Buildings: Environment Connection
The big picture

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Dialogue on Sustainable Buildings

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Beginning of a conversation
Urban explosion

-- By 2025 around 65 per cent of the world’s population is projected to live in cities – equal to the global population in 1986.
-- A billion more will be added over the next three decades in Asia – almost adding a whole new India. More than half of them will be living in cities

India’s urbanisation is still modest at 30 per cent and is expected to be 40 per cent by 2030. But this is more than the population of the United States.

India’s urban mosaic

Skewed growth: 70% of urban population are in about 400 cities. The rest in about 4000 towns and cities. About one third of the total urban population in the megacities.

Shadow growth: Top rung cities show strong trend towards suburbanisation.

Slow growth at the bottom: Lower rung towns stagnating. Some have grown due to infrastructure investments and rural to urban migration.
City: The focal point of climate mitigation and energy security discussions

Cities: the central focus of discussion in the Rio+20 conference ....

Energy Outlook 2009 tracks cities for the first time

Already two-third of world’s energy is consumed in cities – by half of world’s population.

By 2030 cities will be consuming 73% of world energy.

Globally cities account for 70% of CO2 emissions.

Big increase in global CO2 from increase in floor space in buildings of various types, -- especially in non-OECD countries.

Massive increase expected in ownership of household appliance

CITIES collectively consume 75% of world natural resources, generates 50% of waste, and emits 70% of greenhouse gases.
Cities: Energy guzzlers

Global cities under pressure to mitigate setting targets and deadlines for CO2 reduction......

London – 60% by 2025
Paris: -- 25% by 2020
Toronto – 30% by 2020; 80% by 2050 from 1990 level
Tokyo – 25% by 2020 from 2000 levels

Indian cities to frame climate mitigation plan and targets

Energy security challenge

Bigger Indian cities guzzle more fuel
Total CO2 equivalent emissions (million tons/ annum) classified according to different population classes of cities

Source: Based on data provided in ‘Energy and Carbon Emission Profile of 53 South Asian Cities’, published by ICLEI, British High Commission and Census of India 2001 for city population data
**Middle class growing rapidly:**
The 2010 McKinsey study on urban infrastructure estimates that the seeker class (with household income of 200,000 – 500,000 per annum) will be the most dominating income class and 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, live 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)
Track and record building typologies for better planning

Very poor data base on trends in building spaces in India:

- Ministry of housing and poverty alleviation tracks demand for housing but not other built up areas. Planning commission and others on trends in the construction sector. But buildings are a very small component of the construction industry…..

- Real estate service providers, investment banks, and research foundations are the principal source of information……But very opaque and not verifiable……

- A few cities – Hyderabad, Bangalore, Chennai, Delhi, Mumbai have a little better data due to new growth etc.

**Disparate estimates make a curious jigsaw ..... But indicative of an explosive trend:** Eg. Constructed area in 2005: close to 25 billion square feet. Expected to be 5 times and reach to approximately 104 billion square feet by 2030. A CAGR between 5 to 10 percent to be achieved ….. Hospitality and Retail to achieve higher CAGRs -- 8–10%. By 2030, -- 7 to 11 times of the level in 2005. Maximum growth in residential and commercial sector -- four to five times of 2005 figures. (EDF)

**Very poor data on building typologies:** No data on numbers, type, size, use of construction material, natural ventilation, etc. Need good data base for better planning and targeted reduction in energy consumption
**India’s challenge:** The ECO-III forecasts - 70% of building stock that will be there in 2030 is yet to come up in the country.

**Developed countries,** a very small addition is made to the building stock each year. In the UK, at least 80% of the homes to stand in 2050 have already been built. In France buildings constructed before 1975 thermal regulations will represent over 50% of the building stock in 2050.
**Metro cities: explosive trend**

**Office stock** must increase nearly 20 million sf/ year in New Delhi, Mumbai, Bangalore to meet growing demand;

**Commercial floor space to increase 5-6% a year:** Space of shopping malls 79 million sf in 257 centers are estimated in 15 largest cities of India (BEE) Energy intensity will increase due to higher levels of lighting and equipment in commercial spaces.

**Suburbs: new growth and resource conflict areas**
- 95% of new residential projects in suburbs
- 60% of operational office spaces in metro cities in suburbs
- More than half of retail spaces in suburbs (J Lange)
Challenge of residential space

Residential space: Planning Commission: The housing shortage to be more than 26 million housing units for all income classes.

The government to focus more on EWS and LIG: RAY -- 20-25% of developed land in all housing projects (both public and private agencies) for EWS/LIG with cross-subsidization. These need designs for improved comfort..

Middle and high income housing: More private players. Eg. CREDAI - association cover 80% of the real estate development in 13 states. Scope of corporate social responsibility.
Towns made to order

**Town boom**: IDFC’s India Infrastructure report 2009:
-- the size of private ‘integrated’ townships ranges from 100 to over 1000 acres.
More than 200 such townships planned -- especially around the metros.

Touted as Walk to Work Green Towns – without green benchmark

**Urban planning in existing towns: an opportunity**
-- 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
Green worries?...............
Buildings: earthscrapers

Burden of Built Environment

SHARE OF BUILT ENVIRONMENT IN RESOURCE USE

<table>
<thead>
<tr>
<th>RESOURCE</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Energy Use</td>
<td>40</td>
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<tr>
<td>Raw Material Use</td>
<td>30</td>
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<tr>
<td>Water Use</td>
<td>20</td>
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<tr>
<td>Land</td>
<td>20</td>
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SHARE OF BUILT ENVIRONMENT IN POLLUTION EMISSION

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<thead>
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<th>POLLUTION EMISSION</th>
<th>Percentage</th>
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<tr>
<td>CO2 Emission</td>
<td>40</td>
</tr>
<tr>
<td>Solid Waste Generation</td>
<td>30</td>
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<tr>
<td>Water Effluents</td>
<td>20</td>
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Electricity Use in the Commercial Sector is exploding, climatic zone-wise and building-use-wise.

Residential sector consume nearly the highest
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 and sustainability**

**Environment Impact Assessment (EIA)………..**
First generation action in Delhi

Initiated and proposed

-- Cool roof programme initiated

-- Implementation of ECBC in government buildings

-- Revision of master plan

-- Fulfill the targets of Enhanced Energy Efficiency Mission to retrofit 100 existing buildings with area above 10,000 sq ft

-- Delhi secretariat to be converted into a green building. About 15 more government buildings identified

-- Solar water heater system mandatory in industries, hotels, hospitals, nursing homes, and residential buildings with 500 sq meter area. Subsidy for purchase of solar water heater etc

-- Proposal for a solar city in the NDMC area
Cool roof: Low hanging fruit

Need cool roof programme – Light reflective surface; vegetative cover; etc
LBNL and IIIT-H study found annual energy savings in range of 13-14 kWh/m² with cool roof in a commercial building in Hyderabad. For a building with 150 sqm roof area this saving can be worth Rs. 14,700.

Assess methods –
-- Most paints are toxic and do not last more than four years. Consider white tiles etc.
-- The glare from the reflective roofs can annoy nearby high rise buildings.
First generation action in Haryana

Much ahead of others.........

-- Implementation of ECBC in government buildings.
-- Modification of municipal building bye laws
-- Amended schedule of rates to include energy efficient materials
-- CFLs, water heating system, street light luminary system introduced
-- Energy efficient building module for replication
-- Monetary incentives for architects and buildings that adopt energy efficiency measures
-- Announced financial support in bearing energy audit costs for various commercial buildings
-- Capacity building programmes
Second generation challenge........need scale and impacts
-- **Scalability**: The challenge is 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**: The challenge of including not just a few top end large buildings but mass construction. Ensure much larger aggregate savings. Need low cost energy saving measures

-- **Retrofit existing stock**

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

-- **India still has a large stock of very low-energy homes**: Leverage this to achieve much better energy targets. Do not lock up more energy by design
Can we have targets?

Can all/large new buildings have energy performance targets by 2020?

Can substantially large number of 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?

Are these questions premature?

How will ECBC help to make the second phase of transition?
Impact of energy efficiency measures on the EPI of commercial buildings (office and hospital buildings)

Energy Conservation Building Code – for five climatic zones

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

Low carbon strategy of the Planning Commission
Possible to make massive cuts in energy usage

Source: EDS, 2010
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 verifiable as no credible sample survey or scientific study

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 neither of the agencies have shared any sort of performance data with nodal agency.
Prescriptive method: Provides step by step directions for all sections – building envelop, lighting, HVAC etc -- and set the minimum requirements. This is a rigid system

The whole building method uses the simulation models of buildings to verify that the total integrated design is ECBC compliant. This allows innovation and creativity

Cities find it easier to implement prescriptive method.

Where do we want to take this?
principles vs benchmark
New construction is expected to have high energy consumption. Code sets the limit for level of heat transfer through the building envelop; sets energy performance standards for heating, cooling etc.

Towards high performance approach...

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 (R-value) to ensure rapid uptake of high performance insulating material in air conditioned buildings.

Increasing demand of air conditioned building increasing demand for high performing insulation. ....

-Insulation materials -- mineral wool, rock wool, vermiculite, foams, expanded polystyrene, extruded polystyrene among others
Should we assume 100% AC requirement?

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

Can we look at more creative methods? Buildings without HVAC systems will need whole building performance method. But Code mandates sealing of enclosed building envelop to minimize air leakages from all fenestrations – thus blocks scope of natural ventilation needed for thermal comfort of non-air conditioned space.

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

Other concerns…..Increased use of expensive, imported and environmentally inappropriate materials. Environmental lifecycle effects not accounted for: Glass wool, rockwool are bad for health. Thermocol (polystyrene) is less stable, releases gases through process of degradation ………
Adapt comfort......avoid ‘oven vs refrigerator syndrome’

AC performance is directly linked to its temperature setting. ECBC has not set thermostat standards. Lower temperature means more electricity.

The National Building Code puts the desirable indoor temperature during summers at 27.5°C.

CEPT study: reducing a temperature of thermostat below 26°C leads to increase in cooling load at the rate 10 per cent per degree centigrade. AC's efficiency could drop by 3% to 10% with every degree lower than this.

Global good practice

South Korea and Japan have regulation that forbids commercial units to reduce their temperature settings below 26°C and 28°C respectively. Sri Lanka has set it at 26°C.

Bushirt Rule in Japan
Ensure total energy performance of buildings 
....reduce need for cooling

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 technology –complex technological package requiring high investment …Eg. Special glazing technology

Low cost simple Technology for enhanced environmental and functional performance

Cavities in the walls insulate an apartment in Bellary, Karnataka (Photo by Ashok B Lall)
What is this paradigm?
Where does this belong?
Where does this belong?

Shillong

Gauhwati

Gauhwati

Agartala
Five climatic zones defined under ECBC

Yet for some critical parameters it prescribes the same norms for all zones.............

Eg.
The prescribed R-values for the overall roof and wall assemblies are the same for four of the five climatic zones.

It allows 60% WWR in all climatic zones
Northeast is different from East India, then why put it in same category
Dazzled by Glass

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… ECBC allows a maximum wall-to-window ratio (WWR) of 60 per cent.

Make its use strategic. Different orientations require varying WWR.
Ask why?

Air tight glass building in hot and humid climate of Chennai

Why?.............?
Ask why?

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

Then Why so much glass? And how come Gold rated?

-399,280 kWh

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

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
Eastern region’s own wisdom

(Photographs: *Courtyards Houses of Kolkata: Bioclimatic, Typological and Socio-Cultural Study* by Nibedita Das)
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
Rizvi house
- NE-SW orientation.
- Openings and the entrance on 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 facilitates shaded spaces and ventilation through openings facing the courtyard.
- The projection of the courtyard provides shade from direct solar radiation
- The jharokhas catch wind and allow air circulation.
- Massive walls and heavy roofs offer greater thermal resistance and increase the time lag.
- The exterior of the building is white washed which helps in reflecting solar radiation.

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

Shell roof and the 25 kWp solar photovoltaic plant
Paradigm shift in building material

Promote locally appropriate, locally available material with low embedded energy……

The new policy expected to incorporate measures to promote the use of green materials to create sustainable buildings.

This may be looked at as an opportunity to use alternate building materials.

Availability of appropriate material as listed in schedule of rates difficult to source….

Thermal properties of most of the local material not always known
Implementation challenges

Design stage scrutiny for ECBC compliance

Checks during construction, at construction site or at the time of giving completion certificate.

How building commissioning system can ensure that it is built according to the planned design and is ready to perform ....

Need continuous monitoring system

Need indicators for performance
Sri Lanka

-- Covers all commercial buildings, industrial facilities and large scale housing developments – with any of the four features -- four or more stories, floor area 500 m2 or more, air-conditioning cooling capacity of 250 kW or more apart, electrical power demand of 100 kVA or more

-- The energy code compliance expires every 3-5 years and needs to be revalidated. This ensures maintenance throughout their life-span.

-- CPEEB also prescribes efficiency standards for the mechanical equipment and appliances. But for building envelop it seeks relative efficiency of the complete envelop measured by the Overall Thermal Transfer Value (OTTV). This makes is relatively easier to adopt at large scale and less complex capacity development.

-- Mandates temperature setting at 26 degree centigrade for design of HVAC systems. It even takes into account the adaptive comfort conditions.

-- Energy audits and energy data reporting
EIA: A lost opportunity

Only comprehensive legal instrument that addresses environmental and resource impacts of high impact buildings comprehensively – land, water, energy, waste, pollution, etc

Legally binding under the Environment Protection Act

Influence much larger built up area than any other: Eg -- from energy stand point compare -- EIA and ECBC.
Only in Haryana, -- about 927 buildings reviewed for environmental clearance between 2008-2011. The area data for 446 buildings shows -- 8,29,89,836 square meters.
In contrast, according to the BEE website the ECBC registered buildings nationwide accounted for 829,787 sq meter until 2010.

How can we realise the full potential of this instrument?
Promising tool... but a blunt tool............

Why EIA is not working effectively for buildings?

Form 1 and 1A are not as exacting as the detailed EIA for industrial and mining projects

Construction can precede consent ... blunts the edge

Escape routes ... the phenomenon of 19,999 sq mt............

No clear siting policy .......... Very weak post construction monitoring

No follow up on compliance reports

No public consultation

Inadequate resources and staff .......... and many more....
For each sector Form 1 and Form 1A demand some information……

Eg – on Energy it demands to know --
-- Power requirement
-- Application of glass in buildings
-- Renewable energy application
-- Passive solar architectural features
-- Lighting, ventilation, space conditioning
-- Thermal characteristics of the building envelop
-- Impact on micro climate
-- safety etc

No formal linkage with ECBC

But can this make a difference?………..

No clear numbers and benchmark; Sometime response as generic as – “All relevant features like orientation of building, shading effect will be incorporated…” On thermal characteristics of buildings — “in accordance of ECBC„„
EIA could not prevent Gurgaon dilemma…….

Privatised new towns…….
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
-- Due to acute power shortage heavy dependence on generator-sets
-- Violation of development rules related to open spaces and community services
Green rating of buildings

Voluntary green rating schemes growing in popularity globally.

<table>
<thead>
<tr>
<th>Country</th>
<th>Rating system</th>
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<tr>
<td>United States</td>
<td>Leadership in Energy &amp; Environmental Design (LEED-United States)</td>
</tr>
<tr>
<td></td>
<td>The Green Globe Rating System</td>
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<tr>
<td></td>
<td>Energy Star (United States Environment Protection Agency)</td>
</tr>
<tr>
<td>Canada</td>
<td>Leadership in Energy &amp; Environmental Design — Canada (LEED Canada)</td>
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<tr>
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<td>Green Star</td>
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<td></td>
<td>Australia Greenhouse Building Rating (AGBR)</td>
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<tr>
<td>United Kingdom</td>
<td>Building Research Environment Assessment Method Consultancy (BREEAM)</td>
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<tr>
<td>Europe</td>
<td>European Environment Agency rating</td>
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<tr>
<td>Hong Kong</td>
<td>Building Environment Assessment Method-Hong Kong (HK-BEAM)</td>
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<tr>
<td>Japan</td>
<td>Comprehensive Assessment System for Building Environment Efficiency (CASBEE)</td>
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<tr>
<td>Taiwan</td>
<td>Ecology, Energy Saving, Waste Reduction and Health (EEWH) (Taiwan)</td>
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<tr>
<td>Singapore</td>
<td>BCA Green Mark</td>
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<td>Philippine</td>
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<tr>
<td>India</td>
<td>GRIHA</td>
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Greening of building spaces

Details on green rating systems in India

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<tr>
<th>Heads</th>
<th>LEED/IGBC</th>
<th>GRIHA</th>
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<tr>
<td>Inception year</td>
<td>2001</td>
<td>2007</td>
</tr>
<tr>
<td>Total buildings registered</td>
<td>2,111</td>
<td>375</td>
</tr>
<tr>
<td>Total buildings rated</td>
<td>362</td>
<td>NA</td>
</tr>
<tr>
<td>Square ft registered</td>
<td>1,450 million</td>
<td>118 million</td>
</tr>
<tr>
<td>Square ft rated</td>
<td>NA</td>
<td>NA</td>
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Source: IGBC and GRIHA website

Yet another estimate shows that about 730 million sq ft. have been rated. That is a mere 3 per cent of the existing built up area of 25 billion sq ft. Miniscule!
Voluntary rating schemes work on reputation advantage. It stimulates market and speeds up market uptake of green features. But as private voluntary schemes these remain outside the pale of regulations.

But now the voluntary rating programmes are getting linked with official incentive programmes.

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

**Maharashtra government:** Increased floor space index; reduced consent fee; rationalisation of property tax; reduction in state taxes etc. Pimpri Chinchwad

**NOIDA, UP:** NOIDA authority awards 15 per cent extra FAR (floor area ratio – extra built up area) to projects which commits for LEED gold rating.

**Ministry of Renewal Energy** incentives for on-site renewal system

**Union Environment Ministry** allows separate queues for environmental clearance for fast track clearance to buildings that are pre-certified for GRIHA and LEED.

This demands performance monitoring
Opaque system: There is no data and information on the performance of the green rated buildings. Even in cases where rating systems have been promoted with government back up and incentives there is no record of the actual performance of the buildings.

No performance monitoring and reporting: The Government of India as well as state/ local governments are beginning to give incentives for rated buildings. But no official system for regular monitoring, reporting of information on actual performance of buildings.

No strategy to improve public acceptance of the green rating systems: Documentation of the efficiency measures in buildings and their performance is essential to build public support and acceptance of these programmes. But there is very poor level of information on the applications, costs and pay backs in the public domain.
Globally rating systems are being made more accountable………..

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

Eg. In the US the US Green Building Council -New Buildings Institute study of 2008 showed wide variability in LEED energy performance which was a cause for concern.

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

This demands performance based green rating
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.
Appliances and behaviour ........ An opportunity
Varying pattern of end use of energy ……

**HVAC use up maximum energy in commercial buildings**

- Lighting: 25%
- Internal Loads: 15%
- Others: 5%
- Heating, Ventilation and Air Conditioning (HVAC): 55%

**Fans and refrigerators use maximum energy in residential buildings**

- Lighting: 28%
- Refrigeration: 13%
- Evaporative Cooler: 4%
- Others: 10%
- TV: 4%
- Fans: 34%
- Air-Conditioning: 7%

Lighting and AC use up 80 per cent of the energy in a commercial building. AC market is growing at 25% a year.

Source: Bureau of Energy Efficiency
Ownership of Appliances in India Growing Rapidly

By 2030, more than 70% of the stock of appliances will have been added just after
Can we have energy prudent society?

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

**Impacts**

Labelling is encouraging shift to efficient models in some categories.

- In 2009-10 and 2010-11, 85-90% of labeled frost free refrigerators were 4 or 5 Star.

- But room ACs, -- only 15-20% are 4 or 5 Star, but increasing.

- Appliances without mandatory labelling, -- large fraction are unlabeled.-- Only 2% of ceiling fans are labeled.

Estimates From Daljit Singh 2011, Prayás
But…..

Energy losses from rebound effect

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

-- Study (WBCD) -- people may increase usage after installing efficient lights -- Lose up to 12% of the expected energy savings by leaving them on longer. Efficient furnace lose up to 30% because people raise the thermostat.

-- Use a range of energy indicators -- absolute total usage; Per person per year; Per square meter per year -- to track change.

-- Need policies to influence behaviour – 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%.

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

-- Special challenge of captive power generation – Solar and gen sets
Poor persons home are not energy guzzlers. But need design innovation to improve comfort……
Greening of poor people’s home

Not just resource efficiency in rich person’s home. Green measures needed to improve comfort and efficiency of poor people’s home

Slum development plans can be leveraged. In Odisha slum population has grown by 78% over last decade

Good practices -- Eg. SAM-BKL project of IGSS: In 2008 ‘Micro Home Solutions’ – Night shelters: designed comfortable shelter with canvas, chicken mesh, bamboo and ropes

-- Design innovations in low cost homes

DHS- Design Home Solutions

Source: Micro Home Solutions

Opportunity for affordable housing in Rajarhat New Town
Need high density development: Cities to set norms

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.

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

Source: Kolkataskyline.wordpress
Only 1 per cent of Delhi’s population live in Lutyen’s Delhi.

Most part of urban boom – housing and commercials have been 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

Massive illegality: About 49% lives in slums, unauthorized colonies -- 860 jhuggi-jhonpris
Why this difference in urban form?

Kolkata city

New Town Kolkata
Low density can lead to sub optimal use of metro
Metro Corridor – Density disparity – The Yellow Line

- Chawri Bazar
- Race Course
- Green Park
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
Delhi framing Transit Oriented Development Policy (DDA/UTTIPEC)

Density minimums as per the table below:

<table>
<thead>
<tr>
<th>Gross FAR (site)</th>
<th>Minimum permissible density (with ±10% variation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Residential dominated project (Residential FAR ≥ 50%)</td>
</tr>
<tr>
<td>Below 1.0</td>
<td>Under-utilization of FAR (not permitted)</td>
</tr>
<tr>
<td>1.1 - 2.0</td>
<td>200-400 du/ha</td>
</tr>
<tr>
<td>up to 3.0</td>
<td>400-600 du/ha</td>
</tr>
<tr>
<td>3.1 - 4.0</td>
<td>600-800 du/ha</td>
</tr>
</tbody>
</table>

* 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.
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

<table>
<thead>
<tr>
<th>Hierarchy of Facilities</th>
<th>Accessibility Standard from each home/ work place:*</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRTS Station</td>
<td>Approx. 800 m or 10 min walk</td>
</tr>
<tr>
<td>Metro feeder/ HOV feeder Stop</td>
<td>Approx. 400 m or 5 min walk</td>
</tr>
<tr>
<td>Bus Stop</td>
<td>Approx. 400 m or 5 min walk</td>
</tr>
<tr>
<td>IPT/ auto-rickshaw Stand</td>
<td>Approx. 250 m or 3 min walk</td>
</tr>
<tr>
<td>Cycle Rickshaw Stand</td>
<td>Approx. 250 m or 3 min walk</td>
</tr>
<tr>
<td>Cycle Rental Stand</td>
<td>Approx. 250 m or 3 min walk</td>
</tr>
<tr>
<td>Shared private parking garage</td>
<td>Approx. 500 m or 6 min walk</td>
</tr>
</tbody>
</table>
High rise vs high density

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.

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
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).
Building and the neighbourhood.....
Mitigate traffic impacts of buildings

Eg EIA provides for traffic impact assessment of buildings. But rarely assessed.…

But --- There is no provision for demand management to mitigate traffic impact in the surrounding areas.

Cumulative impact of the construction on the carrying capacity of the surrounding areas not addressed.

Self reported plans provided by the project proponents are not cleared by any assigned authority

Make traffic related clearances from competent authorities mandatory
But..................

Poor walking access

Footpaths for beautification

Source: CSE

No mid block crossings for pedestrians – Advantage to vehicles
Low density car centric growth: wasteful use of valuable urban land

This kind of road and transport infrastructure will lock up more energy and undermine building efficiency gains

- In Sri Lanka – buildings also report transport energy use
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.
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.

**Slow down vehicles on Roads :**

- No more signal free corridors- signalize existing ones.
- Remove gates on public streets from gated colonies from vulnerable areas.
Need financial mechanism..

Financial mechanisms can make energy savings more valued by those involved in the development, operation and use of buildings.

Need transparency in energy use and cost in the building value chain

• Split incentives between building owners and users -- the returns on energy efficiency investments do not go to those making the investment

Inexpensive loans for green buildings and retrofitment (Eg. France – Zero Rate Eco loan to property owner to improve energy performance of buildings)
Lessons from first generation action
Cities need clear roadmap and targets on green building construction and operations

Legal framework
-- Enforce building energy codes. Make them progressively more stringent
-- Need measurable results from post-occupancy valuation of buildings – Audit energy performance.
-- Sub-metering controls and charging according to use; Incentive based billing
-- Labeling systems

Incentives and subsidies for green buildings

Capacity building for architects, engineers, developers; understanding of code requirements; technical tools for execution
-- Introduce process incentives for developers for integrated design approaches to urban planning

Need integrated approach to zoning laws and town building norms
Peoples’ participation in planning (eg. Global best practices -- Friedburg, Germany).

Renewable energy application -- Onsite renewable generation for buildings.
-- Feed-in tariffs for on-site generation
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 (eg. Global best practices -- Vaxjo, Sweden – 30% decline in city GHG but 20% increase in regional GDP).

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