Developing a Low Carbon Society: Actions for Indian Building Sector

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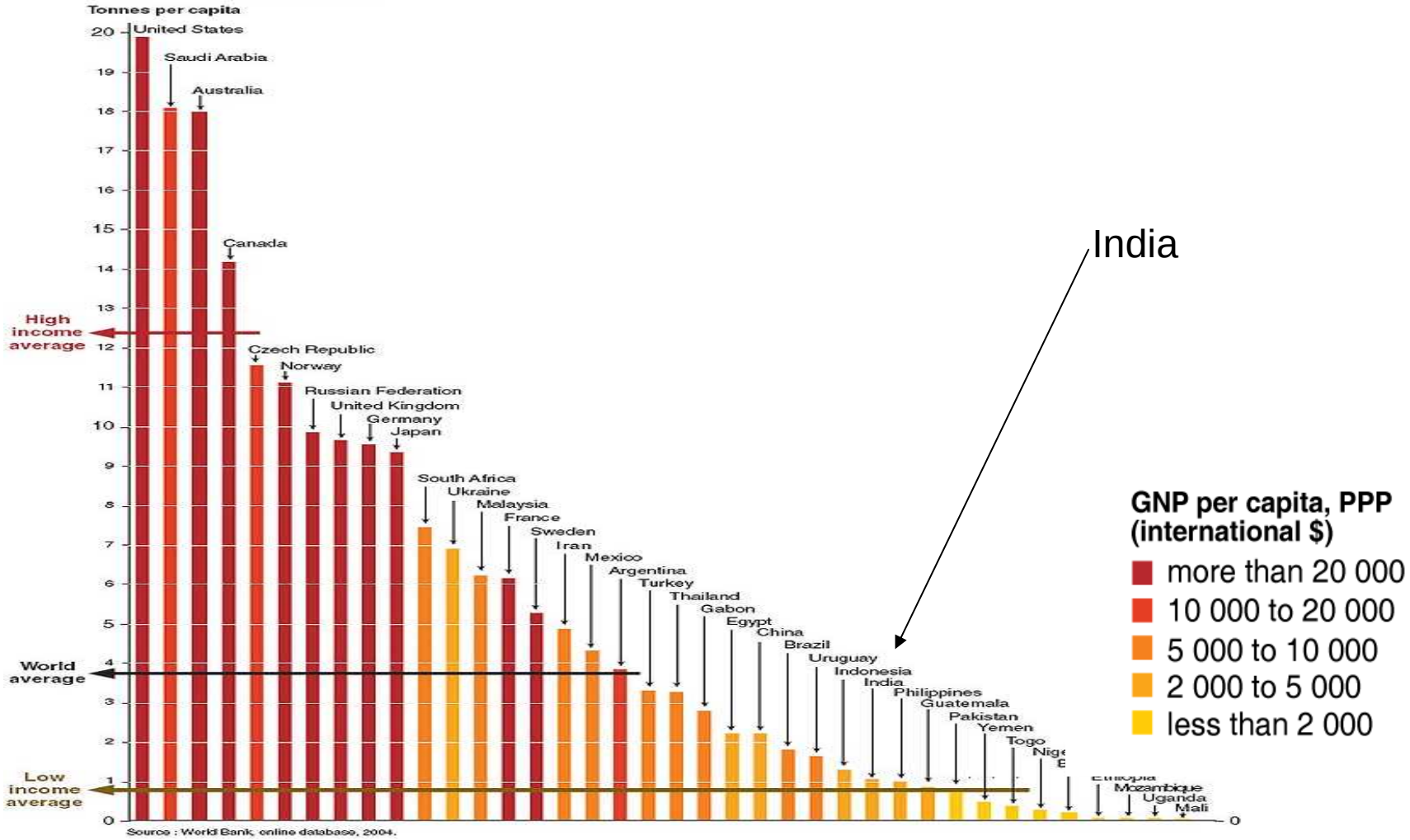
Presentation Outline

- Climate and Building Sector
- Building Sector Life Cycle, Energy and Emissions
- Building Sector in India – A Profile
- Proposed Actions for Indian Building Sector
- Conclusion

Carbon Emissions Per Person

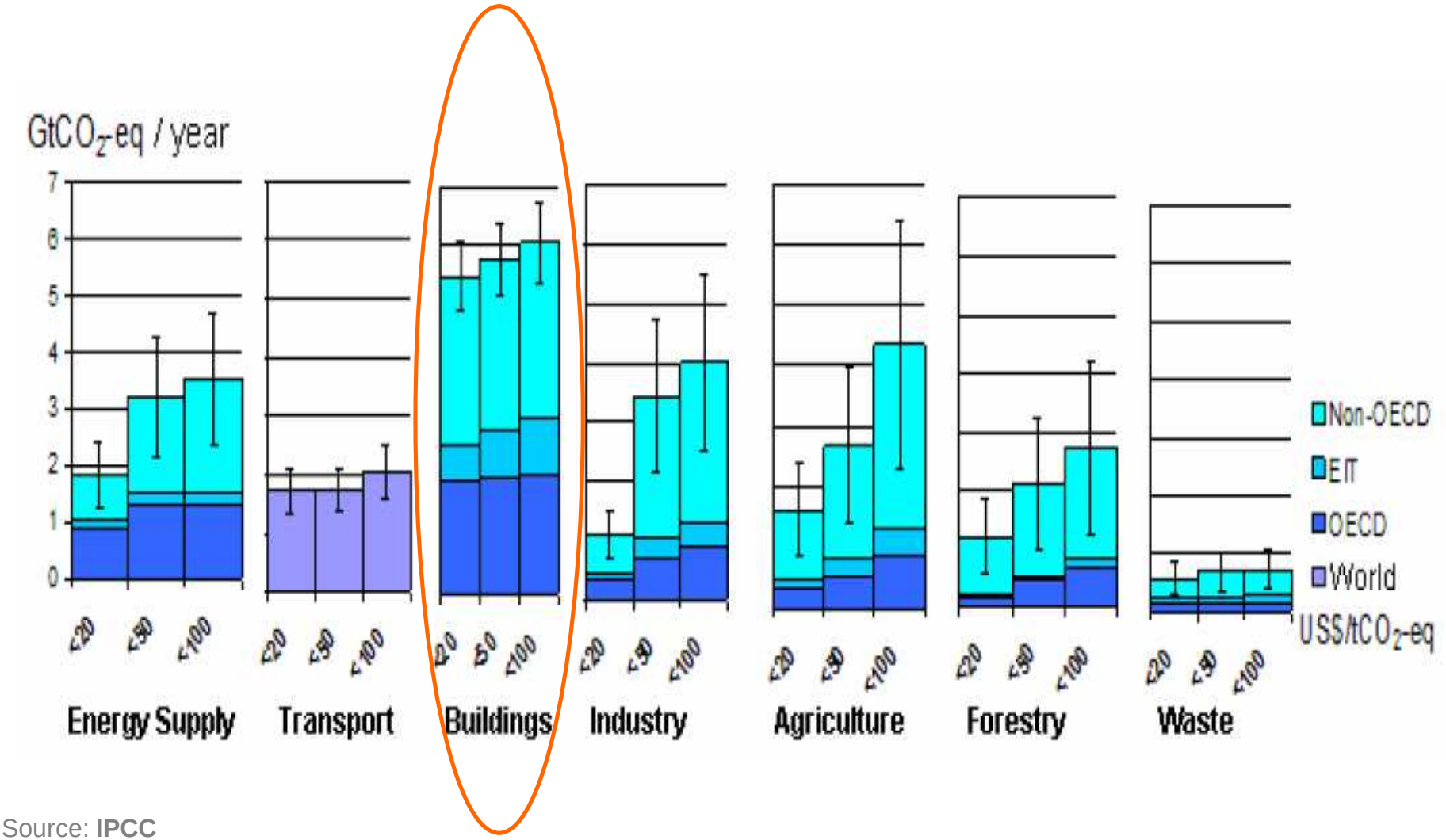


Source: National carbon dioxide (CO_2) emissions per capita. (2005). In *UNEP/GRID-Arendal Maps and Graphics Library*. Retrieved 09:56, Feb 15, 2009 from: http://www.grida.no/graphic.aspx?f=series/vg-climate2/large/16.jpg

Climate and Building Sector

- Buildings are responsible for 1/3 of all energy related greenhouse gas emissions (~68% of electricity)
- Climate change will influence building energy use – more cooling, less heating
- Stabilizing climate will require ~3x reduction in energy use per square meter.

Potential of Carbon Emissions Reduction



Source: **IPCC**

Energy Use by Buildings Over the Life Cycle

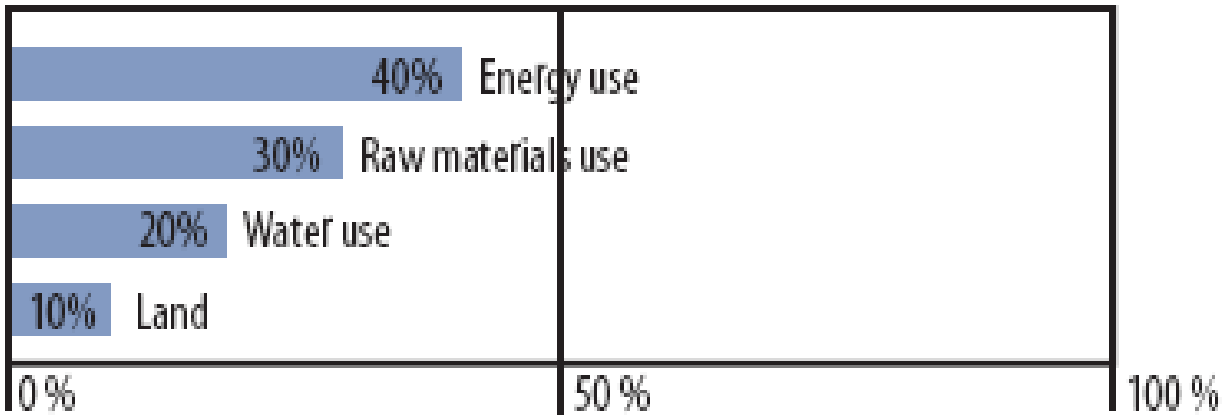
- **First phase**: Manufacturing of building materials and components, termed as *embodied energy*.
- **Second and Third phases** correspond to the energy used to transport materials from production plants to the building site and in the actual construction of the building, referred to as *grey energy* and *induced energy*.
- **Fourthly**, energy is consumed at the operational phase (*operation energy*).
- **Finally**, energy is consumed in the demolition process of buildings as well as in the recycling of their parts

Building Sector, Energy & Environment

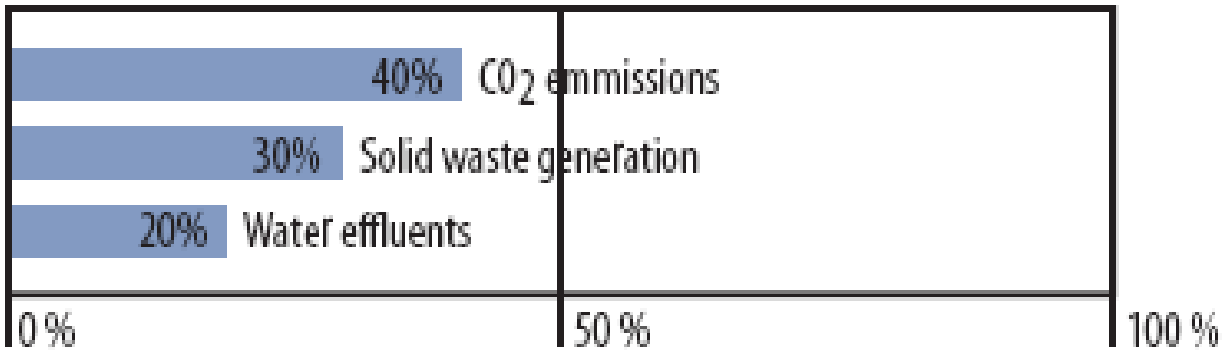
- **Buildings are highly resource intensive**
  - building materials, energy, water
  - Generates 5-15% of the GDP.
- **30-40% of world's primary energy is used in buildings**
  - Building Construction
  - Operation & Maintenance
  - Demolition and disposal
- **High rise in demand for new construction**
  - Greenfield projects
  - Re-densification (Demolition of low-rise zones to construct high-rise buildings)
- **Negative impacts on the environment**
  - Contributing to GHG emissions
  - Depletion of resources & increase in waste generation

Building Sector, Resource Use & Environment

Share of Building Sector in resource use



Share of Building Sector in pollution / emission



Source: Sustainable Building and Construction Initiatives, 2006, http://www.unepie.org/scp

Building Sector end use energy consumption

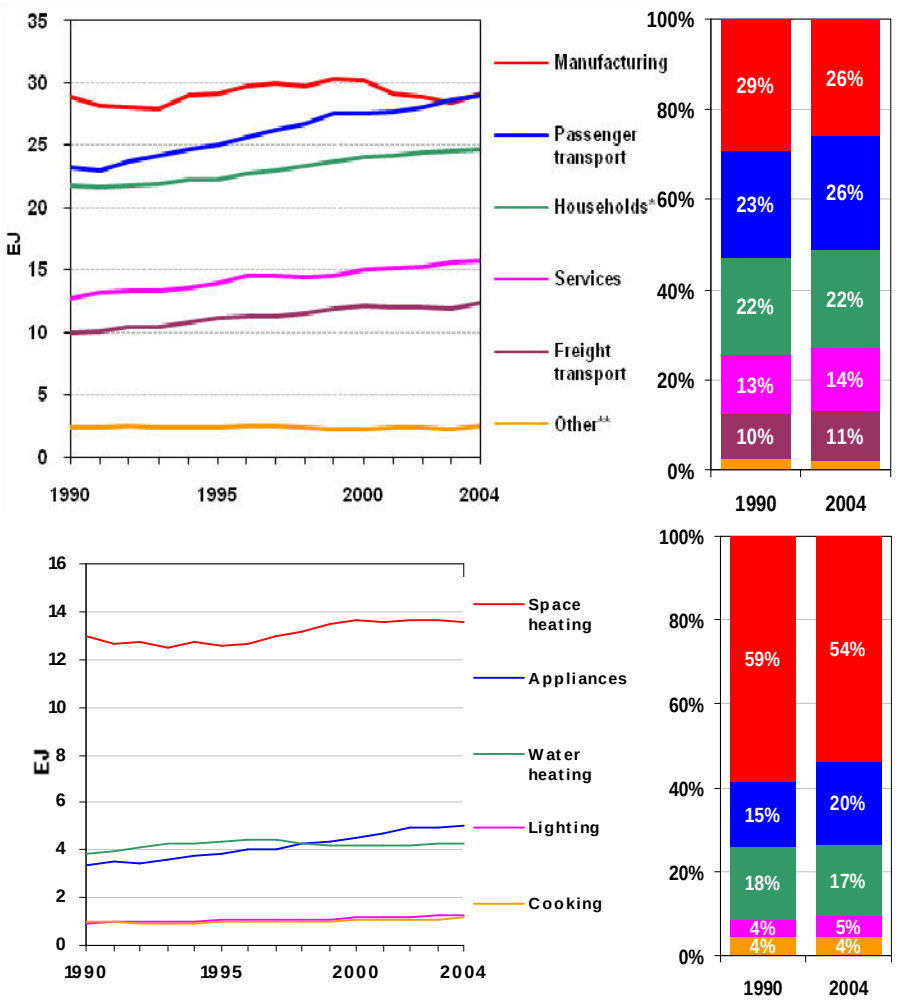
- **Buildings consumes largest end use energy**

  Building sector account for 40 % of the worlds end use of energy.

- **Most used in building envelope**

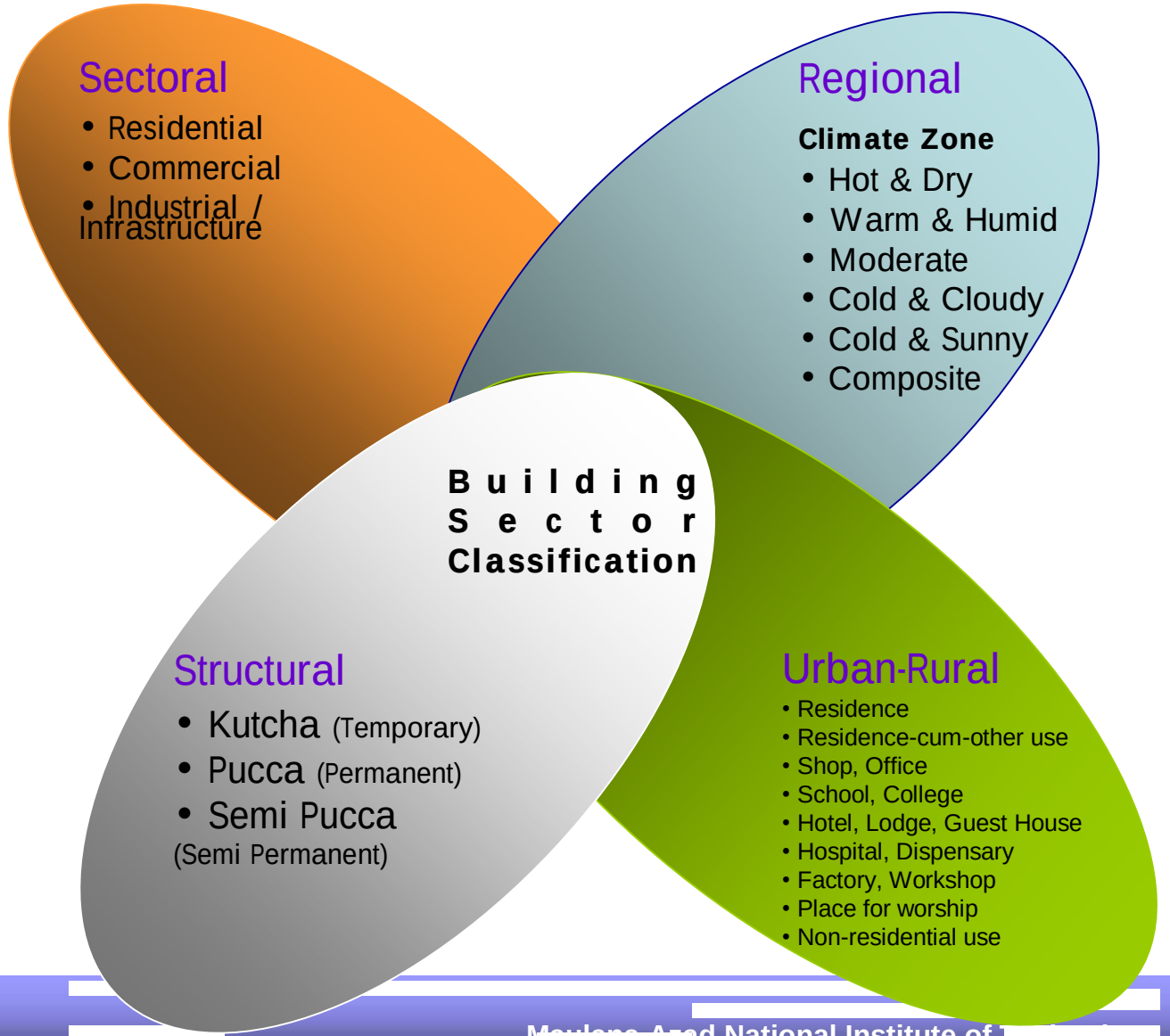
  For HVAC and water heating.

  Especially in residential buildings



Source: IEA, Energy Use in the New Millennium, 2007,

Building Sector in India - Diversity

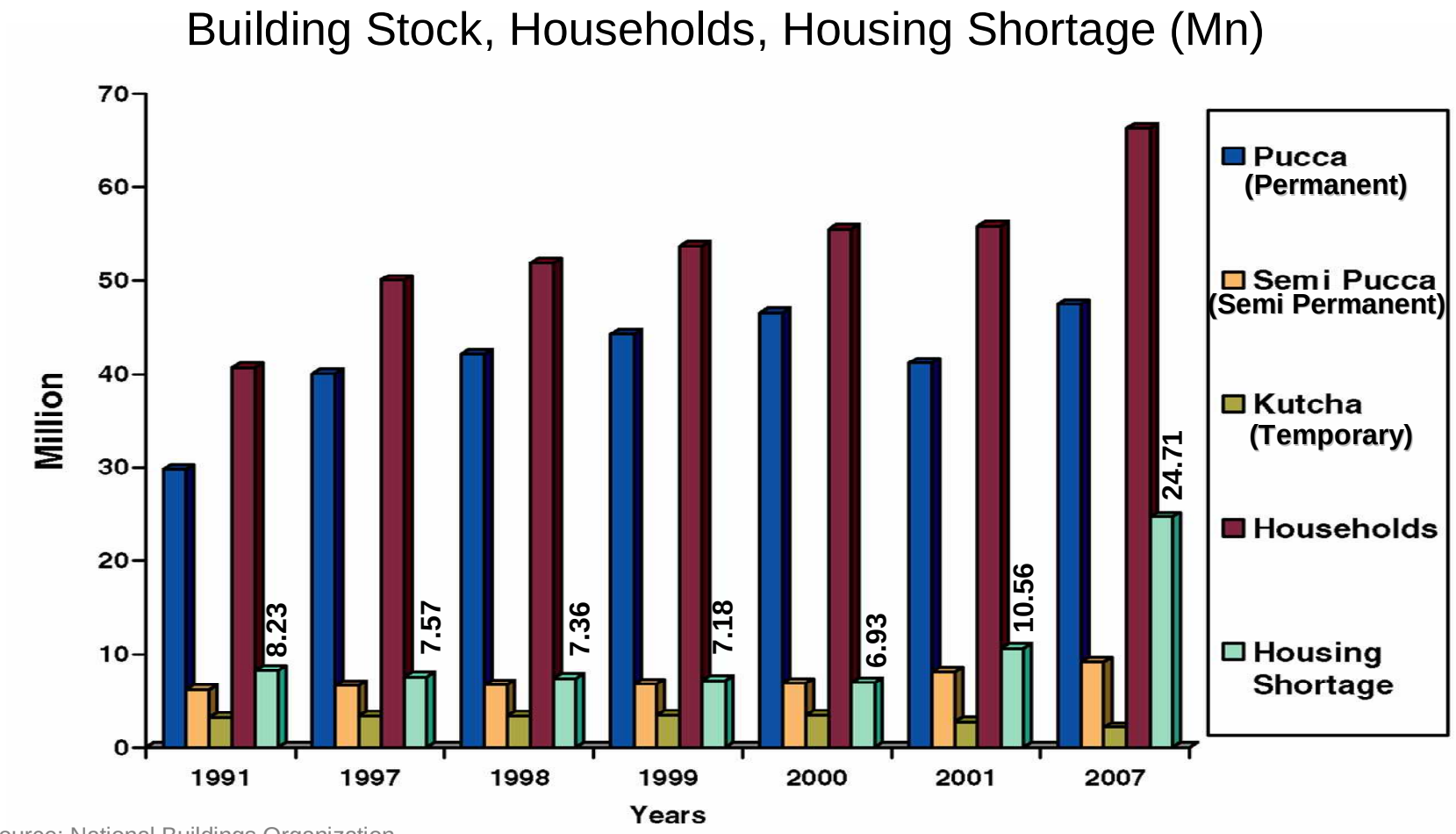


Building Sector in India – A Profile

- 2.4% of land area with 16% of the world's population
- Accounts for 5% of the GDP
- Gross Annual business Volume: Rs.230,000 crores
- Growth Rate: 8-10% in recent years
- Second largest employer after agriculture
- Employs about 18 million persons directly and 14 million indirectly
- Recorded highest growth rate in employment in the last two decades

Change in Building Stocks and demand

Growing demand as per structural classification

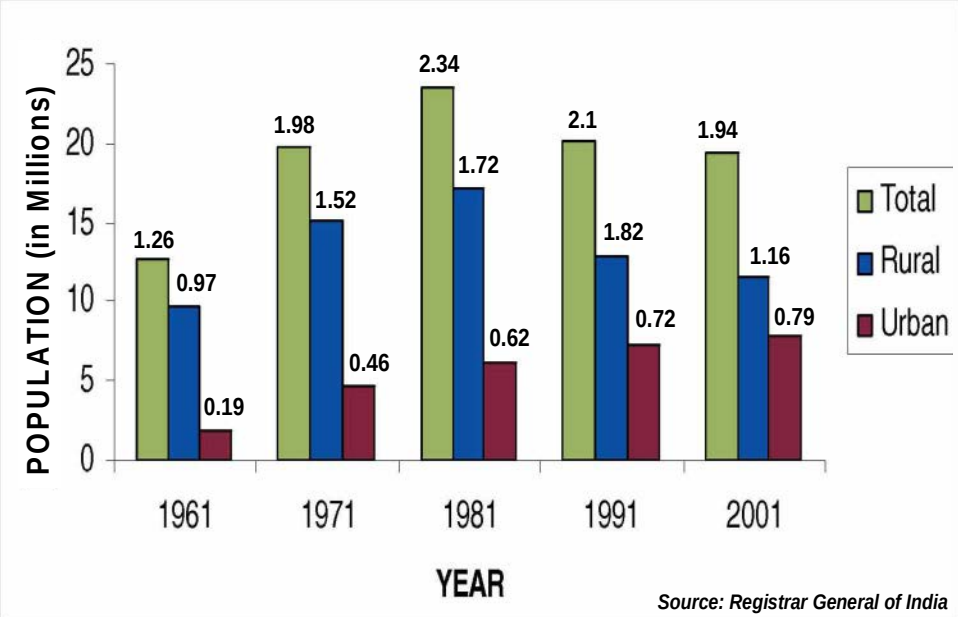


Source: National Buildings Organization

Drivers of Building sector demand in India

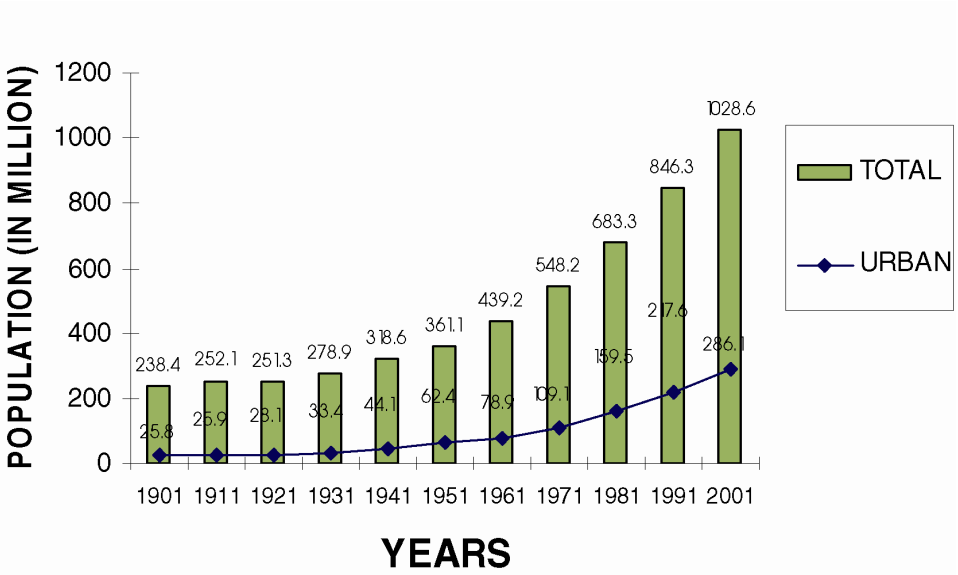
Demand drivers

Houseless population



Source: Registrar General of India

Share of Urban population in growth of total population of India

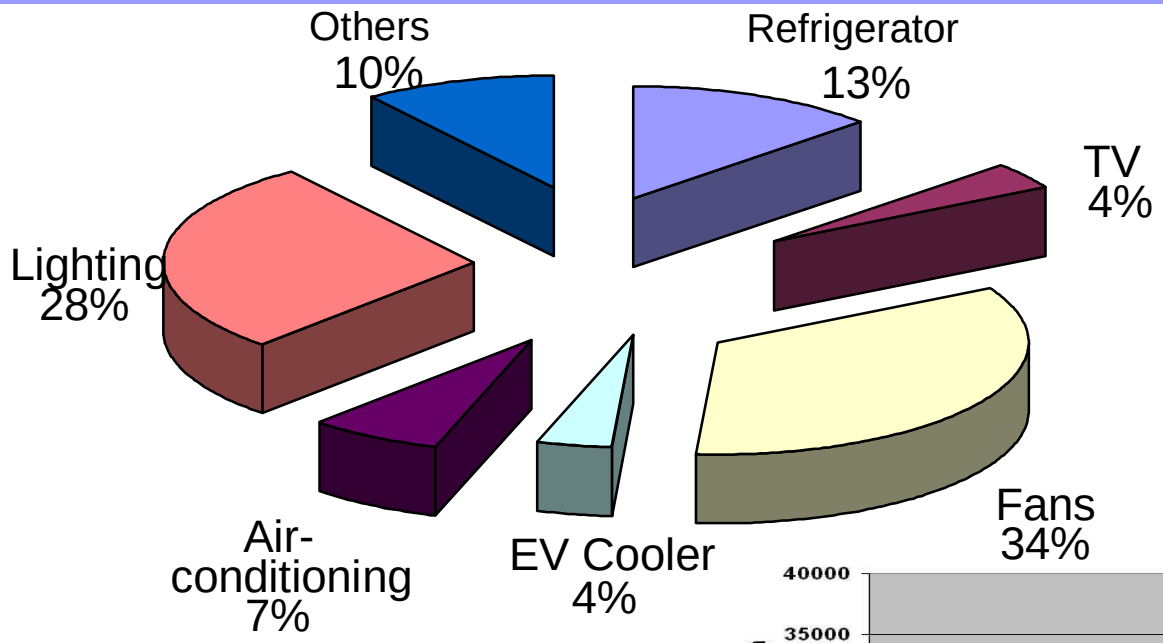


Demand for Key Building Materials in India

Building Materials (in million)	2001-06		2006-11	
	Residential		Residential	
	Urban	Rural	Urban	Rural
Cement (ton)	124.26	49.01	195.89	77.26
Steel (ton)	13.64	5.22	21.80	8.23
Timber (cu.m.)	8.40	5.87	13.24	9.26
Bricks (nos)	318.29	281.60	501.76	443.92

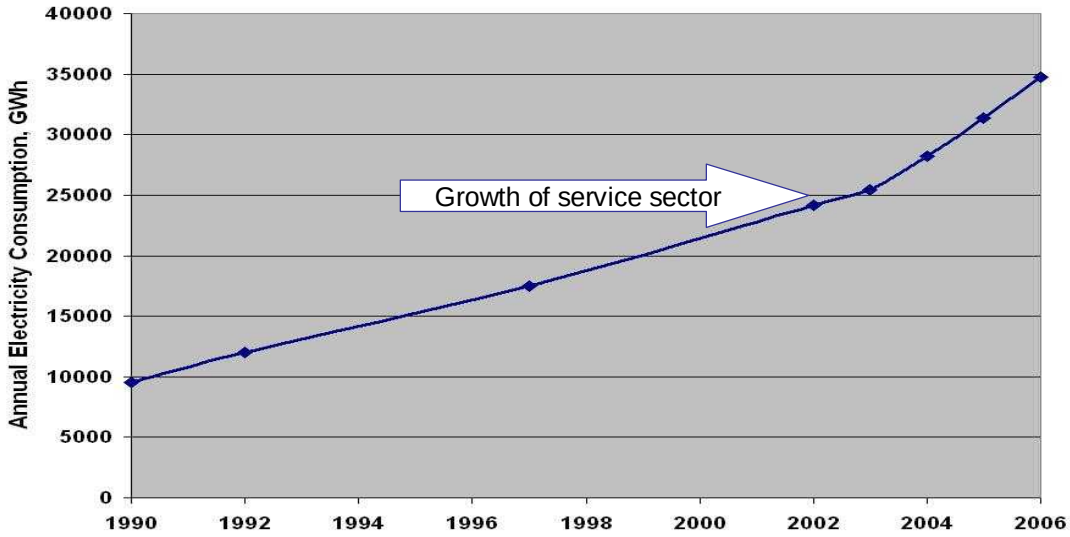
Source: **BMTPC, India**

Energy use in Building Sector - Electricity



Total Annual Consumption > 100 TWH

Trends in



Source: BEE, India

Transition in Building Sector Energy Mix

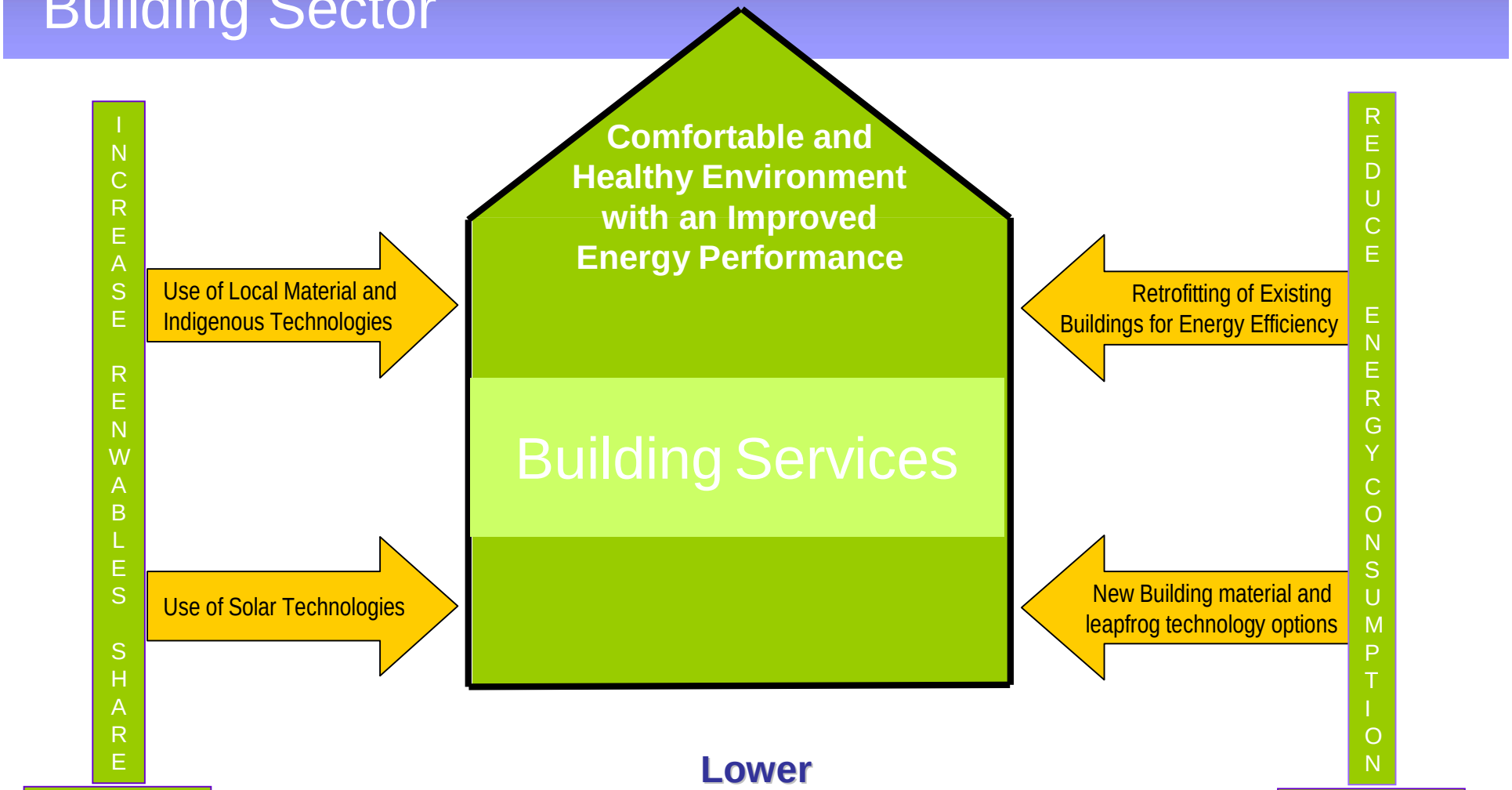
Rural

- Household energy mix is rapidly moving from inefficiently-utilized biomass to gas and electricity

Urban

- Commercial space is increasing; and energy use is commercial space is increasing at a faster pace

Proposed Actions for Developing LCS in Indian Building Sector



Lower

⇩Energy consumption - ⇩"Life-cycle costs – ⇩Carbon emission

- Start with building fabrics to lower energy demand (life span: 50-100 years)
- Then look for devices to generate energy from renewable (life span:10-20 years)

Actions for Low Carbon Building Sector

- Retrofitting of Existing Buildings for Energy Efficiency
- Use of Solar Energy Technologies
- Use of Local Material and Indigenous Technologies
  - Rat-trap Bond in Wall Construction
  - Brick Arches
  - Filler slab in roof
  - Compressed Earth Block
- New Building material and leapfrog technology options

Retrofitting of Existing Buildings for Energy Efficiency

- **Minimize loads**
  - Insulation
  - Colors cut solar gain
  - Vegetation
  - Orientation & Day lighting
  - Hot water management
- **Renewable**
  - hot water
  - electricity

- **Efficient Appliances**
  - Lighting
  - Low voltage transformers
  - Refrigerators, etc.
- **Efficient HVAC**
  - Equipment efficiency
  - Controls
  - Design (separate H+V+AC)

Use of Solar Energy Technologies

Fulfilling Rural needs

- Solar energy is practically inexhaustible
- Widely distributed
- Environment friendly
- Cost free in raw form
- No need to transport raw materials to villages
- No towers, heavy cabling, etc.

Use of Local Material and Indigenous Technologies

- Rat-trap Bond in Wall Construction
- Brick Arches
- Filler Slab in Roof
- Compressed Earth Block

Use of Local Material and Indigenous Technologies

	Cost-Effective Technologies	In place of Conventional options	% of Saving
I. FOUNDATIONS			
1.	Pile foundation (under reamed)	Traditional stone/bricks	15
2.	Brick Arch foundations	Footings	25
II. WALLING (SUPER STRUCTURE)			
3.	Stabilised mud blocks	Burnt brick walls	20
4.	FaL-G Block masonry	Clay brick walls	20
5.	Fly ash brick walls	Clay brick walls	25
6.	Rat trap bond walls	English/Flemish bond	25
7.	Hollow blocks walls	Solid masonry	20

Source: **BMTPC, India**

Use of Local Material and Indigenous Technologies

	Cost-Effective Technologies	In place of Conventional options	% of Saving
III. ROOFING			
8.	Brick panel with joists	RCC	20-25
9.	L-panel sloping roofing	RCC	10
10.	RCC planks over RCC joists	RCC	10
11.	Ferro-cement shell roofing	RCC	40
12.	Filler slab roofing	RCC	22
13.	RCC channel units	RCC	12
14.	Micro-concrete roofing tiles	Clay tile roofing AC sheet roofing	20 15

Source: **BMTPC, India**

Use of Local Material and Indigenous Technologies

	Cost-Effective Technologies	In place of Conventional options	% of Saving
IV. MISCELLANEOUS ITEMS			
15.	RCC door frames	Timber Frames	30
16.	Ferro-cement door shutters	Timber shutters (second class timber)	30
17.	RCC jallies (Grills)	Timber windows/ventilators	50
18.	Precast thin lintels	RCC lintels	25
19.	Precast sunshades	Cast sunshades	30

Source: **BMTPC, India**

Use of Local Material and Indigenous Technologies

Resource and Energy Saving through Use of Natural Fibers and Agro-Wastes in Building Materials in Rural Sector

	Waste and source	Commercial product using natural fibre & agro-waste	Traditional resource fully or partly saved	Energy Saving %
1.	Coir fibre (coir industry)	Coir fibre-cement roofing sheet & panels	Asbestos	10
2.	Rice husk (Rice mill)	Rick-husk- cement building board	Resin (PF or UF) bonded particle board timber	20
3.	Ground nut hulls (Oil mills)	Ground nut- hull-cement building board	Resin-bonded particle board timber	20
4.	Jute fibre (Jute mills)	Jute-fibre-polymer bonded panel; door and window	Timber, metal	10
5.	Cotton waste (Textile mills)	Cotton-lint-cement bonded board	Gypsum, timber	25

Source: **BMTPC, India**

Use of Local Material and Indigenous Technologies

Resource and Energy Saving through Use of Natural Fibers and Agro-Wastes in Building Materials in Rural Sector

S. N.	Waste and source	Commercial product using natural fibre & agro-waste	Traditional resource fully or partly saved	Energy Saving %
6.	Bagasse (Sugar mills)	Bagasse-polymer-bonded boards	Timber fibres (in insulation board)	30
7.	Corn cobs (Corn mill)	Corn cobs-cement bonded boards	Timber, polymer	40
8.	Sisal fibre (Sisal plant)	Sisal fibre-polymer/ cement bonded roofing sheet, door, window	Asbestos fibre, Timber	20-15
9.	Rice straw &Wheat straw (Farms)	Compressed and paper covered board	Timber, Polymer	40
10	Banana fibre (Banana plant)	Banana fibre + cotton pulp/paper pulp and polymer insulation boards	Timber, Traditional Timber, Traditional light weight mineral viz. vermiculite or mica	25

Source: **BMTPC, India**

Use of Local Material and Indigenous Technologies - examples

Wall

Fly Ash Hollow Blocks

Interlocking Fly Ash Blocks

Rat-trap bond walls

Fly Ash Bricks

Different Walling Options

Use of Local Material and Indigenous Technologies - examples

Roof

RCC Planks & Joists

Micro Concrete Roofing Tiles

Ferrocement Roofing Channels

Bamboo Mat Corrugated Sheets

Use of Local Material and Indigenous Technologies - examples

Rat Trap bonded brick masonry

Micro concrete roofing tiles

Ferro cement roofing channels

New Developments in Building Sector in India

- **Energy efficient building designing**
  - Reduced embodied energy of the building
  - Designing concepts & advanced materials to lower the operating energy
- **Green buildings**
  - Low resource intensive
  - Least impact on the environment
  - Improved quality, health & comfort of the inhabitants
- **Zero carbon buildings**
  - High performance buildings (low energy or zero-energy)
  - Energy-positive buildings (distributed co-generation)

New Development in Building Sector in India - examples

CII-Sohrabji Godrej Green Business Centre
LEED - Platinum Rated 63% Energy Savings

Wipro Technologies, Gurgaon
LEED – Platinum Rated 40% Energy Savings

ITC Green Centre, Gurgaon
LEED-Platinum Rated 45% Energy Savings

IGP Office Complex, Gulbarga
LEED – Gold Rated

Source: Confederation of Indian Industry Report on Energy Efficiency in Building Design and Construction

Mitigation counter measures in Buildings in India

- sun shading and natural ventilation
- improved insulation of the building envelope
- use of reusable building materials
- adoption of the size and form of the building to its intended use

A12 **Advice please CAN iT BE DELELTED**

A Deshpande, 2009/02/15

Leapfrogging with mitigation counter measures in Building Sector

- sustainable construction system including
  - intelligent lighting and ventilation systems,
  - low temperature heating and cooling systems and
  - installation of energy saving household appliances

Leapfrogging possibilities in Indian Rural Building Sector

Land line communication **to** Mobile phones is happening

- Villages without electricity **to** Solar PV Cell based lighting with Distributed co-generation
- Incandescent lamp **to** LED
- Natural gas cooking **to** bio-gas based cooking fuel
- Regular building construction material **to** localised sustainable technology based building materials and technologies
- Gas/electricity based water heating **to** Solar water heaters

To Sum up

- Climate change resulting from human activity is an extremely serious global threat
- Buildings sector is a major source of GHG emissions
- Efficient appliances support efficient buildings
- Environmental action by the building construction and use is both cost-effective and can make a very large contribution to LCS goals.
- Leapfrogging in new building material and technologies can lead towards LCS.

Role of Industry and Government

- Indian Industries increasingly adopting energy efficient building practices.
- Indian Government adopting suitable policy and measures, and setting up exemplary practices.

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