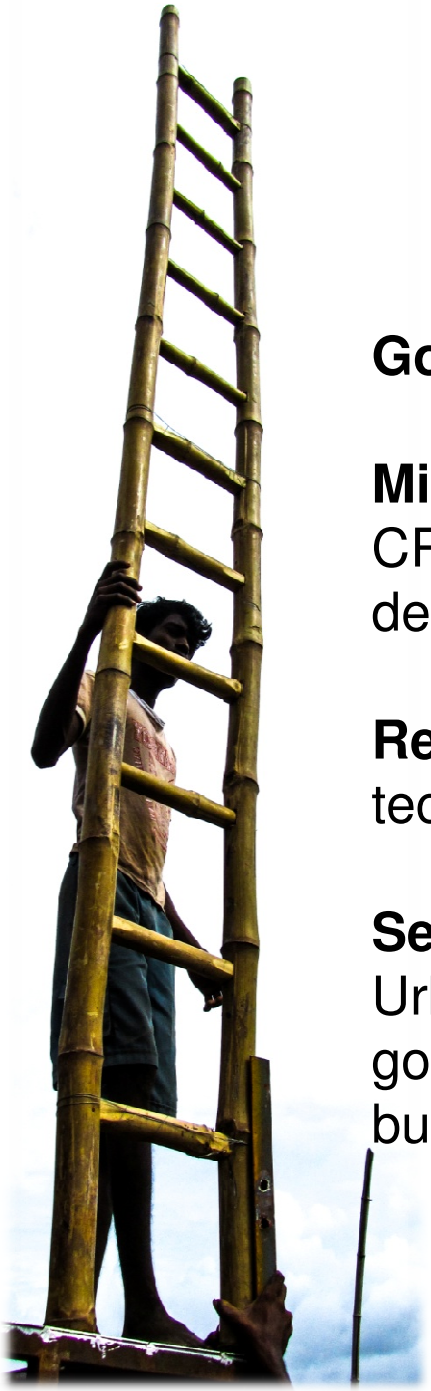
Town building mania

Town boom: Private integrated townships with area of 40 ha to 400 ha each and more than 200 townships planned, under approval and construction. (IDFC's India Infrastructure report 2009) -- especially around the metros.

Touted as Walk to Work Green Towns – without green benchmark

Need smart guidelines for them to -- Support sustainable infrastructure

- -- Public transport connectivity
- -- Metered water and electricity supply
- -- Decentralized waste water management
- -- Decentralized, sustainable energy management
- -- Increase permissible density especially in areas with infrastructure.
- -- Higher density along transport corridors



Who will build and share responsibility?

Government to focus on EWS and LIG

Middle and high income housing: More private players. Eg. CREDAI - association cover 80% of the real estate development in 13 states.

Real estate industry will have significant influence on the technology trajectory and building design

Self constructed housing for the poor: Institute of Urbanology estimates -- between 1997 and 2002 – the government and builders built 500,000 houses in urban India but people built 8.5 million units in informal settlement

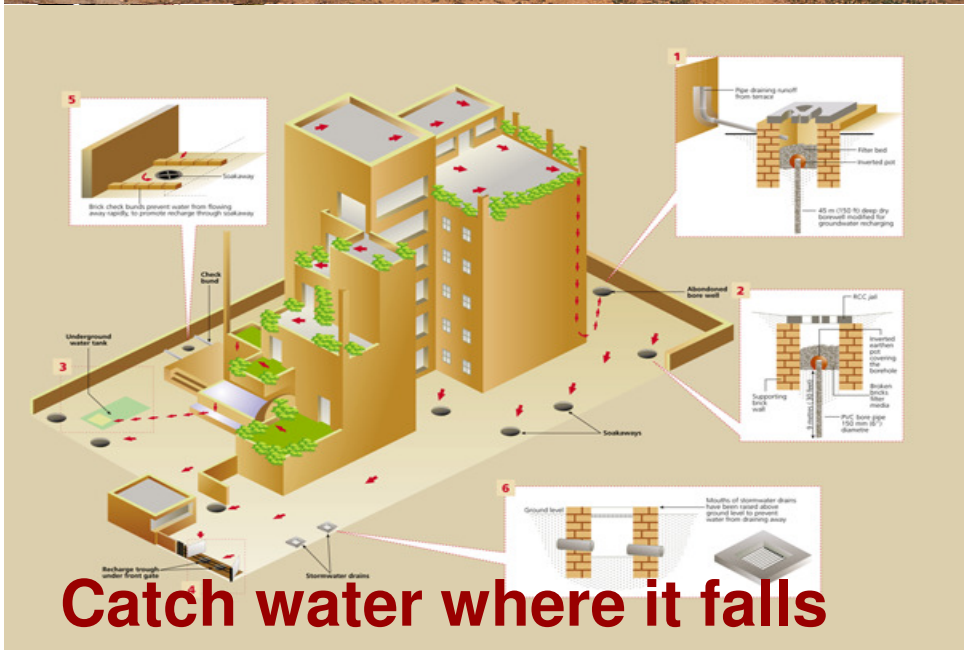
Green worries?.....

Cities face challenge of providing higher levels of comforts to people in resource efficient ways.

Buildings are responsible for 40 per cent of energy use; 30 per cent of raw material use; 20 per cent water use; and 20 per cent land use.

But they cause 40 per cent of carbon emissions, 30 per cent of solid waste generation; and 20 per cent of water effluents. Their repairs and demolition also cause enormous debris.

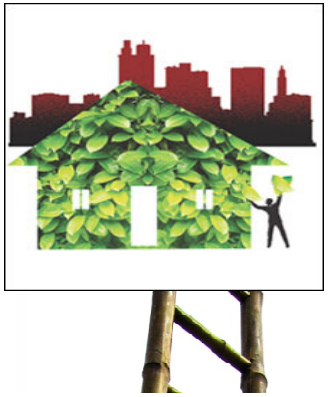
Supporting a water literacy movement.



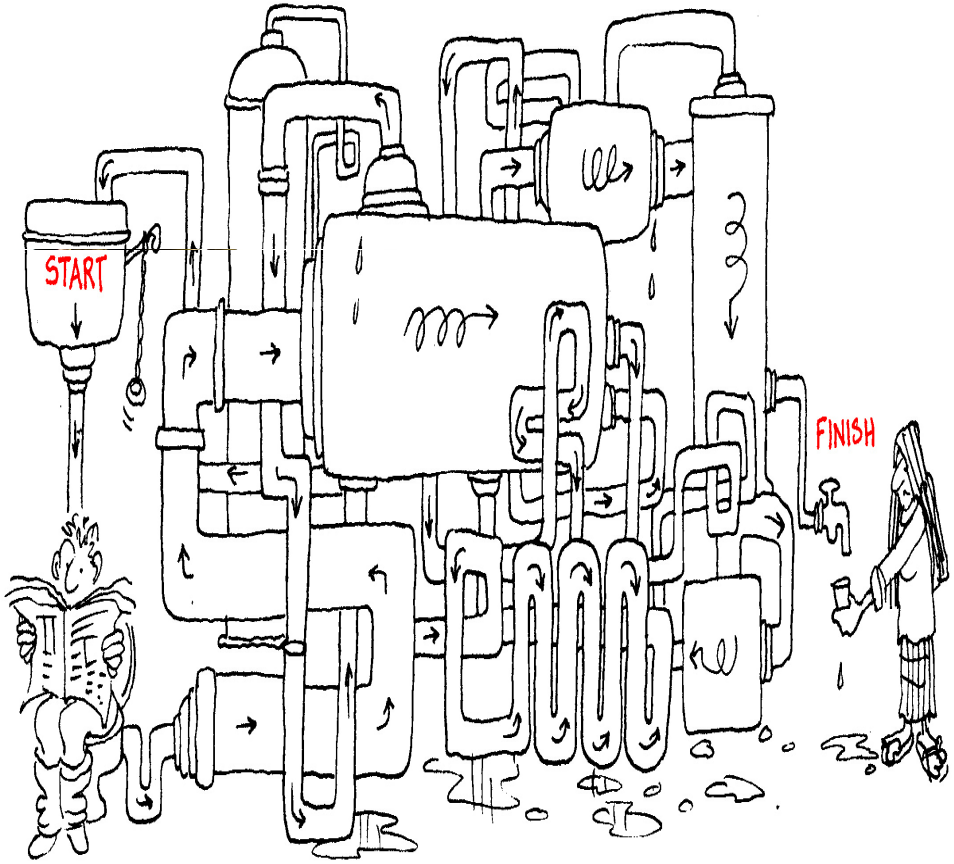
- Out of 8760 hours in a year, most of the rain in just **100 hours**. In low rainfall areas, most of it in a **few cloudbursts**.
- The only solution --capture, store, recharge and **use the rainwater** over the long dry periods
- Even if 50% of rainfall in one ha of land is collected we get 0.5 million litres of water. This can provide 91 persons 15 litres per day for drinking and cooking for a whole year.

This made us look at buildings

Building a water-prudent society. Learning to live with our rain, recycle our waste..recharge our aquifers. Doing and practicing change.



Reinvent -- leapfrog water approach



- Rainwater harvesting – tanks, ponds, rooftop rain harvesting -- to rebuild local water aquifers. (learn from our ancestors)

- Minimise water use.
- Be water efficient.
- Reuse and recycle all waste water.

Challenge to science

80% of treated water flushed down

- Need toilets that do not destroy the country's hydrological systems;
- that are hygienic and equitous.

Regulations taking shape to lower the threshold level of water and energy requirements and minimize waste while improving comfort levels.

This is new area of governance… there are many challenges…

Green norms – if not crafted well – can lead to unintended consequences…..

Emerging policy opportunities…..

Integrated Energy Policy 2006: Demand side management in buildings. NBC should be amended to facilitate efficient buildings Publicise innovative approaches. Make energy audits compulsory for all load above 1 MW. Initiate benchmarking; Amend building byelaws to enable solar water heaters

ECBC: Sets minimum energy performance standards. Has legal back up from the Energy Conservation Act; Voluntary, to become mandatory

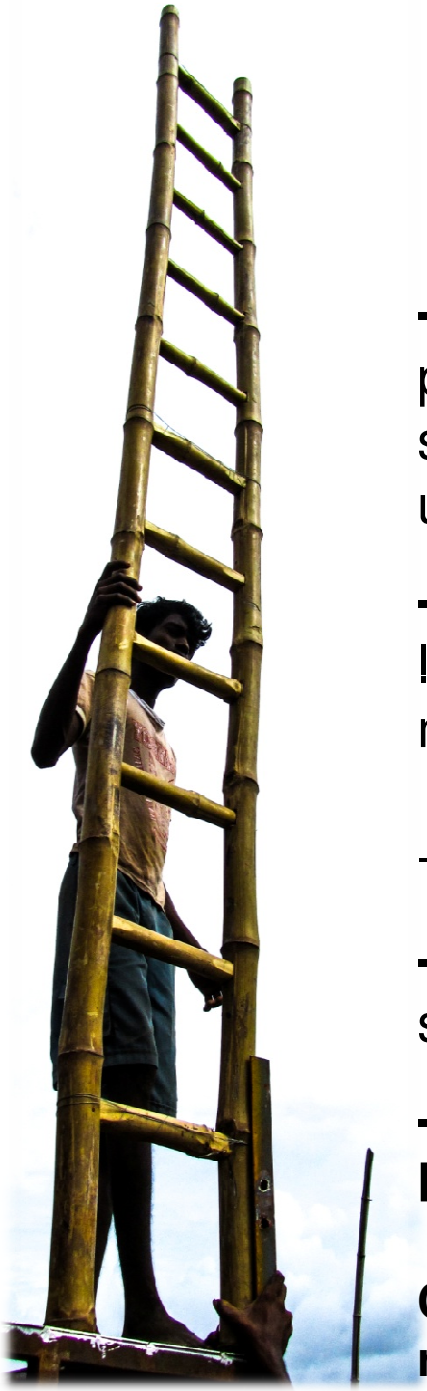
Star rating of buildings and appliances

National Habitat Standard Mission: Acknowledges Building energy consumption increasing from a low of 14% in 1970 to 33% in 2004-05. That mandatory ECBC can save 1.7 billion units of electricity per year….

National Habitat Standards: In the making to guide action in cities

National building code adding a chapter on sustainability

Environment Impact Assessment (EIA)……



Change the practice……

-- **Scalability**: Not to have a small number of high performance sustainable buildings, but to raise the sustainability of the entire stock of buildings in active use.

-- **Effective reduction in new stock**: Ensure much larger aggregate savings. Need low cost energy saving measures. Do not lock-in resource guzzling by design

-- **Retrofit change -- existing stock**

-- **Improve performance of appliances** to maximise savings.

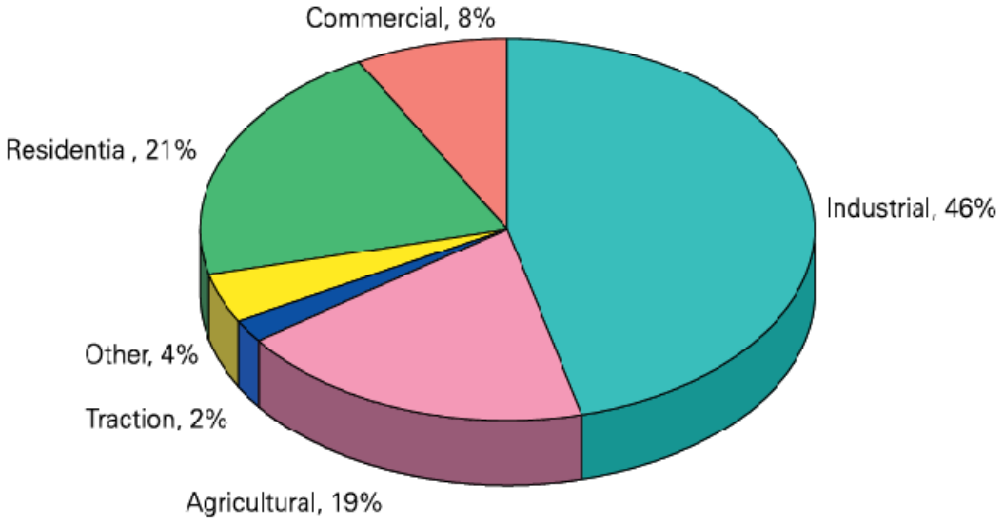
-- **India has a large stock of very low-energy homes:** Leverage this for better energy targets.

Challenge of bringing all interventions under one unified regulations. This requires more harmonized action

Energy prudence….

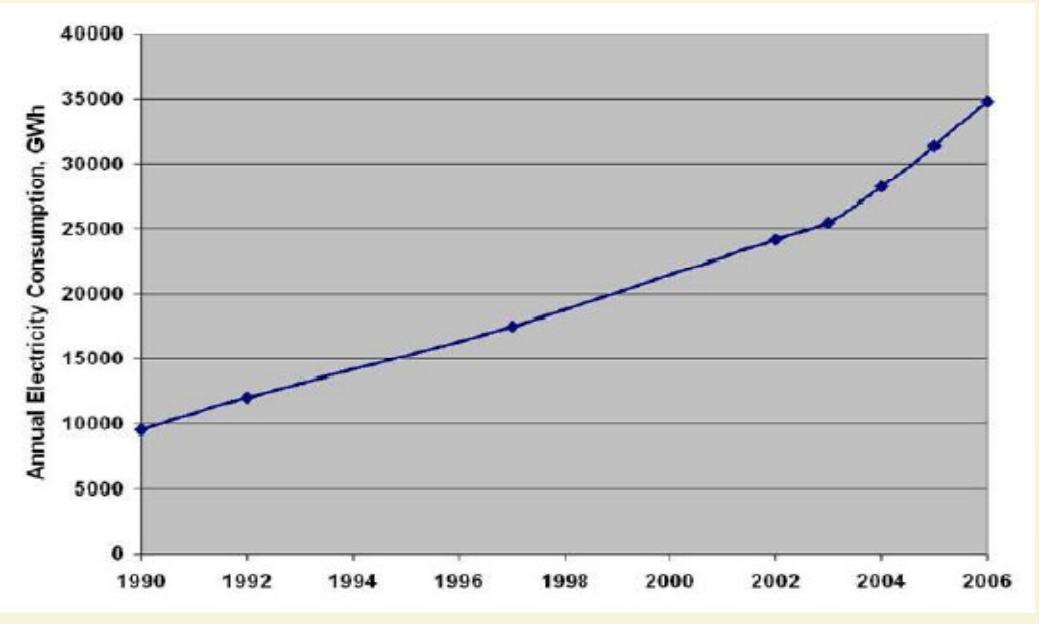
New growth delinked from local climatic advantages

Case of energy efficiency in buildings….



Residential sector consume nearly the highest

Electricity Use in the Commercial Sector is exploding. climatic zone-wise and building-use-wise



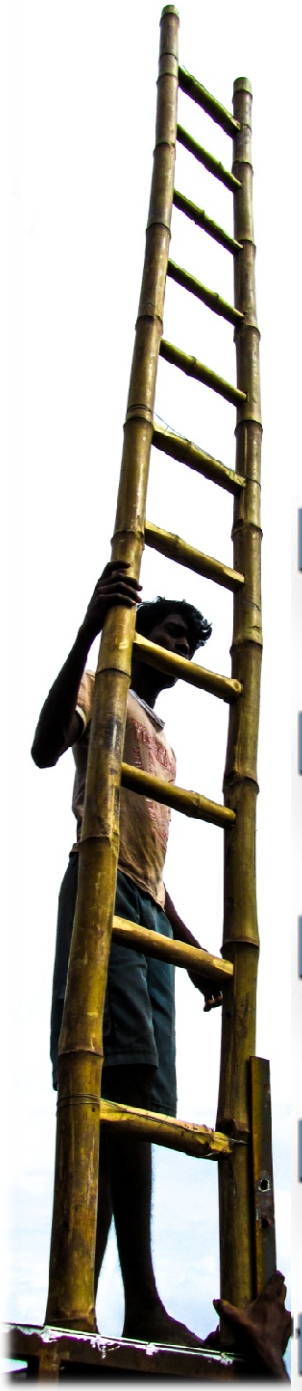
A shot in the dark…….
What is ECBC targeting to achieve?

According to BEE:

An average commercial building in India has electricity consumption of 180-200 EPI. ECBC compliance can bring this down by 20 to 25 per cent. An ECBC compliant building will be 3-star on BEE's building star rating scale.

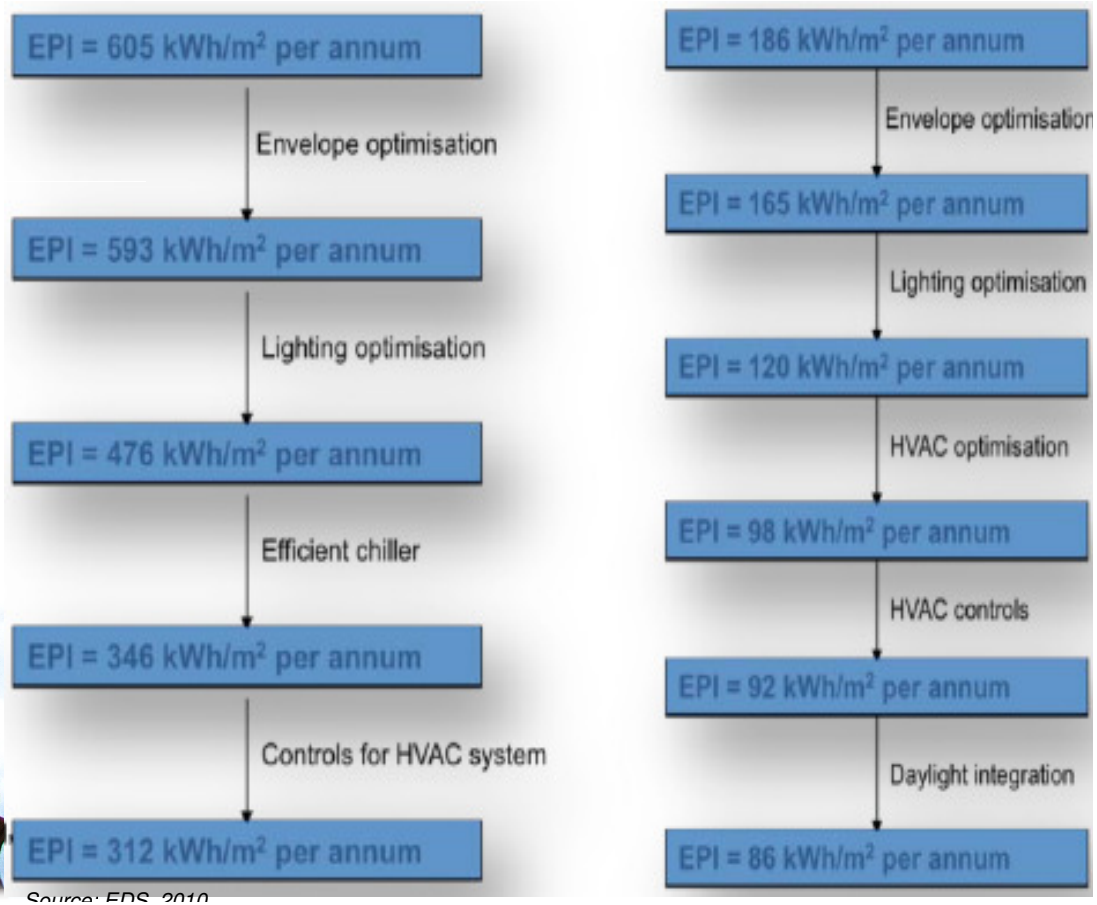
But not supported by survey or monitoring. There is no data on record of number of buildings that have voluntarily implemented ECBC.

Buildings rated by IGBC and GRIHA green building rating systems claim to comply with ECBC but little information in public domain or with BEE.



Building code: A beginning

Impact of energy efficiency measures on the EPI of commercial buildings (office and hospital buildings)

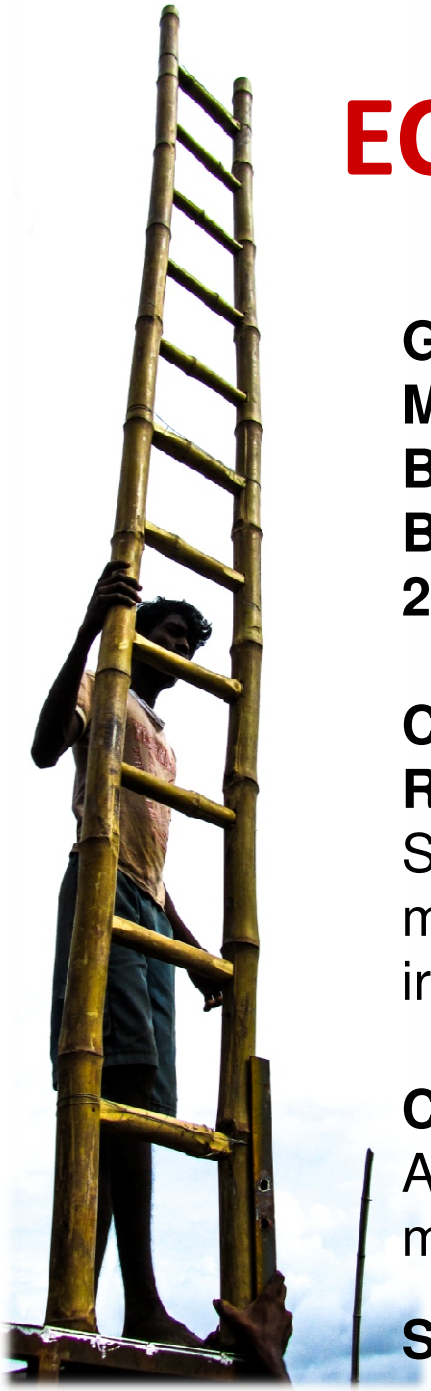


Source: EDS, 2010

Energy Conservation Building Code – for five climatic zones

All commerical buildings with connected electricity load of 100 kW or contract demand of 120 KVA covered by ECBC.

The energy audits of buildings by the BEE shows that existing buildings have 30 to 50 percent energy savings potential.



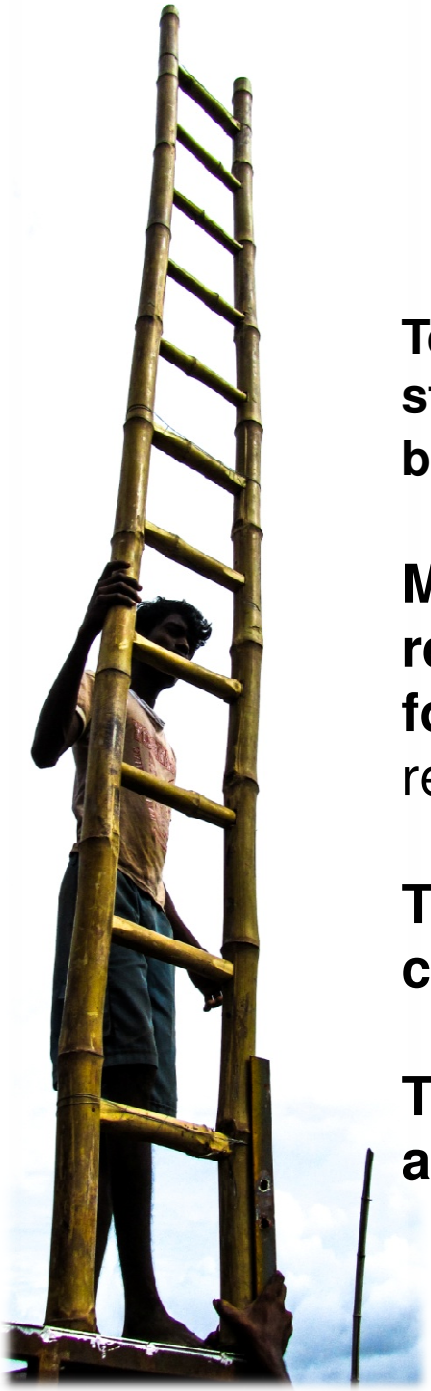
ECBC in Andhra Pradesh

GOVERNMENT OF ANDHRA PRADESH ABSTRACT MA&UD Department – Adoption of Energy Conservation Building Code (ECBC) – Amendment to Andhra Pradesh Building Rules, 2012 – Notification – Issued. Dated: 28.01.2014 Read the following

Code applicable to commercial buildings and other Non Residential Buildings with plot area of more than 1000 Square Meters or built up area of 2000 Sqm; Also multiplexes, Hospitals, Hotels, Convention Centers irrespective of their built up area.

Code mandatory for all new buildings, -- to comply with AP ONE STAR with prescriptive/whole building performance method of compliance for the buildings.

Star rated based on level of energy savings



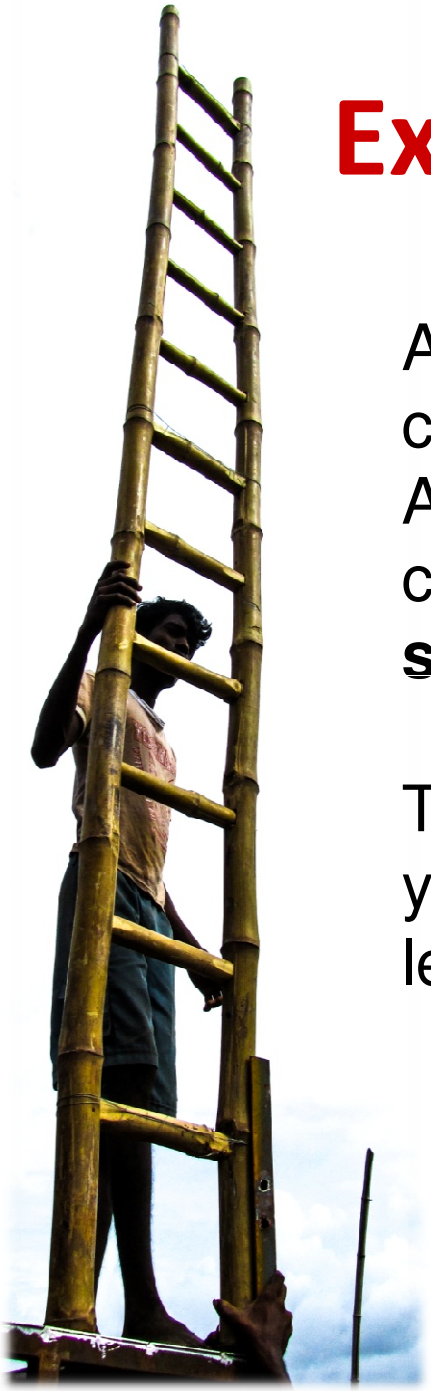
ECBC in Telengana

Telangana is developing an online building approval system to streamline the process for owners and builders, and fast track building approvals

MAUD Technical Committee in Telangana State have reviewed and examined the existing building approval forms to identify and integrate ECBC compliance requirements.

The online system is being fine tuned to integrate ECBC compliance provisions in a seamless manner.

The online system to be replicated in local bodies across the state to scale up ECBC implementation.



Expected energy savings

A study by NRDC and ASCI shows that minimal code compliance by commercial buildings in Andhra Pradesh (40% complying with the ECBC..) can be **86 terawatt hours of cumulative energy saved by 2030**

This can power 8.9 million Indian households per year over the next 17 years based on the current level of annual energy consumption.

ECBC approaches

Prescriptive Method: Minimum thermal or performance values prescribed for every component of the building

Some mandatory requirements

Whole Building Performance Method: Computer simulation programs that with the exception of the mandatory requirements, assess the rest for the performance of the entire and not individual components.

This assumes buildings are both cooled and heated.

Buildings without HVAC system will use passive architecture and need this assessment for compliance.

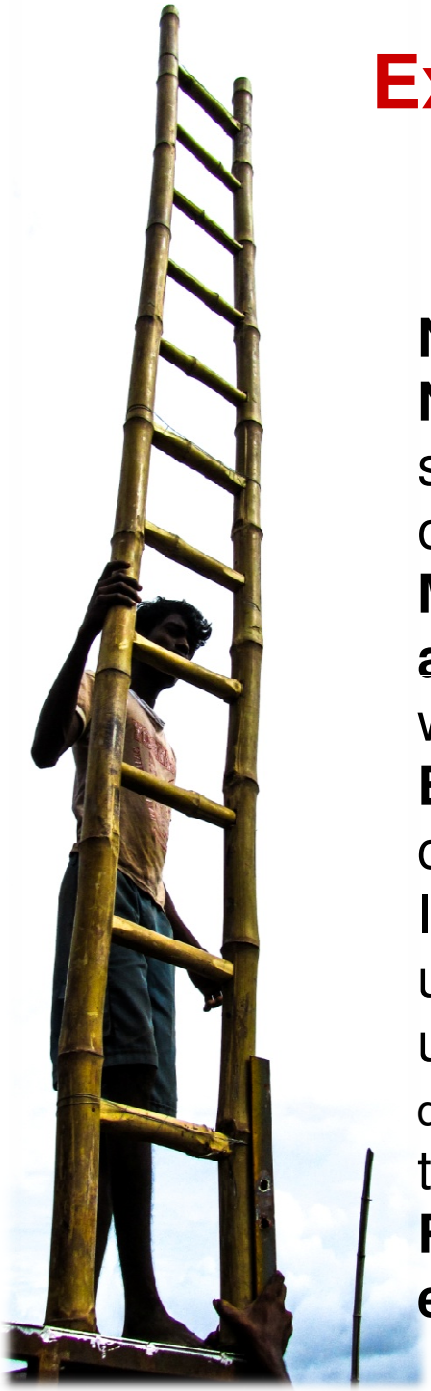
EPI calculation game

The Energy Conservation Act: Energy per square meter of area and location of buildings

Star Rating of Buildings: Considers all energy purchased and generated through out the area. But excludes basement that is assumed to be a low energy area

GRIHA excludes internal equipment energy load from annual energy consumption and includes basement area of parking in the total built up area. Equipment is considered end user behaviour that should not be included in the design of the building

Different methods give different EPI value for the same building with basement



Expectation of personal comfort to change significantly….

Notion of comfort to alter design and use buildings.
NBC defines thermal comfort in tropical India – as somewhere between 25 degree C and 30 degree C with the optimum condition at 27 degree C. Plus other criteria
Mechanical cooling and heating technologies that artificially control temperature and humidity inside buildings will change this significantly.
Energy budget is already upset with only three percent air conditioner penetration in urban households.
In air conditioned building operation and use of buildings use up maximum energy – as much as 84% of total energy use in buildings. (2010 World Business Council for Sustainable development estimates) In non-air conditioned buildings material take the largest share.
Regulations focus on electricity efficiency and not energy efficiency.

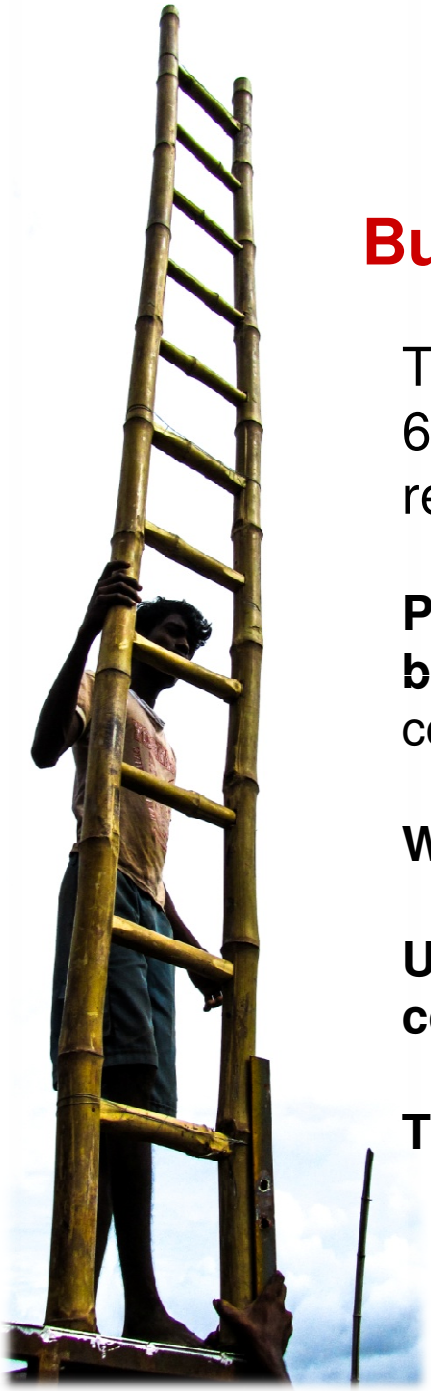
Challenge of the AC paradigm…..

ECBC standards are designed assuming that 100% of India's commercial building stock will be fully air conditioned requiring both cooling and heating.

Code sets norms for level of heat transfer through the building envelop; Sets energy performance standards for heating, cooling etc

High performance buildings will require good insulation. Poorly insulated buildings severely affect the efficiency of air conditioning units, cause high energy losses.

Needs high performance insulation products: Code has fixed high insulating capability norm to ensure rapid uptake of high performance insulating material in air conditioned buildings.



But why should we assume 100% AC?

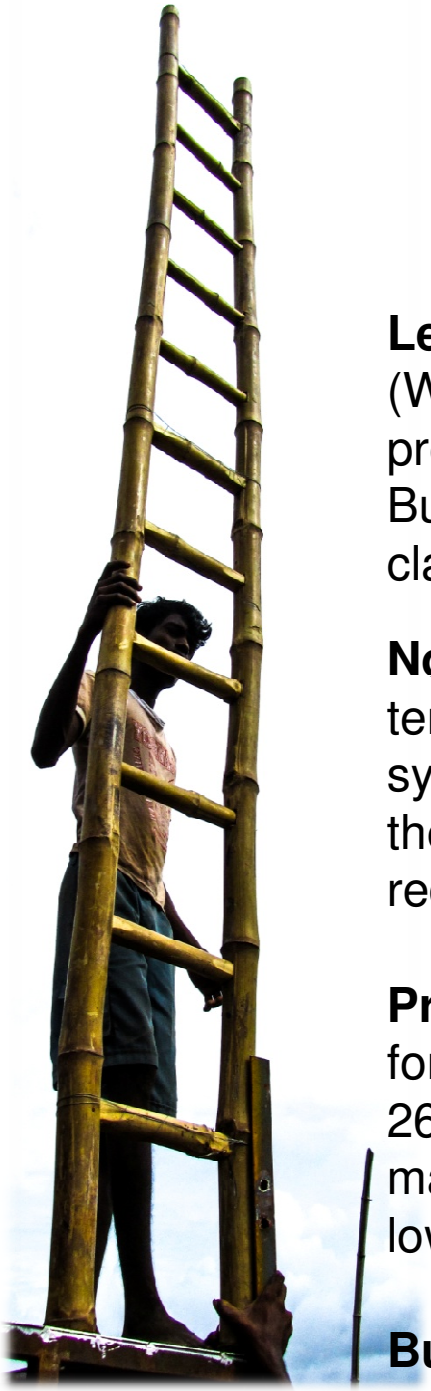
The commercial floor space is forecasted to become only 60% air conditioned by 2030 (McKinsey). Most of our residential buildings are not air conditioned.

Prescriptive requirements are relevant only for air conditioned building. Therefore, mandates performance of individual components

Whole building performance method allows flexibility. But….

Under ECBC it is not possible to simulate partially or completely unconditioned spaces in buildings or buildings

There is no thermostat setting



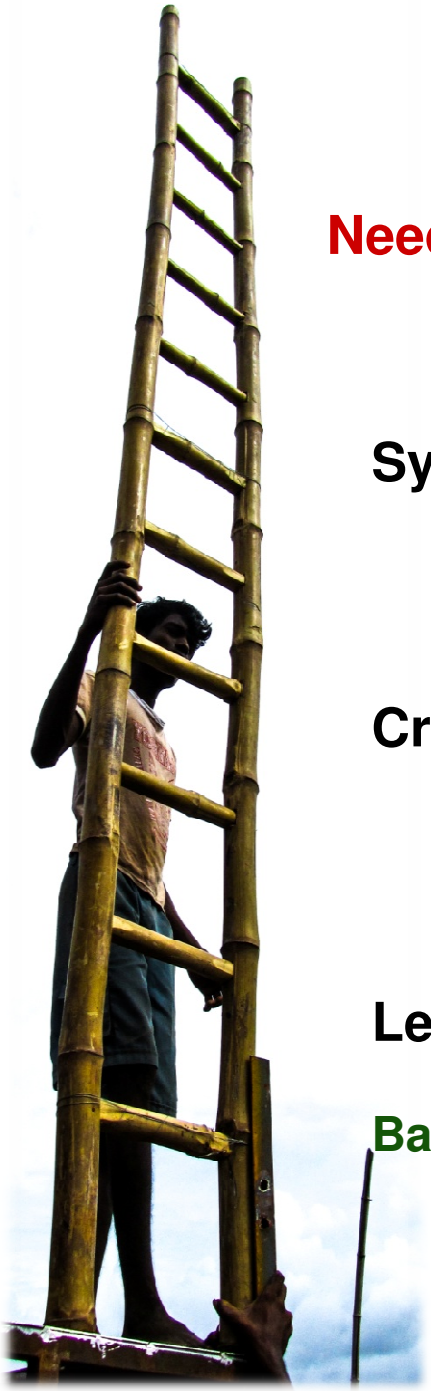
What ails ECBC?

Legalise very high glass use: ECBC caps the window-to-wall ratio (WWR), the glazed portion of building envelop,at 60 per cent in the prescriptive approach, irrespective of climatic zone. The Whole Building Performance method has no such cap as the concerned clause is not mandatory.

No temperature setting for HVAC system: Lower set point temperature has direct bearing on energy consumption of an HVAC system. Test results by Tokyo Electric Power Co indicate that raising the AC's thermostat from 26 to 28°C and using an electric fan can reduce electricity consumption by up to 22 per cent.

Proactive approach in other countries: South Korea and Japan forbid commercial units to reduce their temperature settings below 26 and 28°C respectively. After Fukushima Japanese government mandated all ACs in the country not to run at temperature settings lower than 28°C.Sri Lanka has fixed this at 25°C.

Bush Shirt Rule in Japan



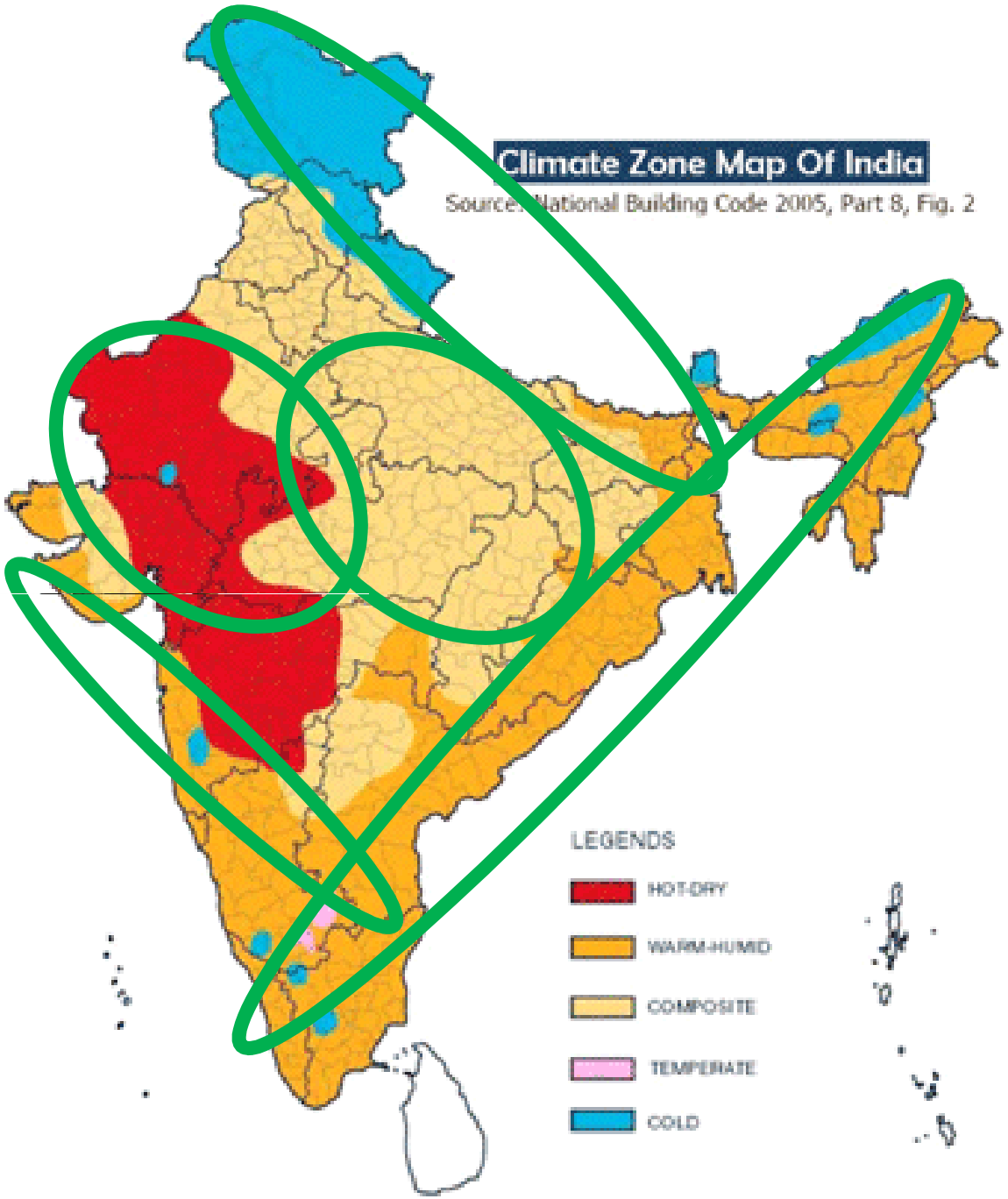
Need focus on total energy performance ….

System approach for thermal comfort -- using natural and passive cooling methods. – orientation, sun shades, ventilation, insulation for cool and comfortable structures. Ceiling fans for low energy cooling

Creative passive cooling designs and methods. to reduce to solar heat gain. Innovative/alternative designs -- filler slabs, double roofs, cavity/filler walls, composite walls, shading and many others.

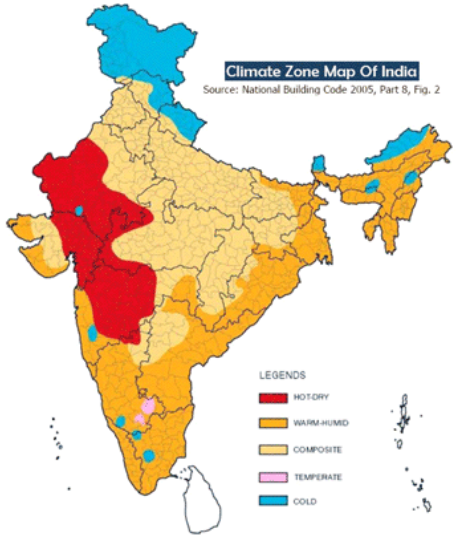
Let many methods and material bloom:

Balance high cost with low cost technology



Designing for 5 climatic zones.....

What is this paradigm? Five climatic zone and yet climate insensitive…..

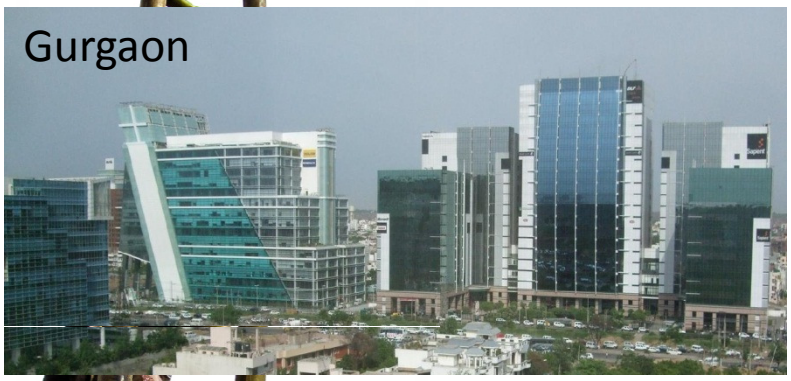


Chandigarh

Mumbai

Kolkatta

Gurgaon



Noida

Chennai

Bangalore

Where does this belong?

Where does this belong?

Shillong

Gauhwati

Gauhwati

Agartala

Northeast!!!!…

Dazzled by Glass .....

RMZ Millenia Business Park, Chennai
Source: www.flickr.com

Uses.... sense of open space. Allows natural light. Keeps dust away…Reduces the need for artificial light; aesthetics etc

But..... Traps heat… the principle of greenhouse. Increase energy use for cooling.

Why so much glass in tropical climate of India that needs to control heat gain and high glare.
Eg. Delhi receives 2,688 hours of sunlight annually London only 1,480 hours.

Glass environmentally harmful. Unsafe, fire hazard

Yet… legal sanction for very high usage of glass.....

Mumbai – Glazed

Glass houses in this region

Wipro technologies, Vizag

HSBC GSC, Hyderabad

Locally we built differently...

Mr. Krishan Prakash Residence

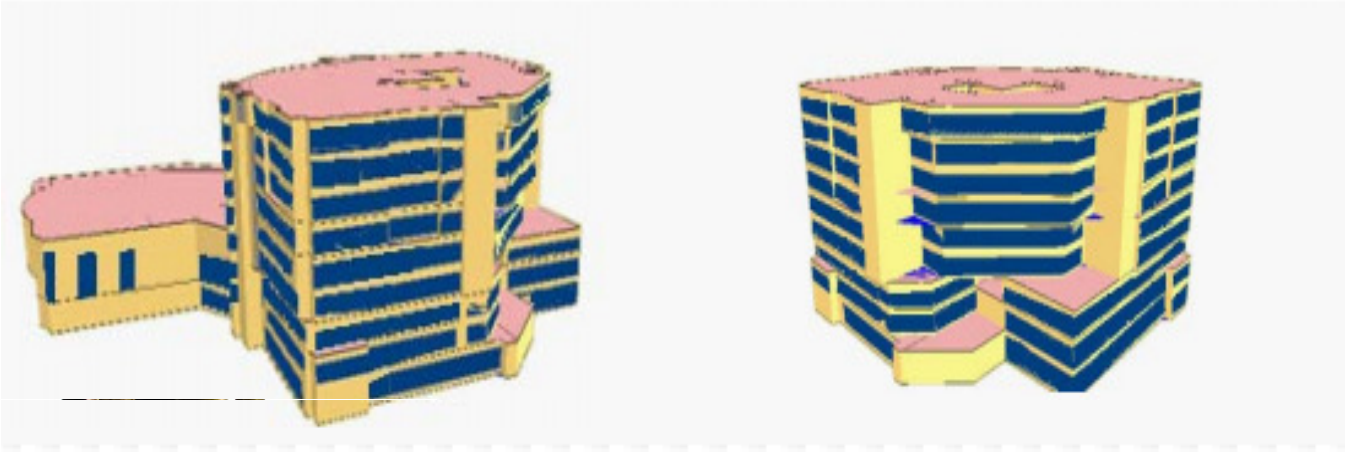
Ask why?

Anna Centenary Library Building

Chennai -- Air tight glass building in hot and humid climate of Chennai

Why?.....?

Ask why?



Electrical Use Summary

Alternative	Lights	Equipment	Cooling	Tower/Heat Reject.	Pumps/Aux.	Fans	Total
Electrical End-use Totals (kWh)							
Base Case	2,243,820	132,491	1,401,766	471,594	45,991	315,098	4,610,760
Proposed Case	1,141,850	132,491	1,801,046	0	26,631	201,021	3,303,039
Incremental Electrical Savings (kWh)			(compared with previous alternative, negative savings represent increases)				
Proposed Case	1,101,970	0	-399,280	471,594	19,360	114,077	1,307,721

-399,280 kWh

Source: LEAD Consultancy & Engineering Services (India) Private Limited (LCES)

Even the consultant point out in their report the power consumed for cooling the building is more than a conventional building.

Why so much glass?

Ignoring local wisdom

Dakshinachitra

Chettinad Houses of Tamil Nadu

For hot-humid climate

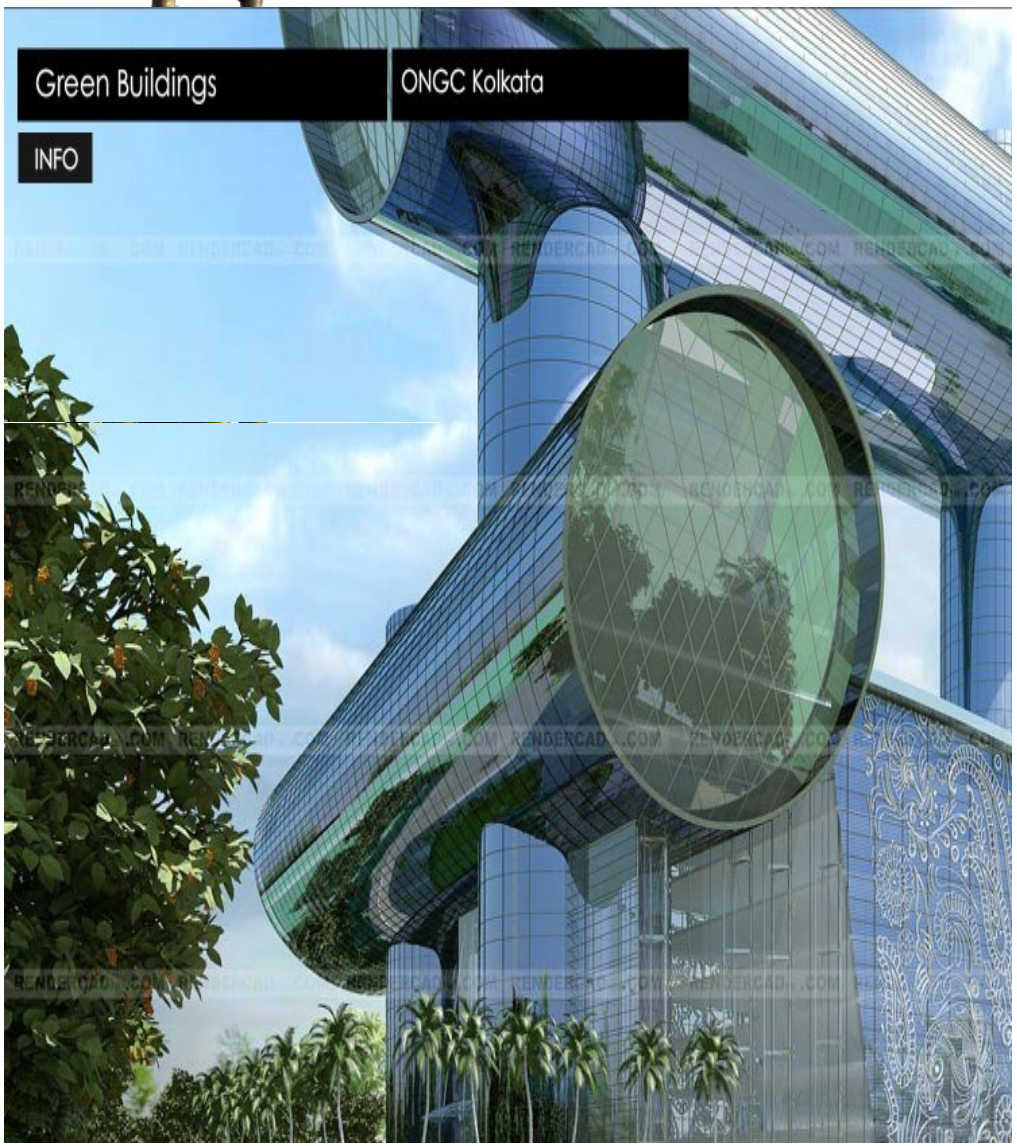
SOLAR ACCESS: Solar radiation is helpful in January and February. Other months -- only wind can give comfort.

VENTILATION -- A deep arcaded area is a transition space ….Provide shade and also ventilation

Allow summer breezes to ventilate and cool…... Windows designed to provide shade from south sun but allow southern breezes.

Need local science for strong modern identity

Ask why?



Kolkata: Air tight glass building in hot and humid climate

Why?.....?

ONGC Green Building
AA II, New Town Kolkata

Eastern region's own wisdom

Courtyard Houses in East

For hot-humid climate of the region

SOLAR ACCESS: Solar radiation is helpful in January and February. Other months -- only wind can give comfort.

VENTILATION -- A deep arcaded area is a transition space ….Provide shade and also ventilation

Allow summer breezes to ventilate and cool…... Windows designed to provide shade from south sun but allow southern breezes. (Source N Das)

Need local science for strong modern identity

Tell why?

Kolkata Museum of Modern Art
(Herzog & de Meuron)

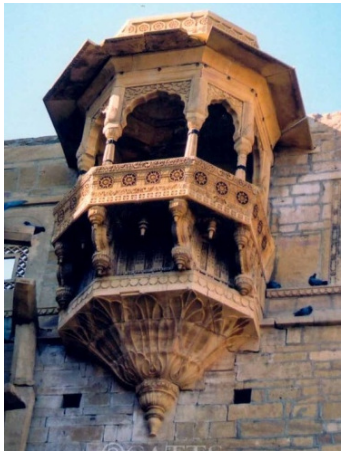
It provides the logic……..

"-- Kolkata has a tropical wet and dry climate, experiencing hot and humid summers and high levels of precipitation…...

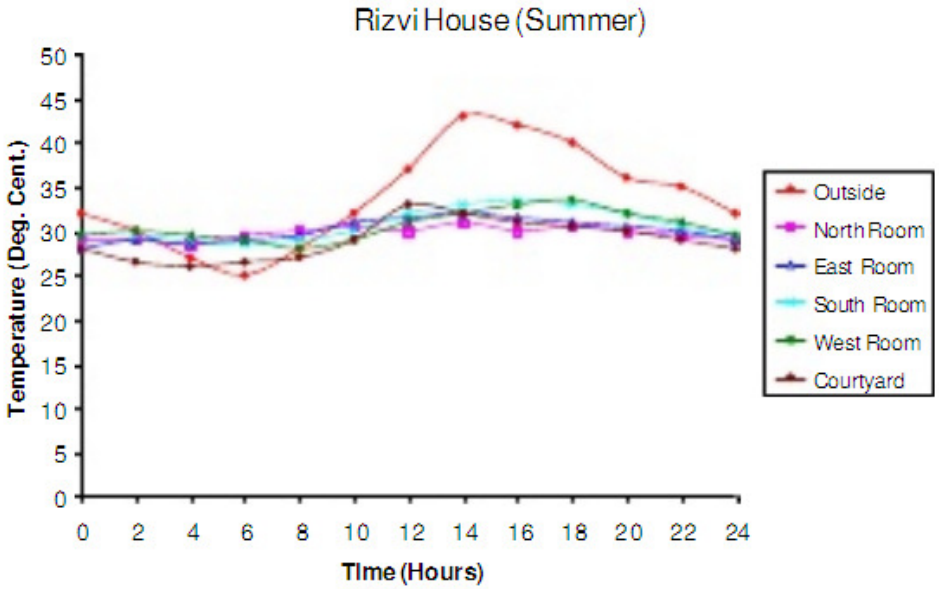
-- This uses **passive methods** where feasible **to control the climate in and around the building**,

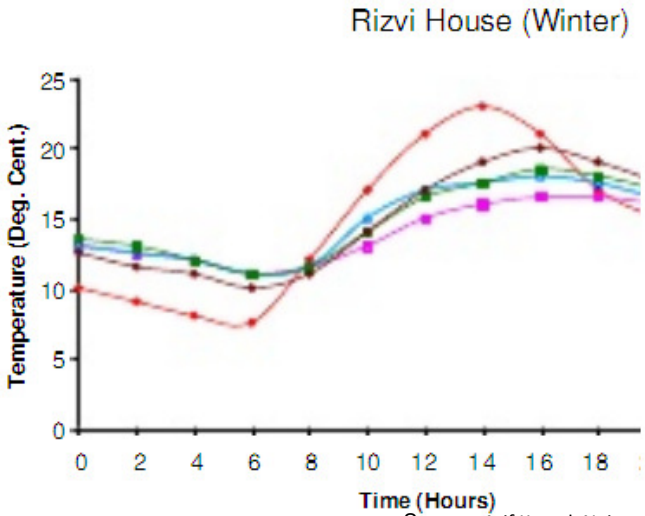
-- The urban scale spaces are shaded and **offer natural cross ventilation through careful planning**….
etc……"

Rizvi house Lucknow



-NE-SW orientation. -Openings and the entrance windward side-Absence of the openings on exterior surfaces facing southeast and southwest.-Main entrance opens into the narrow shaded street inducing cool air from the street.
-Courtyard with shaded spaces and ventilation. -Projection of the courtyard provides shade -The *jharokhas* catch wind and allow air circulation. -Massive walls and heavy roofs offer greater thermal resistance and increase the time lag. Etc etc





Source: Arif Kamal, Najamuddin. 2011

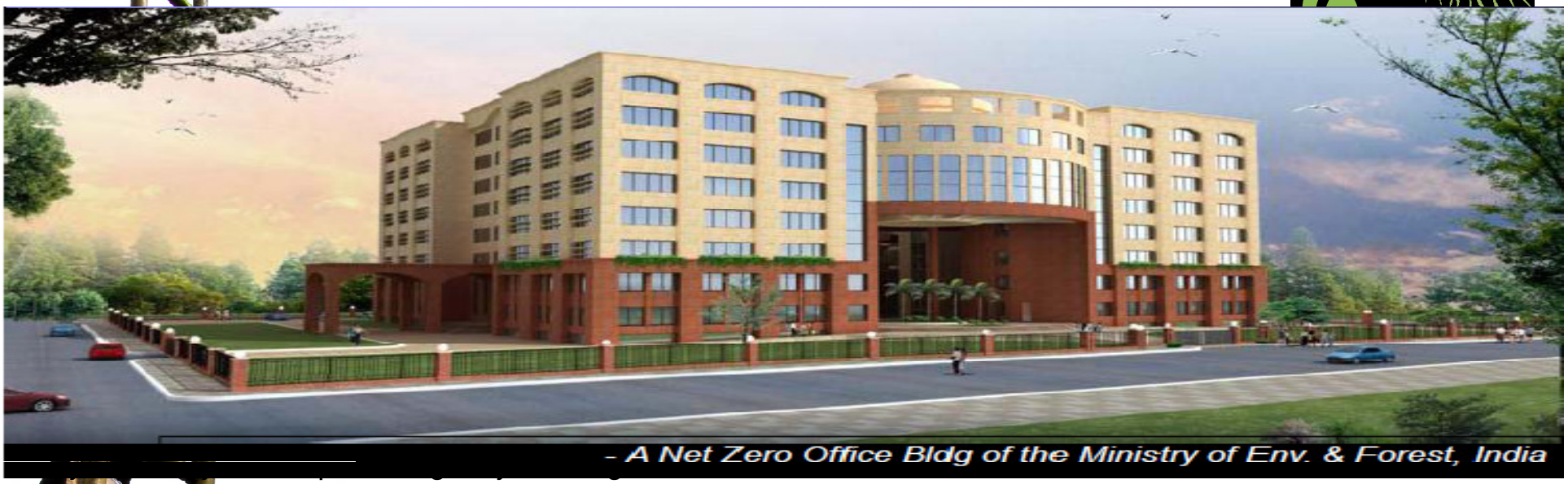
Drawing lessons from our local wisdom

Create opportunities for – more creative use of building orientation, positioning of interior spaces according to direction, variation in glazed area according to orientation of façade, combination of appropriate building material etc

First commercial radiant cooled building, - Infosys Software Development Building

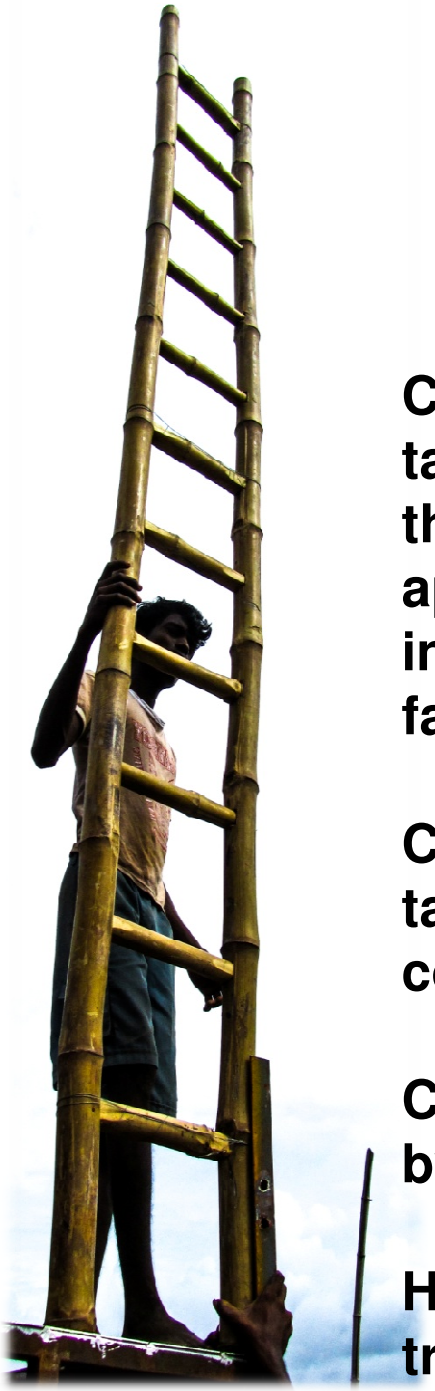
Source: NRDC

Green building Suzlon One Earth



Model building design that helps save energy and money by leveraging sun's movement

Shell roof and the 25 kWp solar photovoltaic plant



ECBC cannot work in isolation. Policy question -- Can we have energy performance targets?

Can all/large new buildings have energy performance targets? Otherwise ECBC approach of "design better than the unique base model which is worse" approach can shift market towards higher energy intensities. It is possible to be compliant at a level far worse than the national average EPI…….

Can targeted buildings be energy positive by a targeted date, -- generate more energy than they consume?

Can existing buildings reduce energy consumption by certain percentage by a targeted date?

How will ECBC help to make the second phase of transition?

TABLE 1: ELECTRICITY CONSUMPTION INTENSITIES BY END USE FOR COMMERCIAL BUILDINGS IN USA, 2003

The US is setting holistic targets for overall energy reduction from the sector

Building type	National average EPI (kWh/sq m/year)
Office	186
Public assembly	134
Public order and safety	165
Religious worship	52
Service	118
Warehouse and storage	82
Other	242
Vacant	26
Education	119
Food sales	532
Food service	413
Health care	247
Inpatient	296
Outpatient	174
Lodging	145
Mercantile	207
Retail (other than malls)	154
Enclosed and strip malls	240

Note: 1,000 Btu / square foot = 3.1546 kWh / sq m
Source: Energy Information Administration 2003, *Commercial Buildings Energy Consumption Survey: Energy End-Use Consumption Tables,* released in September 2008

Global learning curve…..

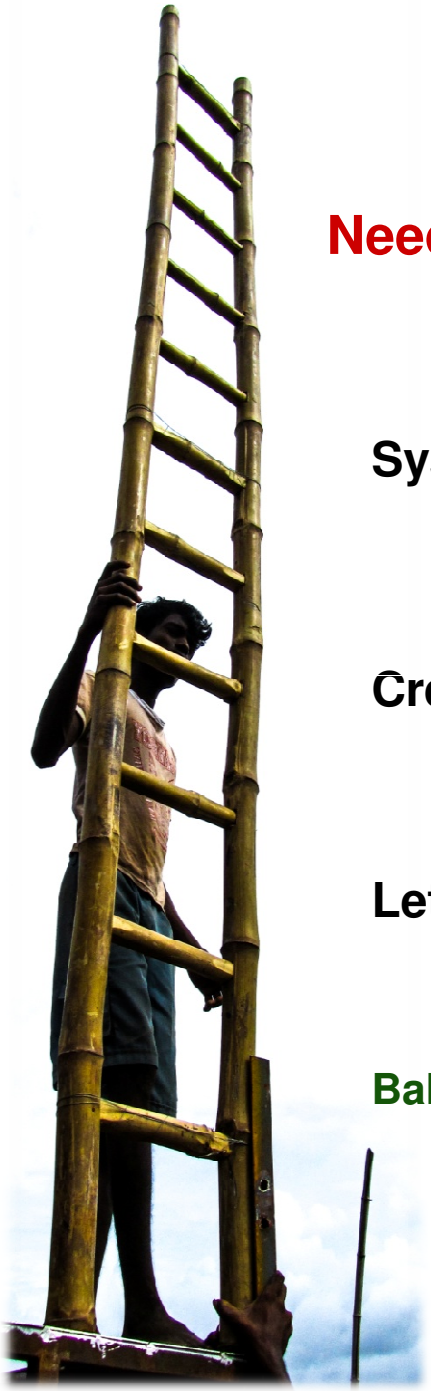
Other governments are working with clear targets for the sector to guide action.

The US: Energy Independence and Security Act requires **all new and renovated buildings to reduce energy consumption by 55 per cent from 2005 baseline**. All new commercial buildings to be zero net energy by 2025 and existing by 2050.

Legally binding benchmarking and discloser of annual energy and water consumption data to public (Austin, Washington, San Francisco, Boston)

Average level of electricity consumption has been developed for different building typologies. Without it the average baseline for the nation will continue to worsen overtime.

Several European cities and the state of Massachusettes Green Communties Act in the US – **Require communities to establish their benchmarking baseline and use it as a starting point for a five year plan to reduce energy use by 20 per cent by 2020 to qualify for state funding for energy projects.**



Need focus on total energy performance ….

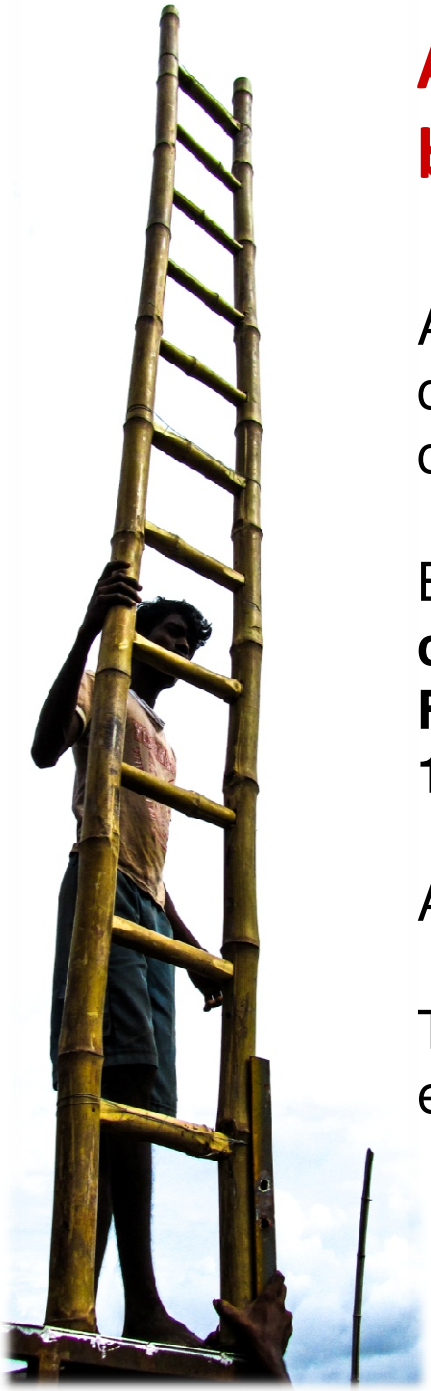
System approach for thermal comfort -- using natural and passive cooling methods. – orientation, sun shades, ventilation, insulation for cool and comfortable structures. Ceiling fans for low energy cooling

Creative passive cooling designs and methods. to reduce to solar heat gain. Innovative/alternative designs -- filler slabs, double roofs, cavity/filler walls, composite walls, shading and many others.

Let many methods and material bloom: autoclaved aerated concrete (AAC) blocks, hollow blocks, thermocrete or other building materials with inherent higher R-values can also improve buildings' insulation….. etc

Balance high cost with low cost technology

Appliances and behaviour ……..



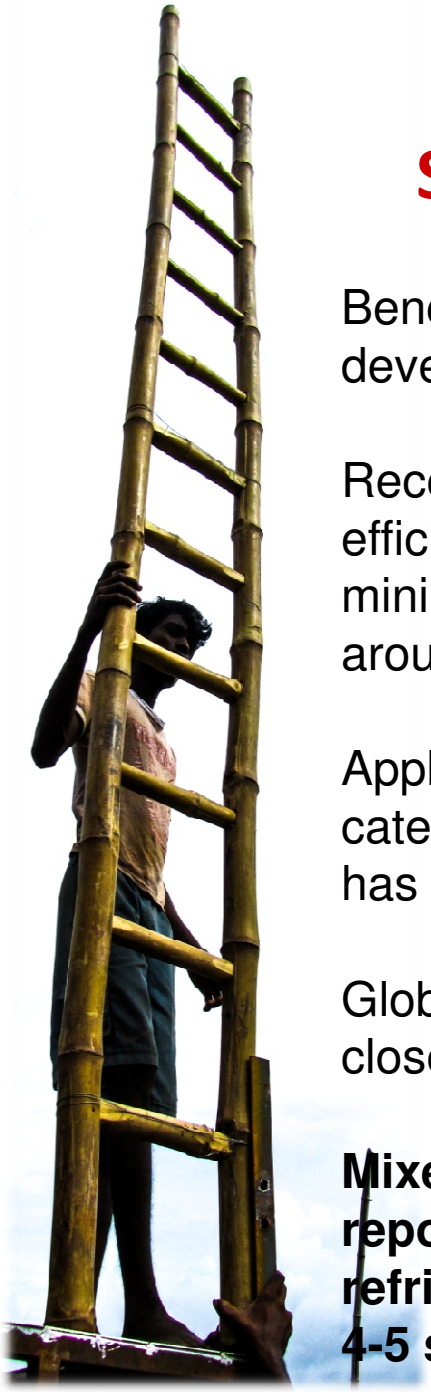
Appliance will drive energy budget of households

Appliance penetration in Indian households is comparatively lower than the global scale. This will change dramatically.

BEE – **Lighting and AC use up 80% of the energy in a commercial building.**
Fans use up 34%, lighting 28%, and refrigerators 13%of the total electricity in a typical household.

AC market is still small but growing at 20 per cent a year.

The challenge is to push appliance market towards super efficient technologies.



Star labelling: Weak benchmark

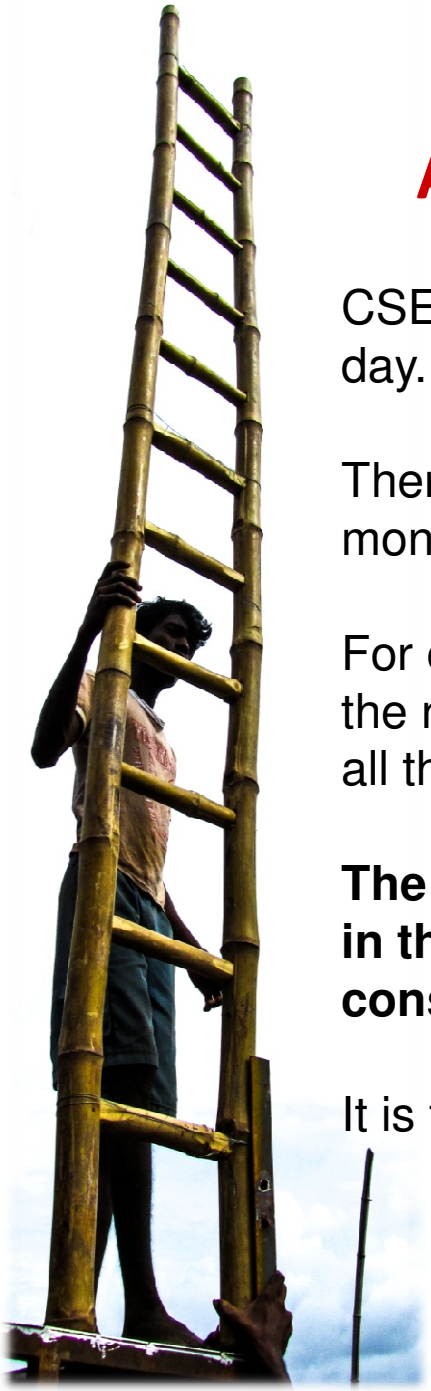
Benchmark not stringent enough to accelerate technology development.

Recent revision of AC star rating in 2014 has brought the minimum efficiency standard for AC in India almost at par with the international minimum standards. With the national average efficiency ratio of around 2.9 our overall efficiency is among the lowest

Appliance maker are mostly global players and have the technology to cater to markets with higher benchmark. Costs of appliances in India has reduced.

Global level better testing methods to bring energy efficiency values closer to real world performance in the world.

Mixed trend in the market: National Productivity Council 2010 report -- almost 90 per cent of purchases of labeled frost free refrigerators in 2009-10 were 4-5 star. But only 14% of room ACs 4-5 star.



AC upset energy budget

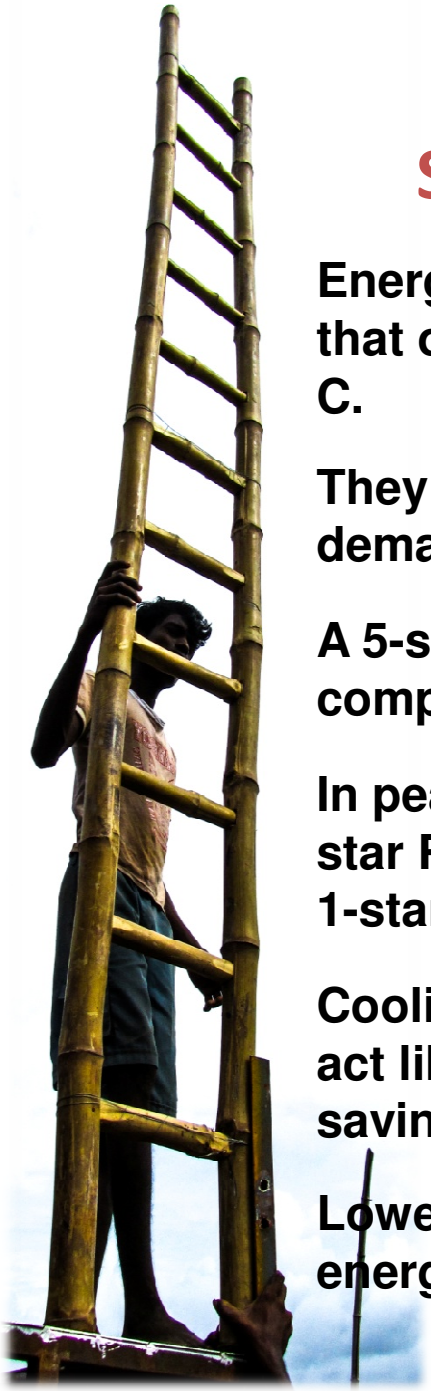
CSE has analysed the trend in demand for electricity during night and day.

There is barely any difference between night and day peak during the month of May.

For example, on May 24, while the day peak demand was 4667 MW the night peak demand was higher - 5091 MW. Such trend is evident all through the month of May.

The night demand is either higher or has a very small difference in the range of 1-4 percent. Yet at midnight all commercial consumers – offices and retails are shut.

It is the air conditioners in homes that skew the demand at night.



Stunning results from CSE's lab tests:

Energy efficiency of a 5 star room air conditioner is worse than that of a 1star room AC when external temperature is 45 degree C.

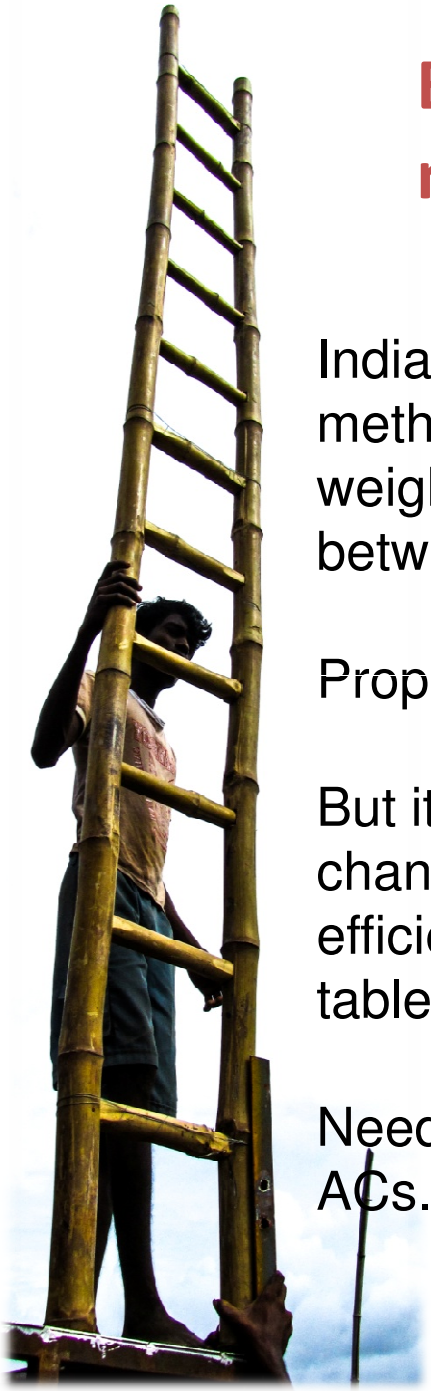
They consume 17-28% more power, spiking the peak load demand on the electricity grid.

A 5-star room AC is supposed to save 20-22% of energy cost compared to a 1-star RAC.

In peak summer when temperature crosses 45 deg C mark the 5-star RAC can consume 5-25 % more than the rated capacity of a 1-star RAC.

Cooling capacity drops by 30-40%, which means a 1.5 ton AC will act like a 1 ton AC. Thus there is neither cooling nor energy saving benefits - if one is running the AC at 27 degree C setting.

Lowering of the internal temperature can further worsen its energy efficiency performance.



BEE proposing to change AC testing method

Indian Seasonal Energy Efficiency Ratio (ISEER) star rating methodology for variable speed inverter AC is based on a weighted average of the performance at outside temperatures between 24 and 43 degree C.

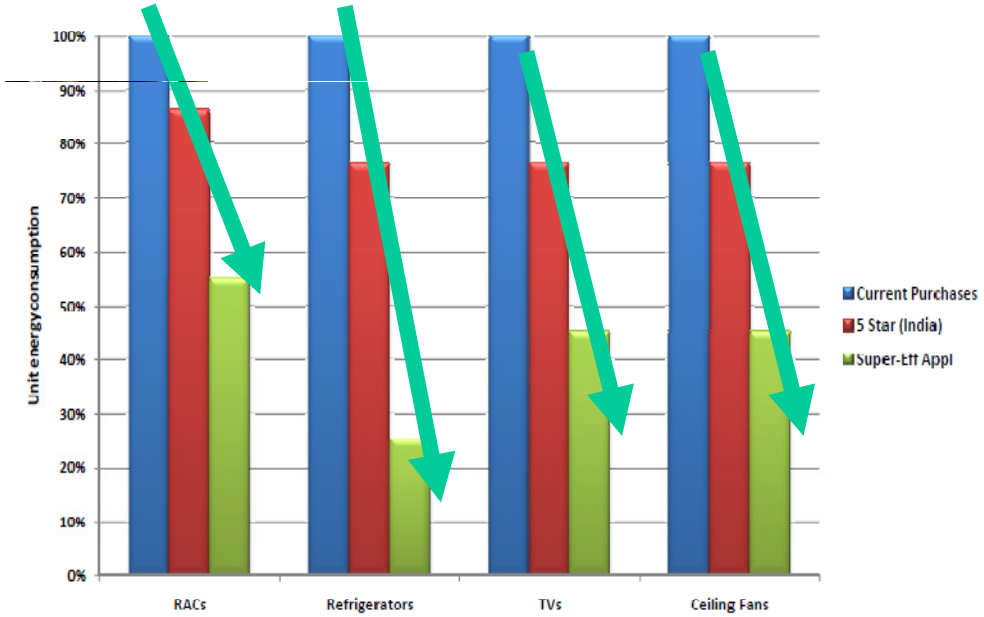
Proposal to merge this with fixed speed AC in 2018.

But it is not clear if the testing methods for fixed ACS will change or it will remain the same and based on energy efficiency ratio the SEER will be declared to make star rating table common for all.

Need urgent intervention to notify new testing methods for fixed ACs.

Improve benchmark to super efficiency level

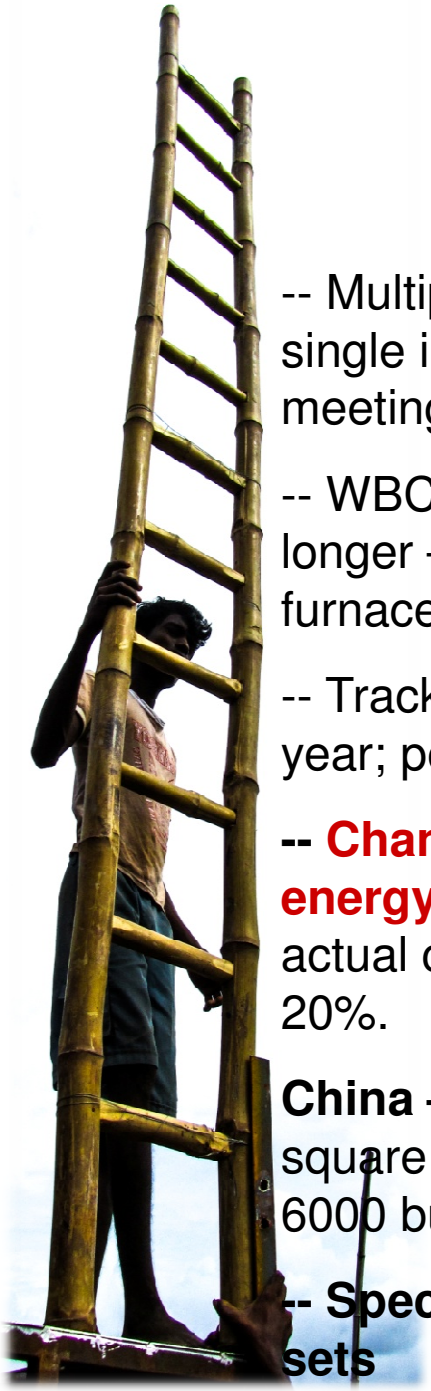
Comparison of Consumption of Current Purchases and Highest Rated in India with Best World-Wide



Large gap between average current purchase and highest rated model (5-Star), and even larger gap between highest rated and best commercially available world-wide.

BEE needs to expand its super efficient equipment programme (SEEP) to all products…..

Now applied only to fans.



But….. Energy losses from rebound effect. **Need policies to influence behaviour –**

-- Multiple ownership of efficient appliances use more energy than a single inefficient one ; -- Retailers increase lighting use even after meeting specifications -- total energy use increases

-- WBCD Study – If use of efficient lights increase by leaving them on longer – may lose up to 12% of the expected energy savings. Efficient furnace lose up to 30% because people raise the thermostat.

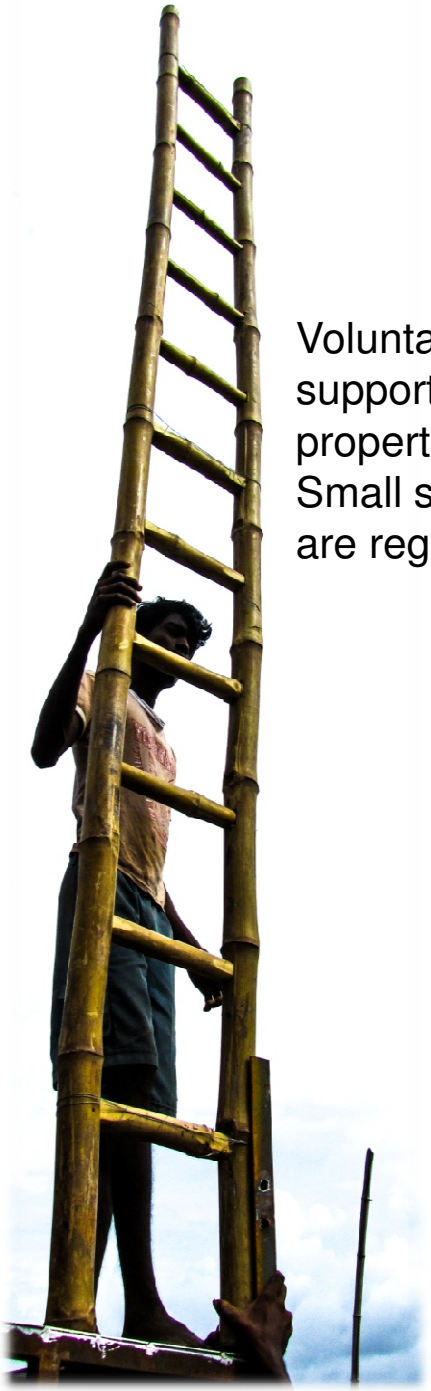
-- Track consumption through absolute total usage; per person per year; per square meter per year etc.

-- Change billing practices to make users pay specifically for the energy used. --- Global studies show that when tenants are billed for actual consumption, energy use for heating typically drops by 10 to 20%.

China – Consumption based pricing and billing covers 317 million square of built up area; Public disclosure of energy consumption in 6000 buildings; energy database for 33,000 buildings… etc

-- Special challenge of captive power generation – Solar and gen sets

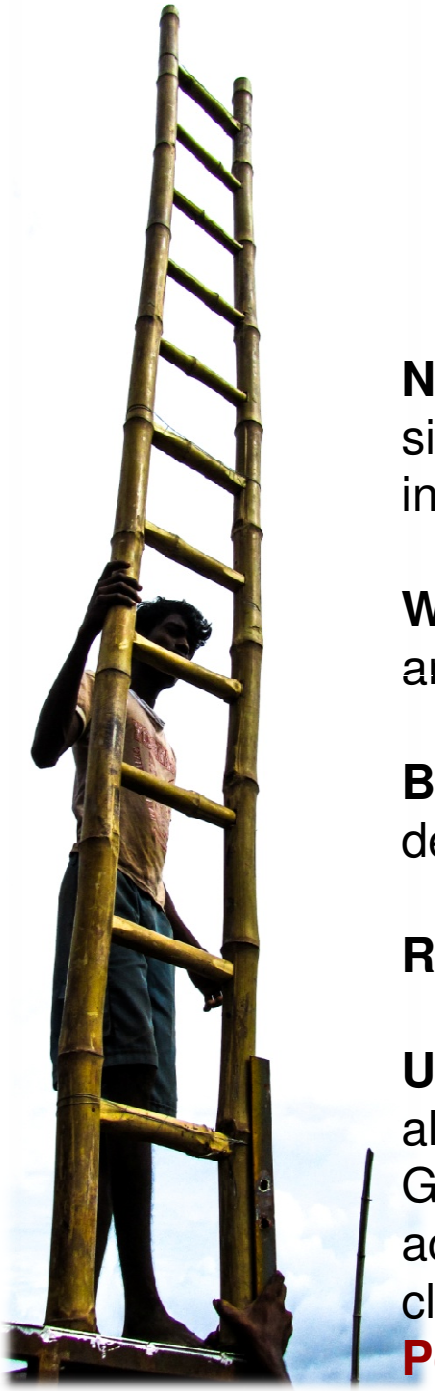
Green rating……..



Green rating of buildings

Voluntary green rating disseminates green building practices. Builds consumer support and awareness. Developers see 'reputation' advantage. This can influence property market. This can mainstream large number of green measures……. Small scale: Only 447 buildings fully rated by LEED and 4 by GRIHA. Most buildings are registered and in the process of rating.

Country	Rating system
United States	Leadership in Energy & Environmental Design (LEED-United States)
	The Green Globe Rating System
	Energy Star (United States Environment Protection Agency)
Canada	Leadership in Energy & Environmental Design — Canada (LEED-Canada)
Australia	Green Star
	Australia Greenhouse Building Rating (AGBR)
United Kingdom	Building Research Environment Assessment Method Consultancy (BREEAM)
Europe	European Environment Agency rating
Hong Kong	Building Environment Assessment Method- Hong Kong (HK-BEAM)
Japan (CASBEE)	Comprehensive Assessment System for Building Environment Efficiency
Taiwan	Ecology, Energy Saving, Waste Reduction and Health (EEWH) (Taiwan)
Singapore	BCA Green Mark
Philippine	Philippine Green Building Council
South Korea	Green Building Council (Korea)
India	GRIHA
	Indian Green Building Council



Incentive galore

NOIDA, UP: 5% extra FAR (extra built up area) to projects which sign up for green rating. 60% of all projects in NOIDA availing of this incentive. No official monitoring; no data

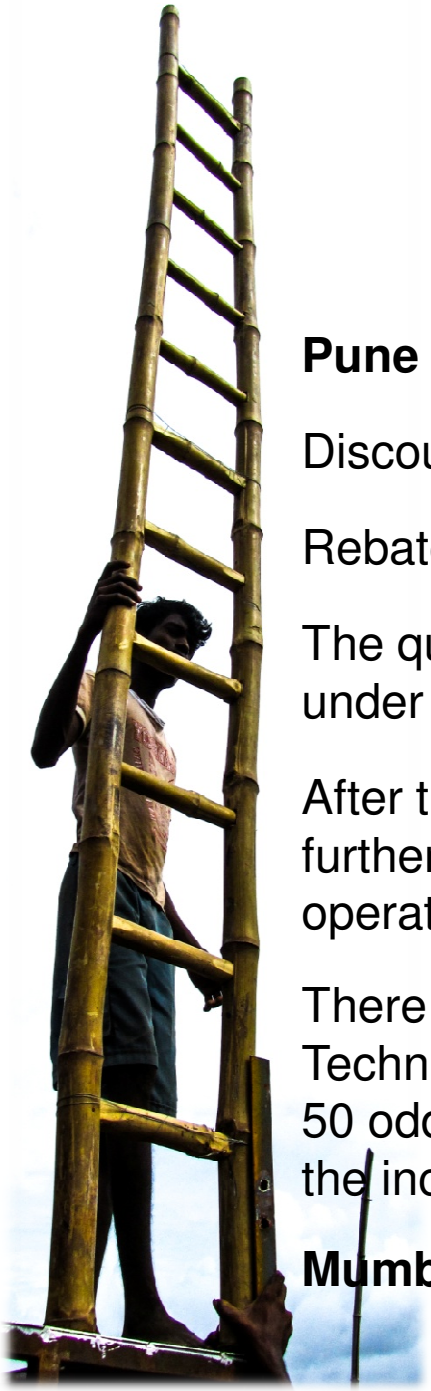
West Bengal notified 10 per cent extra FAR as incentive for GRIHA an IGBC rating. Weak penalty for non-compliance

Bhubaneswar grants extra 0.25 floor area ratio as an incentive to developers for ECBC compliance

Rajasthan: Allows 5% extra FAR for 4-5 star rated buildings etc.

Union Environment Ministry and several state governments allows fast track clearance to buildings that are pre-certified for GRIHA and LEED. There is no legal system to hold developer accountable completing rating or for performance for environmental clearance.

Policy interest in green rating has made the review necessary



Maharastra is different: Can do better

Pune and Pimpri Chinchwad

Discount on premium paid by the builders to municipality

Rebate on property tax paid by the owner of the green rated buildings.

The quantum of incentive is variable according to the number of stars under GRIHA rating. Even one and two star rating gets some incentive.

After the final rating is awarded based on the one year audit there is no further requirement of periodic audit after the building becomes operational.

There is no provision for penalty for underperforming.
Technically, GRIHA requires renewal of rating every five years. Though 50 odd builders have applied for incentives, only 2-3 builders have got the incentives.

Mumbai: No incentive. Developing green building code for all buildings

Opaque system. Difficult to assess impact

-- CSE has done review of publicly available information on rated buildings

-- Limited data on the performance of rated buildings. IGBC has started performance monitoring section on their website – provides annual electricity and eater consumption detail voluntarily disclosed by 50 rated buildings

GRIHA provides design description and projected savings of rated buildings. But not performance detail

None of the websites show the check list of points awarded. This is considered proprietory..

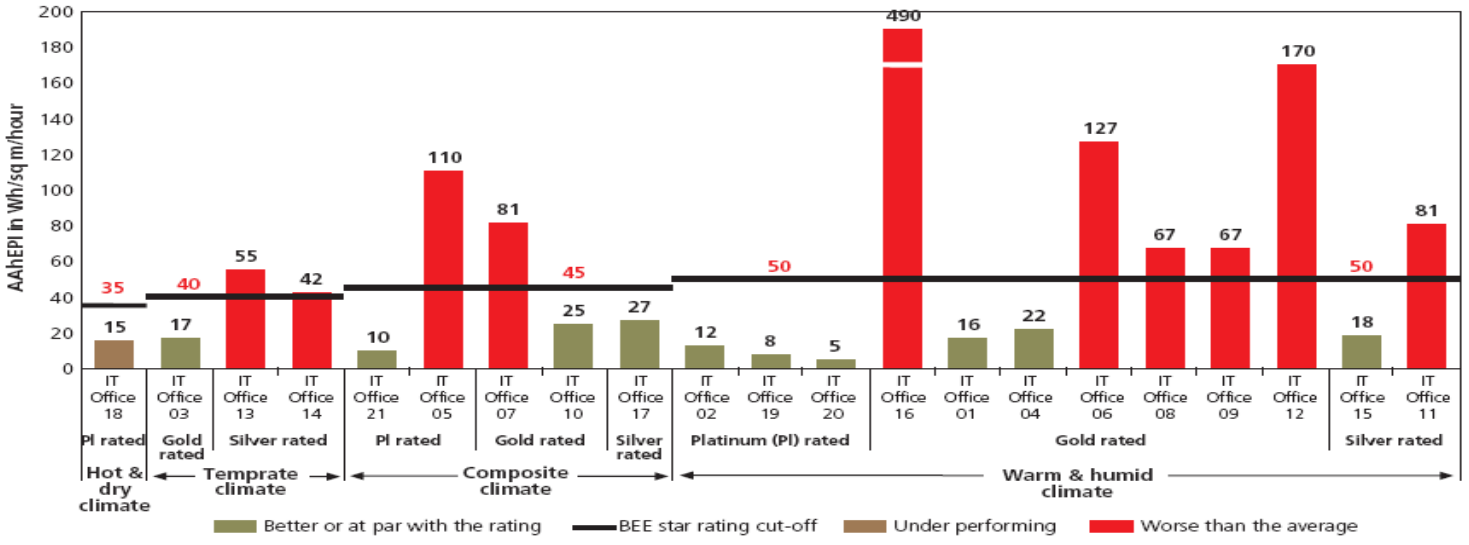
There is no official data base on rated buildings that get officials incentives. MNRE or state governments have not created data bases

Environmental performance: Do they make a difference?

Appreciate that LEED has started putting out data
Review of LEED rated buildings
What if we compare the energy performance with BEE's star rating for building performance…..
-- About 47% of the day time buildings as well as BPO/IT buildings do not meet the BEE one star label

GRAPH 4: ENERGY PERFORMANCE OF LEED-RATED BPO BUILDINGS

Based on annual average hourly energy performance, about 52 per cent seem to be non-performing



Note: See Annexure for the names of the buildings. AAhEPI – Annual Average Hourly Energy Performance Index
Source: Computed by CSE on the basis of LEED-India (IGBC) data

Global evidence …. Rated buildings may under perform. Global shift towards accountability….

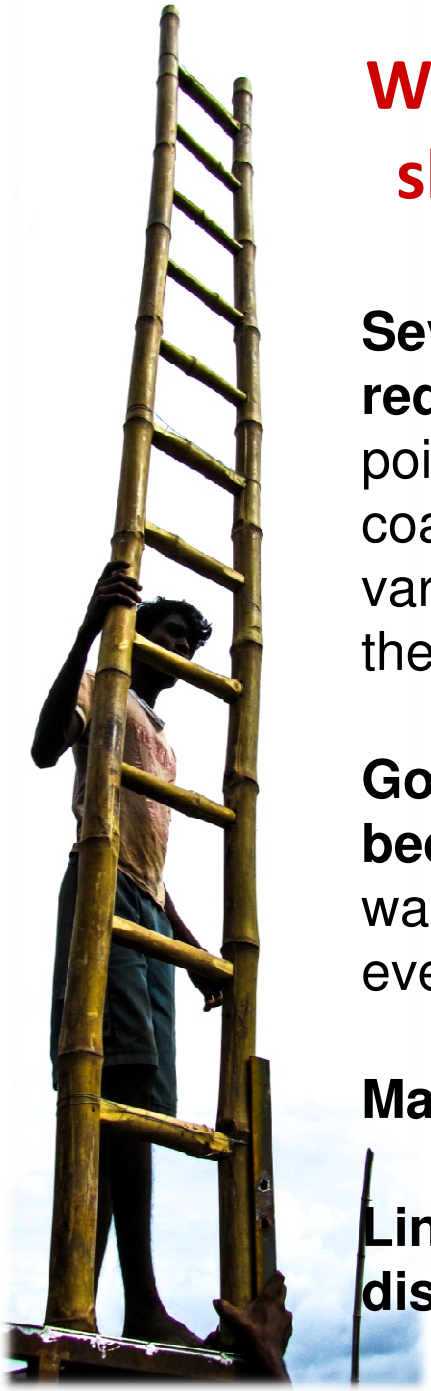
CSE review: without proper performance monitoring green rated buildings perform sub-optimally and sometimes worse than the standard buildings.

Eg. The US Green Building Council -New Buildings Institute study of 2008 showed wide variability in LEED energy performance which was a cause for concern. **Of 121 buildings rated 53% did not qualify for star label**. A good number did not track energy consumption.

In Canada study by the National Research Council Canada, in 2009 shows that on average, LEED buildings used 18-39% less energy per floor area than their conventional counterparts. **But, 28-35% of LEED buildings used more energy than their conventional counterparts**.

Challenge of relating predicted and actual performance

US LEED has further reformed in 2013 mandates disclosure and sharing of water and energy use every year and for at least five years. Otherwise label will be withdrawn.



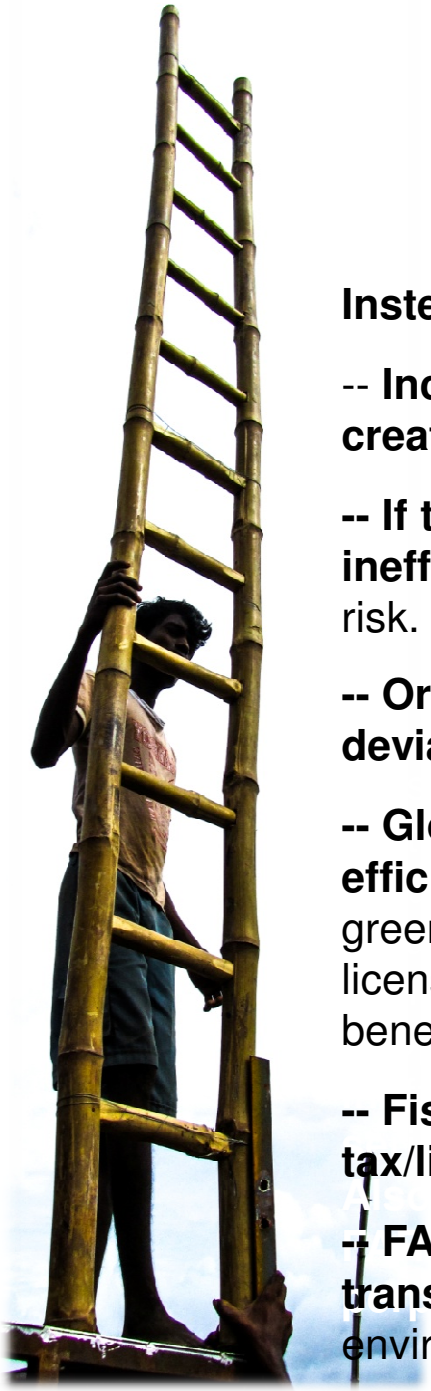
Why sops for a few when all buildings should implement green measures?

Several requirements of rating systems are part of the legal requirement for all buildings. (Eg, under GRIHA buildings get points for meeting rules of eco-sensitive zone regulations, coastal zone regulations, heritage areas, water body zones rules, various hazard prone area regulations, ECBC among others. But these are meant for all buildings.

Governments own energy star rating system of BEE has not been considered for incentive by any state government. This was initially considered in Punjab, Delhi, Noida but it was eventually dropped.

Mainstream resource saving regulations….

Link incentive with super efficient benchmark, regular public disclosure on actual performance and annual audits……



Do it differently……

Instead of FAR bonus grant fiscal incentives:

-- **Incentive in the form of additional space allowance has the potential to create substantially more additional built up area**.

-- If the developers are non-compliant, it will lock up enormous resource inefficiency in the new structures that cannot be reversed. This is a serious risk.

-- Or a post facto penalty at the market rate of FAR will only legalise the deviation and non-compliance and perpetuate business as usual practices.

-- Global best practices indicate that fiscal incentives can work more efficiently. Immediate tax benefits can encourage the developers to build green. Grant fiscal incentives in the form of concessions in corporate tax, license fee or income tax levied on corporations etc. This can go as direct benefit to the developer.

-- Fiscal penalty in case of non compliance can be three to four times the tax/license fee concession thus granted.

-- FAR bonuses should be conjoined with other habitat development and transit oriented development norms to minimise negative impact on environment. Incentivise only top performance……

Need discussion on energy performance….

-- How do we set energy performance target to reduce overall energy intensity and consumption?
-- Agenda for reform of ECBC
-- Improve building star rating programme
-- Make appliance rating more stringent
-- Introduce mandatory energy audit and consumption based energy billing
-- Create capacity for implementation in cities
-- Awareness campaign to inform people
Rating should push the top line

Inequitious…..

Several states have framed favorable policies to boost affordable housing – mandate; FSI relaxation etc

New developments often filter rich residents as property values are high…..
Neighbourhoods get homogenised in terms of income etc. This keeps poor people out
Legal norms and guidelines are needed for inclusive planning….
Provision for affordable housing not well planned – poorly designed, ghettos, building typologies….
Exclusion from formal finance system
Poor design and quality construction
Low priority to rental housing
Needs local skill building for scalability

Self constructed home -- major source of affordable housing -- ignored

Self owned and self constructed houses are incrementally built to allow pacing of construction as per the convenient of the owner. Important.

There are attempts to formalise these settlements through redevelopment – but have not worked well..

In terms of building typology, community space, meet the needs of space for artisan activities..quality is compromised, become unlivable, poor facilities and utilities.. High rise buildings become unaffordable

-- Challenges -- Land availability and tenurial security

-- No professional help on design and planning --- good practice examples from Thailand, Brazil etc

Professional architects coming together to make poor peoples home safe and comfortable

Urbz Mumbai helping with low cost housing Shivaji Nagar and Dharavi slums

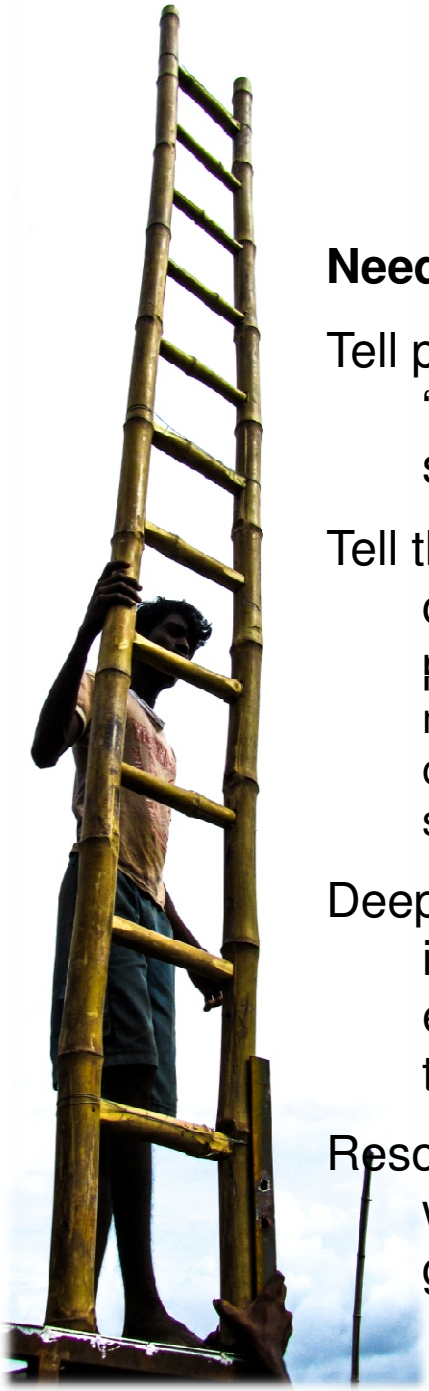
Source: URBZ

Skilling slums
Micro home Solution's initiative

Source: Micro Home Solution

Community participates.....

Microhome solutions in Mangolpuri



Deepen public and policy understanding for the big change

Need people as partners

Tell people what “works” and what “doesn’t work” in terms of energy-saving strategies for homes.

Tell them about the rate of return on costs for energy-efficiency and products and appliances. People must know where to find information on options, prices and suppliers

Deepen understanding -- how individual decisions to conserve energy add up to overall savings that benefit the community.

Resource efficient city development without compromising economic growth

•Chitra Vishwanath's house is made of compressed stabilised earth blocks excavated from the site itself (Photo: Chitra Vishwanath)

ACs and cars transforming urban form

Game of town making…

New rhetoric --- ‘chaos’ ‘poor planning’ ‘crowding’ and ‘stressed infrastructure’ in older cities to justify sprawl and gated development – demand for private townships…

Private integrated townships with area of 40 ha to 400 ha each and more than 200 townships planned, under approval and construction. (IDFC’s India Infrastructure report 2009) -- especially around the metros.

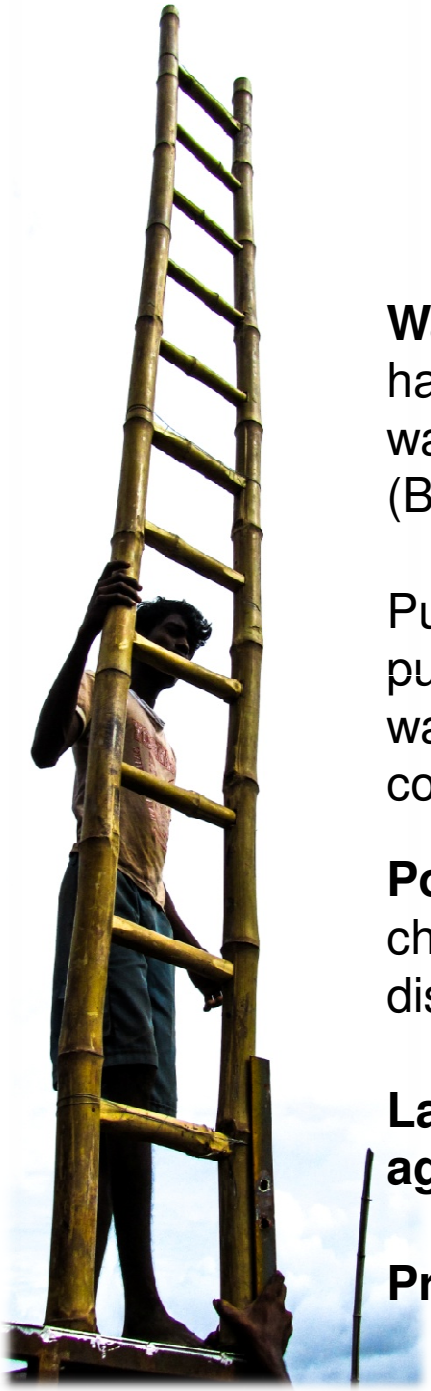
6 private townships along DMIC corridor in the first phase and 18 in the second phase.

Under public private partnership

Enormous real estate business in suburbs, peri-urban and hinterland. FDI in real estate…

Touted as Walk to Work Green Towns – without green benchmark

Developers are also asking for special residential zone…



Towns invade resource scarce areas

War over water: Several builders have stopped advertising 24x7 water supply for their projects (Bengaluru etc)

Punjab and Harayana High Court put a moratorium on use of ground water and fresh water for construction

Pollution liability of towns: The challenge of waste dump and disposal…

Large scale conversion of agricultural land

Pressure on forests , biodiversity

Weak regulatory framework

Environment Impact Assessment (EIA) for large buildings and townships. Only comprehensive legal instrument that addresses environmental and resource impacts of high impact buildings and developments – land, water, energy, waste, pollution, etc… Weak instrument

EIA not working effectively

In buildings -- Construction can precede consent
Escape routes … the phenomenon of 19,999 sq mt…….
No clear siting policy …… Weak post construction monitoring
No follow up on compliance reports
No public consultation
Inadequate resources and staff …… and many more…
No clear numbers and benchmark
No traffic impact assessment of new development in cities

Weak regulatory framework

EIA for township -- Often no integrated land use and transportation planning in cities with adequate legal back up that can be the basis for environmental clearance…. Piecemeal clearances…….

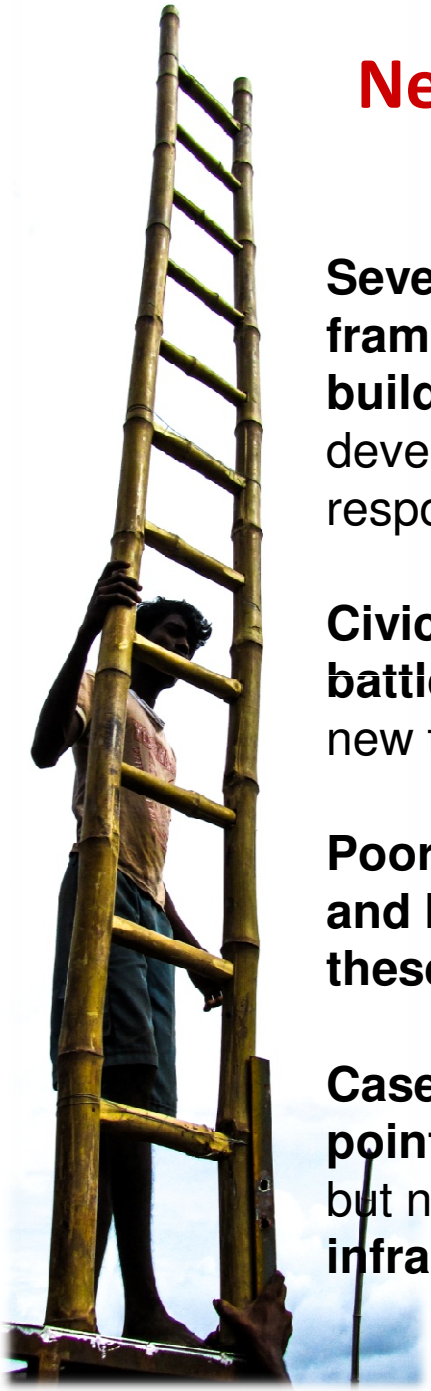
Master Plans under Town and Country Planning. All cities do not have Master Plans and most are outdated.

National Habitat Standards – Do not have legal back up.

City development plan, and city mobility plan to decide investment priorities in cities. Mainly investment plans

Transit oriented development nascent stage

Challenge of design and planning……



New towns: Governance challenge…

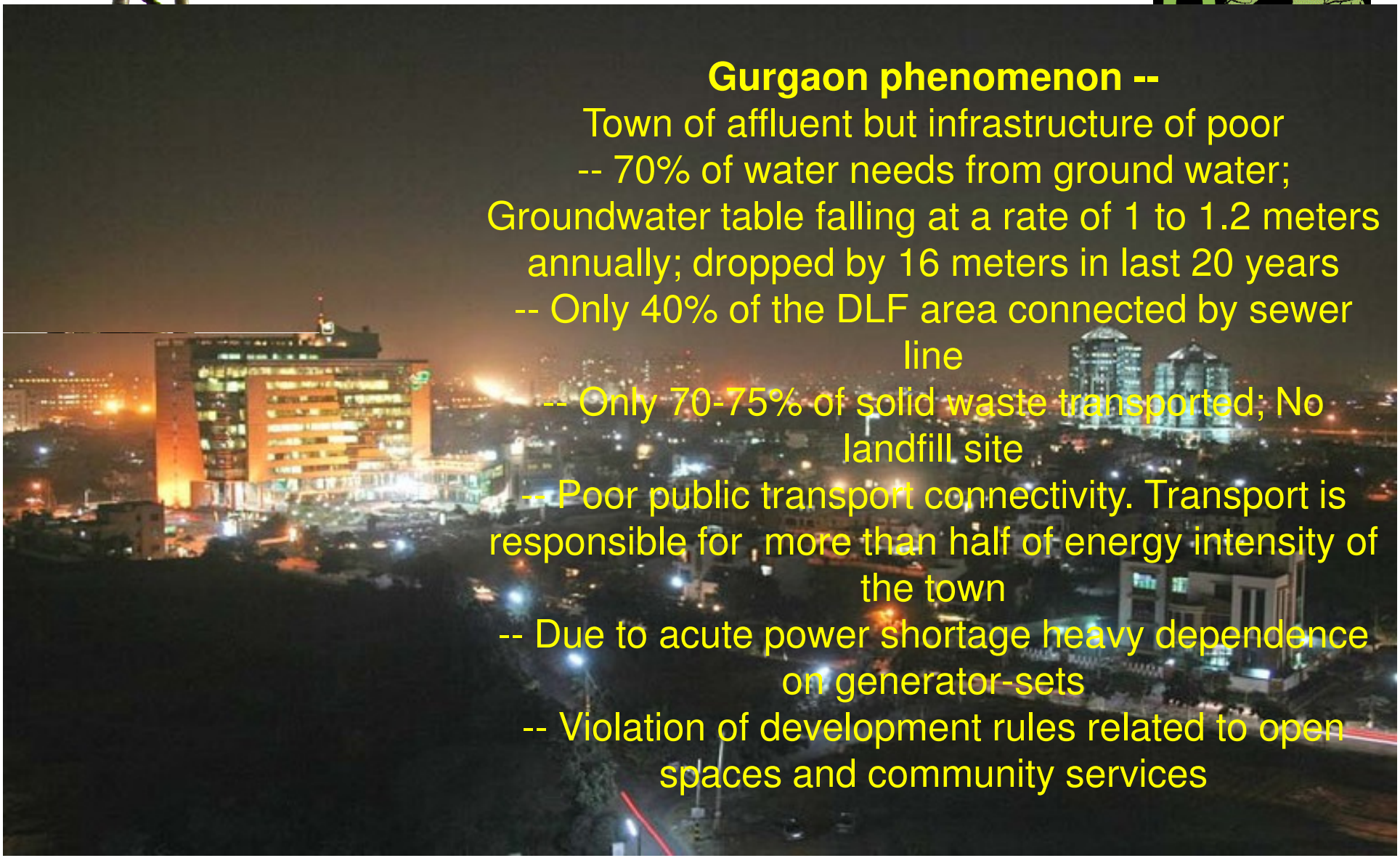
Several State governments (Maharashtra, Gujarat etc) framing legislation to regulate townships and apartment buildings. These define area criteria, incentives for developers, provision of affordable housing, role and responsibilities of RAWs etc….

Civic authorities, and developers caught up in messy battle over resource allocation and service management in new townships…..

Poor clarity about roles of developers, city governments, and local residents in planning, maintaining and operating these towns.

Case study of Gurgaon in Haryana show many flash points. Haryana Apartment Act etc have tried to address these but not adequate. **This undermine delivery of services, infrastructure and quality of life**.

Privatised new towns: slum of the rich……



Gurgaon phenomenon --

Town of affluent but infrastructure of poor

-- 70% of water needs from ground water; Groundwater table falling at a rate of 1 to 1.2 meters annually; dropped by 16 meters in last 20 years

-- Only 40% of the DLF area connected by sewer line

-- Only 70-75% of solid waste transported; No landfill site

-- Poor public transport connectivity. Transport is responsible for more than half of energy intensity of the town

-- Due to acute power shortage heavy dependence on generator-sets

-- Violation of development rules related to open spaces and community services

Rethink on environmental clearance for towns and buildings……..

Reinvent EIA -- Link with the building approval process….

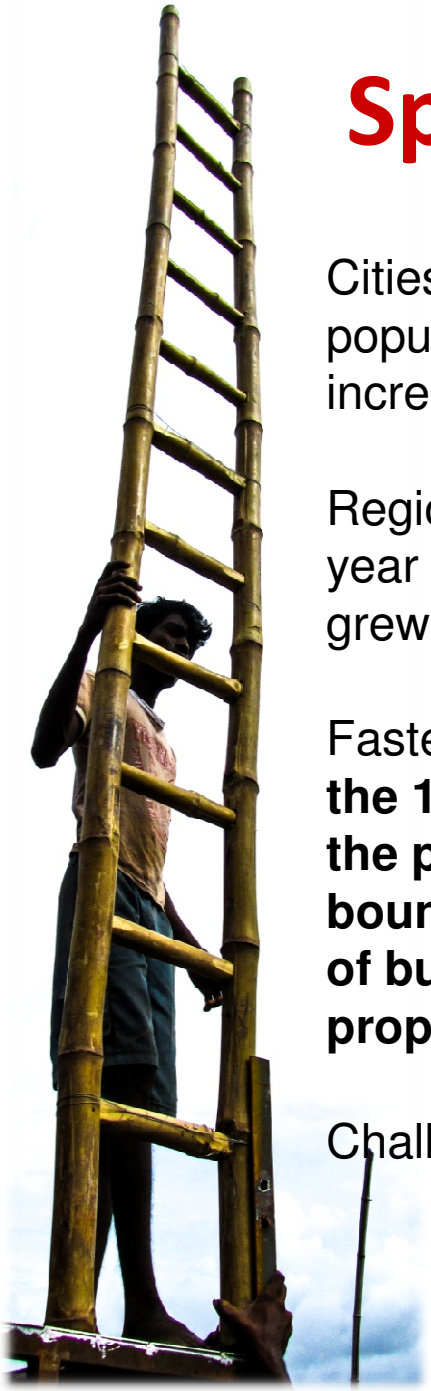
Building approval process cannot remain isolated from the master plan that pre-determine land use plan and reflects carrying capacity of the area…

Needs additional filters and appropriate standards and norms to screen large resource intensive buildings to minimize environmental impacts.

Harmonise with other environmental laws..

Need strong regulatory capacity to handle technically complex green building regulations…

Principles of urban design and planning…..



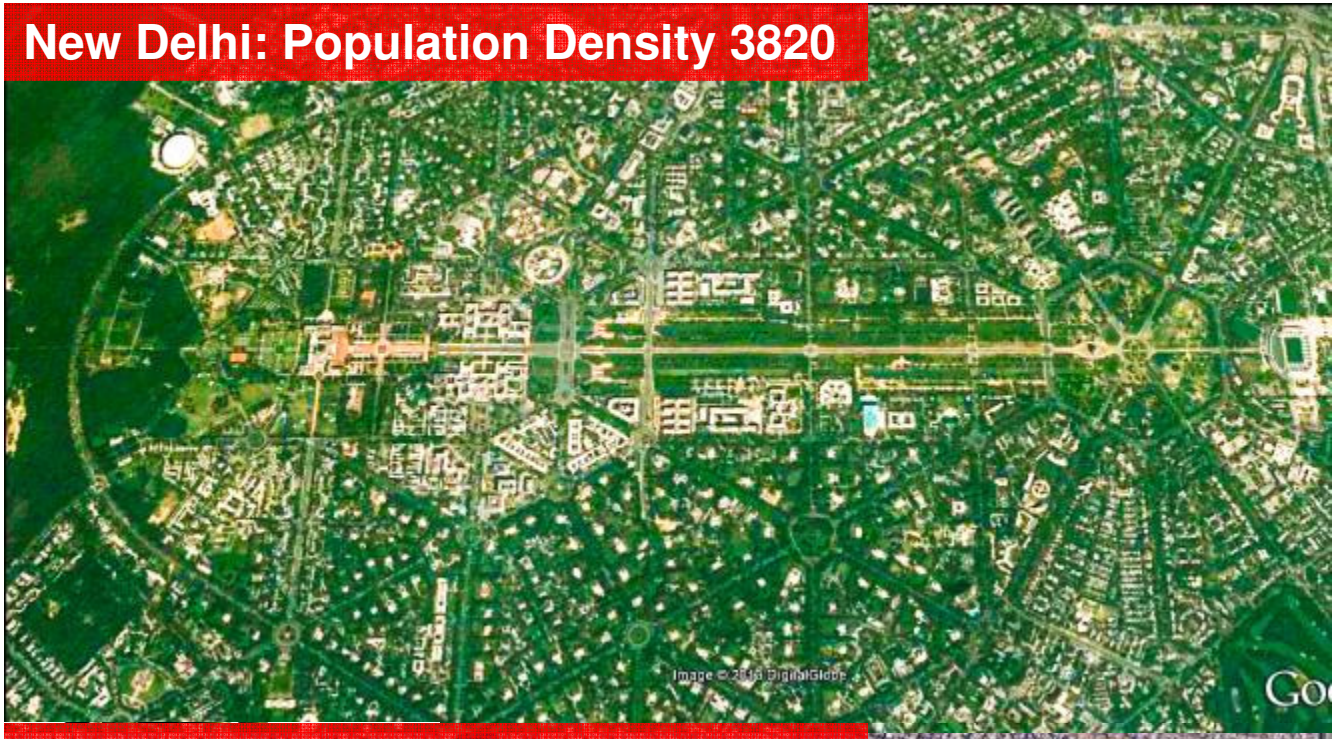
Sprawled……

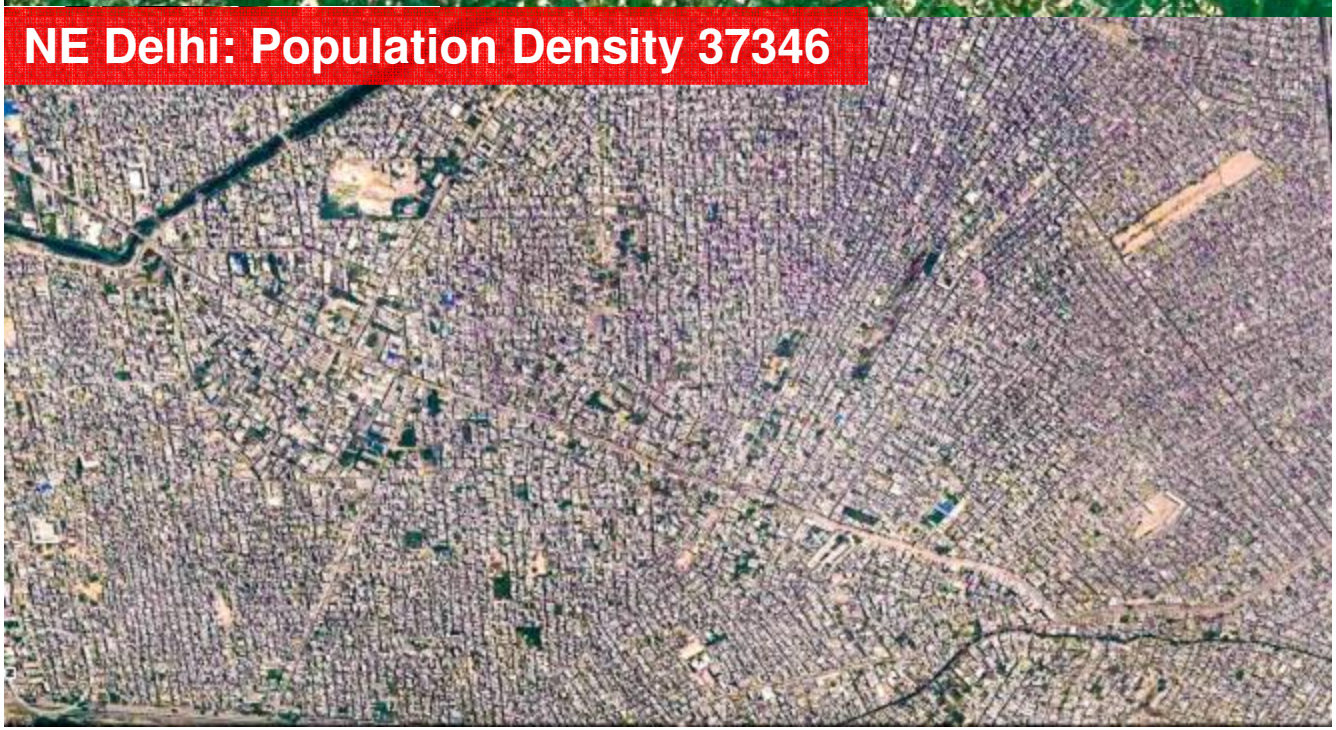
Cities grew about twice as fast in area as they grew in population, -- declining average city population densities and increasing sprawl.

Region's urban areas expanded at slightly more than 5% a year between 1999and 2010. But the region's urban population grew a little less than 2.5 percent a year. (World Bank 2015)

Faster population growth on the peripheries of major cities. **For the 12 largest Indian cities, satellite imagery shows that, the proportion of built-up area outside a city's official boundaries exceeds that within its boundaries. Proportion of buil-tup area outside city boundaries exceeds the proportion of population, -- low density sprawl.**

Challenges for delivery of basic services and infrastructure





Low density development…

Only 1 per cent of Delhi's population live in Lutyen's Delhi.

Most part of urban boom –pushed to the sides and periphery

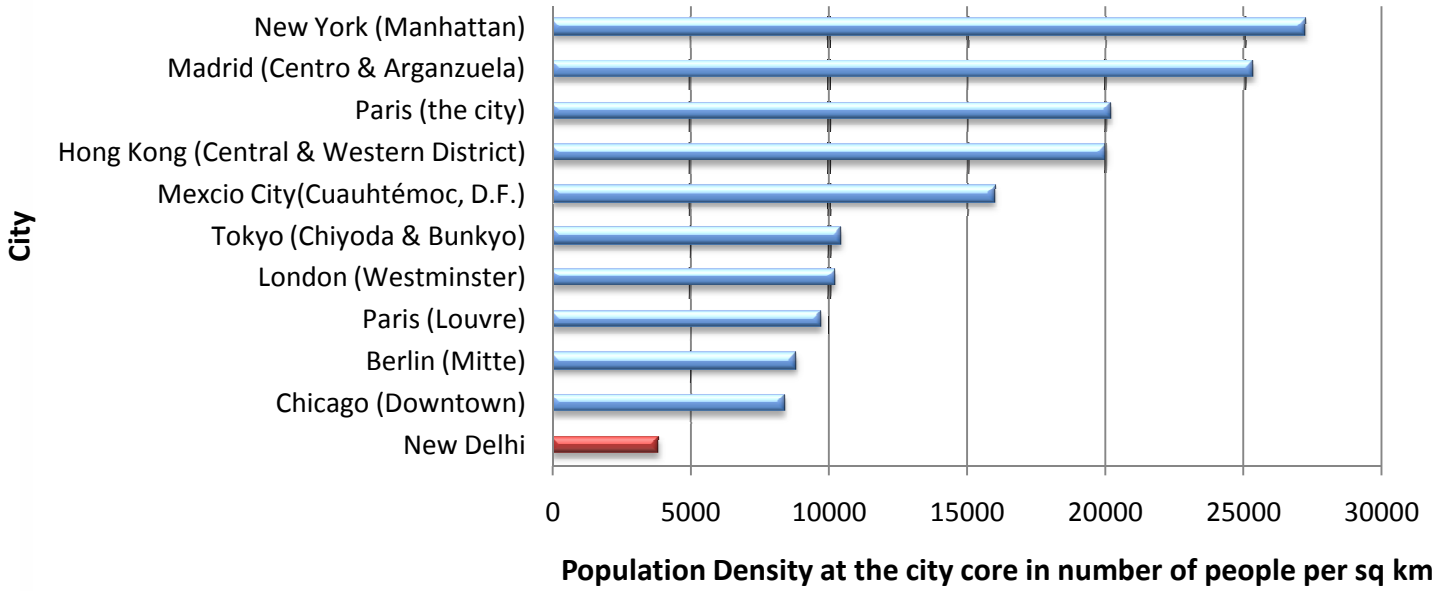
Delhi has not maximised the use of land to provide for its teeming million – Delhi needs 70,000 houses a year to meet the housing deficit

About 40% in informal settlements

Space affluence vs unliveable peripheries

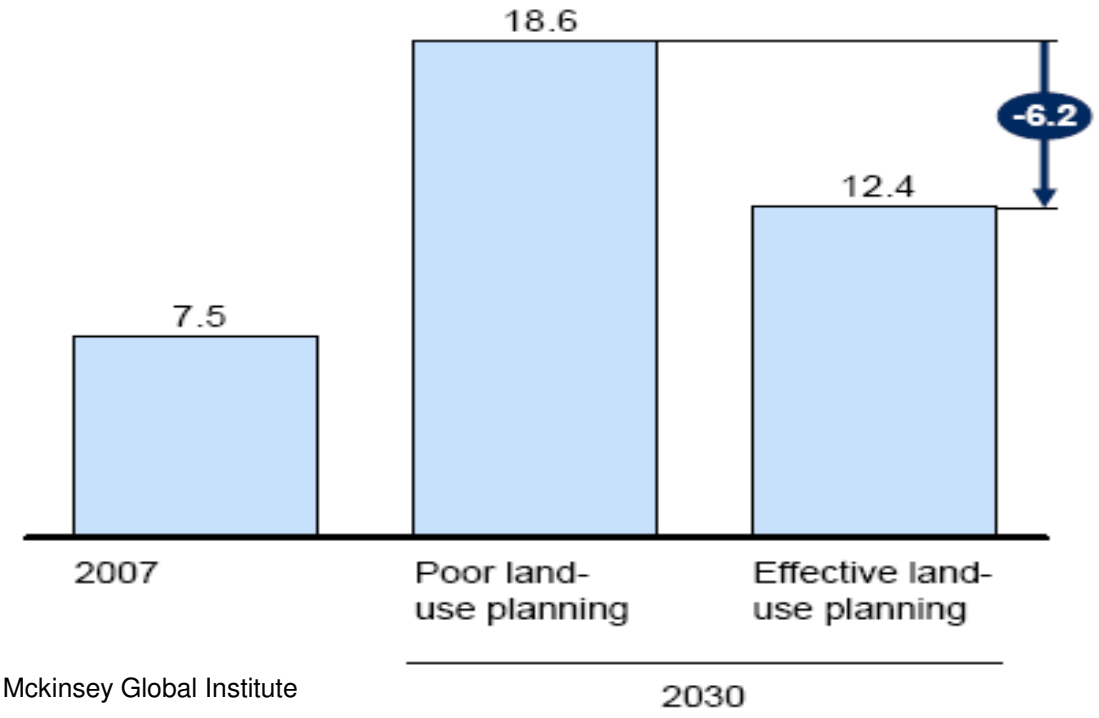
Density control in Delhi has pushed people out of the city core

Density of Administrative Cores of Global Metros



- Delhi has one of the most sparsely populated core in the world.
- New Delhi's density is more than six times lower than core administrative regions of New York and Madrid
- Even the heritage Louvre of Paris is 2.5 times densely populated than New Delhi

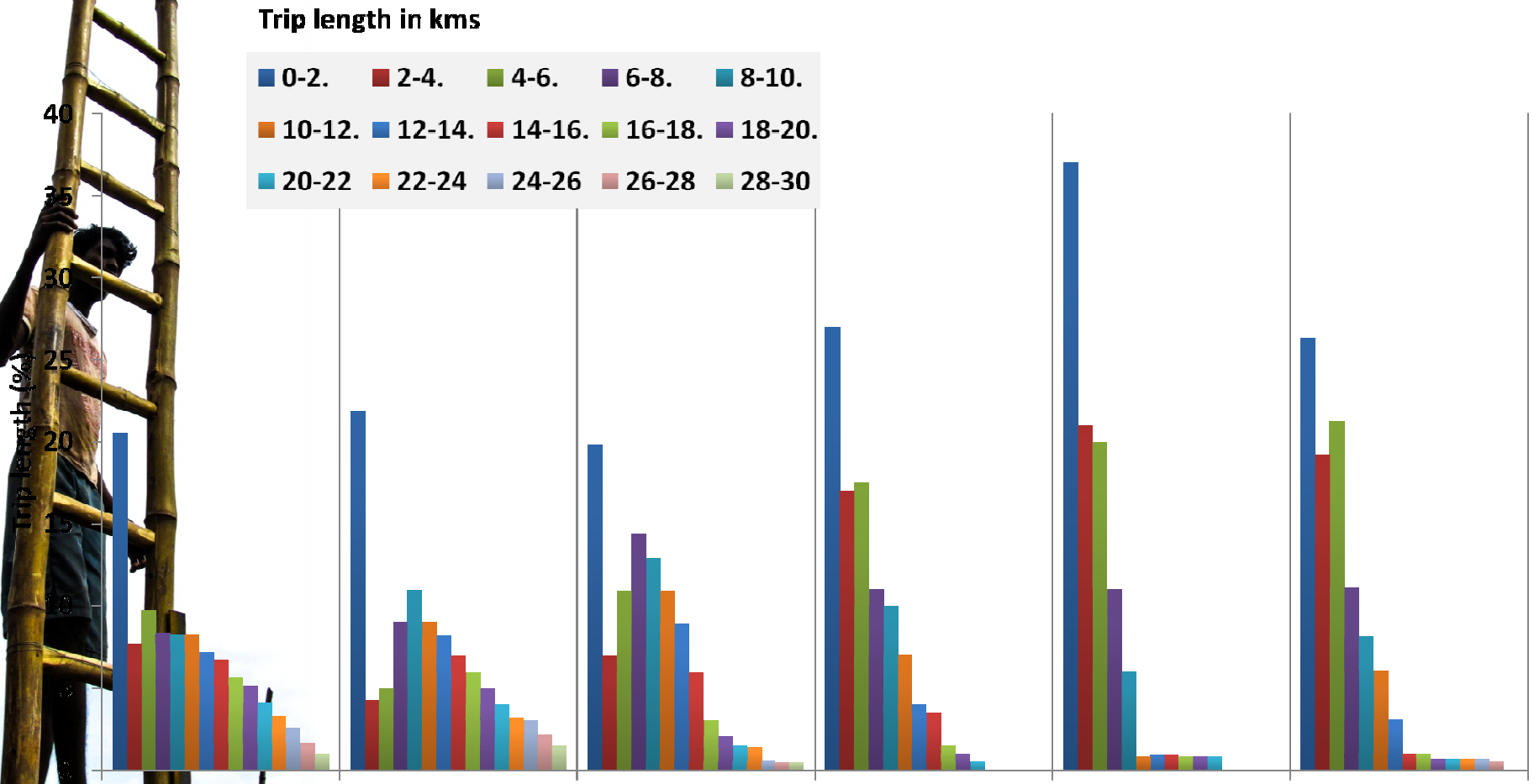
Effective land use planning in CBD can potentially mitigate loss of land



Source:2010, Mckinsey Global Institute

Mckinsey Global Institute estimate shows that India could potentially save 6.2 million hectares of arable land through effective planning for land use in cities in the next 20 years.

Sprawl effect
Bigger cities show more trips in higher distance range



Source: Based on MOUD/WSA 2008 database

FAR/FSI another game in town…..

Source: Kolkataskyline.wordpress

Nationally policy is expected to incentivise ‘high-density’ development for optimal use of urban space and resource efficiency.

Higher FAR do not automatically result in densification.

-- Provision of large unit-sizes defeat the purpose of densification.

Link the FAR threshold with a minimum density requirement.

-- Maximum permissible FAR and densities to be based on the capacity of public transport, circulation network and the physical infrastructure thresholds of the area, other services – water, waste etc. .

Provide a variety of mixed-use, mixed-income housing, employment and recreation options within walking/cycling distance of each

Delhi setting norms for high density requirements

Delhi framing Transit Oriented Development Policy (DDA/UTTIPEC)

Density minimums as per the table below:

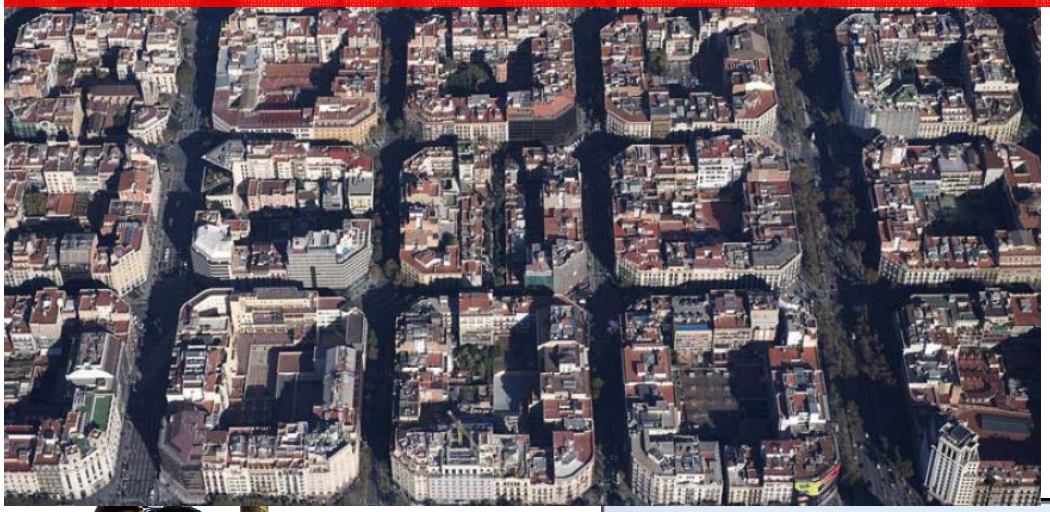
Gross FAR (site)	Minimum permissible density (with ±10% variation)	
	Residential dominated project (Residential FAR ≥ 50%)	**Predominantly non-residential** (Residential FAR ≤ 30%)
Below 1.0	Under-utilization of FAR (not permitted)	Under-utilization of FAR (not permitted)
1.1 - 2.0	200- 400 du/ha	100 - 200 du/ha
upto 3.0	400 - 600 du/ha	250 - 400 du/ha
3.1 - 4.0	600 - 800 du/ha	400 - 600 du/ha

*** Site level FAR shall be based on Approved TOD Influence Zone Plan.**

-- Mixed land-use norms: At least 30% residential and 20% Commercial & Institutional use of FAR is mandatory within the Influence Zone

-- Several other cities including Surat, Pimpri Chinchwad .are incentivising densification along transit corridor. Linking up green building requirements

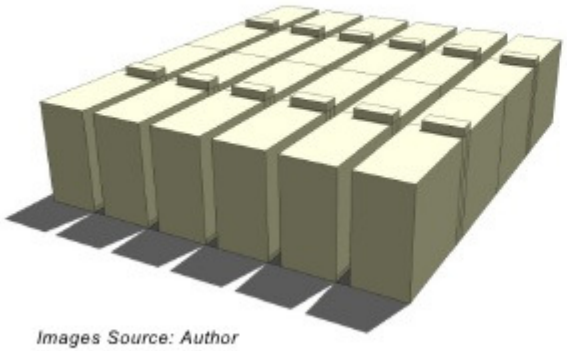
Barcelona: High Density doesn't mean high rise



Barcelona has density ranging between 200 dwellings per hactare to 500 dwellings per hectare

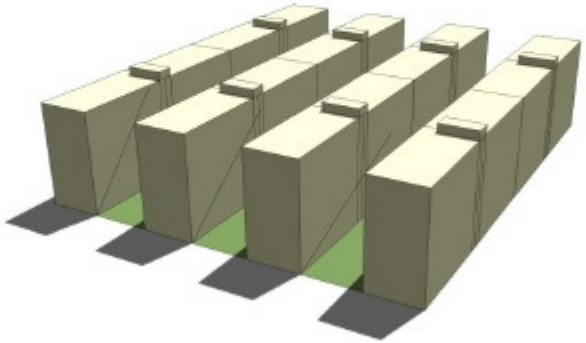
Source: Mid rise, high density. Until what extent does density matter? - Prof. Joaquim Sabaté

High rise vs high density…….

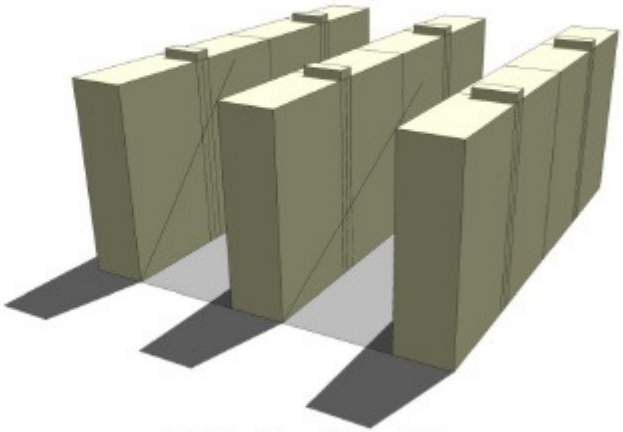


Images Source: Author

Net block level FSI = 6.5
Density = 2600 units/Ha @ 25sq.m. each



Net block level FSI = 4.4
Density = 1750 units/Ha



Net block level FSI = 6.0
Density = 2400 units/Ha

UNDESIRABLE OPTION

Current low-income housing complexes being constructed all over Mumbai Region.

DESIRABLE OPTION

Midrise housing with optimal spacing between buildings allowing daylight and airflow through public spaces and homes.

UNDESIRABLE OPTION

Taller buildings, when designed in rows, require larger spacing in between for adequate daylight access – creating an undesirable urban experience.

Source: UTTIF

Enable change through design……..

Proposed UTTIPEC guidelines for building orientation: All dwelling units should get minimum 2-hour solar access in at least one habitable area (living room, bedroom or private open space) on the shortest winter day of Dec 21 (Winter Solstice).

EIA committee in Delhi setting norms for orientation, depth of the building, shading, day lighting etc…..

Source: UTTIPEC

Delhi Master Plan has a target of 80% public transport share by 2020

If we ignore access, compactness, and travel distances…. investments in bus and metro will be a waste…..

Towards gated development……
Energy intensity of towns?
Efficiency gains lost in sprawled cities

Super blocks

Source: CSE

No mid block crossings for pedestrians – Advantage to vehicles

Build compact city

……Devil is in detail

National Habitat Standard Mission of the Ministry of Urban Development

Guidelines for compact mixed land use

-- 95% of residences should have daily needs retail, parks, primary schools and recreational areas accessible **within 400m walking distance.**

-- 95% residences should have access to employment and public and institutional services by public transport or bicycle or walk or combination of two or more.

-- At least 85% of all streets to have mixed use development.

-- Need small block size with high density permeable streets etc

UTTIPEC guidelines

Hierarchy of Facilities	Accessibility Standard from each home/ work place.*
MRTS Station	Approx. 800 m or 10 min walk
Metro feeder/ HOV feeder Stop	Approx. 400 m or 5 min walk
Bus Stop	Approx. 400 m or 5 min walk
IPT/ auto-rickshaw Stand	Approx. 250 m or 3 min walk
Cycle Rickshaw Stand	Approx. 250 m or 3 min walk
Cycle Rental Stand	Approx. 250 m or 3 min walk
Shared private parking garage	Approx. 500 m or 6 min walk

Avoid car feeders to buildings – Public transport to define the urban form

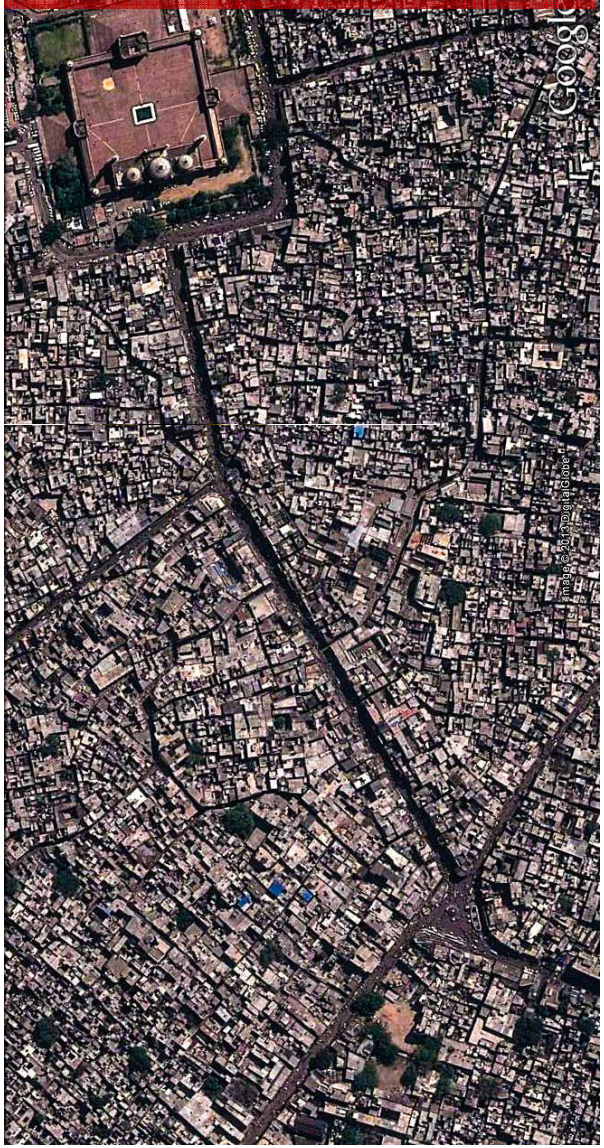
1a) High Density Mixed Use within 5-min walk of stations…

Reason for success of BRT in Curitiba:

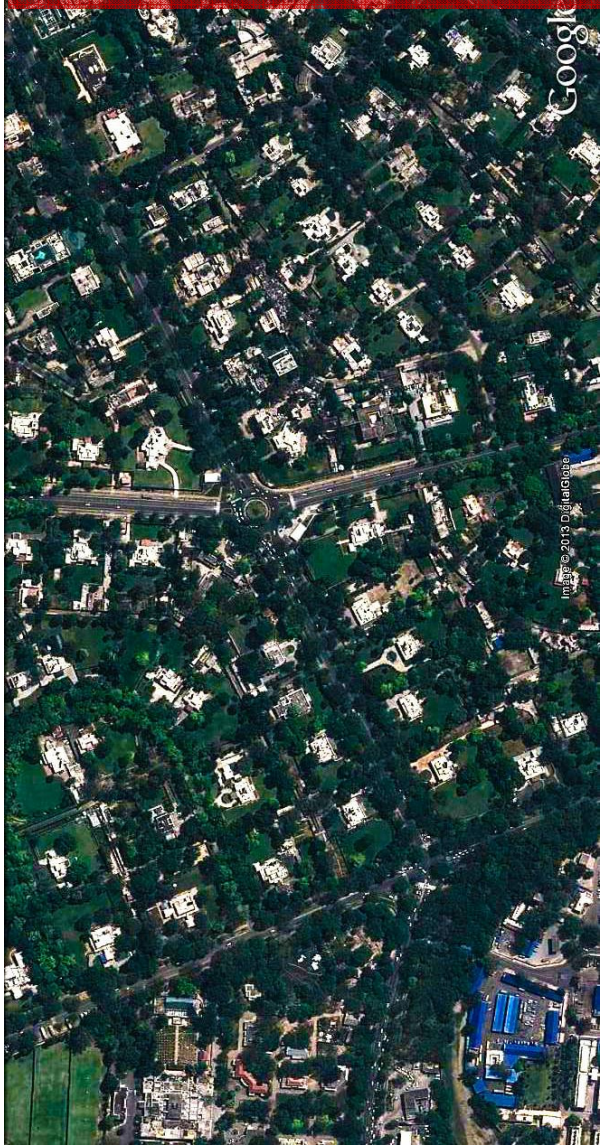
Maximum people Live, Work & Play within 5-min walk of *RAPID TRANSIT* Stations

Density disparity along metro line in Delhi….

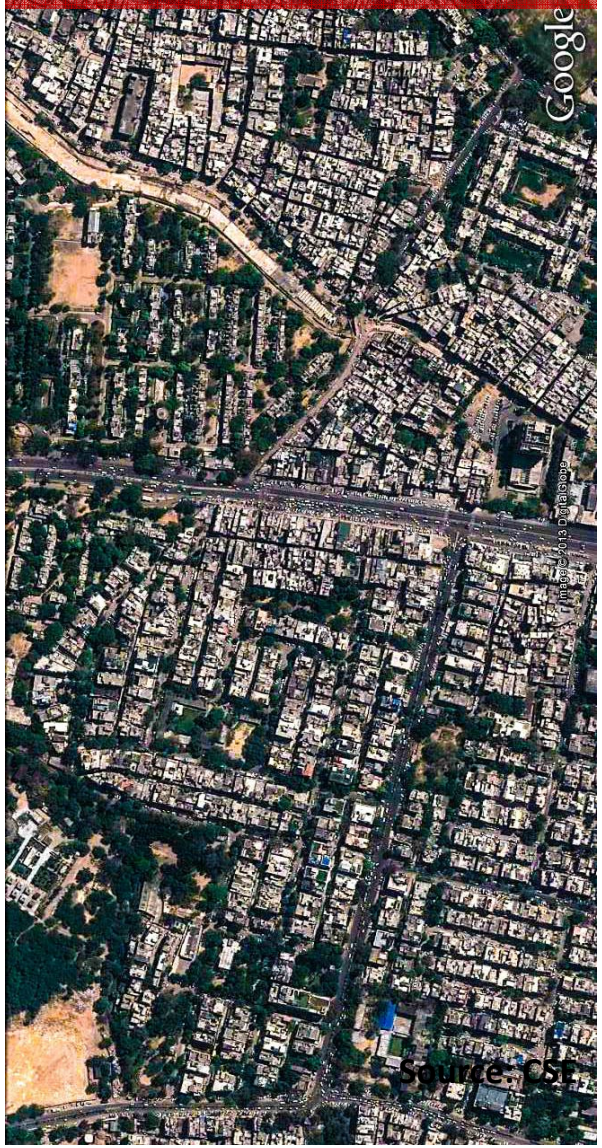
- Chawri Bazar



- Race Course



- Green Park

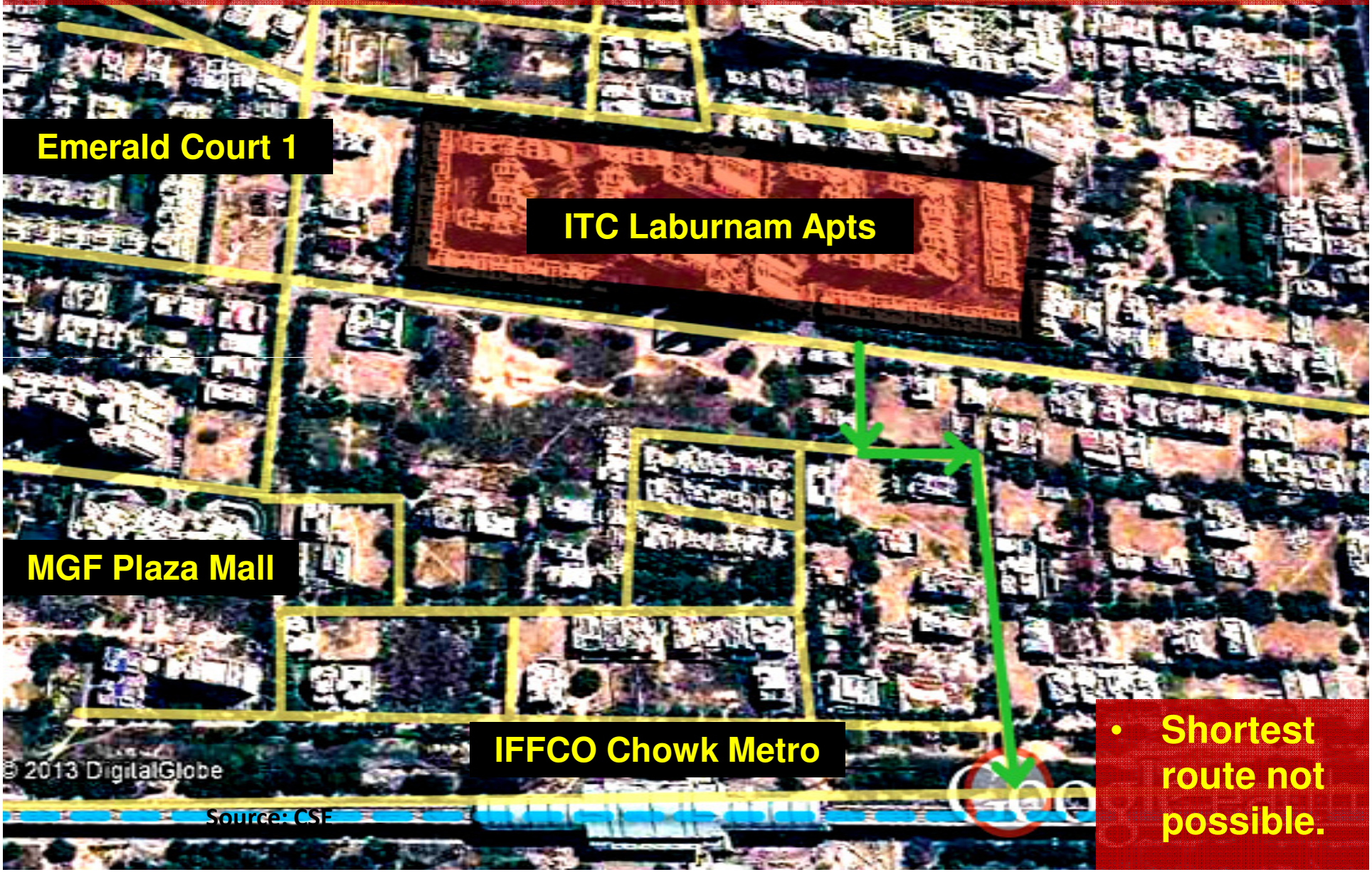


Source: CSE

Case Study – Gurgaon Sector 28

Accessing Metro from ITC Laburnam Apts

400M

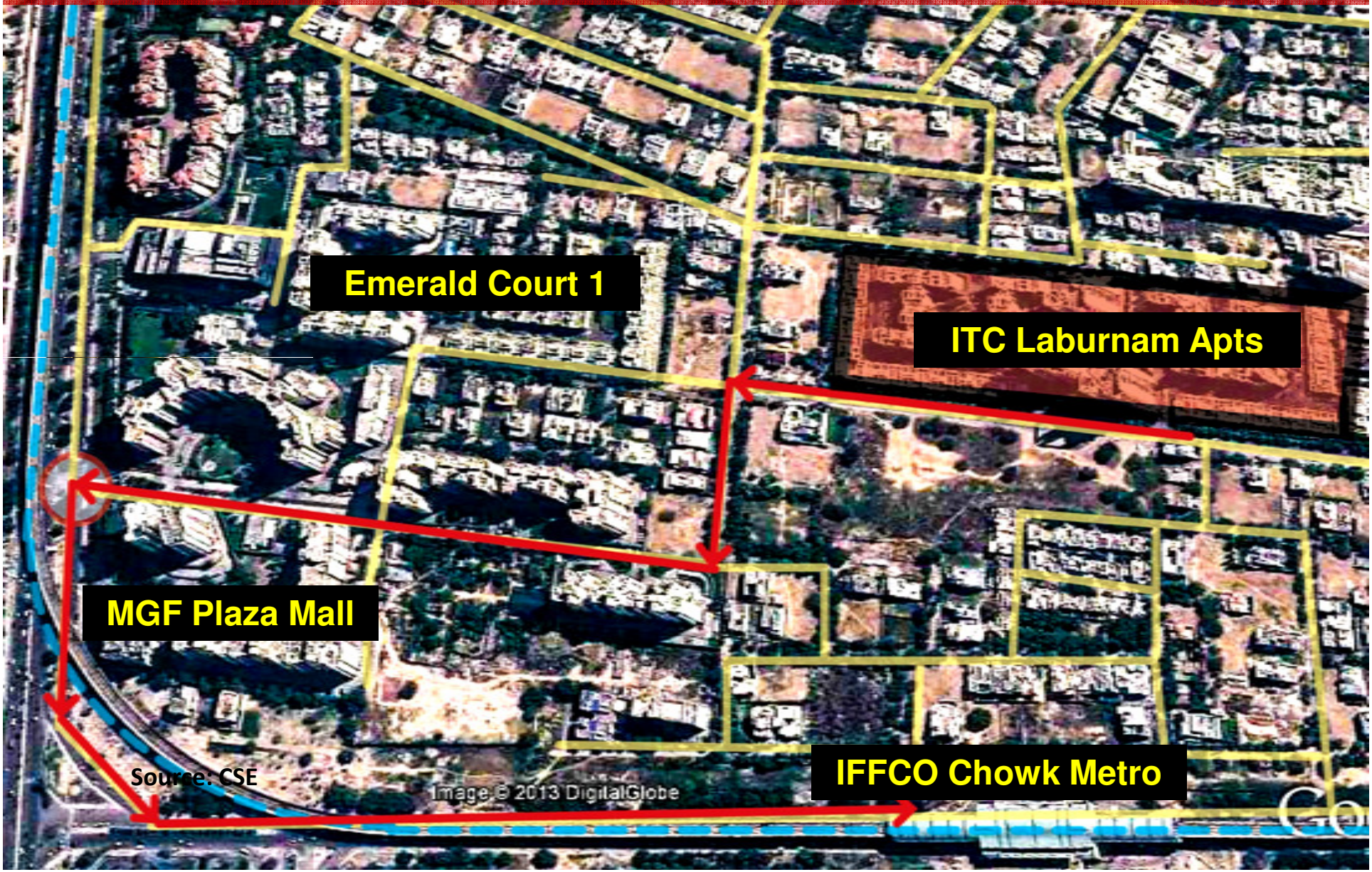


- Shortest route not possible.

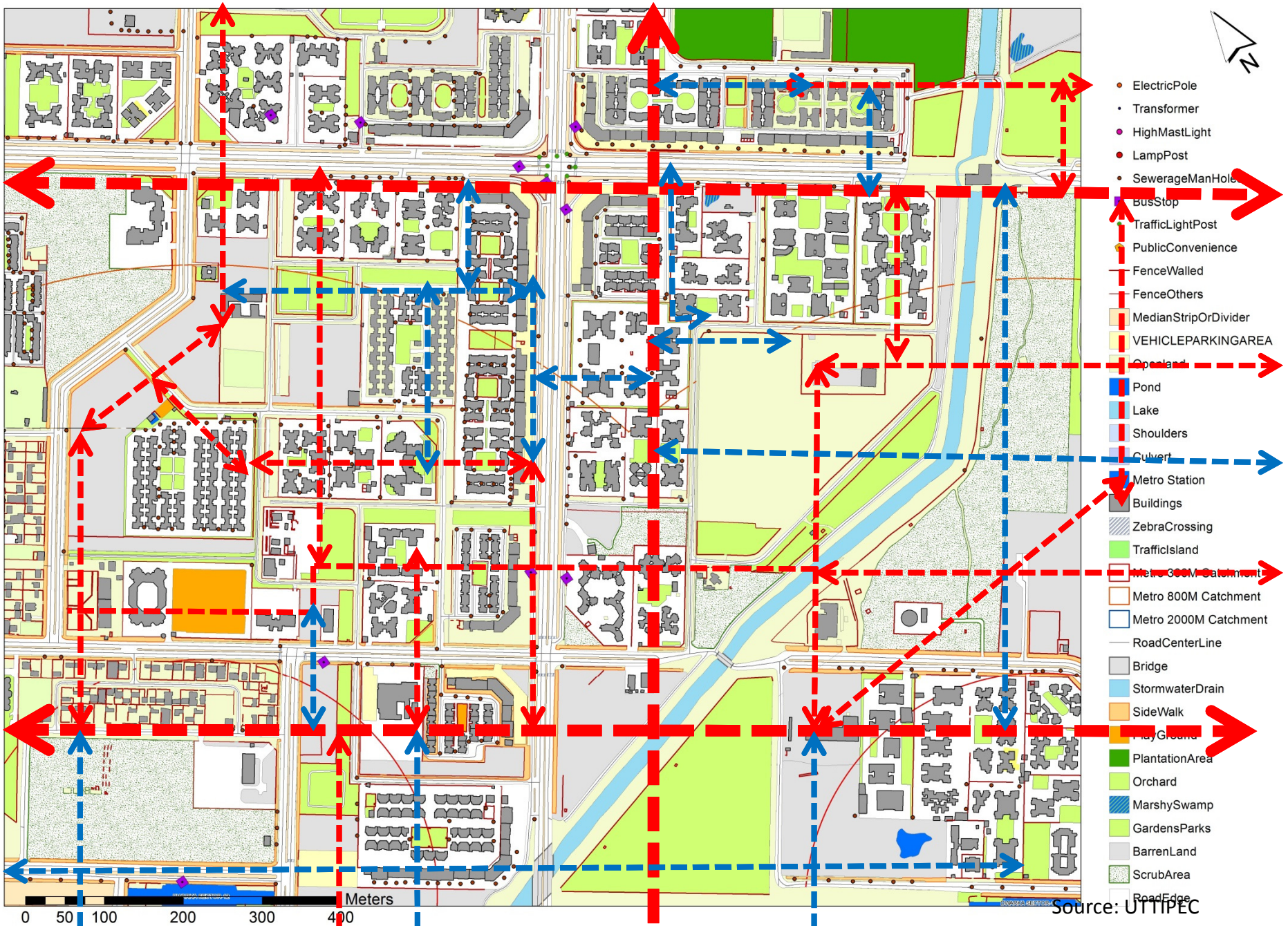
Case Study – Gurgaon Sector 28

Accessing Metro from ITC Laburnam Apts

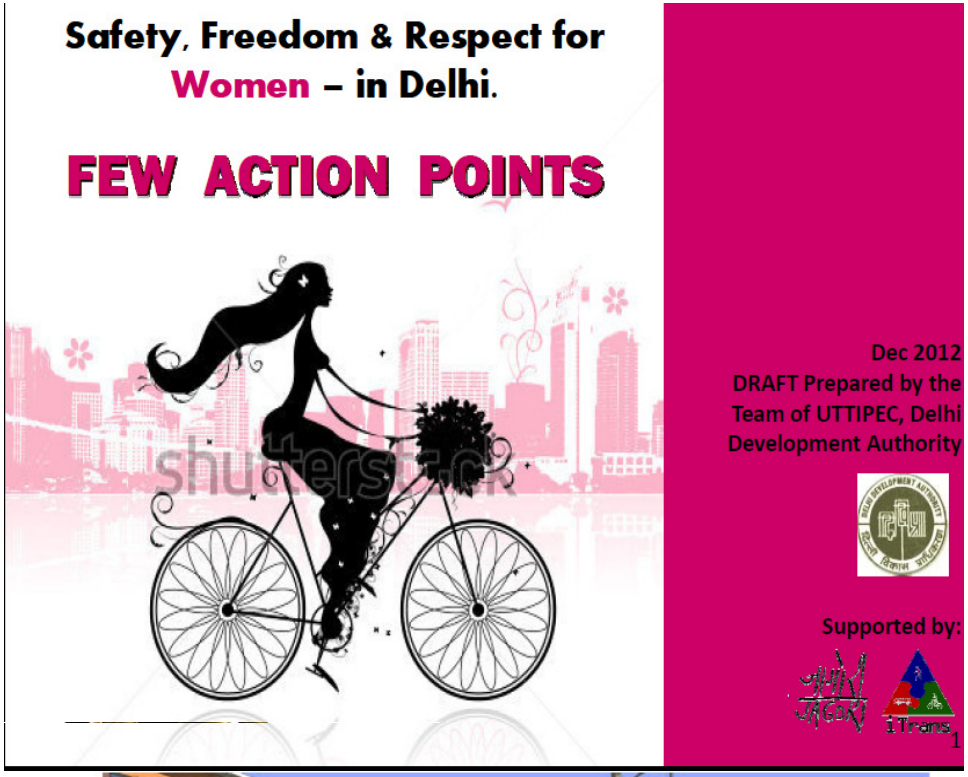
1800M



Street Network



Source: UTTIPEC



To ensure Safety of Pedestrians:

Safety and urban planning…

Excerpts:

Initiate planning and road design schemes where unwatched streets can be transformed... to make safe urban areas:

- **Get rid of walls and setbacks. Add street edge uses -- for road safety at night,**

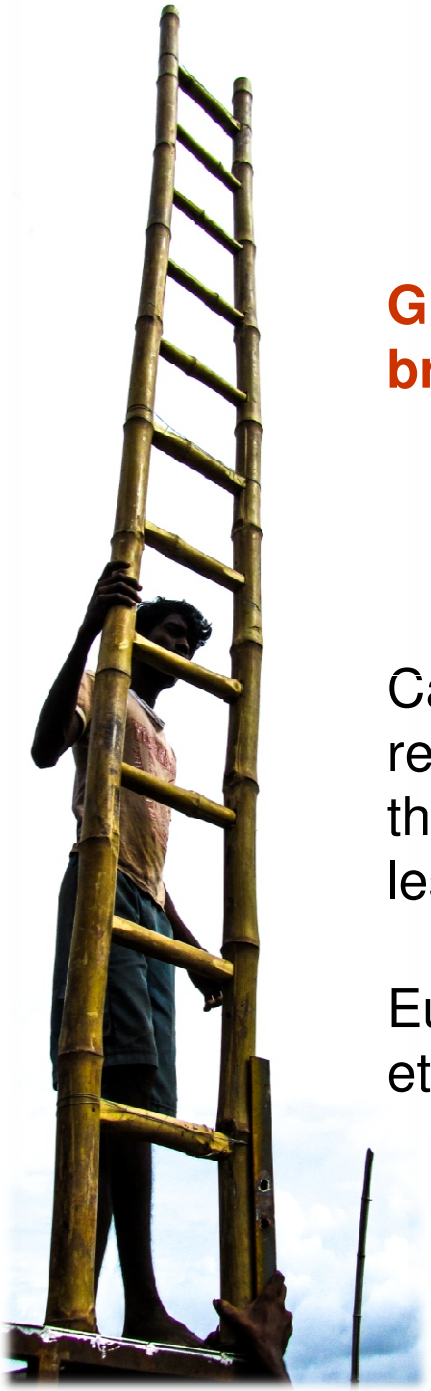
Transparent fencing shall be used above 300 mm high toe wall from ground level.

- Add planned hawker zones.

- Adhere to IRC 103:2012 for Street Design.
- Introduce planned mixed-use housing …along road edges of major vulnerable roads.

Where will you feel more safe to walk?

Why do we have building setbacks and boundary walls?



Globally new urban design principles are bringing back principles of compact forms.

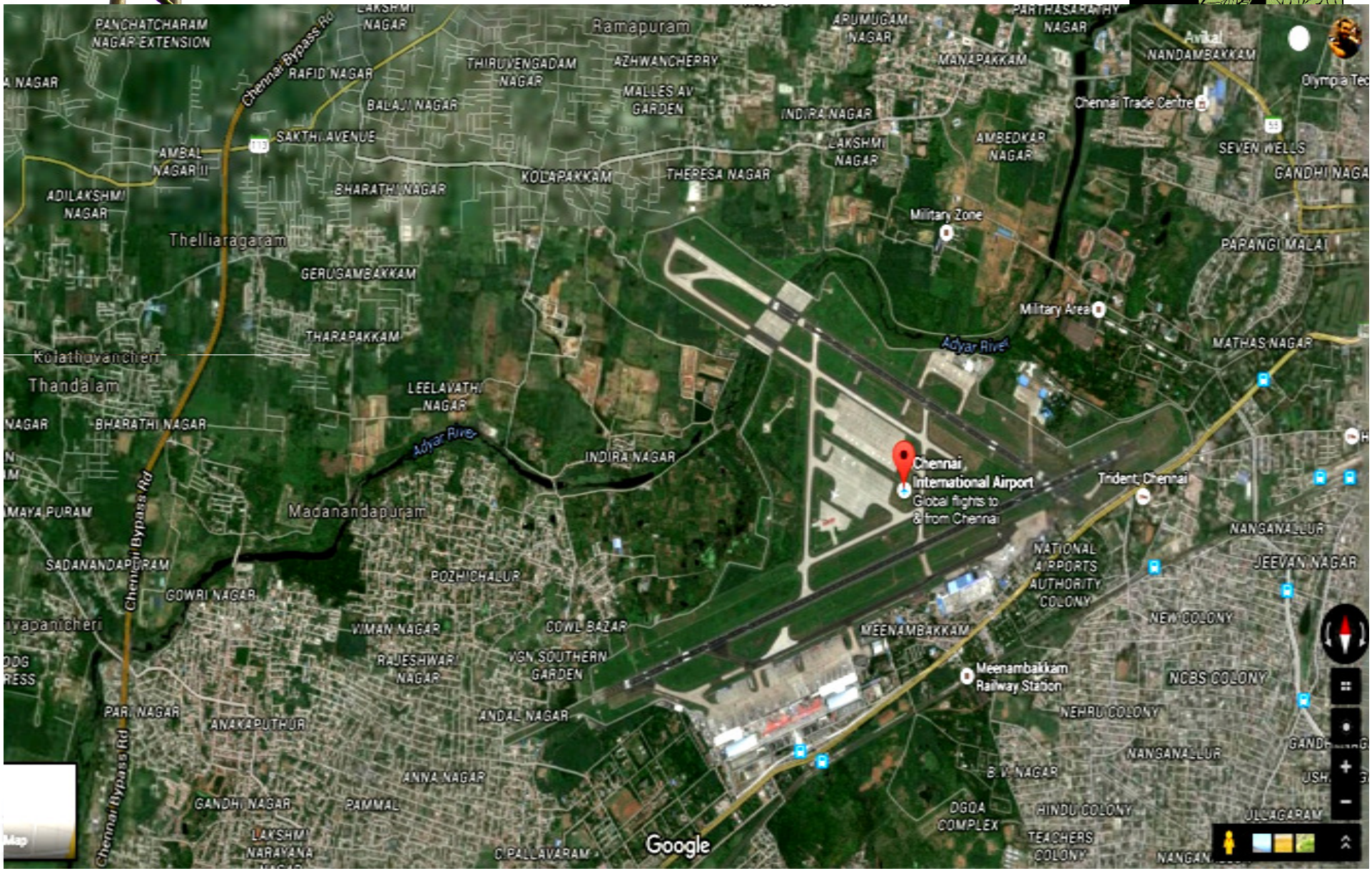
California: SB 375 law -- Bringing back that urban form -- requires jobs, recreation and housing planned in a way that people can live and work closer together, and drive less.

European cities adopting policies to retain compact forms etc

Need climate sensitive planning
Chennai: City built on lakes turns into a lake

450 mm rain in 7 days…more than 1200 mm in November: Chennai had more than 600 water bodies in the 1980s but master plan of 2008 said -- only a few are in proper condition. Area of 19 major lakes has shrunk from a total of 1,130 hectares in the 1980s to nearly 645 ha in early 2000s, reducing their storage capacity….

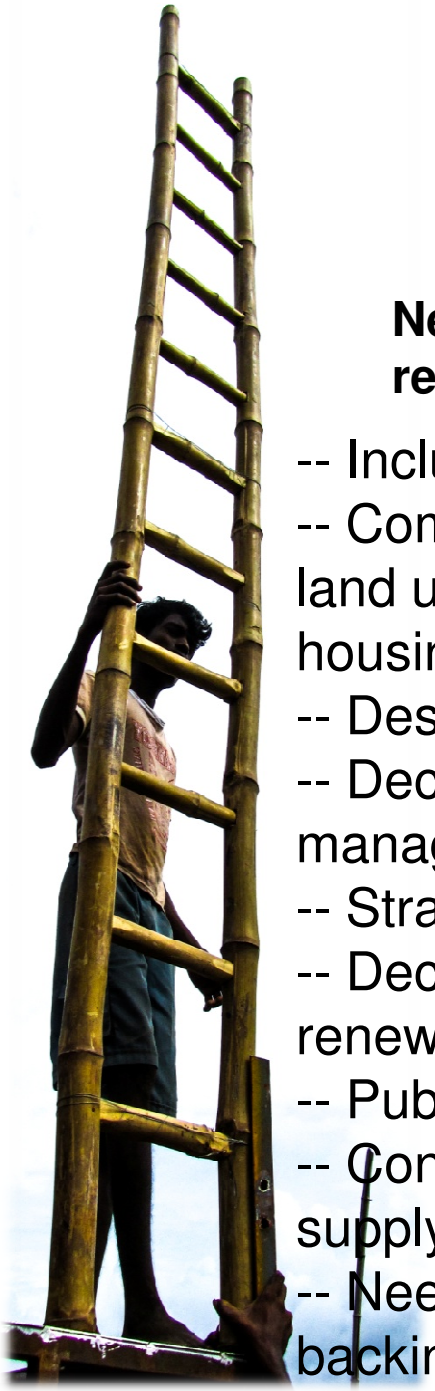
Chennai airport on a river



Mumbai

The Maharashtra 2005 floods killed around 5,000 people and affected 20 million people

Mithi river reclaimed….drainage disrupted



Get the principles right….

Need clear guidelines and mandate to enable change … reduce footprints

-- Inclusive and equitable use of urban space
-- Compact form – small block sizes, density norms, mixed land use, mixed income neighbourhood, affordable housing, dense and permeable streets with active edges, etc
-- Design and implement sustainable infrastructure
-- Decentralized water conservation and waste water management and reuse facilties
-- Strategies to minimise waste
-- Decentralized, sustainable energy management and renewable energy
-- Public transport connectivity and the last mile
-- Consumption based billing. Metered water and electricity supply etc
-- Need integrated land use and transport plan with legal backing…..Reform municipal governance….

Let's begin the discussions…