Buildings Sector

India Energy Security Scenarios 2047

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Outline

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The Buildings Sector in India

- Construction is the second largest economic activity in India and contributes to about 9% of the nation's GDP.
- 70% of the building stock that would exist in 2030 is yet to be built.
- Residential and Commercial sectors account for 29% of the total electricity consumption in India.
- The share of the services sector in the Indian economy has been increasing which increases the demand for office space.
- There has also been a sharp growth in organized retailing, which is expected to grow at over 25% in the next few years.
- Appliance ownership is significantly increasing both in rural and urban households due to a rise in income levels. Lighting and major appliances like ceiling fans, televisions, refrigerators and air-conditioners account for about 80% of residential energy consumption.

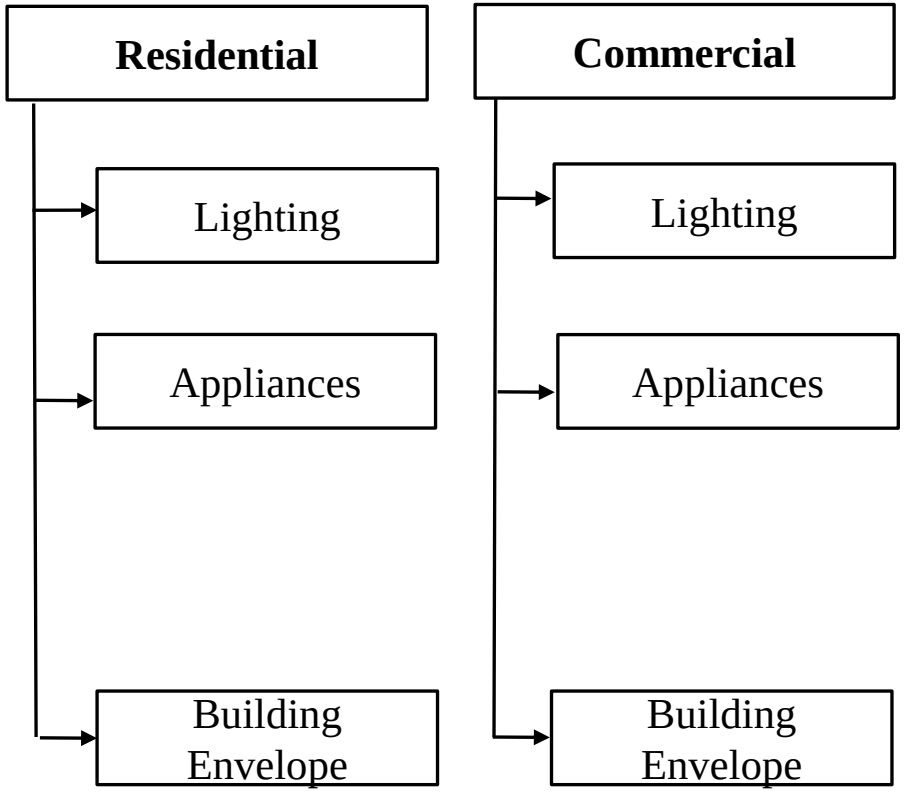
This presents a huge opportunity to lock in energy savings

NITI Aayog Office Building on its way to becoming a 5 star rated energy efficient building- Translation of theory into practice!

Key Policies Considered

Housing for all by 2022	Development of large retrofitting programs for commercial buildings
24x7 Power for all by 2019	Standards and Labelling Programme for Appliances
Pucca house access by 2022	Increased incentive schemes by the Government to promote adoption of energy efficient building codes e.g.: Rebate in property tax etc.
100 new smart cities	Expansion of the scope of building codes in terms of Energy Performance Index to help cover more buildings
Increased adoption of efficient building codes by states	Market transformation E.g.: Demand Side Management (DSM) based Efficient Lighting Programme (DELP)

Version 1- IESS, 2047



This analysis works on the efficiency gains realized from a transition to more efficient appliances. Ownership patterns are assumed to remain constant across all four levels.

Energy Demand from Residential Lighting and Appliances= F(Number of appliances, Hours of Usage, Weighted Wattage)

Energy Demand from Commercial Appliances = G(Energy performance index of different categories)

Percentage energy savings due to envelope interventions in both new and old buildings (Retrofitting) for each of the 4 levels was calculated.
This was then subtracted from the the energy demand by lighting and appliances to arrive at the net residential and commercial demand offering building envelope efficiency as a lever to the user

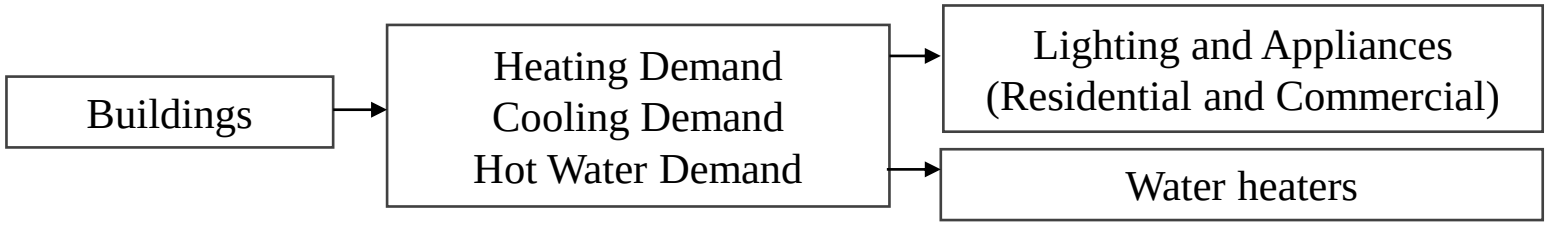
This analysis works on reducing electricity consumption, through greater penetration of building codes into construction of buildings which would reduce the need for lighting, heating, ventilation and air conditioning.

Energy Implications

Implications	Baseline data (2012)	Level 1 (2047)	Level 4 (2047)	Percentage Change
Total Primary Energy Demand (TWh)	240	24016	22647	6% Reduction
Import Dependence (%)	31	85	83	2% Decrease
Total Electricity Demand (TWh/year)	792	5752	4383	24% Reduction
Lighting and Appliances Electricity Demand (TWh/year)	233	3174	1805	43% Reduction
Total CO2 emissions (Million tonnes per year)	1726	13087	11549	12% Reduction
CO2 emissions per capita (Tonnes of CO2 per capita)	1.4	7.7	6.8	

**For Level 1 (2047) column, all the sectors are have been set at Level 1*
***For Level 4 (2047) column, only Residential and Commercial lighting and appliances and Green Building Envelope Optimization sectors has been set to Level 4, everything else is at Level 1.*

Version 2- IESS, 2047

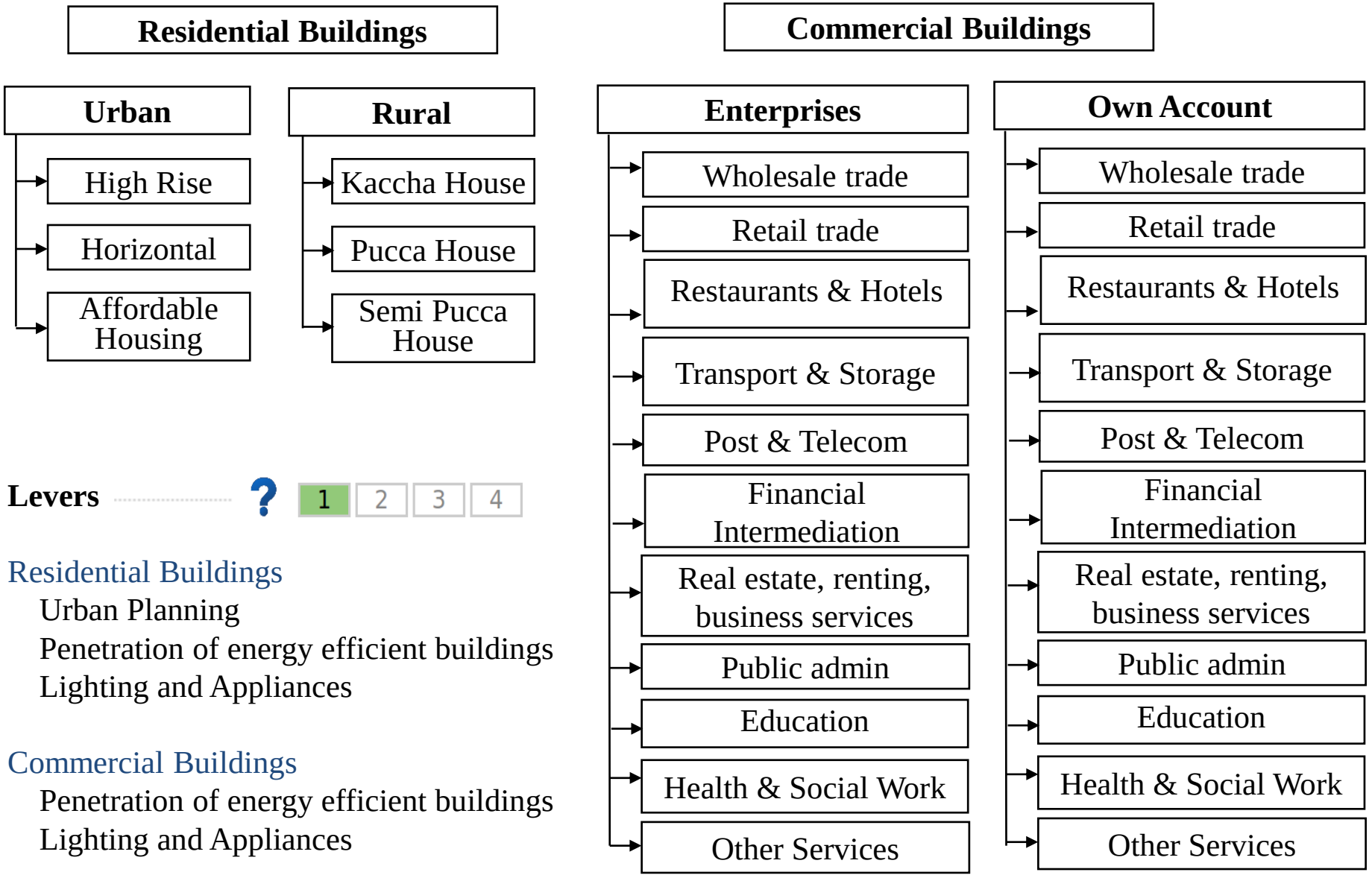


Bottom up approach to estimate Heating, Cooling and Water Heating Demand for different categories of buildings. This energy demand thus generated is met by different categories of appliances.

Drivers:

- Per capita space required
- Internal comfort temperature
- Urbanization rate
- Urban Planning patterns
- Smart Cities
- Floor Space Index
- Rate of heat loss per degree celcius
- Energy Efficiency Interventions

Costing driver: Cost per unit of energy saved



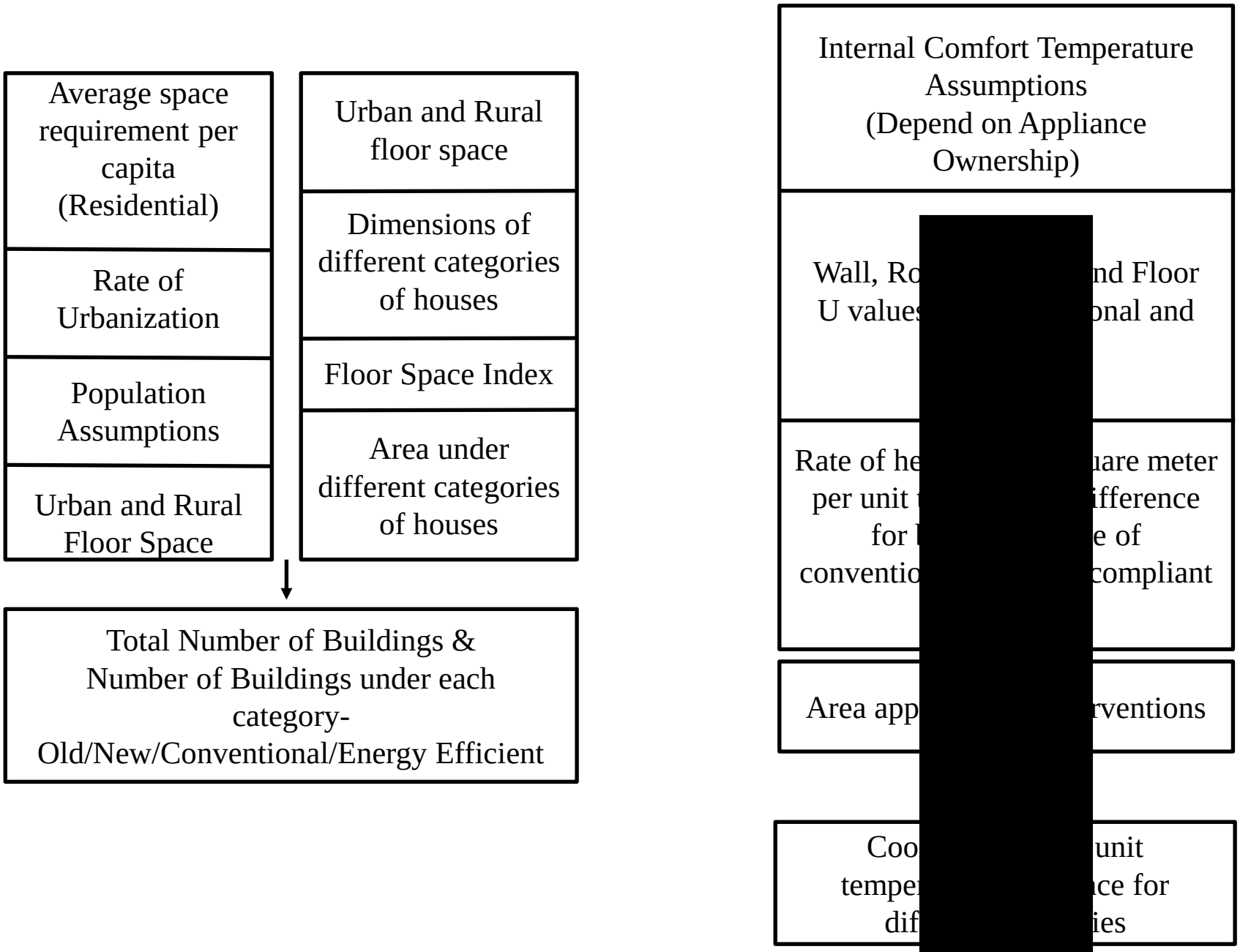
Levers ? 1 2 3 4

Residential Buildings

- Urban Planning
- Penetration of energy efficient buildings
- Lighting and Appliances

Commercial Buildings

- Penetration of energy efficient buildings
- Lighting and Appliances


Average space requirement per capita (Residential)
Rate of Urbanization
Population Assumptions
Urban and Rural Floor Space
Urban and Rural floor space
Dimensions of different categories of houses
Floor Space Index
Area under different categories of houses
Total Number of Buildings & Number of Buildings under each category- Old/New/Conventional/Energy Efficient
Internal Comfort Temperature Assumptions (Depend on Appliance Ownership)
Wall, Ro nd Floor U values onal and
Rate of he uare meter per unit ifference for e of conventio compliant
Area app rventions
Coo unit temper ce for dif ies

Residential

x	Mean seasonal temperature difference
x	Number of buildings of a particular category
x	Percentage of household cooled/heated
x	Cooling/Heating Load per degree Celsius for that category
x	Duration of the season
=	**Cooling/ Heating Demand for any level for a category**

Commercial

x	Mean seasonal temperature difference
x	Rate of heat loss of an efficient building per degree Celsius
=	**New Energy Performance Index**

Percentage reduction from conventional EPI is calculated and applied to the different categories

Subtraction of the same with the base case (All conventional) gives the energy savings

	Temperature difference
x	Average hot water demand per person per year
x	Specific Heat of Water
x	Duration of the season
=	**Total Water Heating Demand per person per year**
	Hot water demand in Residential areas
-	Demand met by solar water heaters
=	Hot water demand met by electricity
x	Efficiency of water heaters
=	**Total Electricity Demanded for hot water**

Challenges

- Since 70% of the infrastructure is yet to be built with asset life of more than 60 years, it is difficult to estimate how the urban planning scenario will pan out.
- Interlinkages with other connected sectors and their modelling approaches
- Absence of relevant data in the Indian building space
- Modelling different climatic zones
- Internal migration and Urbanization patterns

Thank you!

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