Politics of Resource and Ratings

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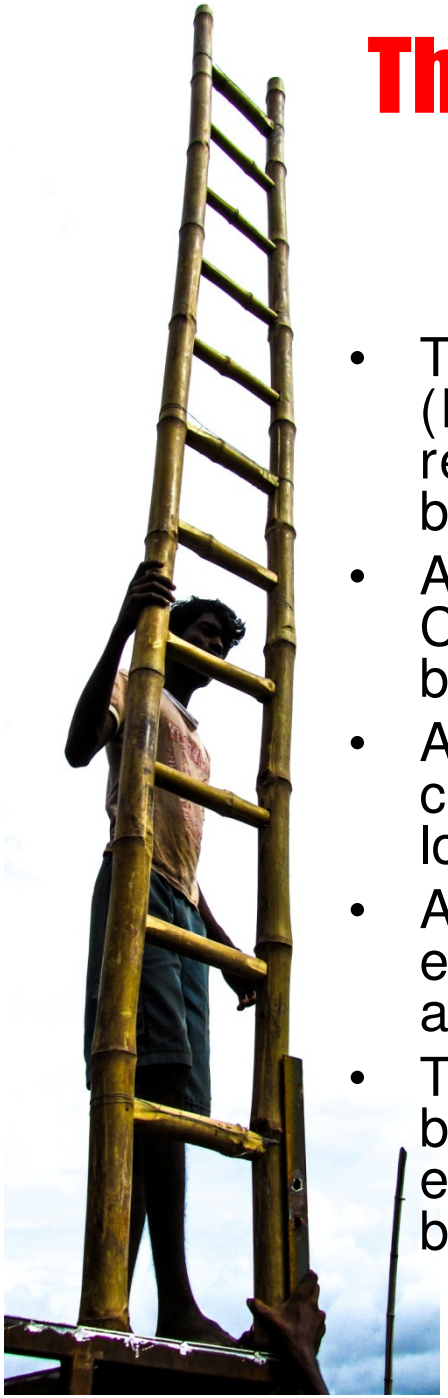
Regional Dialogues: Building Sense Towards Sustainable Buildings and Habitat

BV Rao Hall, Patrakar Bhavan, Pune, November 10, 2015



The Energy Conservation Act, 2001

- The Energy Conservation Act, 2001 (EC Act) had asked for steps to reduce the demand for energy in buildings;
- Amendment of the National Building Code to facilitate energy-efficient buildings;
- Adoption of innovative approaches; compulsory energy audits for all loads above 1 MW;
- Amendment of building bye-laws to enable use of solar water heaters, among other things.
- To "prescribe energy conservation building codes for efficient use of energy and its conservation in the building or building complex."

EPI - Energy Performance Index

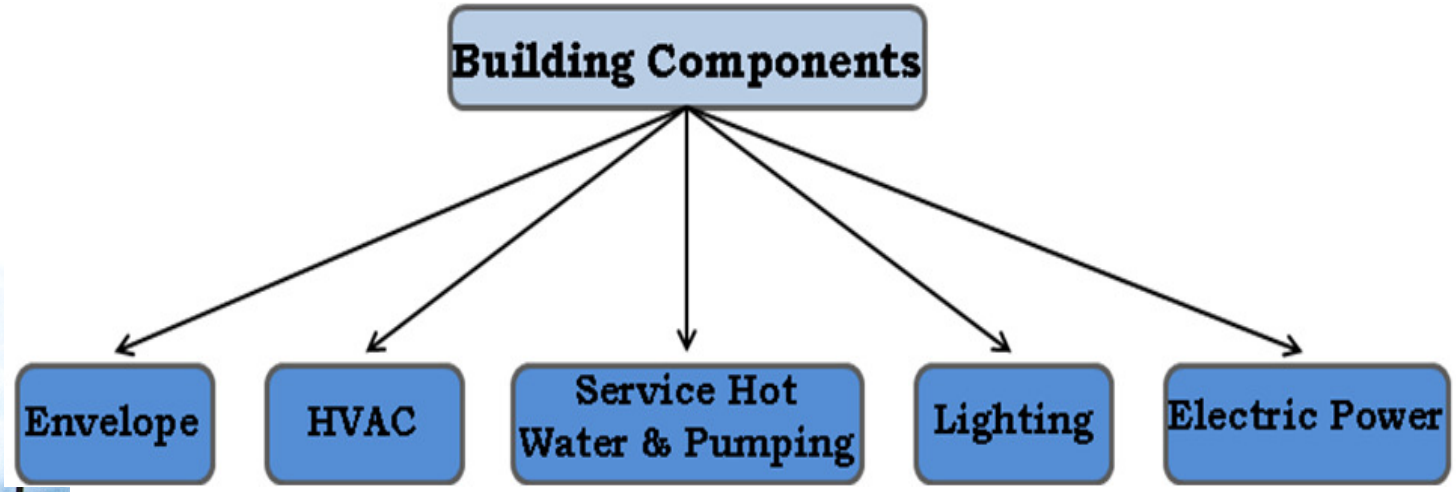
The Energy Conservation Act, 2001 says that energy consumption of buildings needs to be measured and expressed as **energy consumption per square metre of area** and the location of the building.

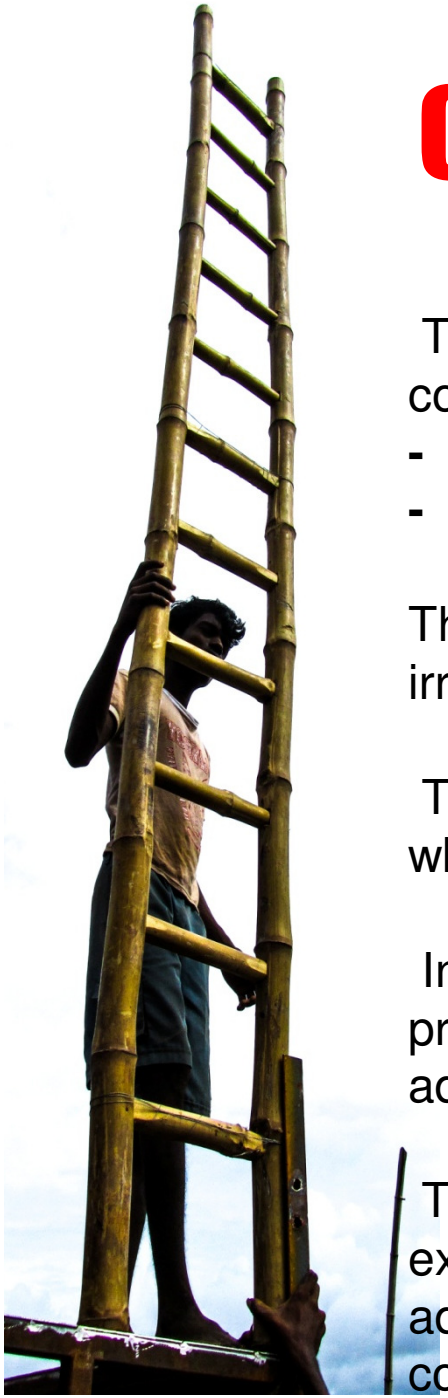
BEE claims than an average commercial building in India has an EPI of **180-200** kWh/ sqm/year

Energy Conservation Building Codes (ECBC)

According to Energy Conservation Act 2001, "energy conservation building codes" means the norms and standards of energy consumption expressed in terms of per square meter of the area wherein energy is used and includes the location of the building.

All commerical buildings with connected electricity load of 100 kW or contract demand of 120 KVA are to adhere with ECBC.





Compliance methods

There are two ways in which a building may be proven to be ECBC compliant:

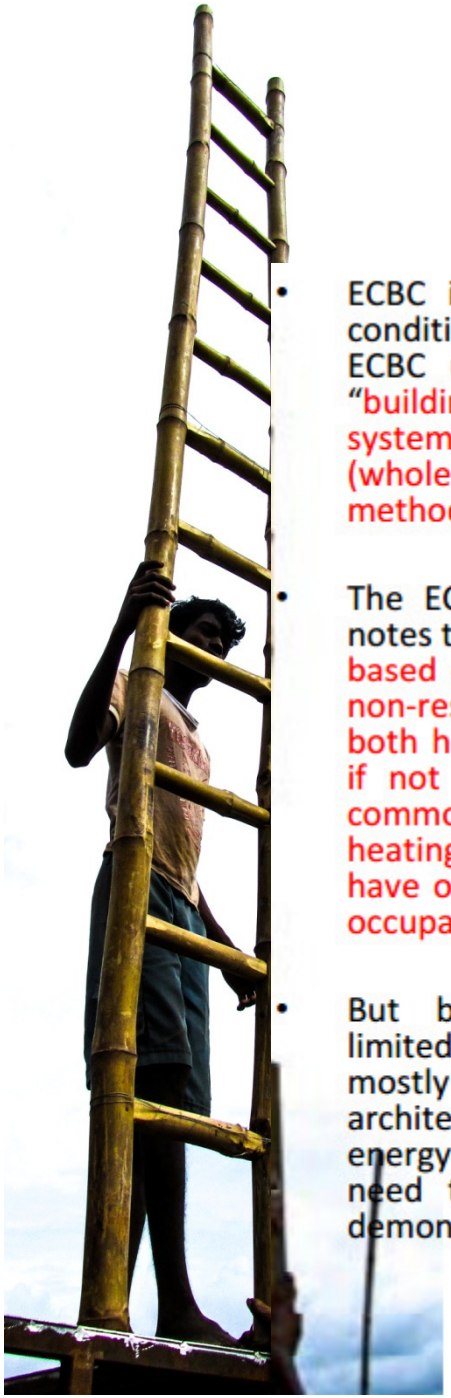
- **Prescriptive Method**
- **Whole Building Performance Method**

There are some mandatory requirements which must be followed irrespective of the choice of method of compliance.

The main difference between the two methods lies in the manner in which the energy performance of the building is ascertained.

In the former, the minimum thermal or performance values are prescribed for every component of the building and must be adhered to.

The latter method employs computer simulation programs. With the exception of the mandatory requirements, the remainder are adjudged considering the entire building and not individual components.

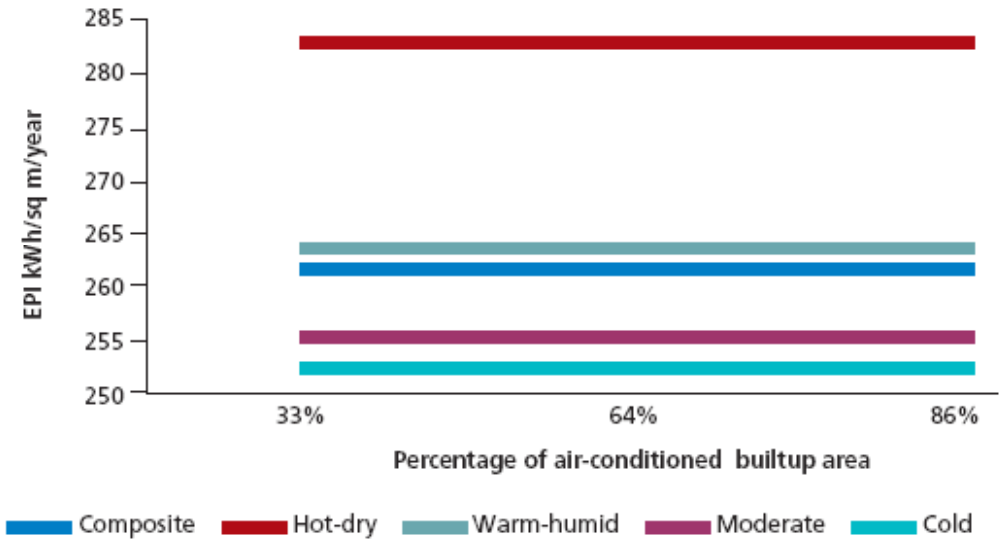


AC - EPI disconnect

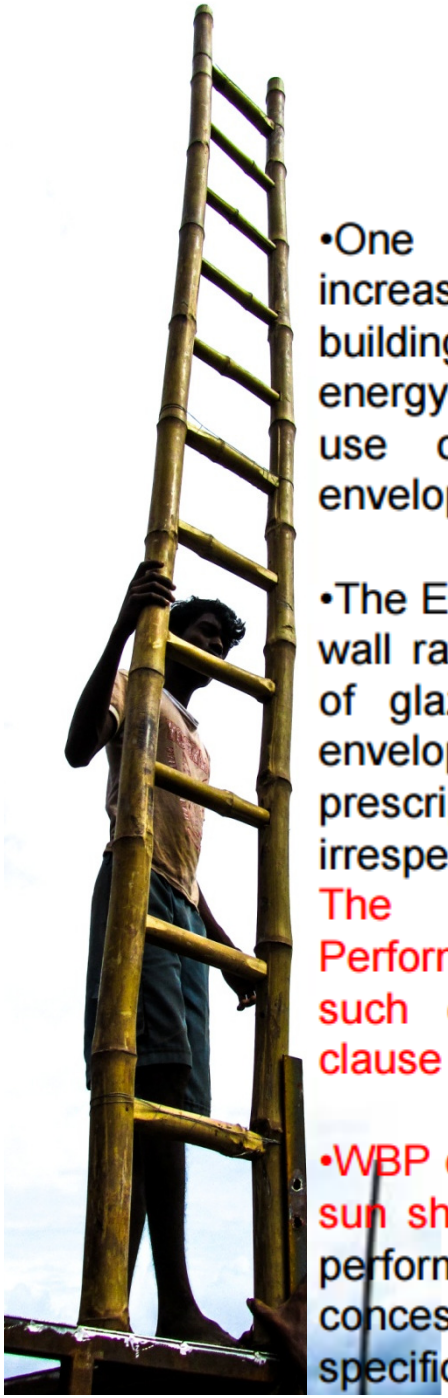
- ECBC is meant for fully air-conditioned buildings. The ECBC user guide notes that "buildings with no HVAC system cannot use the WBP (whole building performance) method."
- The ECBC user guide further notes that "the WBP method is based on the assumption that non-residential buildings are both heated and cooled. Even if not installed initially, it is common for buildings lacking a heating or cooling system to have one retrofitted by future occupants."
- But buildings with no or limited HVAC systems will mostly rely on passive architecture to improve energy efficiency, and they will need the WBP approach to demonstrate compliance.

GRAPH 6: THE CONDITIONING-EPI DISCONNECT

Variations in EPI of the proposed model with variations in percentage of conditioned area within the proposed building across climatic zones



Source: CSE, 2013



Window to Wall ratio

- One of the key drivers of increased cooling load in new buildings and, therefore,high energy demand is the extensive use of glazing in building envelop.

- The ECBC caps the window-to-wall ratio (WWR), the measure of 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.

- WBP doesn't allow modeling of sun shades to improve thermal performance but gives concession on glass specifications if they are

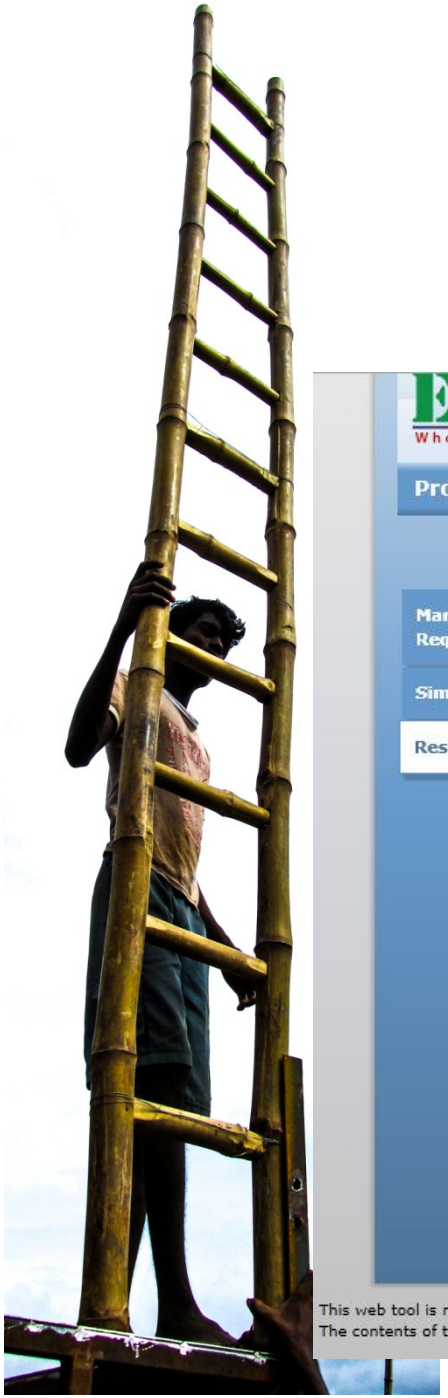
TABLE 2: SPECIFIC ENERGY DEMAND IN AC BUILDINGS

More window area means less energy demand for lighting, but hikes overall energy use due to increased demand for cooling

Window type	Window area % to floor area	Climatic zone	U-value of the building[1] (W/m^3K)	Energy demand per unit area ($kWh/m^3/a$)
Single glazed	10	Hot & dry	1,716	324 (61-69)*
Single glazed	20	Hot & dry	1,892	400 (45-46)*
Single glazed	10	Warm & humid	1,713	380 (65-69)*
Single glazed	20	Warm & humid	1,887	418 (44-47)*
Single glazed	10	Composite	1,711	339 (44-70)*
Single glazed	20	Composite	1,883	376 (35-44)*
Single glazed	10	Moderate	1,693	148 (68-72)*
Single glazed	20	Moderate	1,847	163 (44-46)*
Single glazed	10	Cold & cloudy	1,681	151 (74-79)*
Single glazed	20	Cold & cloudy	1,823	157 (46-54)*
Single glazed	10	Cold & sunny	1,687	530 (65-67)*
Single glazed	20	Cold & sunny	1,835	600 (38-43)*

Note: *The values given in parenthesis are the annual lighting energy demands in various climatic zones and their variations depending upon the orientation of the window; they are inclded in the total energy demand.

Source: Anon 2004, *Indian Urban Building Sector: CDM Potential through Energy Efficiency in Electricity Consumption,* Hamburg Institute of International Economics



Compliance at 390 EPI

ECO nirman
Whole Building Performance

About Help

Project: test 3

Save | Return to Project List

Project Information | Building Use | Envelope | HVAC | Conformance Check

Mandatory Reqs.
Simulation
Results

Conformance Results

	Proposed Design	Standard Design	Difference
Number of hours any zone outside of throttling range	272	263	+9
Number of hours any plant load not satisfied	0	0	0
10.3.2(e) of ECBC Satisfied?	Yes		
Annual Energy Use (kWh/yr)	383,141	387,342.5	-4,201.5
EPI (kWh/yr/m²)	383.14	387.34	-4.2
Mandatory Requirements have been satisfied?	Yes		
Proposed EPI is less than or same as Standard?	Yes		
Building is in Conformance with the ECBC?	Yes		

Report

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BEE Star label for buildings

Table for Building Energy Star Rating Programme
More than 50 % air conditioned built up area

Climatic Zone- Composite

EPI(Kwh/sqm/year)	Star Label
190-165	1 Star
165-140	2 Star
140-115	3 Star
115-90	4 Star
Below 90	5 Star

Climatic Zone - Warm and Humid

EPI(Kwh/sqm/year)	Star Label
200-175	1 Star
175-150	2 Star
150-125	3 Star
125-100	4 Star
Below 100	5 Star

Climatic Zone - Hot and Dry

EPI(Kwh/sqm/year)	Star Label
180-155	1 Star
155-130	2 Star
130-105	3 Star
105-80	4 Star
Below 80	5 Star

Table for Building Energy Star Rating Programme
Less than 50 % air conditioned built up area

Climatic Zone- Composite

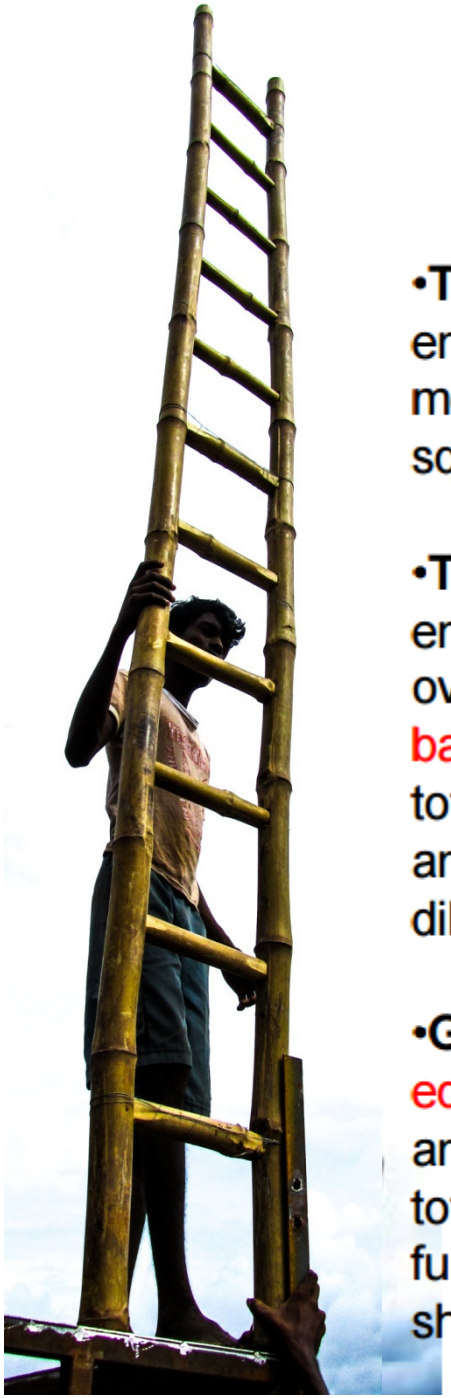
EPI(Kwh/sqm/year)	Star Label
80-70	1 Star
70-60	2 Star
60-50	3 Star
50-40	4 Star
Below 40	5 Star

Climatic Zone - Warm and Humid

EPI(Kwh/sqm/year)	Star Label
85-75	1 Star
75-65	2 Star
65-55	3 Star
55-45	4 Star
Below 45	5 Star

Climatic Zone - Hot and Dry

EPI(Kwh/sqm/year)	Star Label
75-65	1 Star
65-55	2 Star
55-45	3 Star
45-35	4 Star
Below 35	5 Star

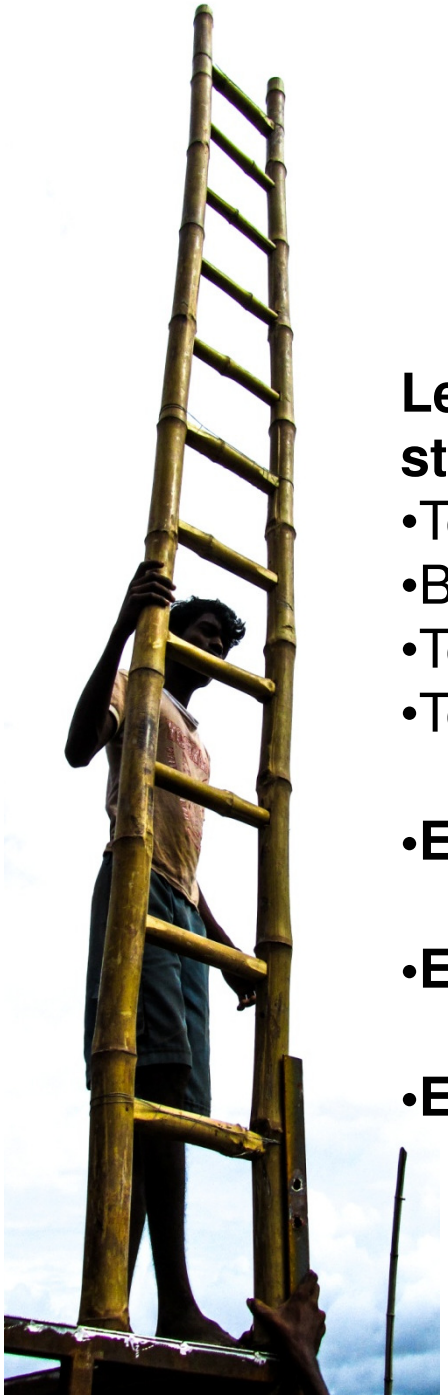


EPI calculation game

•**The Energy Conservation Act, 2001** says that energy consumption of buildings needs to be measured and expressed as energy consumption per square metre of area and the location of the building.

•**The Star Rating Programme of BEE** includes all the energy purchased and/or generated by the building over a year. But calculation excludes area of the basement area, which is used for parking, from the total built-up area. The logic is basement is a sizeable and low energy consumption area and its inclusion will dilute the EPI of the whole building.

•**GRIHA** on the other hand excludes internal equipment loads from annual energy consumption and includes basement area used for parking in the total built-up area. The logic is internal equipments are function of end-user behaviour and building design should not be judged or penalised for it.



EPI calculation game

Lets assume a building building with following following stats:

•Total builtup area (a) - 1000sq m
•Basement area (b)- 400 sqm
•Total annual electricity consumption (c)- 150,000 kWh
•Total internal equipment load annual(d)- 30,000 kWh

•EPI as per EC Act/ECBC = c/a = 150 kWh/sq m/year

•EPI as per BEE star label = c/(a-b) = 250 kWh/sq m/year

•EPI as per GRIHA = (c-d)/a = 120 kWh/sq m/year

EPI calculation game

TABLE: COMPARISON OF MINIMUM ENERGY PERFORMANCE INDEX (EPI) FOR BUILDINGS

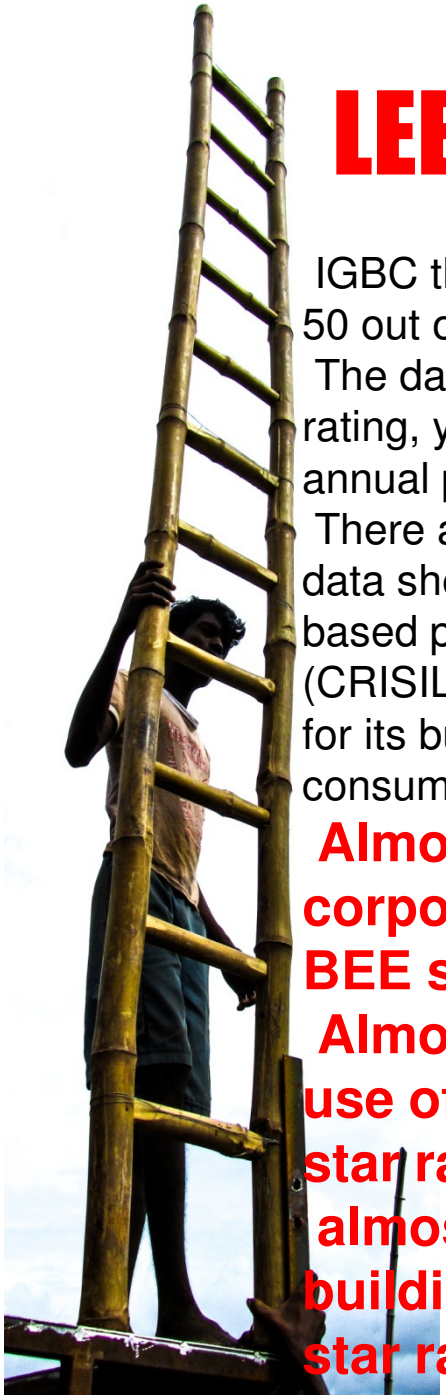
Climate classification	EPI (kWh/sq m/year)				
	Day-time occupancy			24-hours occupancy	
Commercial buildings	GRIHA minimum benchmark	BEE star label minimum benchmark (less than 50% AC)	BEE star label minimum benchmark (more than 50% AC)	GRIHA minimum benchmark	BEE star label minimum benchmark*
Moderate	120	NA	NA	350	306.6
Composite	140	80	190	450	394.2
Warm and humid	140	85	200	450	438.0
Hot and dry	140	75	180	450	262.8

Note: *BEE for 24-hours building measures EPI as Annual Average Hourly Energy Performance Index (AAhEPI) which is EPI divided by number of operational hours in an year. EPI = AAhEPI x 365 x 24 /1000.

EPI formula is annual energy consumption in kWh divided by built-up area of the building. EPI of GRIHA and BEE are based on different formula:
GRIHA: EPI calculation excludes internal loads from annual energy consumption and includes basement area in built-up area.
BEE star label: EPI calculation includes all electricity generated and/or purchased in the annual energy consumption and excludes basement area from total built-up area.

Source: GRIHA manual and Bureau of Energy Efficiency

LEED-India performace data



IGBC that it has disclosed operational data of 50 out of 447 buildings that it has rated green.

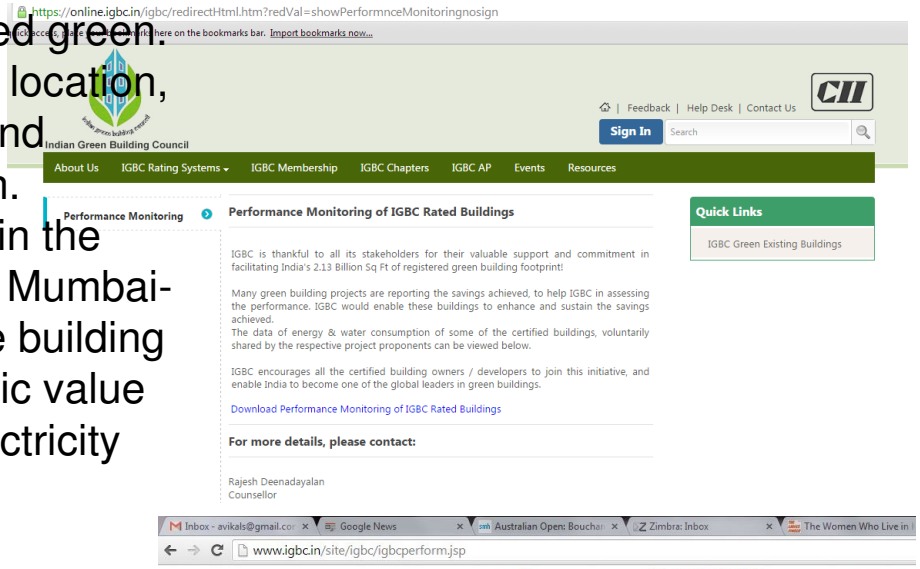
The data gives the names, details of location, rating, year of award, built-up area, and annual power and water consumption.

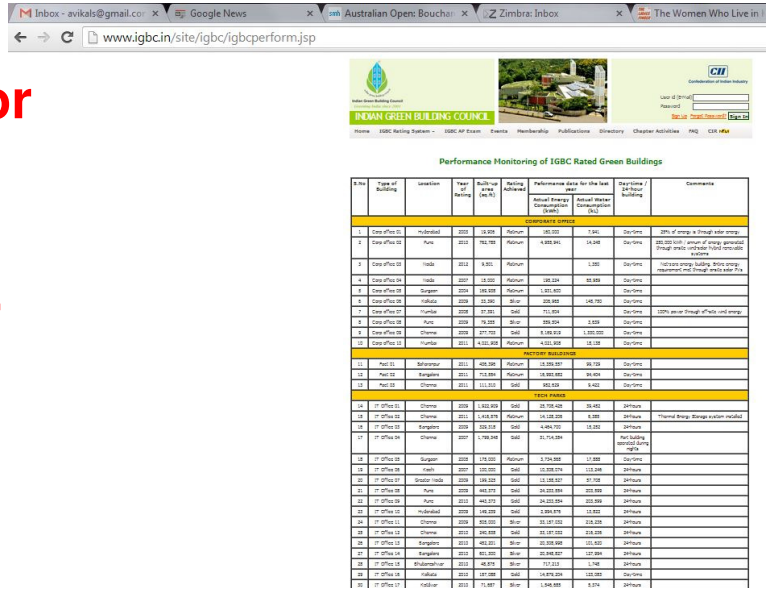
There are gaps and inconsistencies in the data sheet as well. For instance, one Mumbai-based platinum-rated corporate office building (CRISIL House) has the same numeric value for its built-up area and its annual electricity consumption!

Almost 22 per cent of rated corporate offices do not qualify for BEE star rating.

Almost 41 per cent of rated day use offices do not qualify for BEE star rating.

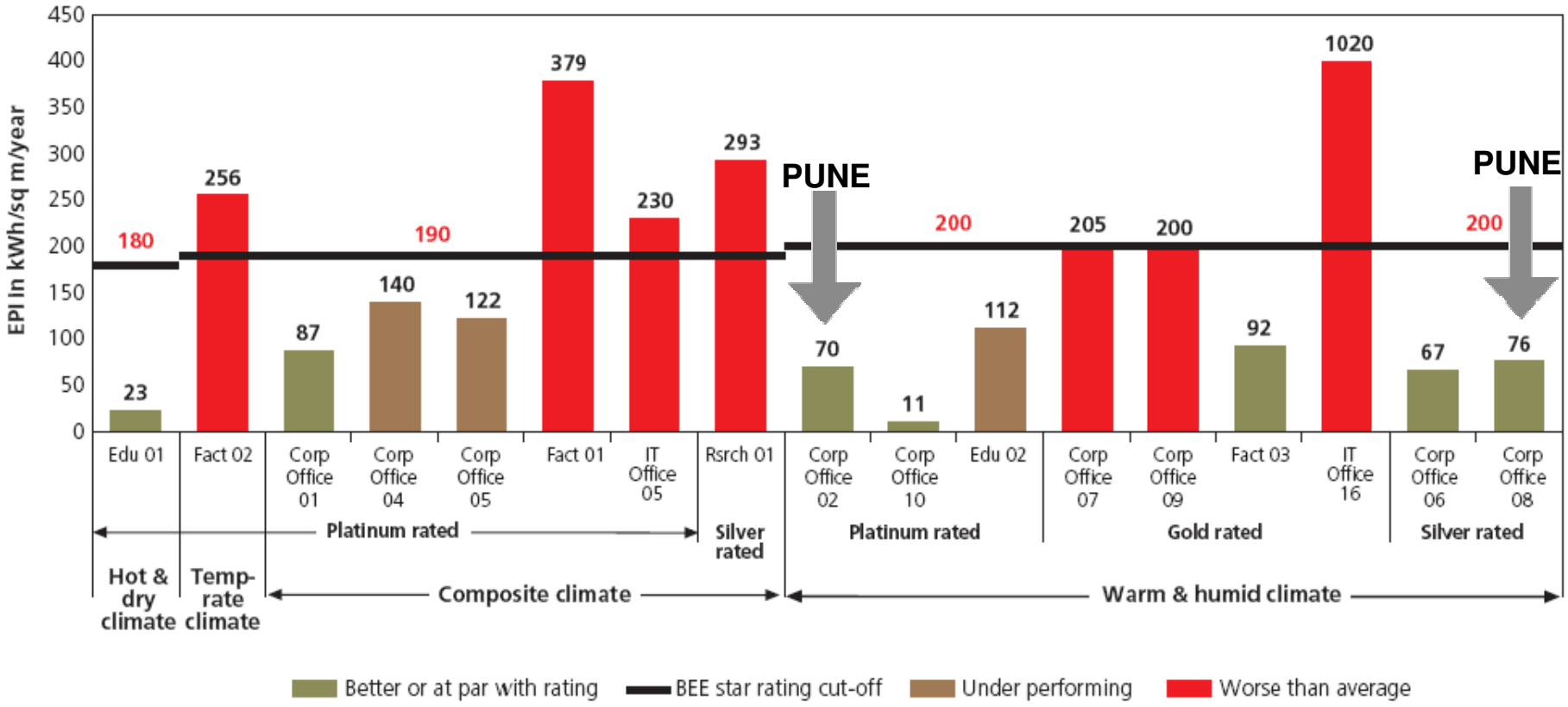
almost 47 per cent of rated IT buildings do not qualify for BEE star rating.





GRAPH 3: ENERGY PERFORMANCE OF LEED-RATED DAYTIME USE BUILDINGS

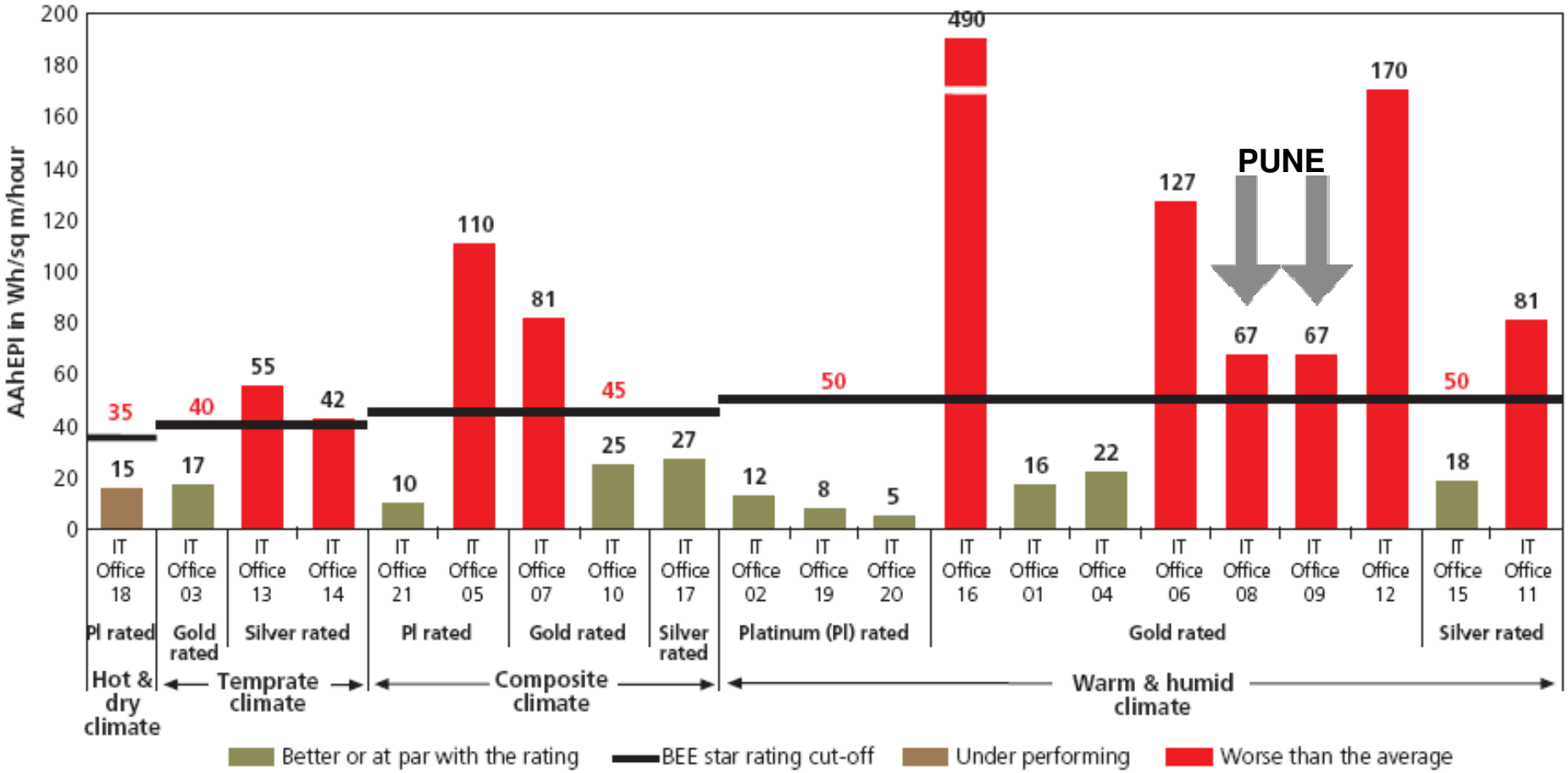
Almost 59 per cent of the daytime use buildings are not performing as per their LEED rating



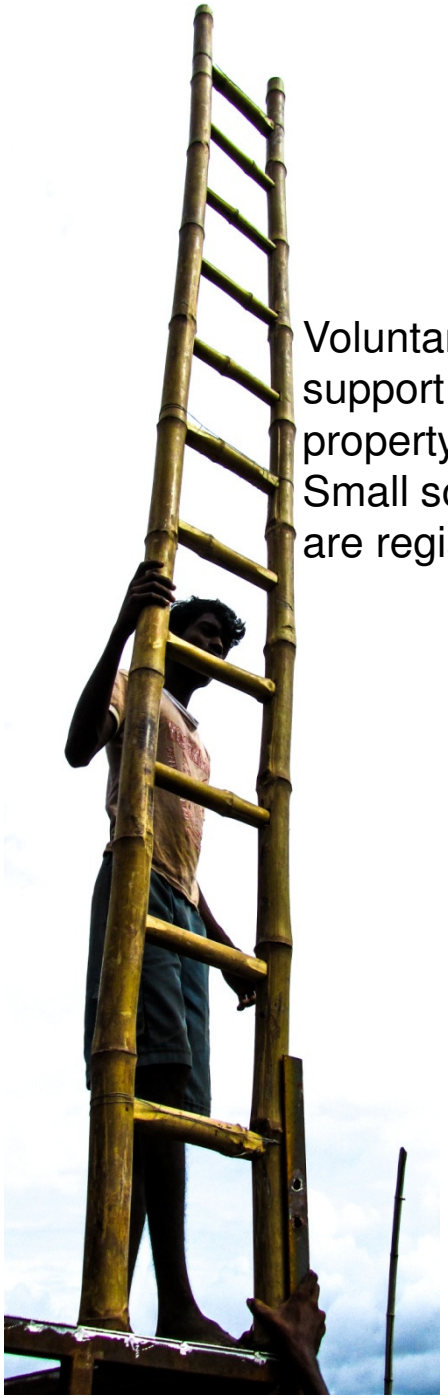
Note: See Annexure for the names of the buildings
Source: Computed by CSE on the basis of LEED-India (IGBC) data

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



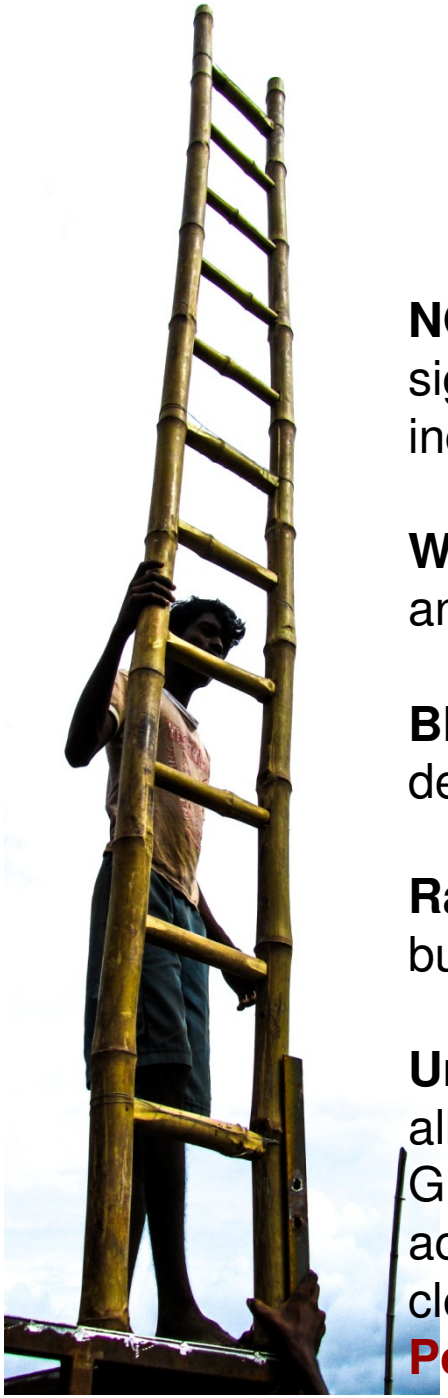
Note: See Annexure for the names of the buildings. AAhEPI – Annual Average Hourly Energy Performance Index
Source: Computed by CSE on the basis of LEED-India (IGBC) data



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 and Punjab: 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

But no Accountability

Global learning curve…..

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

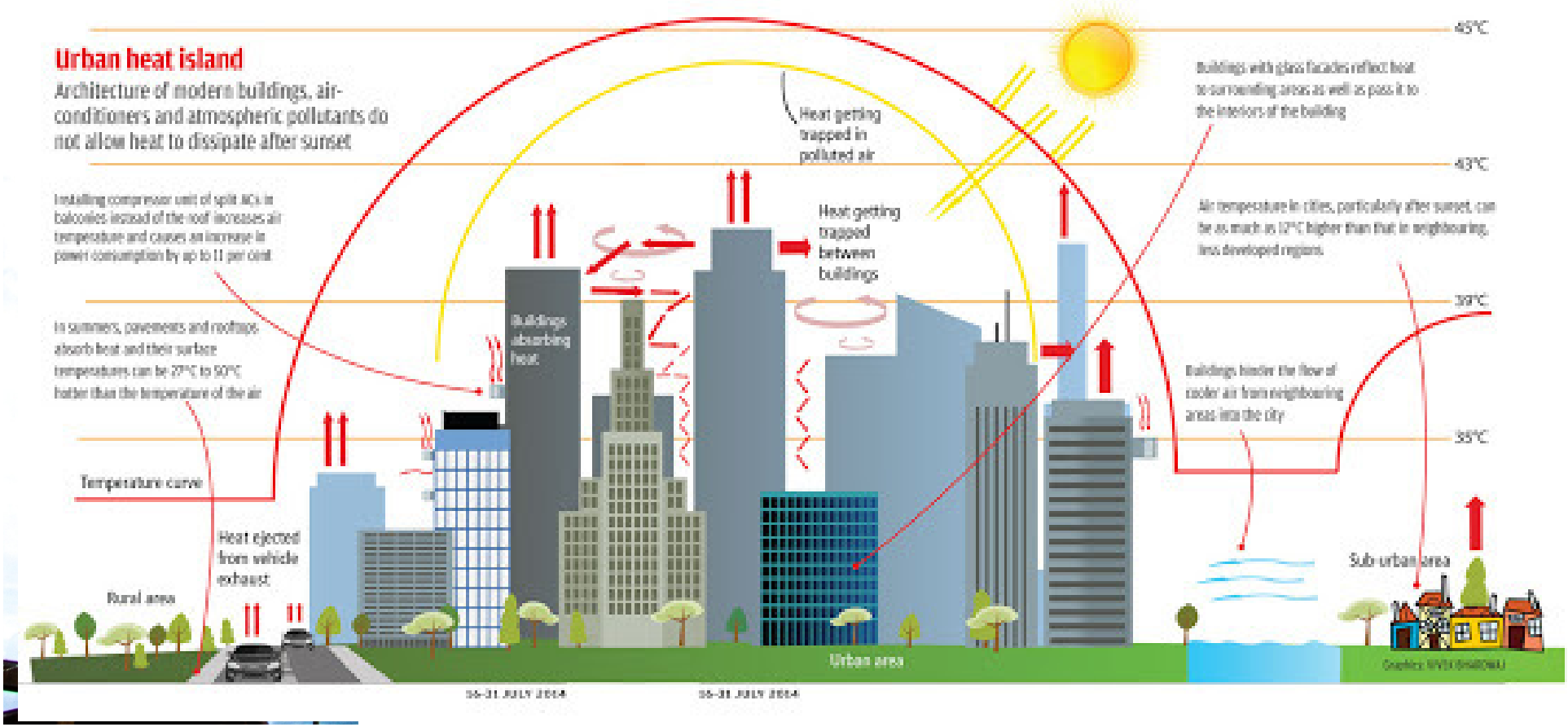
The US: Energy Independence and Security Act requires all new and renovated buildings to reduce energy consumption by 55 per cent from 2005 baseline. All new commercial buildings to be zero net energy by 2025 and existing by 2050.

Legally binding benchmarking and discloser of annual enegy 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.**

Visceral Cycle ....



Resources are being waste ..... nature is devasted to support urban boom

An environmental overview of the housing sector

take any one of the proposed smart city for example

Let us consider a city that has about 1 million odd formal homes. Consider just about 75 sq metres per home (a very moderate figure). This amounts to about 75 million sq metres of built area. To build all these homes it would take:

0.75 million tonnes of construction debris generated

+

375 million cubic metres of concrete (conventional construction)

+

3000 million litres of water for construction

+

1 million cubic feet of wood for all the doors and windows

+

90 million tonnes CO2 would be released as part of this construction activity

Present Water Paradigm

Water Supply

Surface water

Ground Water

Wastewater (Blackwater + Graywater)

How much is the treatment ?

Wastewater Treatment Plant

30-50% loss in leakage

POLLUTION

Recycle ?
Reuse ?

Rivers are being murdered

Twice over

1. Pattinapakkam Beach

2. Yamuna, Delhi

6. Keelkattalai Lake, Chennai

3. Ram Nadi, Pune

4. Mangroves, Navi Mumbai

7. Coimbatore

5. NRI Complex, Mumbai

Managing the material crisis

“Malba”: Cost of development

"construction and demolition (C&D) waste" -- building materials, debris and rubble from construction,. re-modelling, repair and demolition operation and disaster…….

Obstructs Mobility

Lodhi estate, New Delhi

As waste lies waste ..... nature is devasted to support urban boom

•**Sand mining triggers debate**

•2012:Supreme Court order on stronger regulations for minor minerals

•2013: National Green Tribunal declared sand mining with environmental clearance illegal.

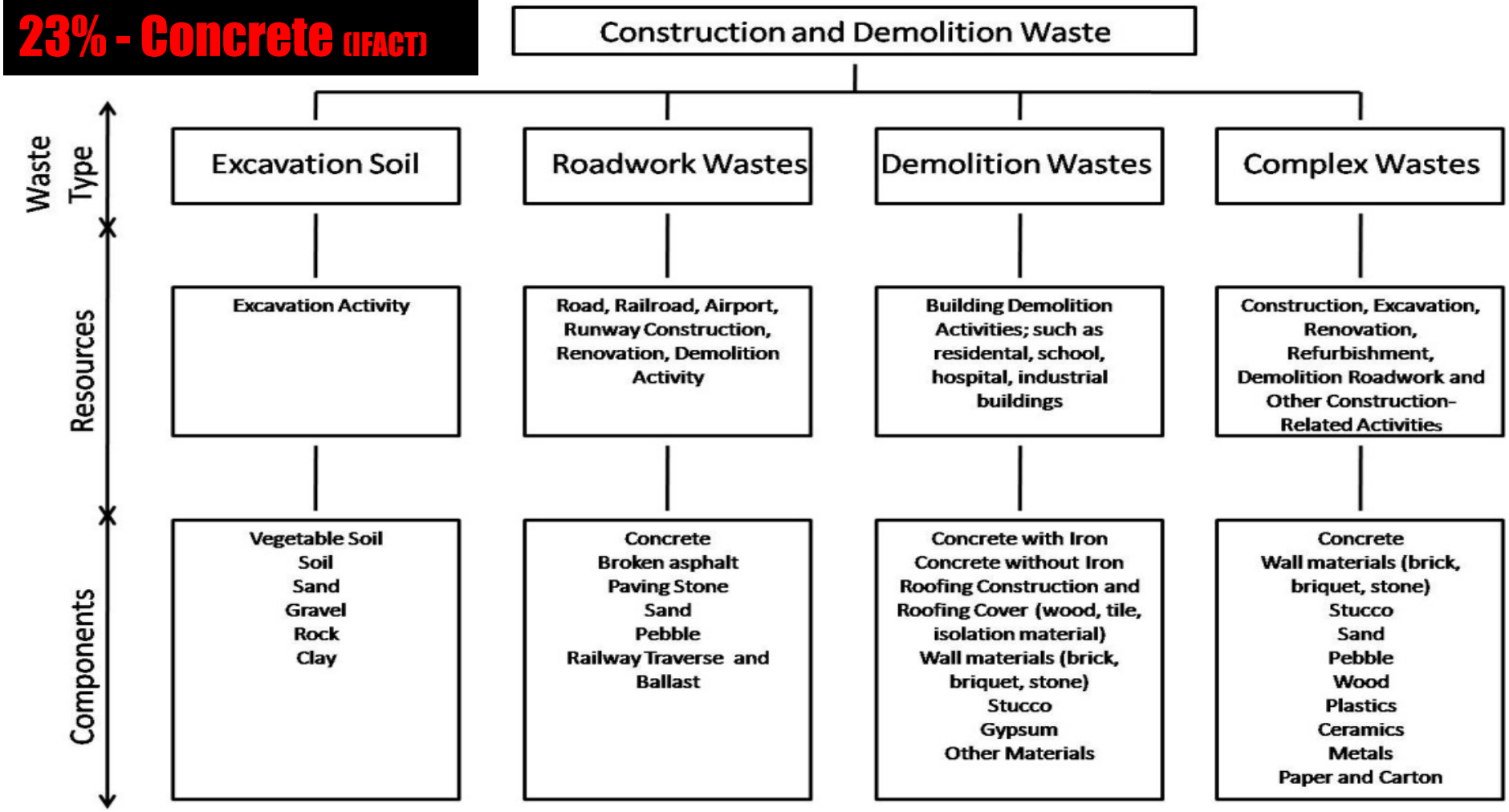
•Union Ministry of Housing and Urban poverty alleviation alerted Rajaya Sabha in 2012 about the shortage of building material especially aggregates. Holding up housing and civic infrastructure projects…..

•**Need substitutes and strategies to reduce demand for naturally sourced material**

Indian C&D Waste

36% - Sand/gravel
31% - Bricks
23% - Concrete (IFACT)

Different types of C&D Wastes



Debris from disaster.....

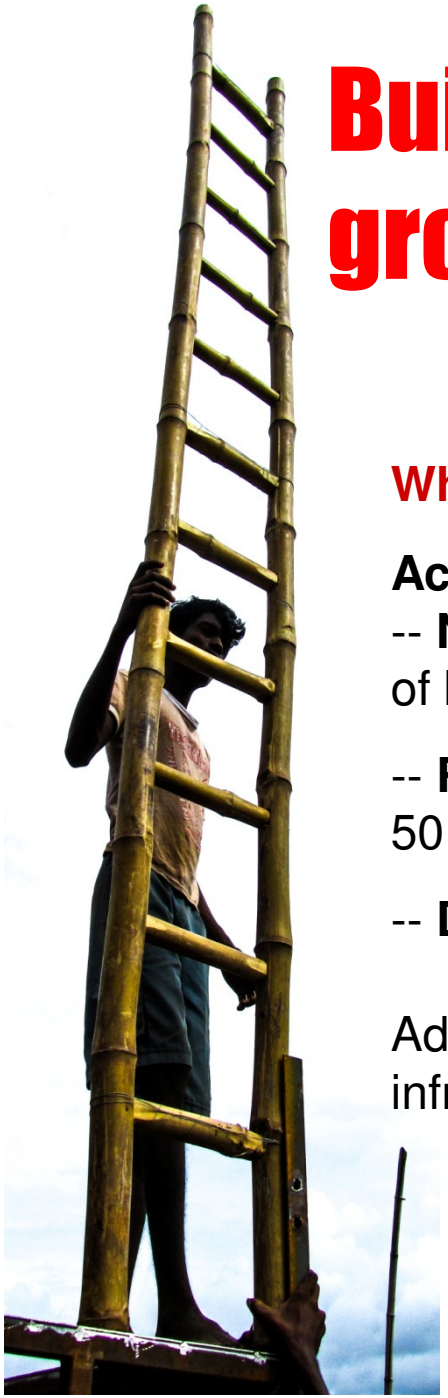
Bhuj earthquake

C&D waste is grossly underestimated in India: No one really knows, how much?

"*No estimates or even guesstimates exist for construction and demolition waste*" in the country - Comptroller and Auditor General of India 2008

Even though built up area has increased dramatically official estimate of C&D Waste in India has not changed for over a decade

Year	Authority	Estimate (million tonnes)
2000	Ministry of Urban Development	10-12
2001	Technology Information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology	12-15
2010	Ministry of Environment and Forest	10-12
2014	Ministry of Urban Development	No estimates exist



Building sector: Explosive growth

What is the implication for C&D waste?

According to TIFAC estimates:

-- **New construction** generates about 40-60 kg per sq meter of build up area

-- **Repair and renovation** of existing buildings generates 40-50 kg per sq meter

-- **Demolition of buildings** generate 300-500 kg per sq meter

Additionally astounding amount of waste is generated from infrastructure projects – roads, flyovers, bridges etc

GUESS the ESTIMATES?

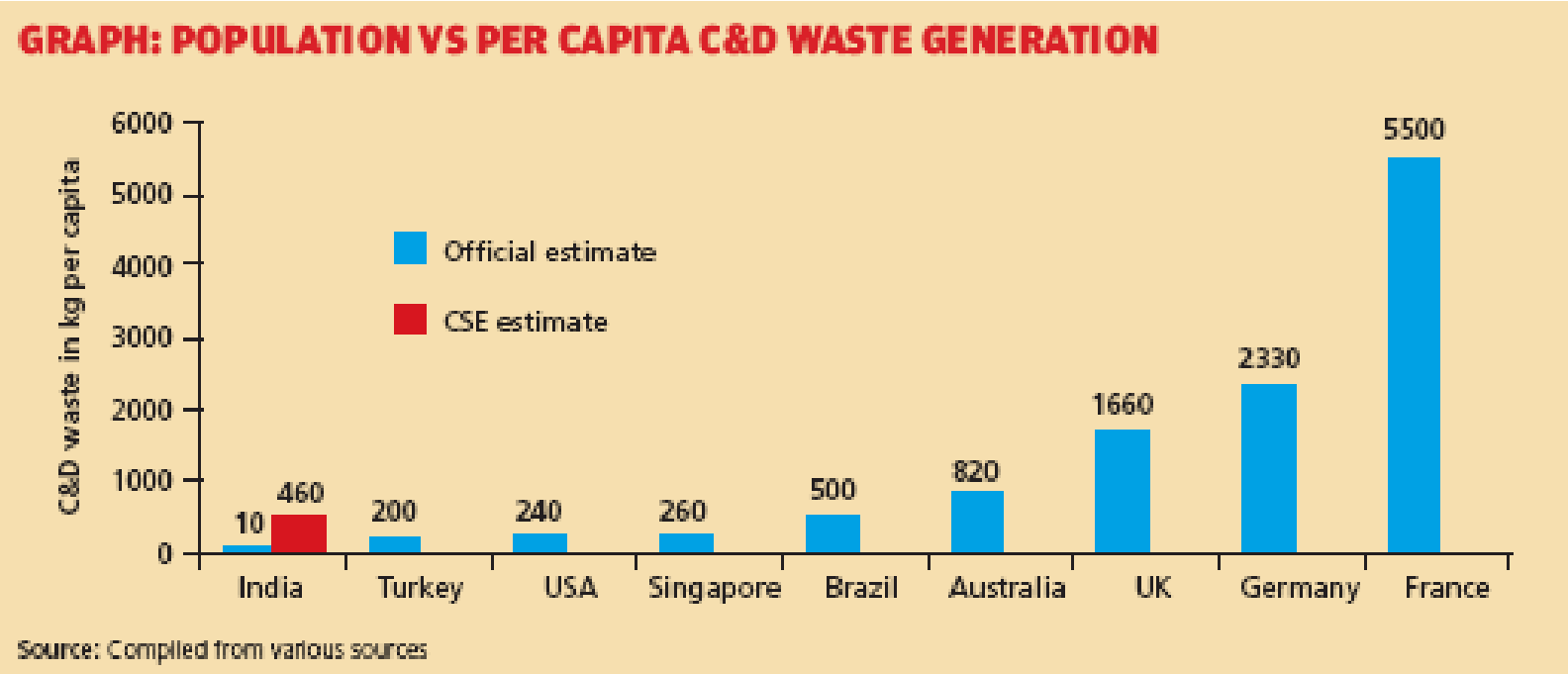
CSE has estimated the C&D waste based on TIFAC factors for C&D waste and Mckinsey estimates for trend in built up area in India. It finds:

-- Indian buildings in 2013 have generated more than 530 million tonnes – 44 times more than official estimates. More than other solid wastes

-- If C&D waste from infrastructure projects like road, dams, flyovers, bridges is also added India is already drowning.

A great part of this waste is also being used to illegally fill up urban water bodies and wet lands to reclaim land for more building construction…….

Brazil: 500kg per capita
India: 10kg per capita



C&D waste accounts for 13-67% of MSW, and the generation in the world ranges from 130 to 3000 kg per capita per year.

Small steps to make resource from waste.....

- **C&D waste can be recycled and reused in construction and minimize environmental degradation and pressure on land. Matured technologies are available.**

- **Small steps in Delhi and Mumbai:**

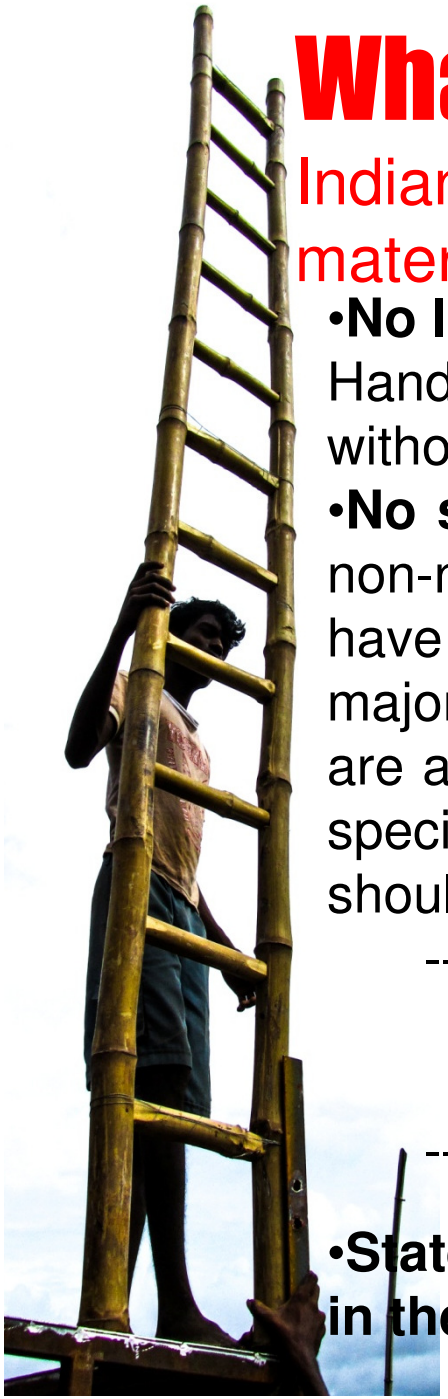
- **MCD-ILFS-IEISL initiative in Delhi:** C&D waste is being recycled into aggregates which are converted to Ready Mix Concrete, pavement blocks, kerb stones and concrete bricks.

- **YUVA and CIDCO initiative in Navi Mumbai:** This has recycled 1500 tonnes of C&D waste between 2002-06. But operations shut down as no policy and market support

- There are small recycling units in Ahmedabad and Bengaluru

- **No takers .....**

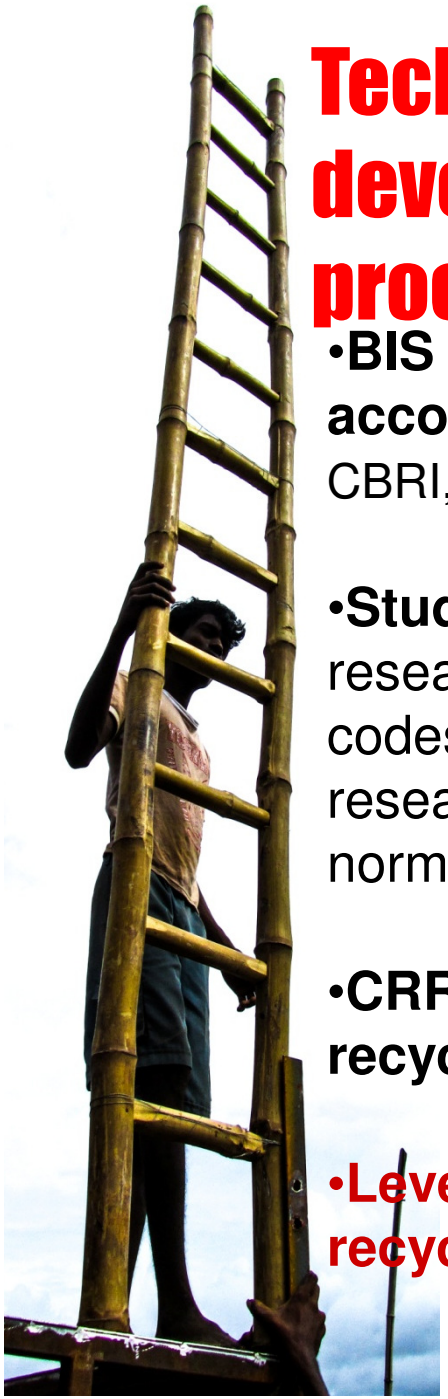
Recycled Products from IL&FS Plant



What is coming in the way?

Indian laws permit only 'naturally sourced' material

- **No legal framework**: Municipal Solid Waste (Management and Handling) Rules 2000 only made a brief mention of C&D waste without laying down any guidelines for its management.
- **No standards for recycled products**: The BIS allows use of non-natural materials to be used for construction but doesn't have any specific standard for recycled material, leading to major confusion among various agencies and developers. Most are abstaining from using recycled waste citing Indian standard specification related to aggregates for concrete state that these should be '***naturally sourced***'.
  - -- Only virgin materials (sand, aggregate) mined directly from nature can be used. This does not allow recycled or reused components.
  - -- Any use of recycled aggregate become 'illegal'.
- **State construction agencies cannot include these material in their Schedule of Rates**



Technical studies for standard development exist. Speed up process

- **BIS requires designated agencies to carry out research according to their criteria to assess suitability of material.** – CBRI, CRRI, NCCBM etc are involved in such research.

- **Studies exist. Need policy action**. Eg. NCCBM and CBRI research has advanced to establish compliance with the IS codes. Other premium institutions like IITs have also carried our research and found recycled material fall within the range of IS norms.

- **CRRI research and pilot projects demonstrates suitability of recycled material including curb stones for road building**

- **Leverage research findings to expedite certification of recycled material**

Reforms in pipeline

- BIS has revised the IS: 383 the code for sand to allow pat substitution of natural sand and stone with recycled C&D waste. The new code is under print as of today.

- MOEF in the draft Municipal Solid Waste Rules 2015 has included a chapter on C&D waste.

- CPWD is using 8.5 lakh pavers and blocks made out of recycled C&D waste in the construction of Supreme Court extension.

- Leverage research findings to expedite certification of recycled material

Are interim measures possible?

- **Explore other avenues to absorb alternative products until standards are notified**

- **Building material and technology Promotion Council under MUHPA promote innovative building material and technologies under "performance Appraisal Certification Scheme"**. Innovative and alternative material that are not covered by BIS can be certified after detailed evaluation. This has been done for products of bamboo for buildings.

- **Revision of schedule of rates (SOR) by state construction agencies like CPWD:** Using publicly available scientific study by premium institutes CPWD can revise its SOR to allow use of paver blocks and flooring tiles from recycled C&D waste. This will develop market for recyclers and reduce subsidy burden on civic bodies.

- **Build on the precedence of fly ash but shorten the time frame**

Need proactive municipal action…

- **Municipalities have powers to act proactively**

- **Solid Waste management Cell of Government of Maharashtra has included C&D waste in its action plan.** Each city required to have collection and disposal of waste from bulk waste producers and construction debris

Municipal Corporation of Greater Mumbai has notified Construction & Demolition & Desilting Waste (Management & Disposal) Rules 2006

Implementation remains a challenge….

Global best practice shows the way

Hong Kong: C&D waste tax on developers lowers C&D waste at landfill by 60%. 100% waste utilisation is charged at $27 per tonne. More than 50% waste needing landfill disposal is charged at $125 per tonne. Revenue is used to subsidise recycling centres. Promoted efficient construction practices.

Singapore recycles 98 per cent of its C&D waste.

South Korea: C&D waste management part of Low Carbon Green Growth strategies. Have separate building codes for recycled asphalt concrete aggregates , recycled concrete aggregates, and road pavements. Effective recycling rate is 36% with a target of 45% by 2016.

European Union: EU 2004 regulations for Aggregates provides for "*aggregates from natural, recycled, and manufactured material*". Some member countries report over 20% recycled material use.

International Best Practice

Recycled concrete was used in the construction of the South Seas apartment building in Greenpoint, Cape Town

London Olympic 2012 Stadium used 30% Recycled concrete in its construction.

The Nalawala Hall, Fairfield City Council's Sustainability Hub, incorporates the world's first concrete load-bearing foundation slab which is 95 per cent recycled.

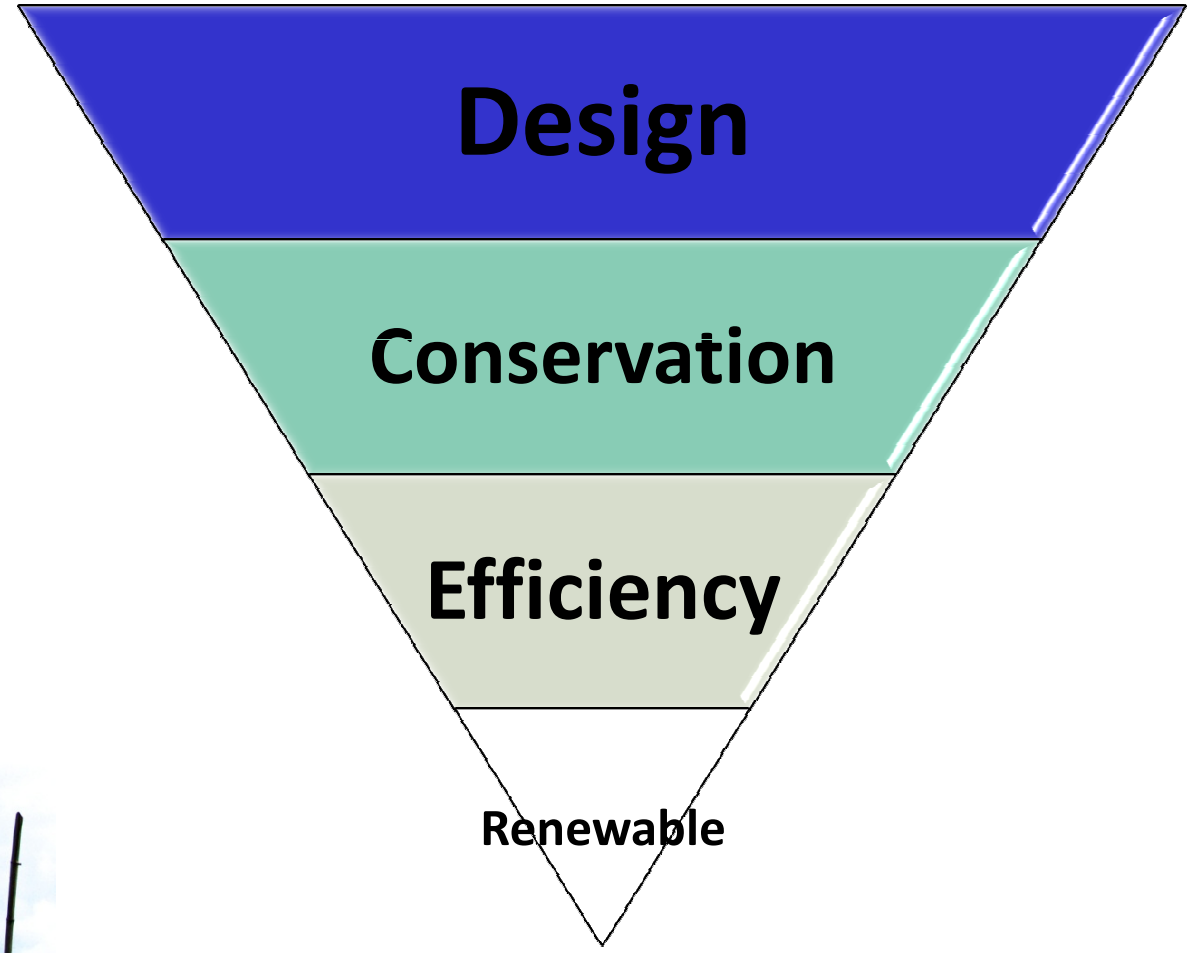
The larger concern:

Rating should be used to push market towards super efficiency --- push the top line of performance

Not to push minimum standards that all should follow. For example -- a minimum energy efficiency requirement; rain water harvesting and in-situ waste management and treatment should be done by all…

Need discussion on resource performance….

Building Sense



Let’s begin the discussions…