Life-Cycle Carbon Assessment of Buildings: Indian Context

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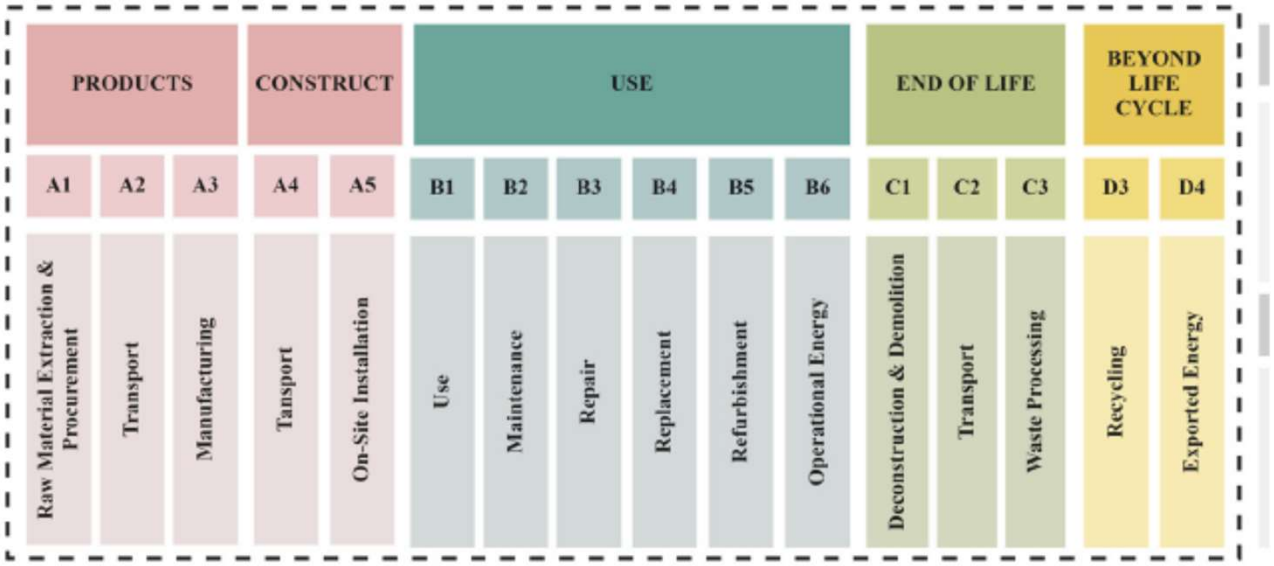
OUTLINE

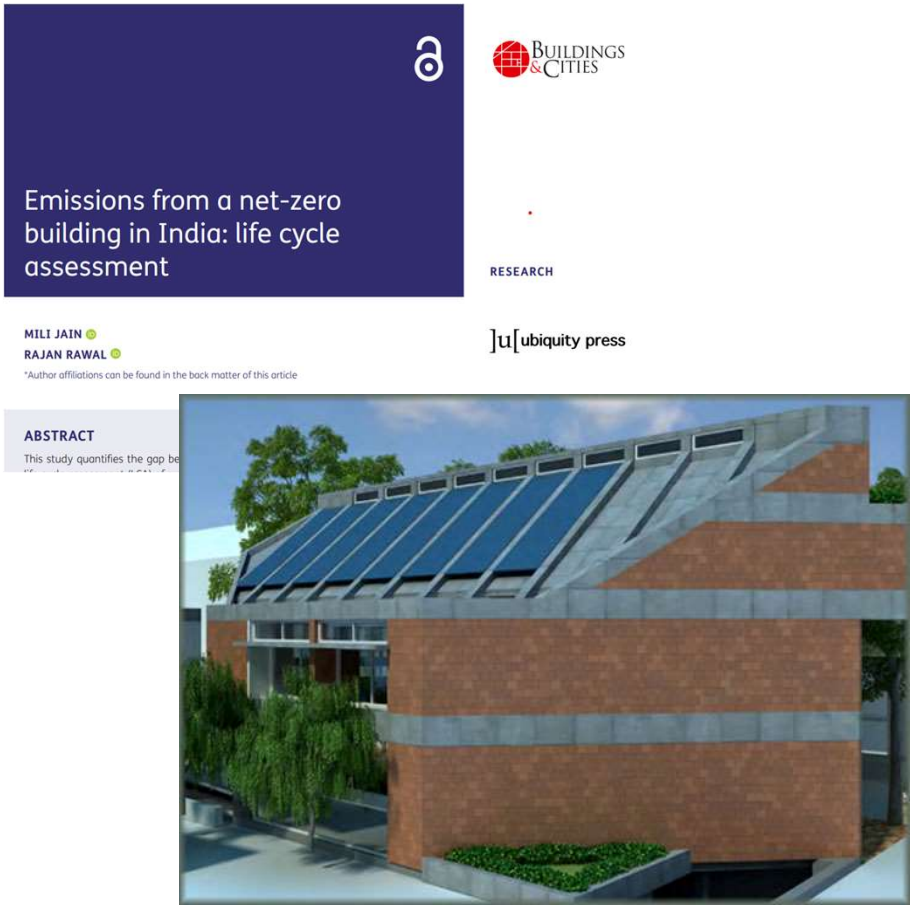
- Life-cycle carbon assessment - An Indian example
- Reducing upfront embodied carbon– An Indian example
- A framework for decarbonization of the building sector
- Conclusions

LIFE-CYCLE CARBON ASSESSMENT FRAMEWORK - BUILDINGS



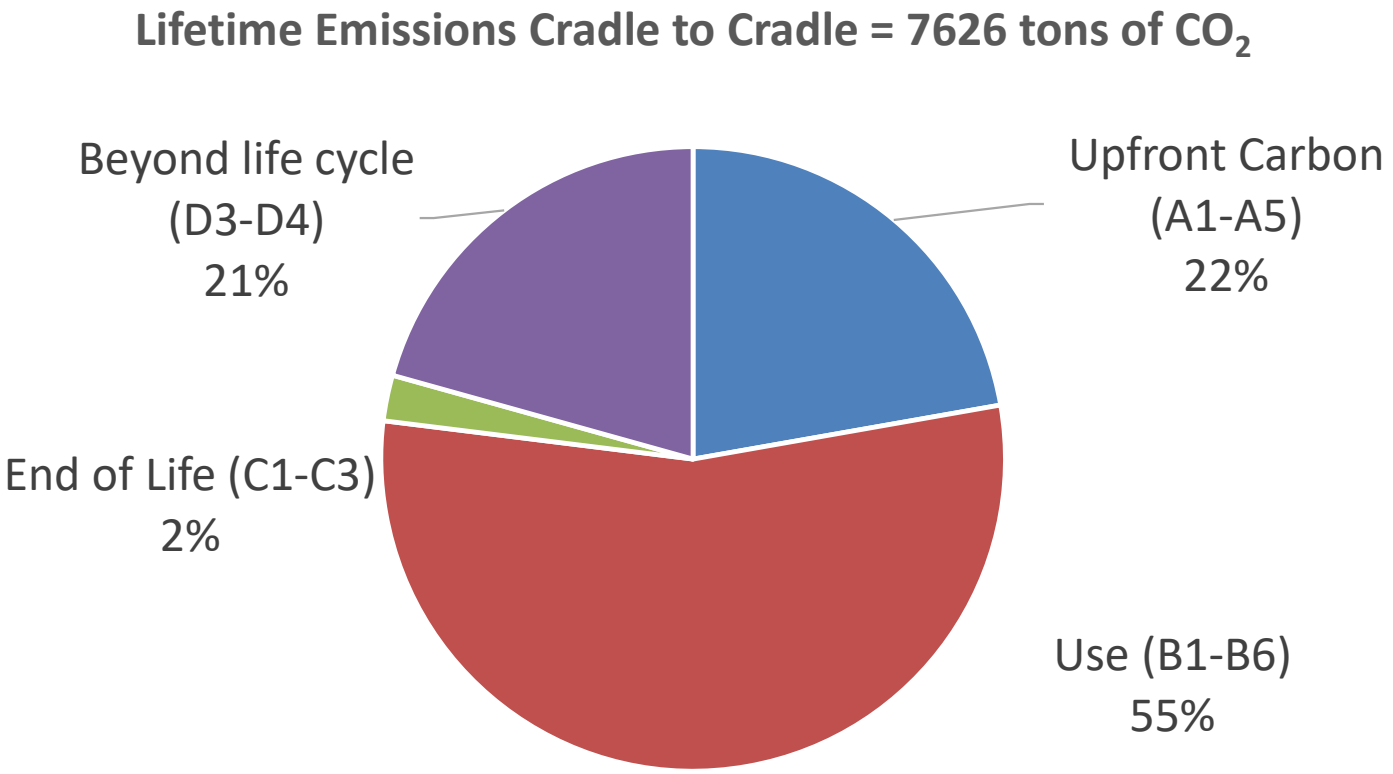
CASE STUDY: CARBSE BUILDING, CEPT UNIVERSITY, AHMEDABAD

- Net-zero energy building
- A research laboratory (515 m^2 area)
- Construction:
  - RCC, burnt clay bricks, XPS insulation for wall and structural systems, uPVC windows, double-glazed, low-E coated windows, stone flooring.
  - 30 kWp PV array and multiple heating, ventilation and air-conditioning (HVAC) systems
- Extensive monitored data available regarding its energy performance.
- Indian embodied carbon data used for analysis.
- Building operational life of 60 years. PV array life of 20 years were taken for analysis



Source: Milli Jain & Rajan Rawal (2021). Emissions from a net-zero building in India: life cycle assessment, Buildings and Cities DOI: 10.5334/bc.194

Lifetime Carbon Emissions

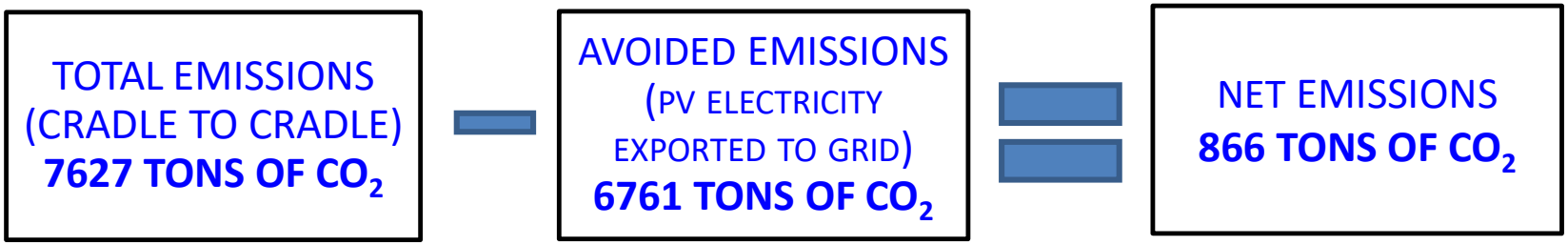


83% contribution of Cement, Steel and Solar PV in Upfront Embodied Carbon

Electricity used for HVAC operation largest contributor

Source: Milli Jain & Rajan Rawal (2021). Emissions from a net-zero building in India: life cycle assessment, Buildings and Cities DOI: 10.5334/bc.194

RESULTS

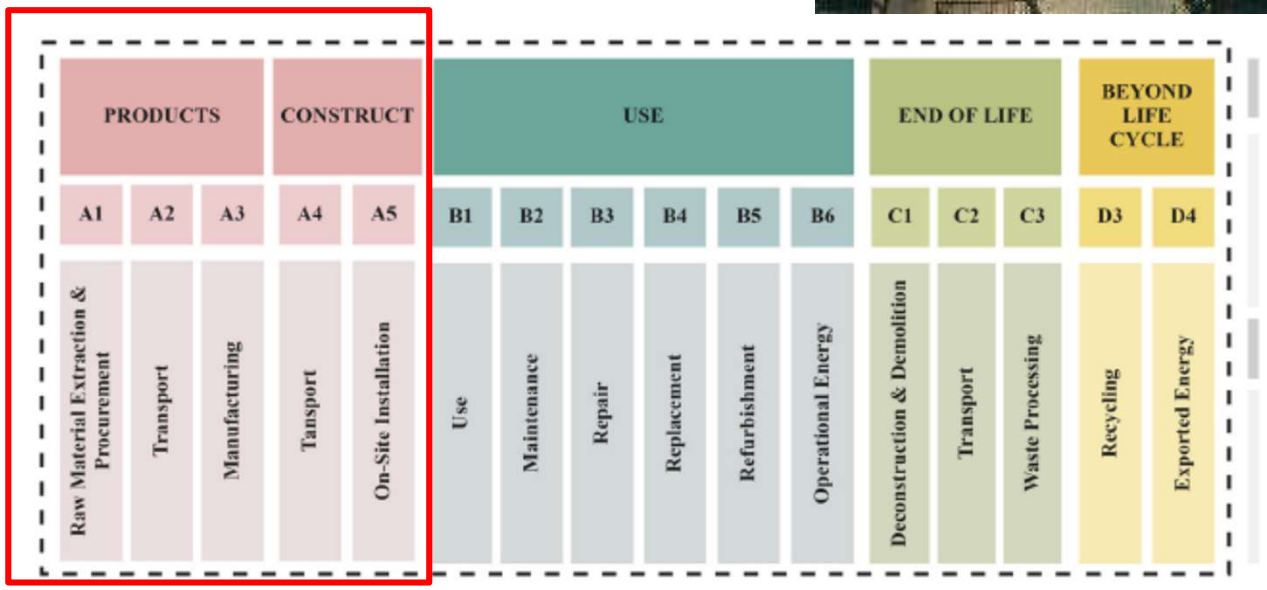


- Net Zero Energy Buildings ≠ Net Zero Carbon Buildings.

- To become net zero carbon significant additional measures e.g. additional solar capacity, trees, etc. are required.

REDUCING UPFRONT EMBODIED CARBON

- G+3 Residential Building
- Total area ~ 5000 sq ft
- Place Kolkata



Source: AB Lal, Japan Shah & GKSPL: Study done for Arth Ceramics, Kolkata

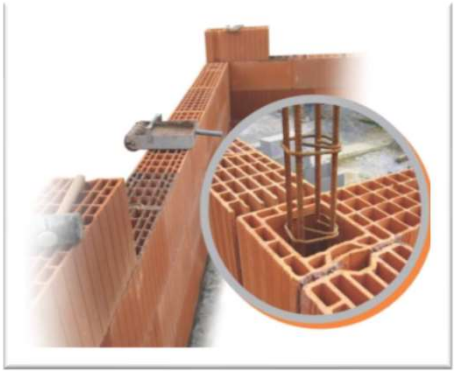
3 Cases: Construction Systems using Burnt Clay Bricks

1

Case 1: Concrete frame construction with solid brick - wall thickness 250 mm (Conventional)

2

Case 2: Concrete frame construction with Hollow Clay Blocks - wall thickness 200 mm



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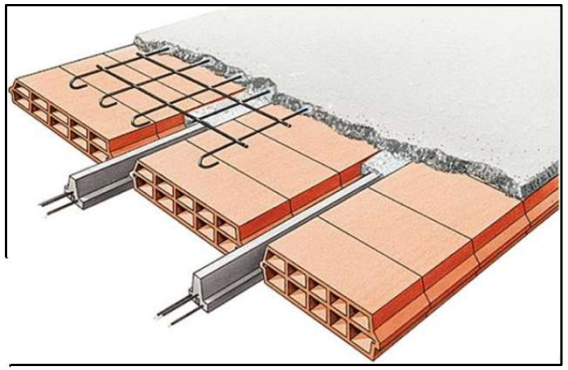
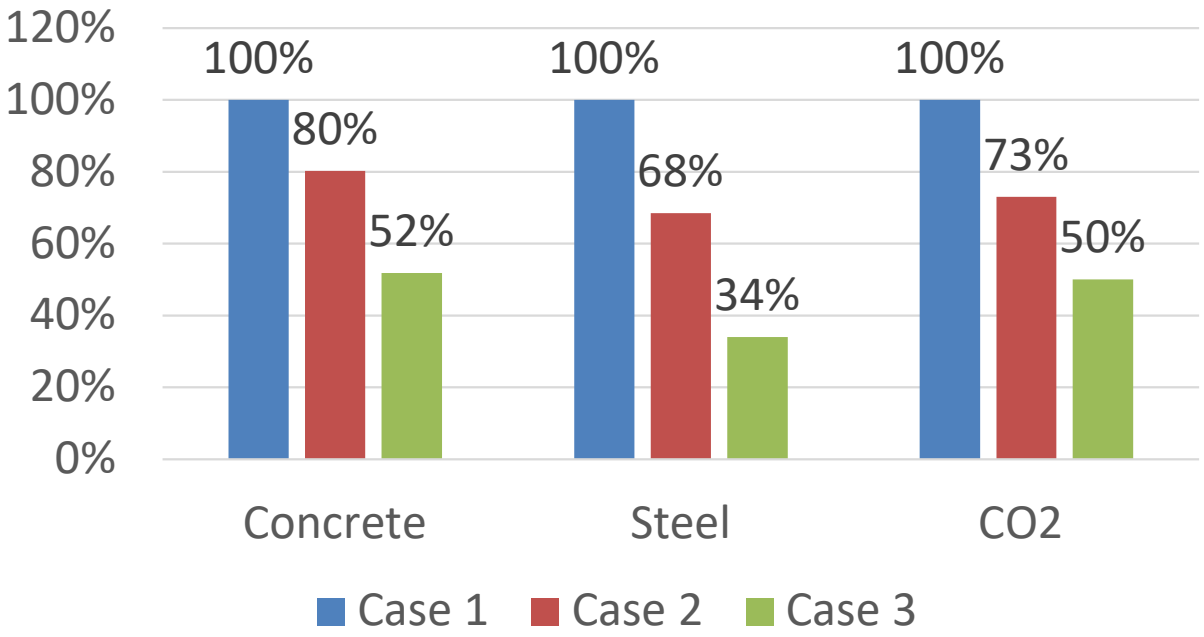


Case 3: vertical cored hollow block confined masonry with waffle slab

Source: AB Lal, Japan Shah & GKSPL: Study done for Arth Ceramics, Kolkata

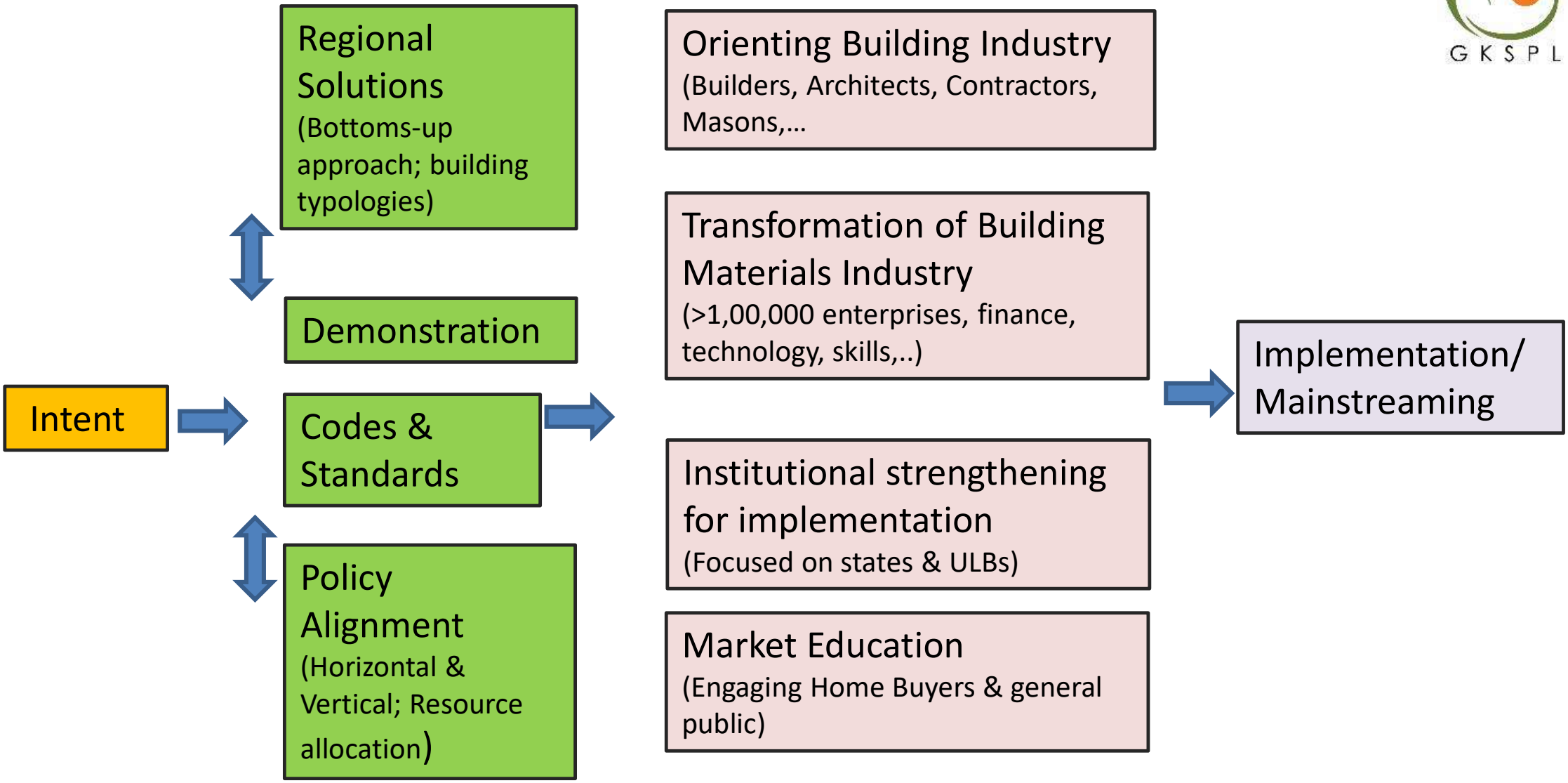
Reduction in Steel, Concrete & Embodied Upfront Carbon



- 50% reduction in upfront carbon
  - 280 kg CO_2/m^2 (Case I) → 140 kg CO_2/m^2 (Case 3)
- With simultaneously decarbonization of the steel and cement industries, much deeper cuts are possible.
- Case 2& 3 also offers better thermal insulation and hence lower operational energy/carbon for air-conditioning
- 53% reduction in structural cost (Case 3 compared to Case 1)
- A win-win proposition

Source: AB Lal, Japan Shah & GKSPL: Study done for Arth Ceramics, Kolkata

Framework For Decarbonization of Building Sector



CONCLUSIONS

- Life cycle carbon assessment
  - More focused work required to understand the implications of “net zero carbon” buildings in the Indian context ; better data base on embodied energy/carbon
- For decarbonization of buildings, immediate attention is required to reduce upfront embodied carbon emissions.
  - Decarbonization of primary building material supply chains, steel, cement, bricks, etc.
  - Employing available construction technologies which economies on the use of higher embodied carbon materials, …
- A new approach required for achieving decarbonisation of building sector
  - Building construction is a conservative sector; involves millions of persons and enterprises; a more inclusive approach is required.
  - Slow progress so far. Top-down approach, lack of time-bound & coordinated efforts
  - Regional focus, decentralised and bottoms-up approach during formulation and implementation are required

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THANK YOU !!!