



Climate-Responsive Affordable Housing

Experience Sharing Workshop

New Delhi | Mar 07 2016

[Tanmay Tathagat

eds 

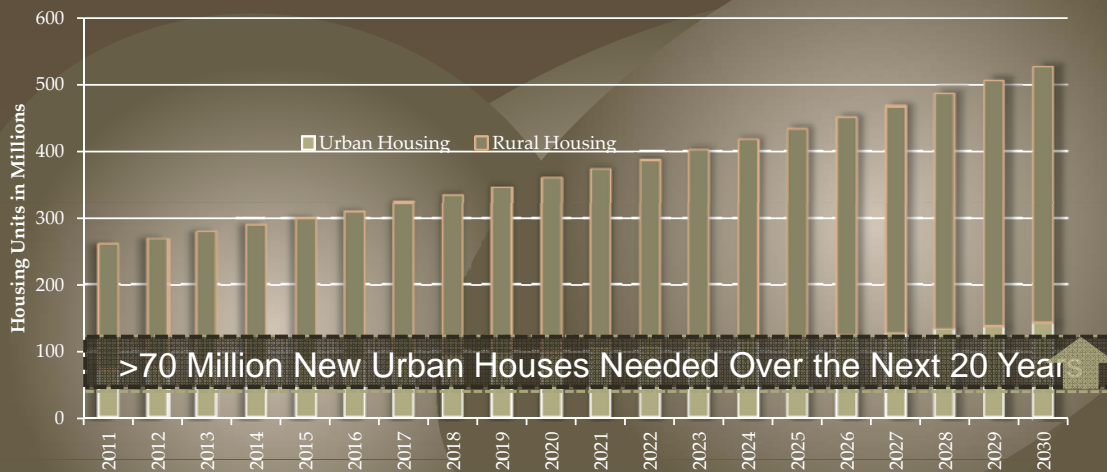
Affordable Housing

Affordable to buy, live in, commute to, and maintain

Includes

Informal, Rental, and Incremental solutions

2 Climate Responsive Affordable Housing eds 



Source: Planning Commission 11th Plan Report & EDS Analysis

Housing Demand Growth in India

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Construction Materials required for this would mean

2.3 million GWh of Energy Use
1.8 billion Tons of CO₂ Emissions
28 new Power Plants*

Even if the Units are not air conditioned this would mean an additional

700,000 GWh of Energy Use
600 million Tons of CO₂ Emissions
9 new Power Plants

And if all new Units have airconditioning in 20 years then this would add

2.4 million GWh of Energy Use
1.9 billion tons of CO₂ Emissions
28 new Power Plants

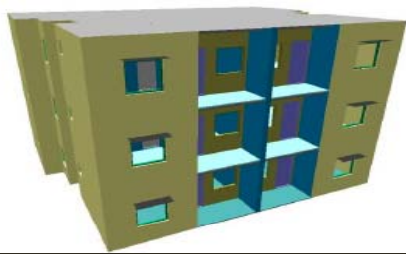
These new housing units will require over **15 billion** liters of water per year

*600 MW Power Plant running at 6000 Hrs PLF

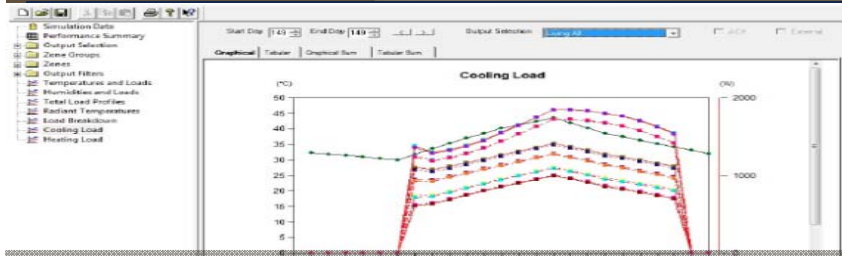
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Simulation Model of a Typical Cluster

Embodied Energy and Alternate Material Analysis
Energy Savings based on Potential Cooling/Heating Demand

Architect: Adlakha Associates

For Ground + 2 Storey Building	m ² Area Per Floor	m ² Area for entire Building	For per m ² Area of Floor	base material	Base case embodied energy MJ/m ² of material
External Wall Area	208.5	625.5	1.40	Brick	615
Internal Wall Area	149.88	449.64	1.00	Brick	615
Door and Window Frame Area	61.04	183.12	0.41	Steel	504
Window Area	22.68	68.04	0.15	Glass	231
RCC Slab Area	149.2	447.6	1.00	RCC	847
RCC Roof	149.2	149.2	0.33	RCC	847
RCC (Beams & Columns)	109.47	328.41	0.73	RCC	847
Plaster	671.4	2014.2	4.50	Cement	10

■ Market Cost of the Apartment ~ Rs. 750,000

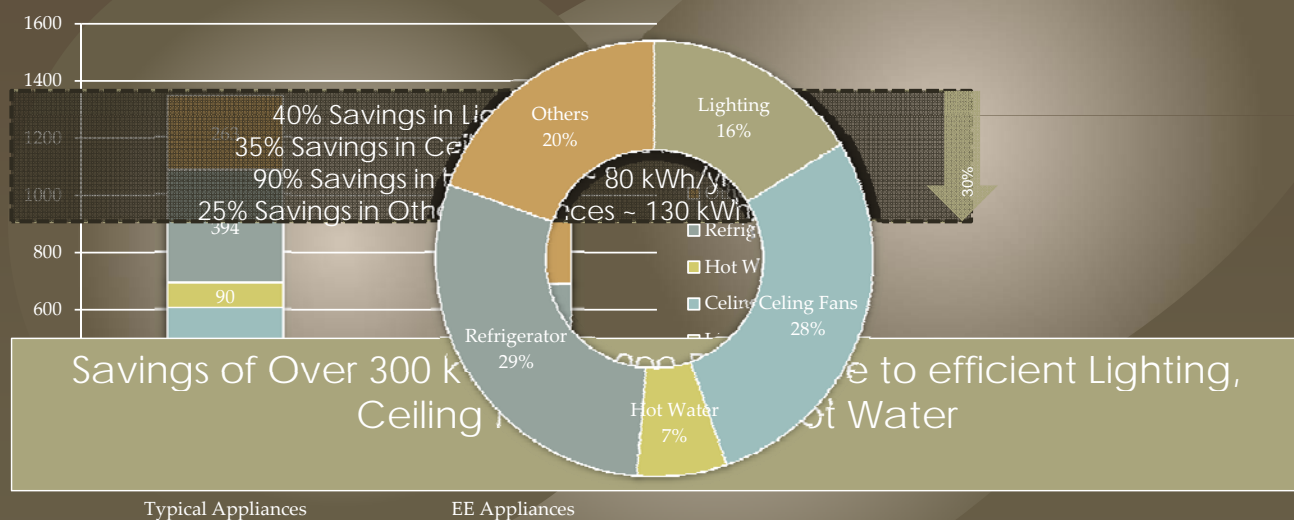
Analysis of a Typical Affordable House

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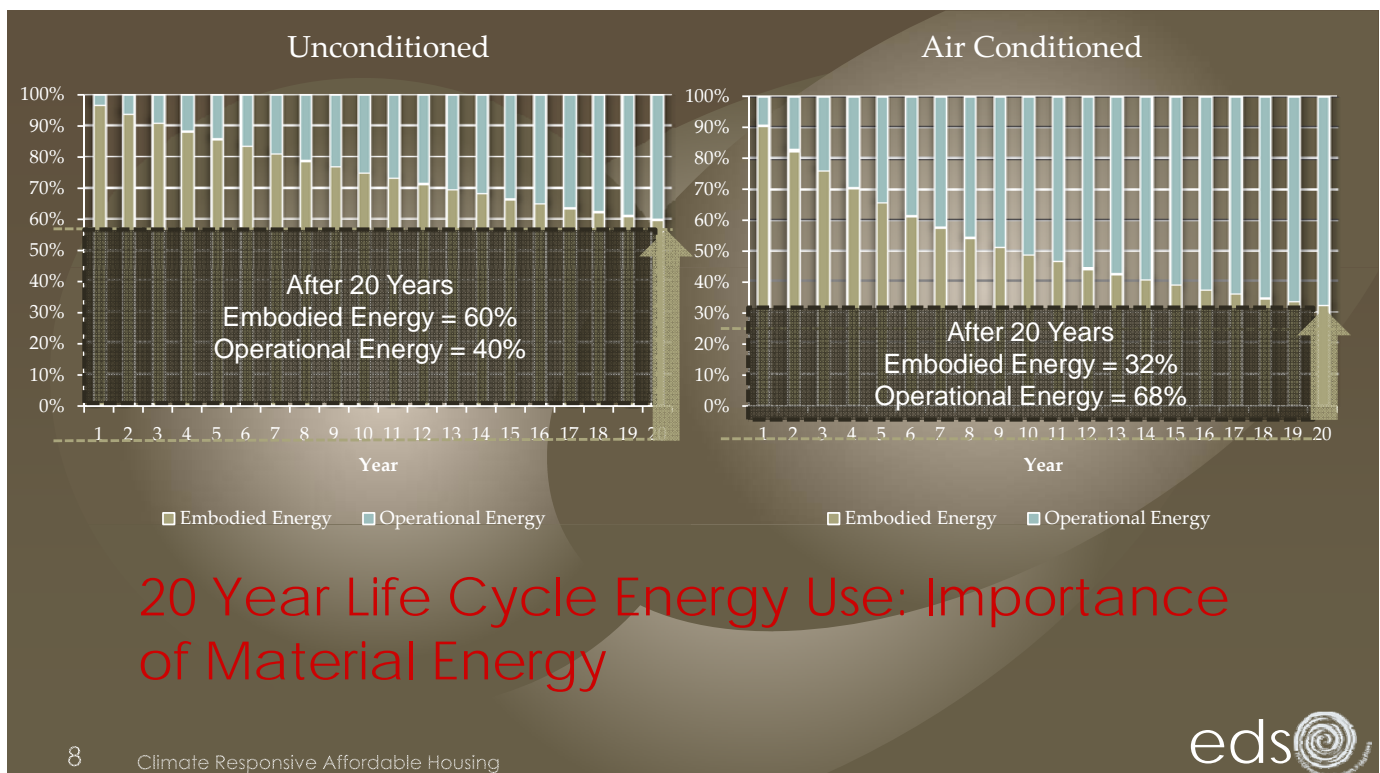
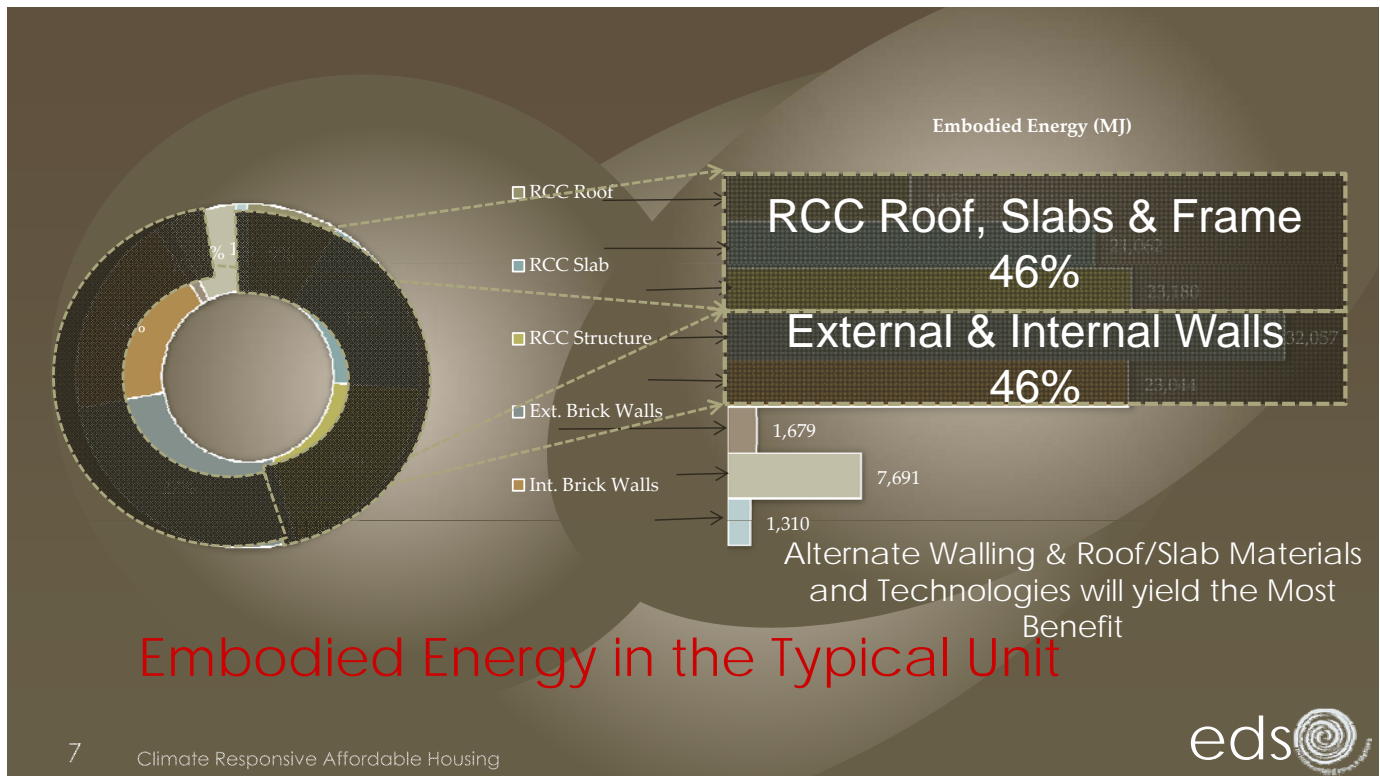
Operational Energy of a Typical Unit

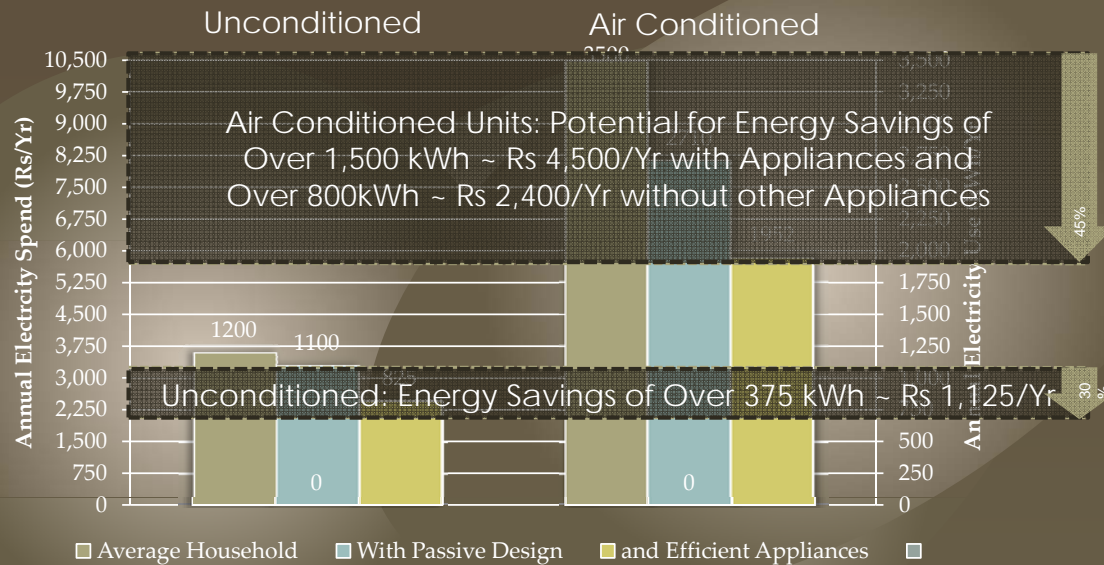


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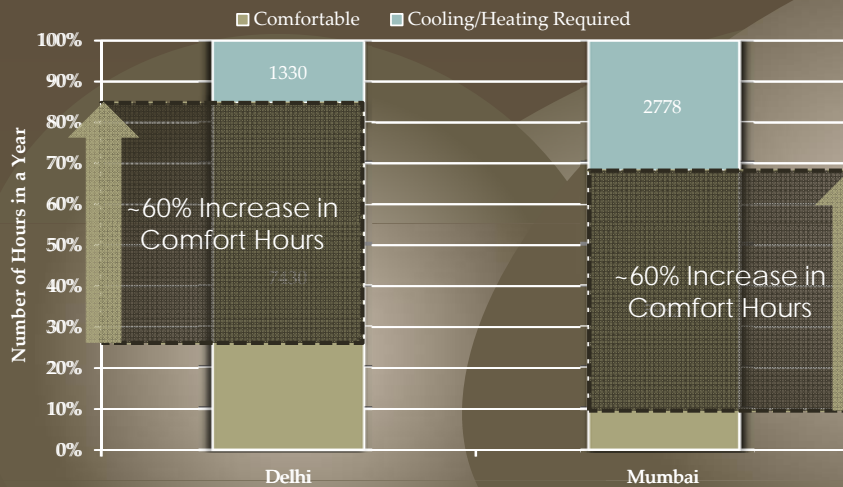




Operational Energy Use & Saving Potential

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Best Case Design incorporating all the Passive and Low Energy Strategies

Adaptive Comfort in a Passive House Allows Greater Number of Hours in the Comfort Range

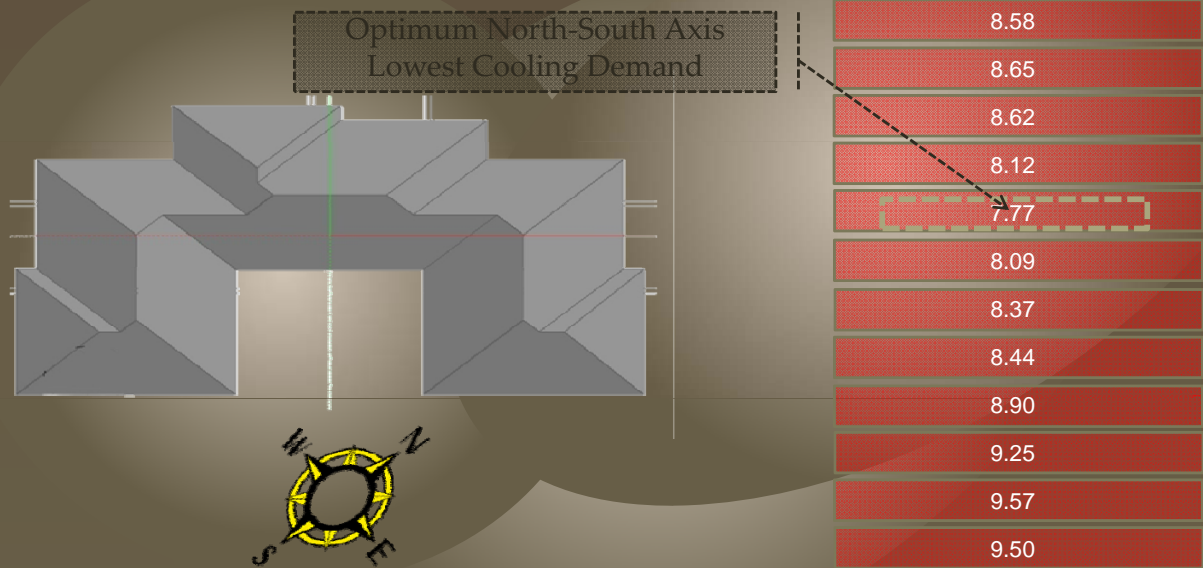
Passive Design for Comfort & Energy Savings

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Passive Design Process: Optimizing Orientation



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- ◉ Capital Cost Impact
 - ◉ Incremental Cost of Green Measures (30-100 Rs/sft of built up area)
 - ◉ This is current market cost, mainly driven by increased labor and transportation
 - ◉ Incremental Cost of Providing Lighting, Fans, and Solar Hot Water
- ◉ Material Suppliers and Vendors
 - ◉ Niche Manufacturing, small scale in most case
- ◉ Worker Skill and Familiarity
 - ◉ New Techniques with untrained workers results in delays and additional cost

Barriers and Challenges

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- ◉ Incremental Costs are small
- ◉ Incremental Approach to Green Measures
 - ◉ Measures that are low-cost no-cost to begin with
- ◉ Market development for lowering costs
 - ◉ Supply chain barriers much lower for large developments
- ◉ Speed of Construction

Approach to Green Affordable Housing

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Experience from NHB-KFW EE-Homes Program

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◎ Residential
 ◎ Affordable and Low-cost Housing
 ◎ Highest Demand
 ◎ Very Low Energy Use
 ◎ No Monetary Benefit of EE
 ◎ Inability to Repay through Savings
 ◎ Home Owners are not willing to pay for EE
 ◎ Robust Demand
 ◎ Increasing Energy Use
 ◎ Can Pay through Savings

The Future Energy Demand will be driven by this segment
 Energy Efficiency in Building Design and Envelope can not be retrofitted later
 Information and Financial Incentives will Drive this Segment
 Need to Provide Credibility and Certification/Labelling

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Promotional Programme for Energy Efficient New Residential Buildings



A programme for promoting energy efficiency in residential (apartments) buildings through energy efficiency labeling and associated mortgage refinance





- ◉ Initiated in 2010 under the Indo German development cooperation
- ◉ Aim: Improving EE in the Indian residential building sector by transferring German experience to India
- ◉ Main element: provision of line of credit of € 50 million for refinancing loans in certified buildings

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- ◉ National Housing Bank: (NHB)
 - ◉ Wholly owned subsidiary of Reserve Bank of India
- ◉ KfW Development Bank : (KfW)
 - ◉ Development Bank, partly owned by Govt. of Germany
 - ◉ Promoting Energy Efficiency in residential sector worldwide for three decades

Technical Assistance by:
 Adelphi GmbH, Germany
 TERI, India
 Environmental Design Solutions, India



- ◉ Projects to be awarded 'Energy Efficiency Certificate'
 - ◉ Energy Efficiency through improvements in design, equipment and material
 - ◉ Technical evaluation to be done by Technical Consultants
- ◉ Loans disbursed for certified projects will be refinanced by NHB
 - ◉ Banks and Housing Finance Companies will provide incentives for EE Mortgage

Market transformation through Certification, Labeling & Financing

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- ◉ Market Research done in Delhi, Mumbai, and Bangalore to assess the demand for Energy Efficiency
- ◉ Potential Buyers, Developers, Banks and Property Dealers surveyed

Based on Extensive Market Research

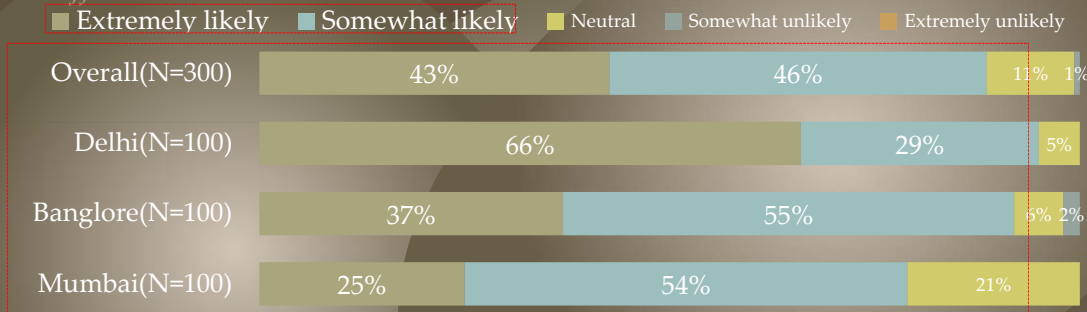
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Targeted market survey –
Consumers

What is your likelihood of buying an energy efficient residential house in case you are offered the same?*



A high percentage has shown inclination towards buying such houses – key merit mentioned was energy and corresponding electricity bill savings

~90% of buyers are interested in purchasing EE houses ...

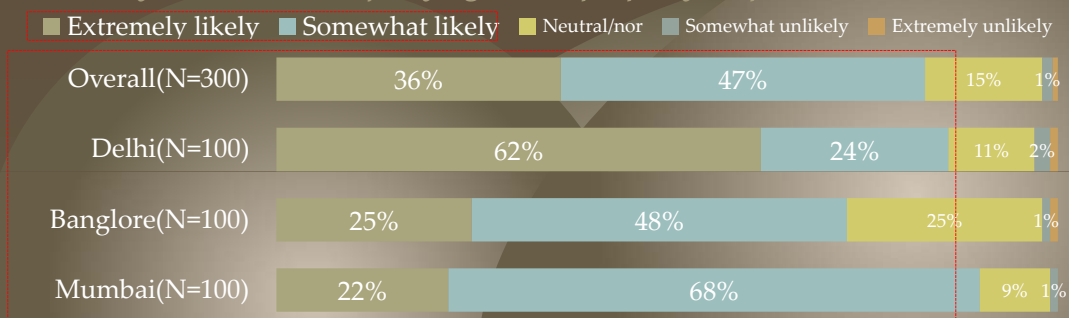
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Targeted market survey –
Consumers

What is your likelihood of buying such a property, at premium rates?*



N shows number of respondents

willingness to buy these houses at a premium rate, purely on the basis of merit even though no specific additional incentives were mentioned

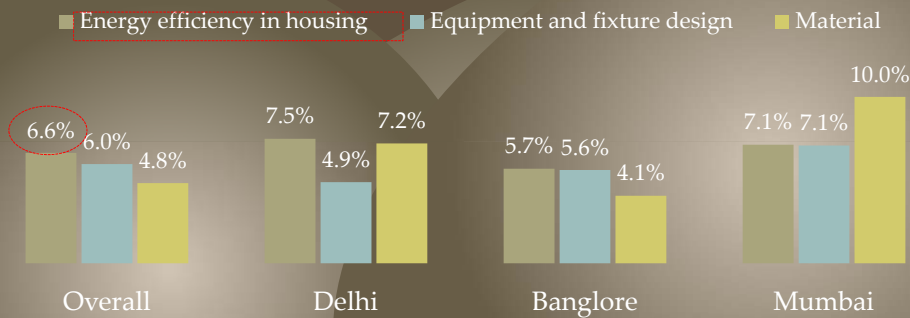
... and >80% would do so even at a higher price

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What premium can you pay for each?



The willingness to pay for EE features is lowest in Bangalore and highest in Delhi – NCR, it increases as we move towards more uncomfortable climate zones

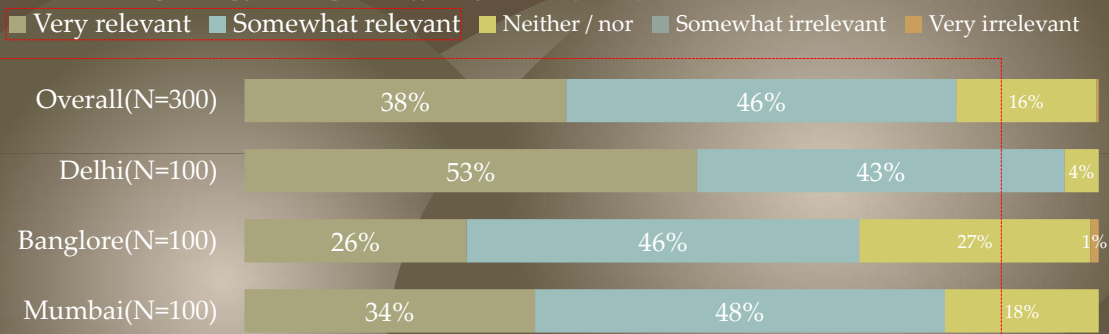
Average willing to pay ~7% premium for EE feature

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Now if energy efficient houses come with such labels that gives you assurance on comfortable living, energy saving and offers you benefits of loan. How relevant do you find it?



(N shows number of respondents)

The key benefits that were associated with labels were

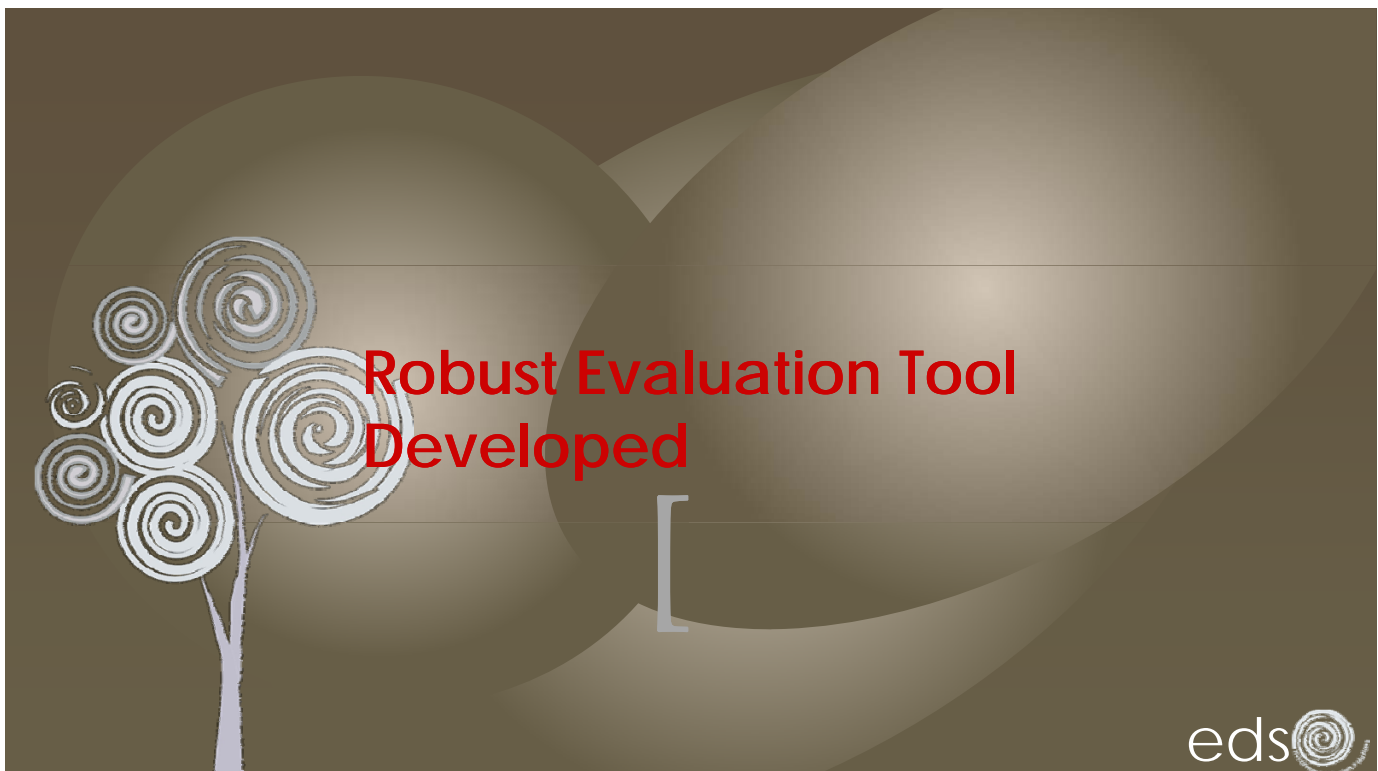
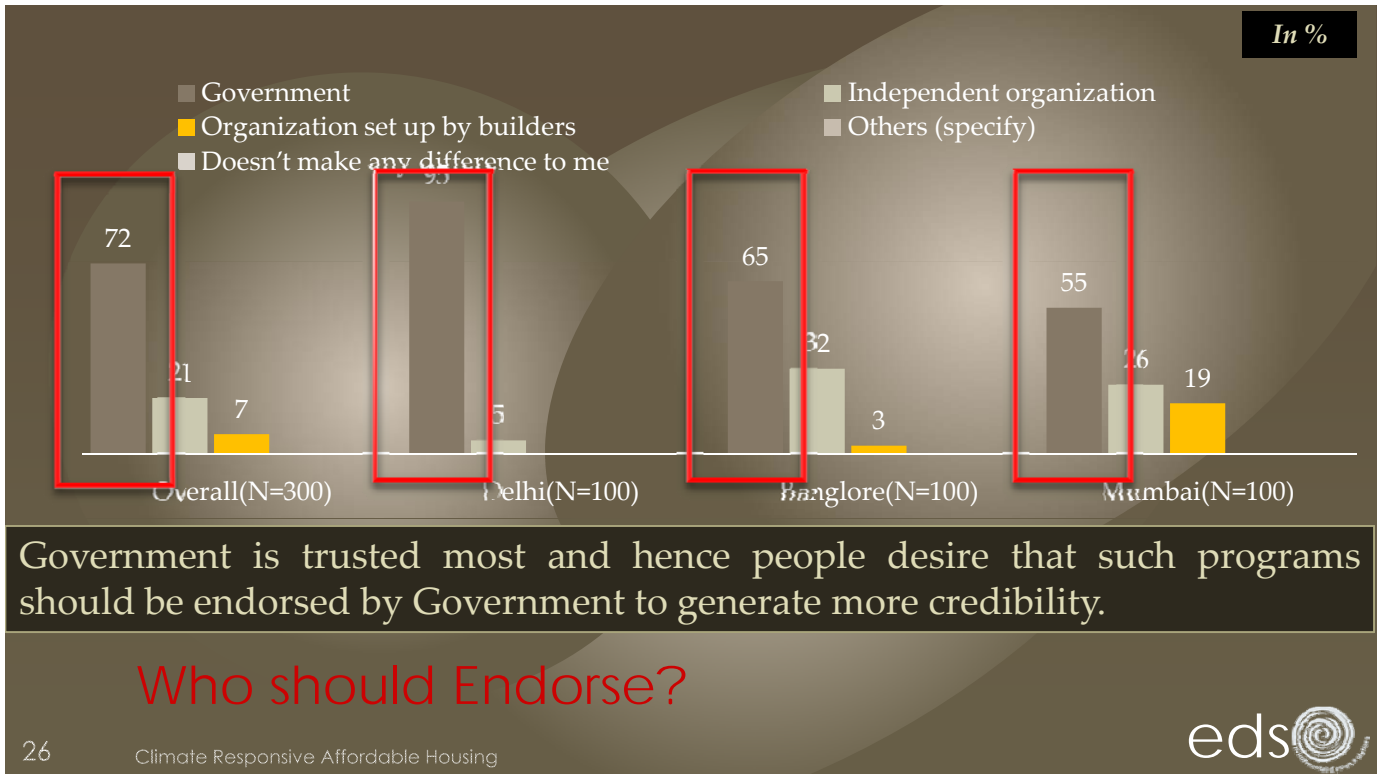
- Mark of confidence / trust
- Mark of approval
- verified electricity savings

>80% find the concept of Energy Labelling the houses as 'relevant' ...

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EnEff:ResBuild India
Toolkit for energy efficient residential buildings in India

Project: Sahara City Homes –Type C

Building:
Address of project: Sitapur Hardoi By-Pass Road, Near IIM, Lucknow, Uttar Pradesh 226020

Occupant/Owner:

Building parameters
Building type: Residential building
Total building area: 6,174.00 m²
Climatic zone: New Delhi
Created with: EnEffResBuild:India Version 0.9.1.0

Consumption of electrical energy in kWh/m²yr:

This building: 42 kWh/m²yr
Reference: 61 kWh/m²yr
Savings: 32%

Energy shares considered for the loan application:
☒ Internal lighting
☒ Common lighting
☐ Parking lighting
☐ Heating
☐ Cooling
☒ Hot water
☐ Ceiling fans
☐ Appliances

Qualitative parameters (0 out of 6 measures are applied in this building):
☐ Daylit area in the core area is 20% to 40%
☐ Solar street lights
☐ Efficient transformers
☐ Presence detection or photo sensors for outdoor and
☐ Efficient water pumps
☐ Tailored user manual

Issuer:
The Energy And Resource Institute (TERI)

04.07.2011

Evaluation Tool and Label

Based on the ISO whole-building-approach (Flexibility)

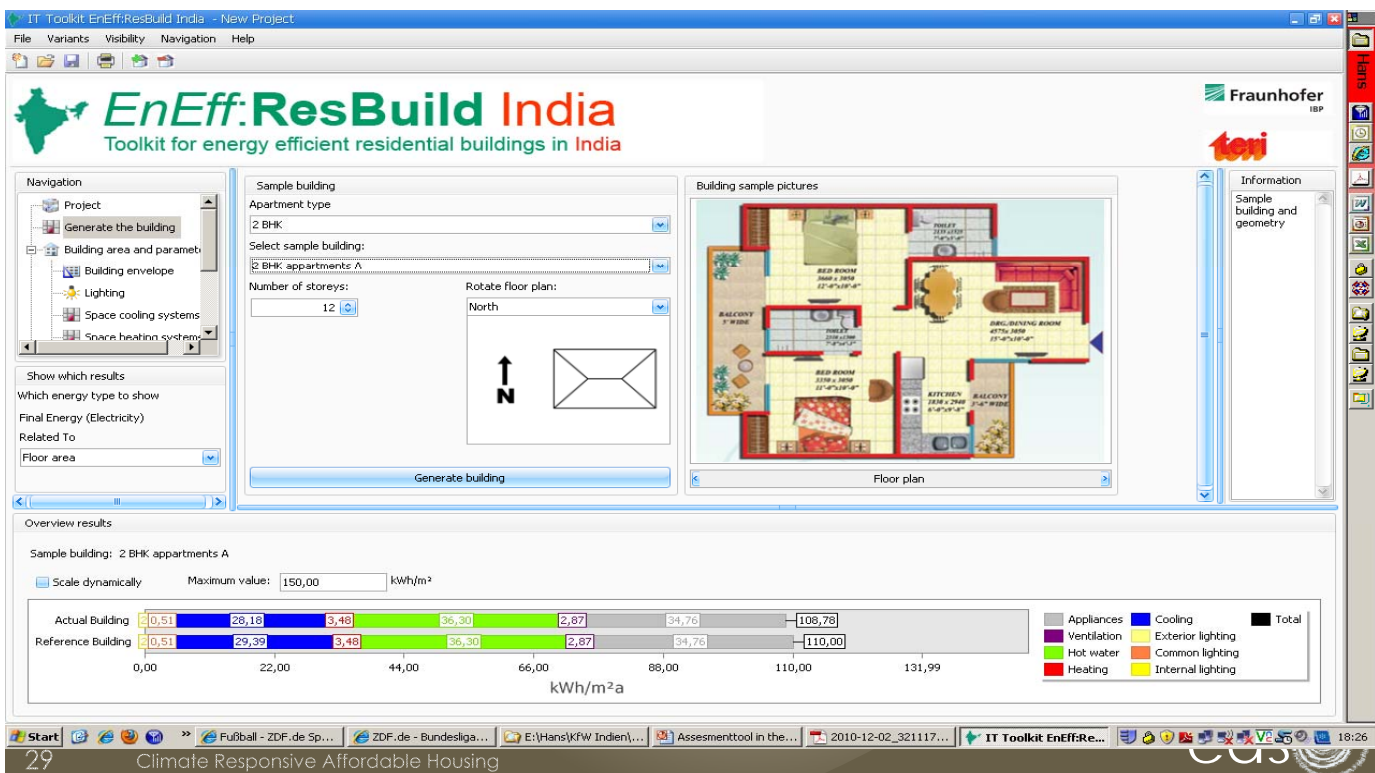
Robust energy performance assessment (Comparability)

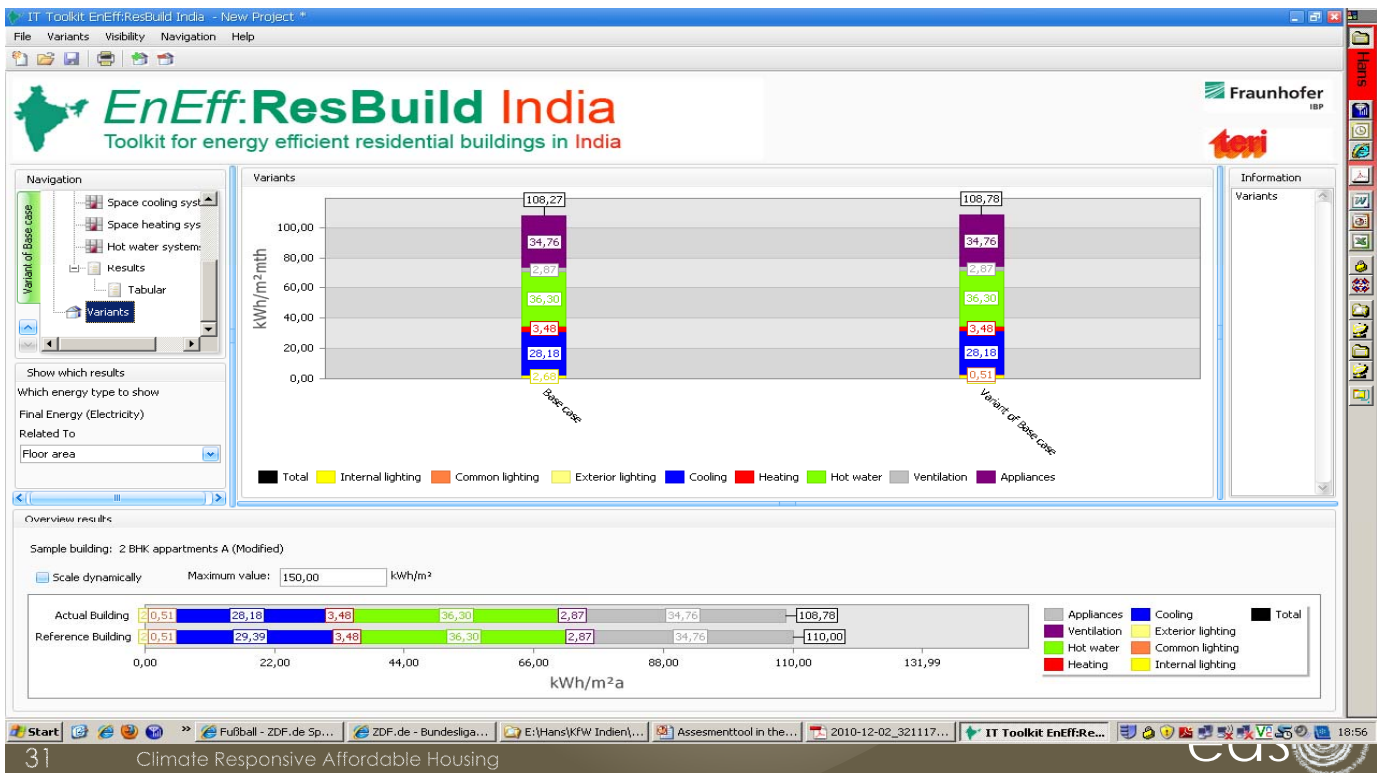
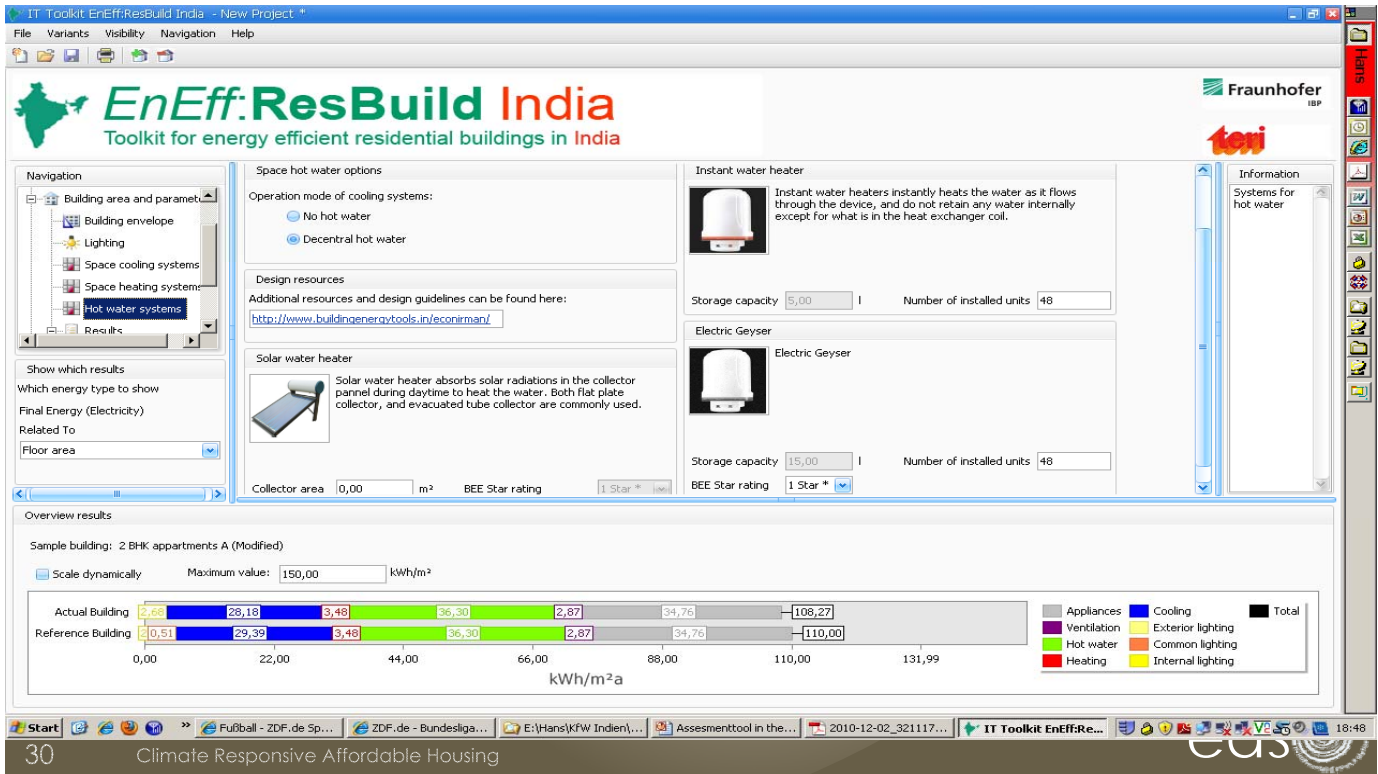
- Easy to use by architects and auditors (Scalability)

Easy to compare different EE design, material and technology combinations (Optimization)

Basis for Energy Efficiency Label (Communication)

Joint Assessment Tool Developed by Fraunhofer Institute and TERI,





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Table of results - Electric energy in kWh/m²yr:

	This building	Reference building
Internal lighting	12.81	12.81
Common lighting	1.24	1.24
Parking lighting	0.00	0.00
Cooling	20.27	35.50
Heating	5.28	5.28
Hot water	8.97	11.15
Ceiling fans	1.74	1.74
Appliances	25.00	25.00

Occupant/Owner:

Building parameters
Building type: Residential building
Total building area: 5,174.00 m²
Climate zone: New Delhi
Created with: EnEffResBuildIndia Version 0.9.1.0

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Issue: The Energy And Resource Institute (TERI)
Date: 04.07.2011
Signature: [Signature]



Deviations with respect to reference building

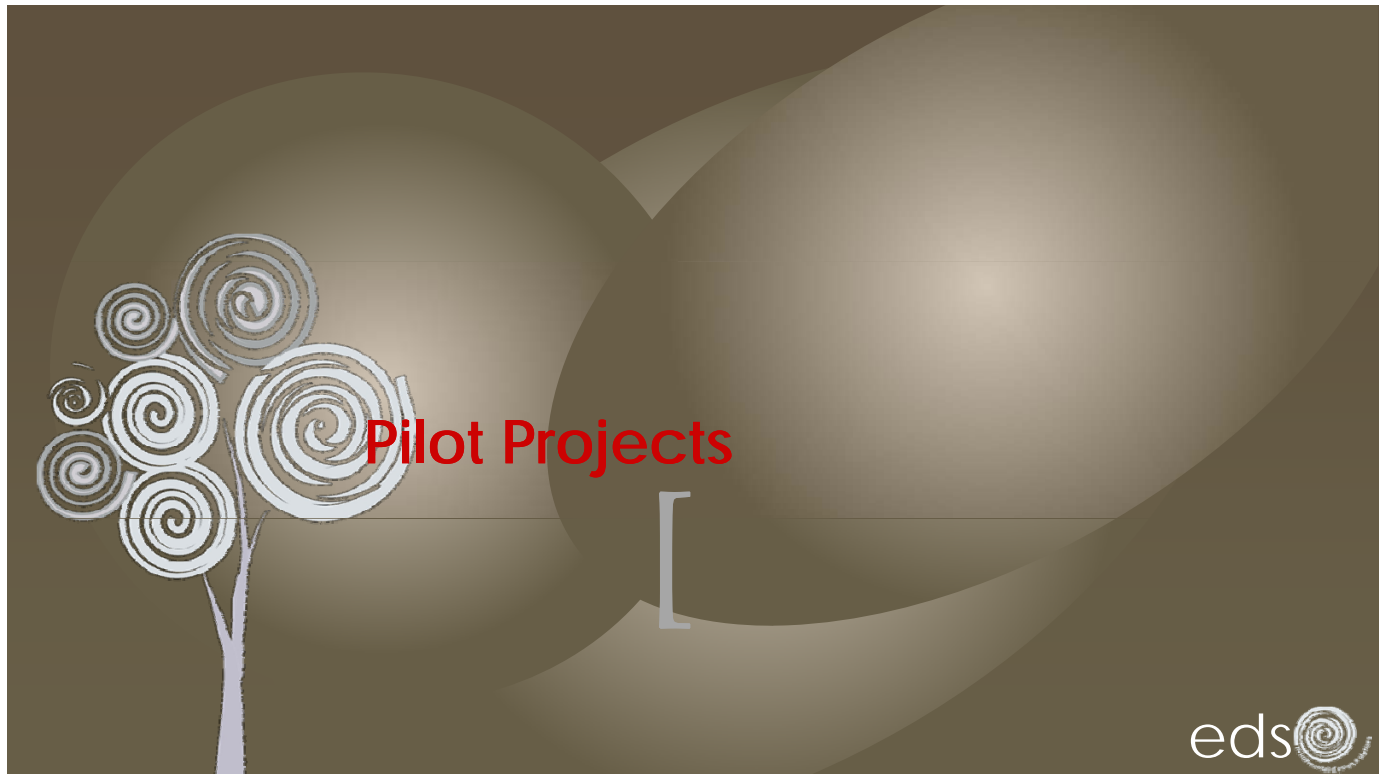
Façade North			
U-Value	W/(mK)	0.91	1.57
Window North			
U-Value Glazing	W/(mK)	5.50	5.17
U-Value Frame	W/(mK)	5.81	13.51
U-Value Total	W/(mK)	5.89	8.37
SHGC Glazing	-	0.29	0.81
Effective SHGC	-	0.26	0.73
Façade West			
U-Value	W/(mK)	0.91	1.57
Window West			
U-Value Glazing	W/(mK)	5.50	5.17
U-Value Frame	W/(mK)	5.81	13.51
U-Value Total	W/(mK)	5.89	8.37
SHGC Glazing	-	0.29	0.81
Effective SHGC	-	0.26	0.73
Façade South			
U-Value	W/(mK)	0.91	1.57
Window South			
U-Value Glazing	W/(mK)	5.50	5.17
U-Value Frame	W/(mK)	5.81	13.51
U-Value Total	W/(mK)	5.89	8.37
SHGC Glazing	-	0.29	0.81
Effective SHGC	-	0.26	0.73
Façade East			
U-Value	W/(mK)	0.91	1.57

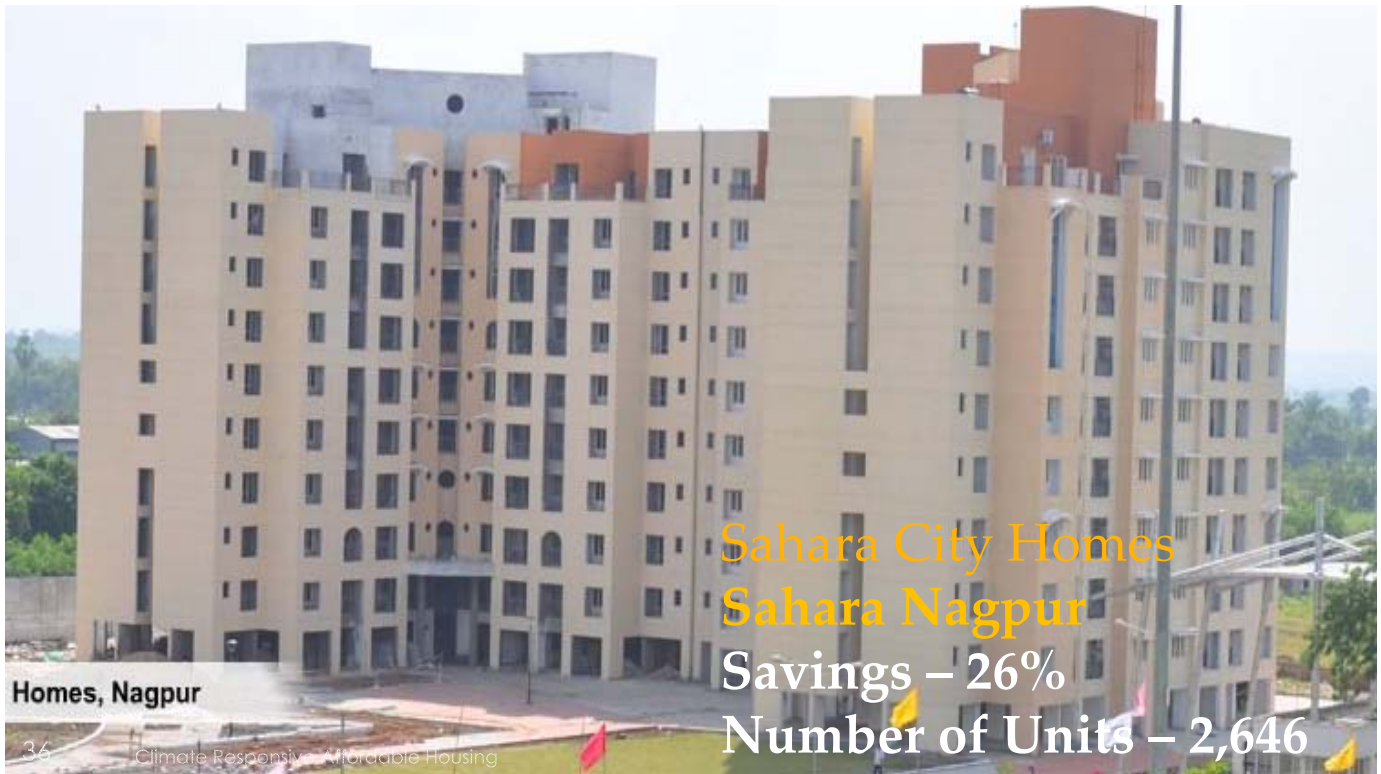
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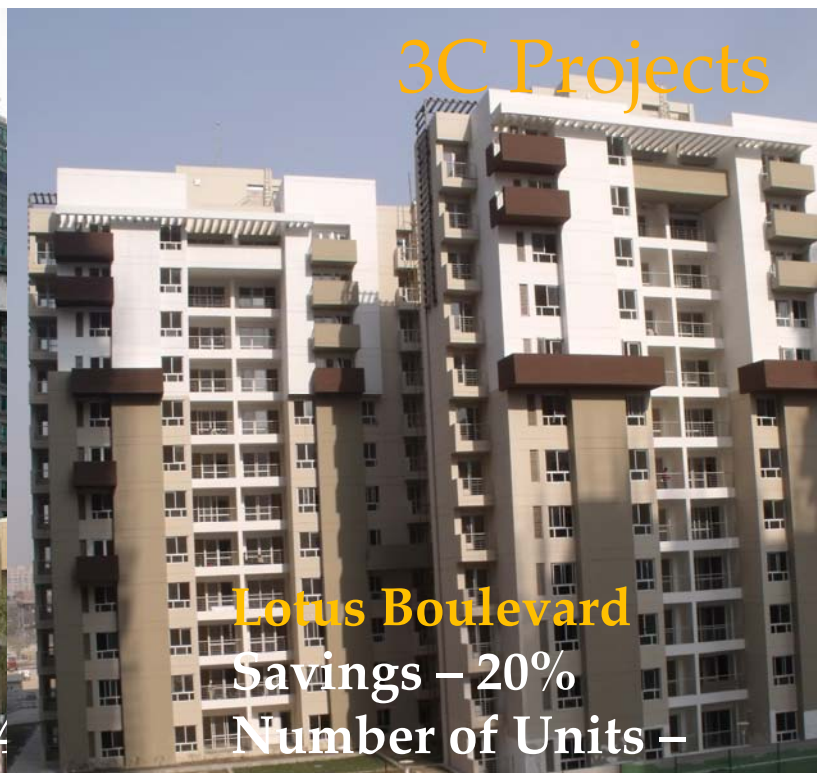


- Multi family apartments
 - For Certification :
 - Energy Savings > 18% for Passive Measures
 - Energy Savings > 30% for Passive + Active Measures
- (over the reference building using the Tool)

Eligibility Criteria for Inclusion







PASSIVE	ACTIVE
Appropriate Orientation	Efficient Common Area lights
Walls & Roof Insulation	3-5 Star Rated Air Conditioners
Appropriate Number & Size of Windows	3-5 Star Rated Ceiling Fans
Double Glazing	3-5 Star Rated Geysers
Window Shading	Efficient Lighting in the Units
Solar Hot Water	
Light Colored Walls and Roof	

Contributing Measures to EE

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Number of Buildings Certified	442
Calculated Energy Consumption (MWh/yr)	130,978
Benchmark Energy Consumption (MWh/yr)	174,286
Energy Saving (MWh/yr)	43,308
Energy Saving (%)	25%
CO2 Savings (tCO2/yr)	36,811
Per Unit Area (m ²)	
Calculated Energy Consumption (KWh/m ² /yr)	56
Benchmark Energy Consumption (KWh/m ² /yr)	74
Energy Savings (KWh/m ² /yr)	18

Apartments are Air Conditioned to Maintain Comfort Through the Year

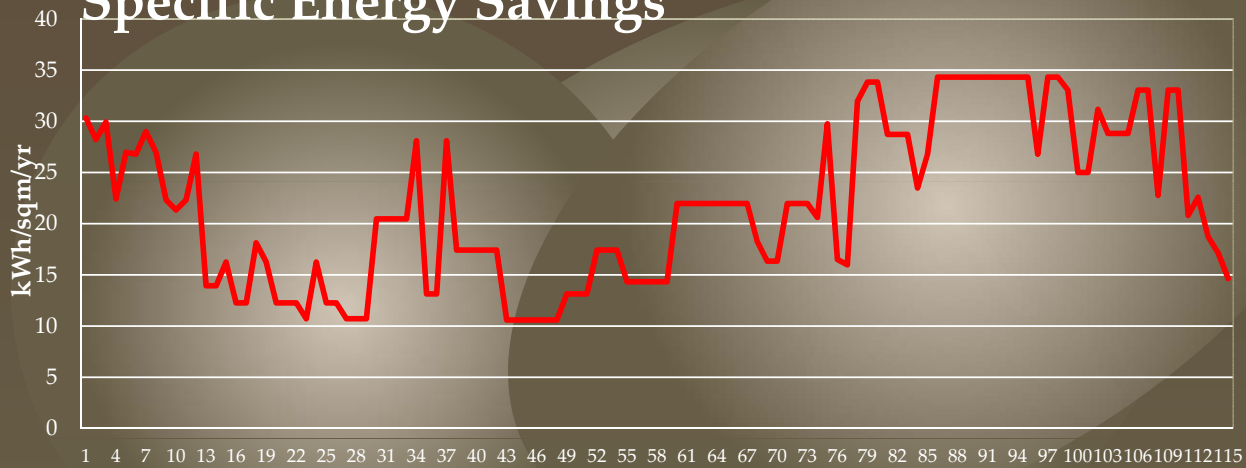
Pilot Project Energy Use Summary

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Specific Energy Savings



Average Specific Savings is **19 kWh/sqm/yr**

For a 2BHK apartment (say 100sqm) \approx **1900 units/yr**

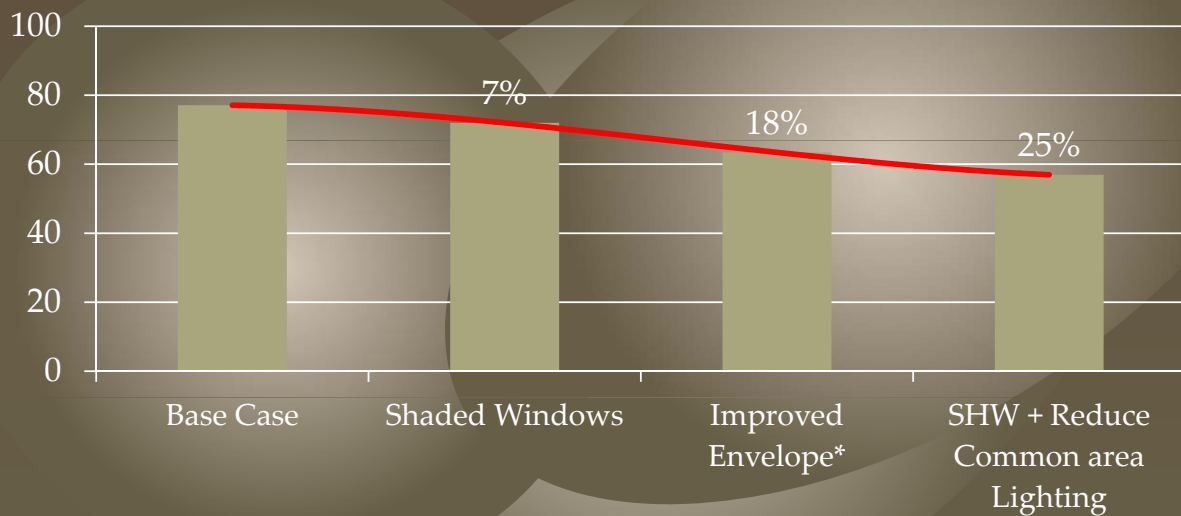
Monitory Savings (1kWh = 5.5 Rupee) **>10,000 Rupees**

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Energy Saving Potential (kWh)

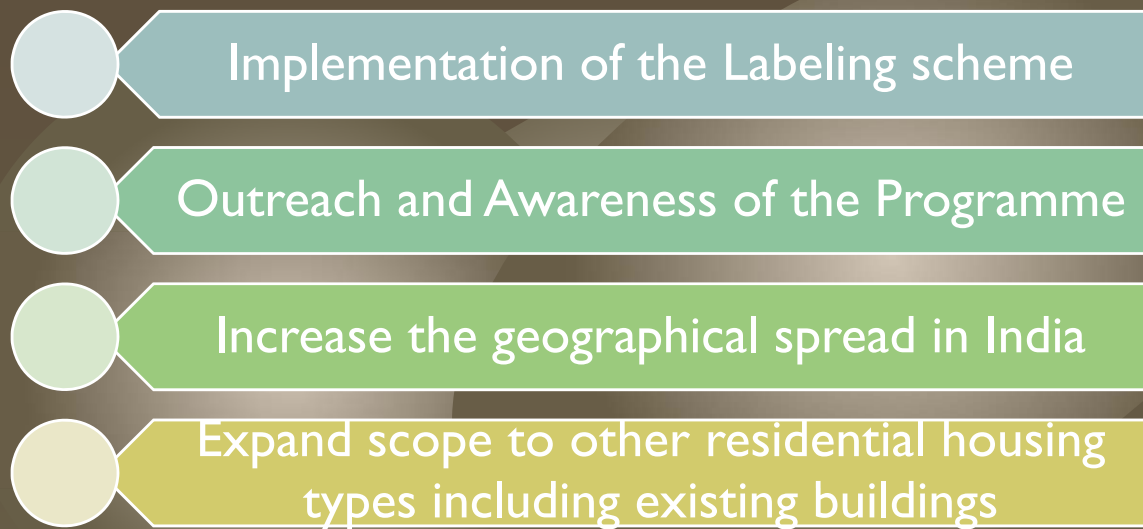


Improved Envelope* - AAC Wall, Insulated Roof, Reflective Glass, Light Color Exteriors

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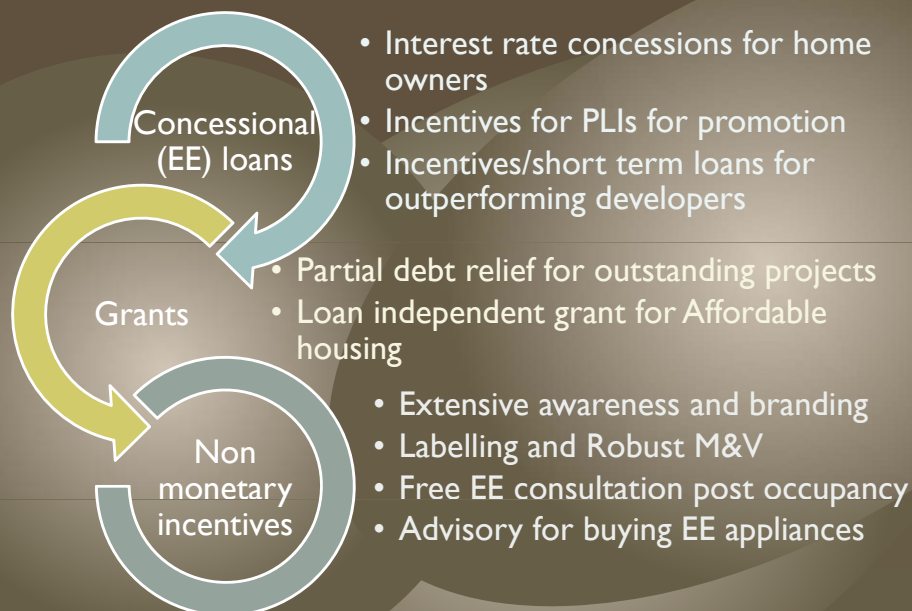
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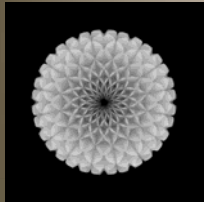
Way Forward

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Incentives for Programme take off

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Thank You

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