



Design-integrated LCA using early BIM

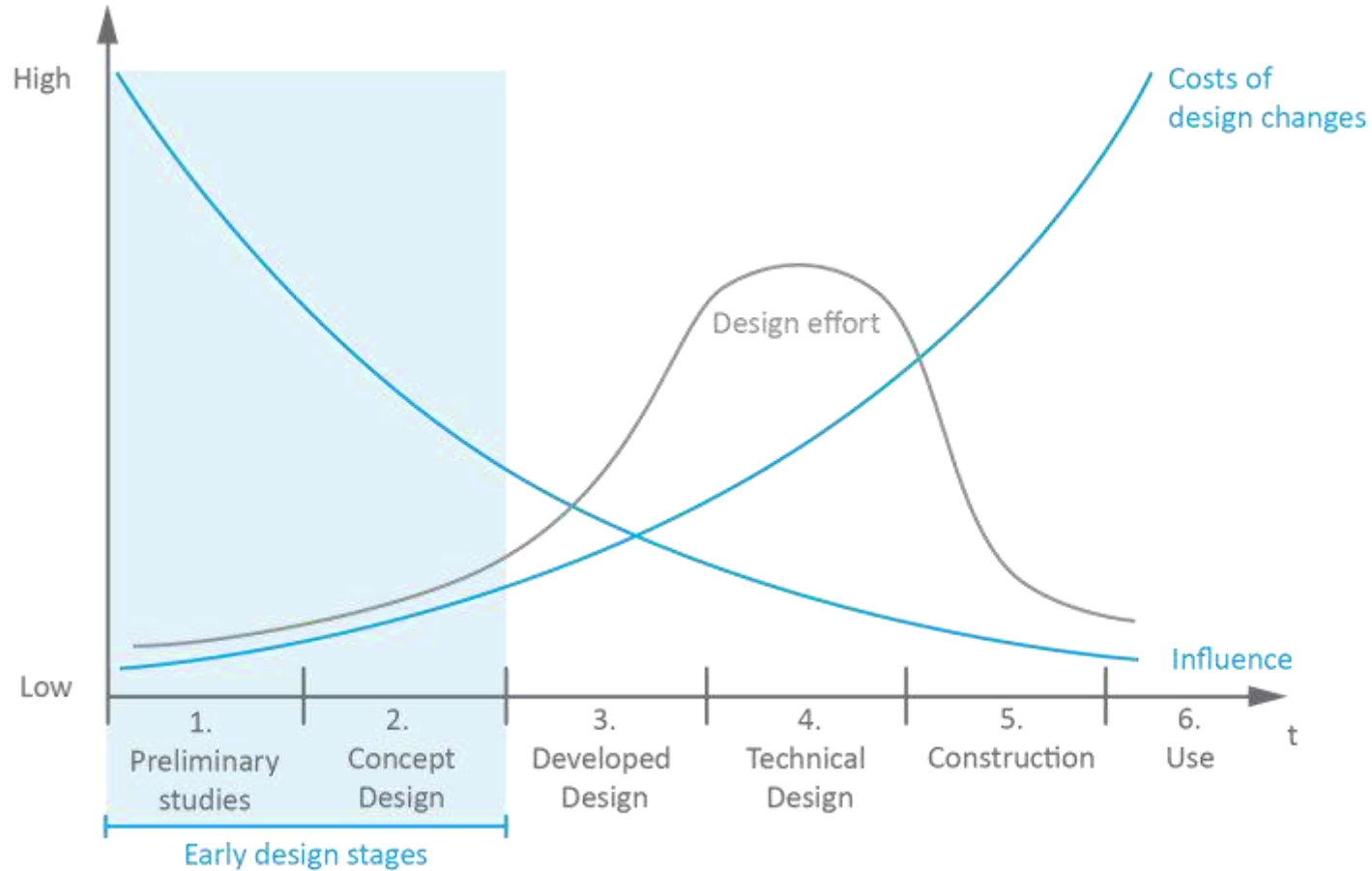
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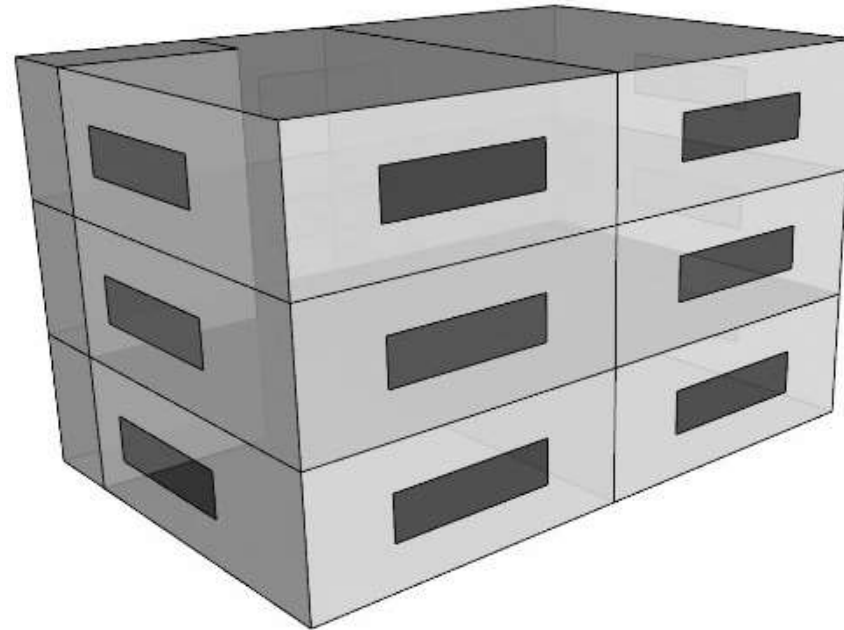
*hollberg@ibi.baug.ethz.ch

Early design stages



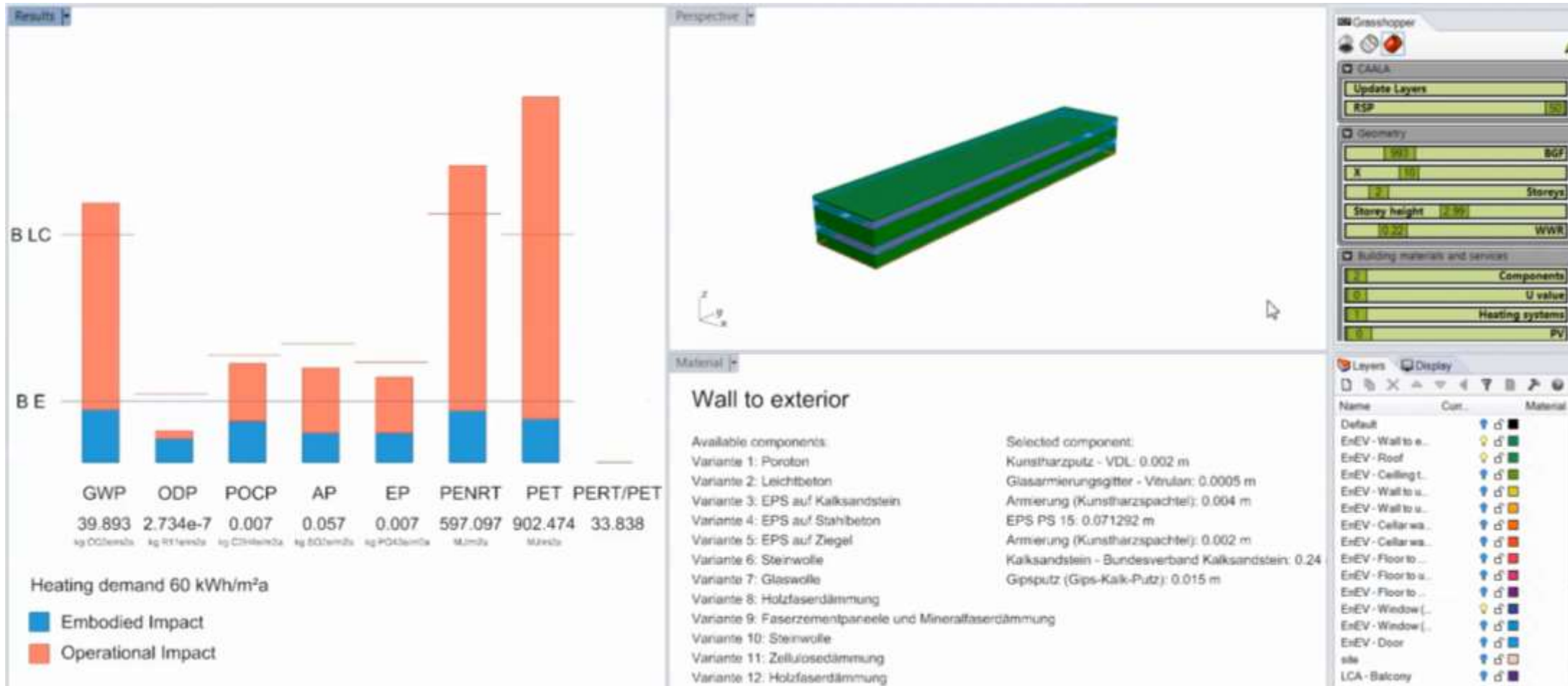
(Paulson Jr., 1976, *Designing to Reduce Construction Costs*, *Journal of the Construction Division*, 102(4), p.588)

Early BIM LCA

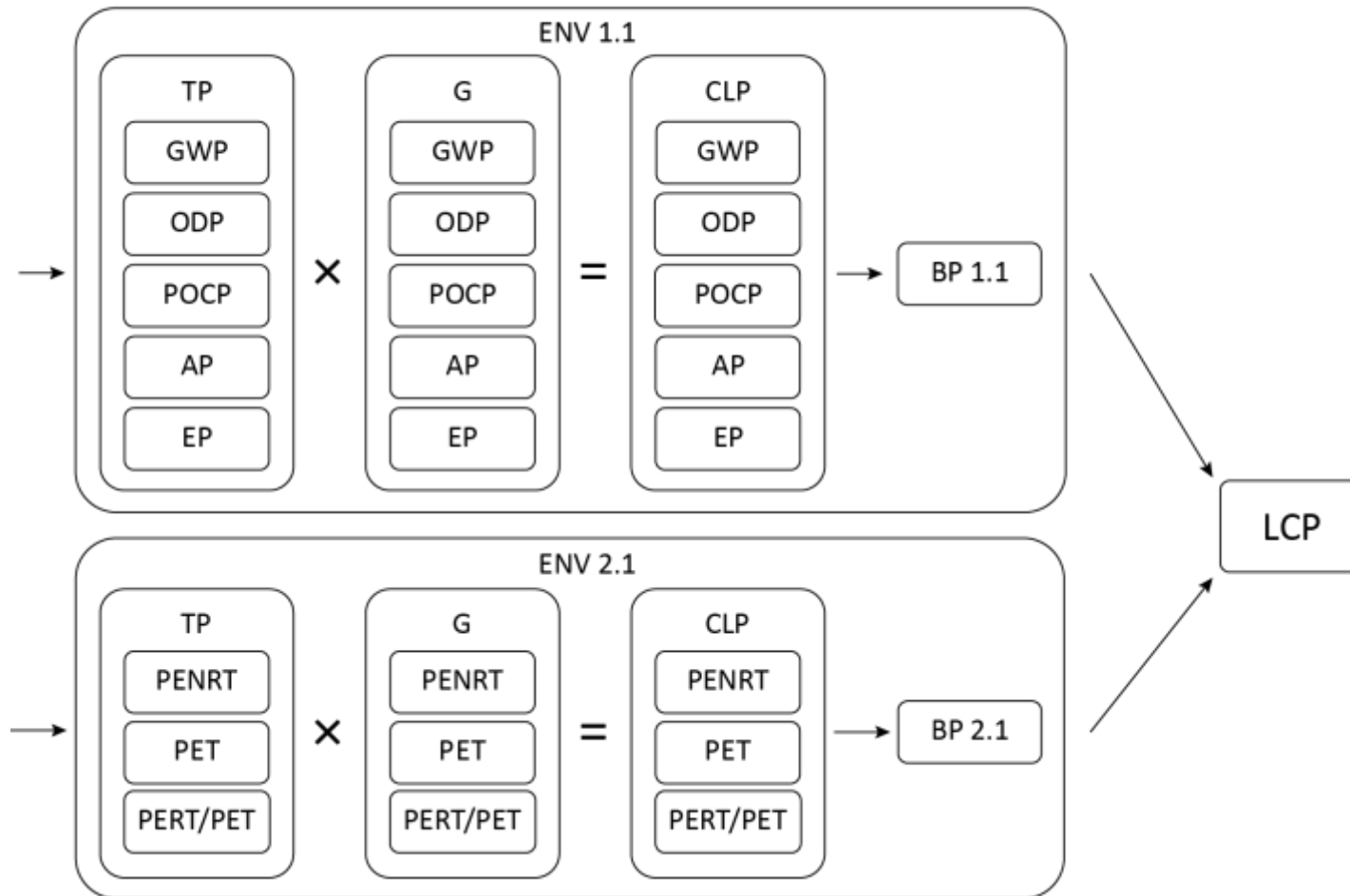


Simplified building representation using surfaces only – “shoebox”

Early BIM LCA



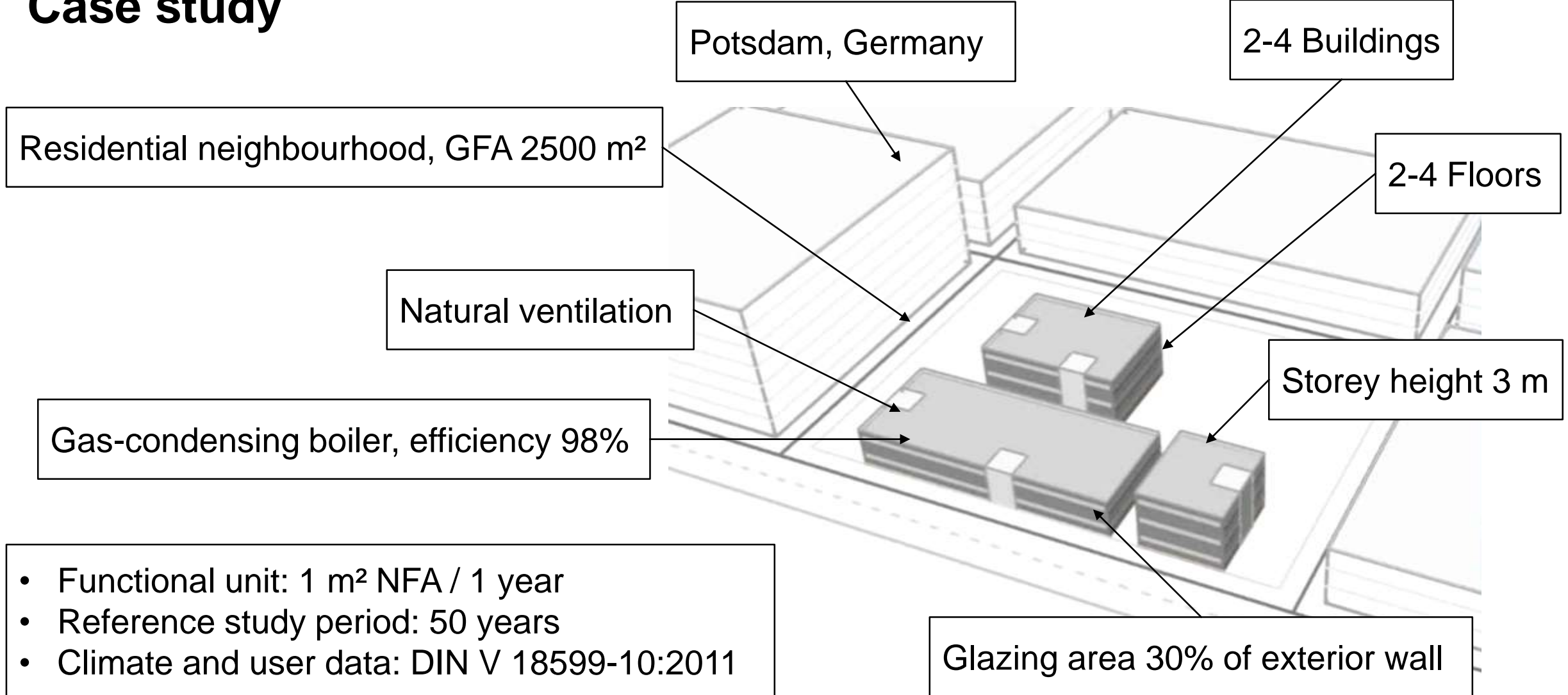
Life cycle performance indicator



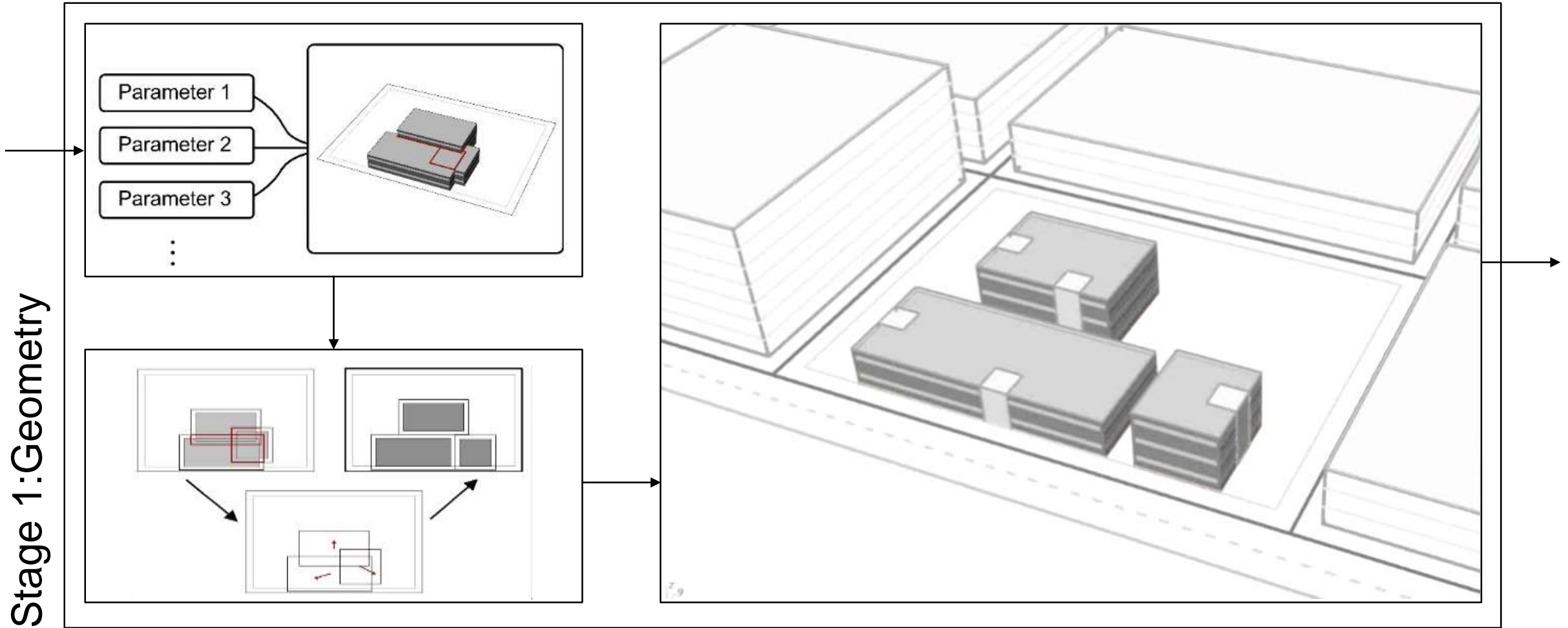
Schematic overview of the weighting process according to DGNB certification system (German Sustainable Building Council)

*TP = Teilpunkte (individual points)
 G = Gewichtungsfaktoren (weighting factors)
 CLP = Checklistenpunkte (checklist points)
 BP = Bewertungspunkte (evaluations points)
 LCP = Life cycle performance*

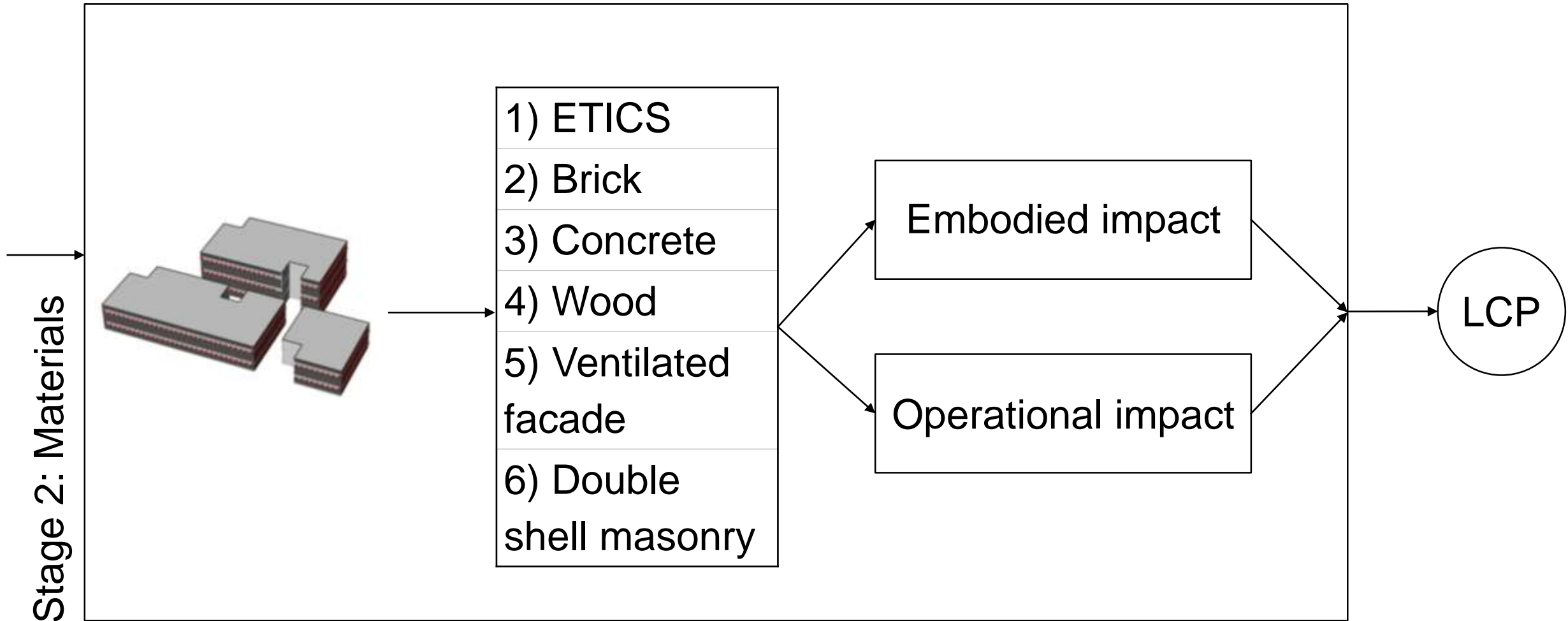
Case study



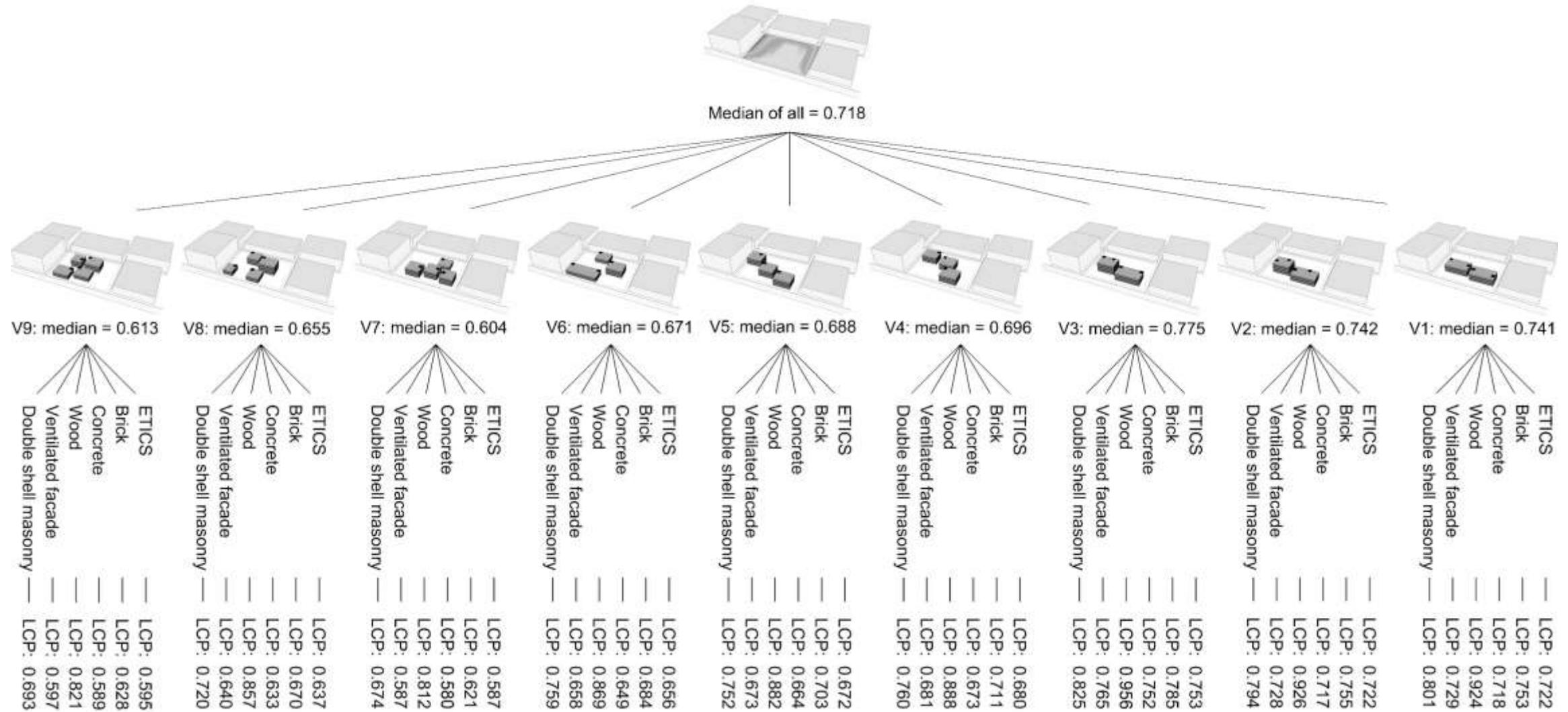
Case study



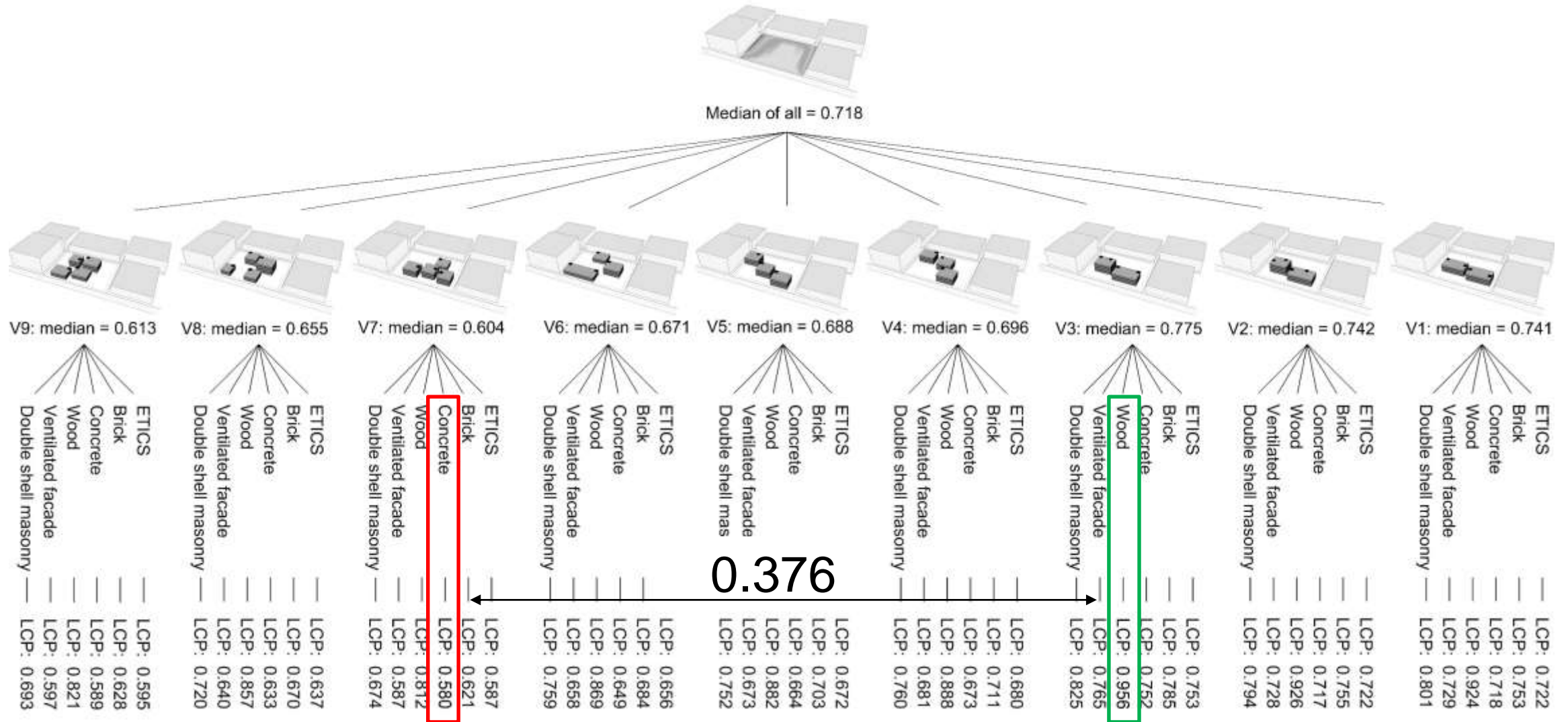
Case study



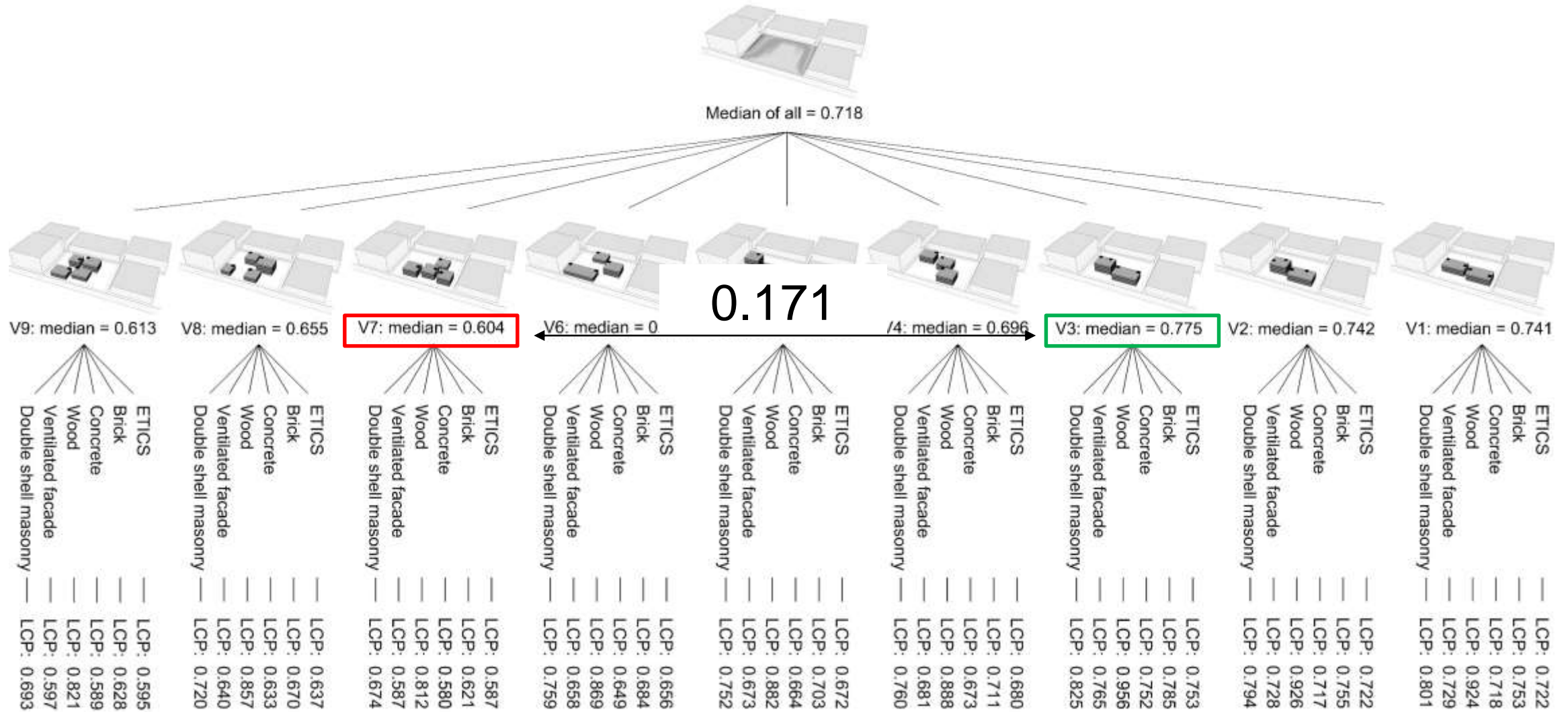
Results



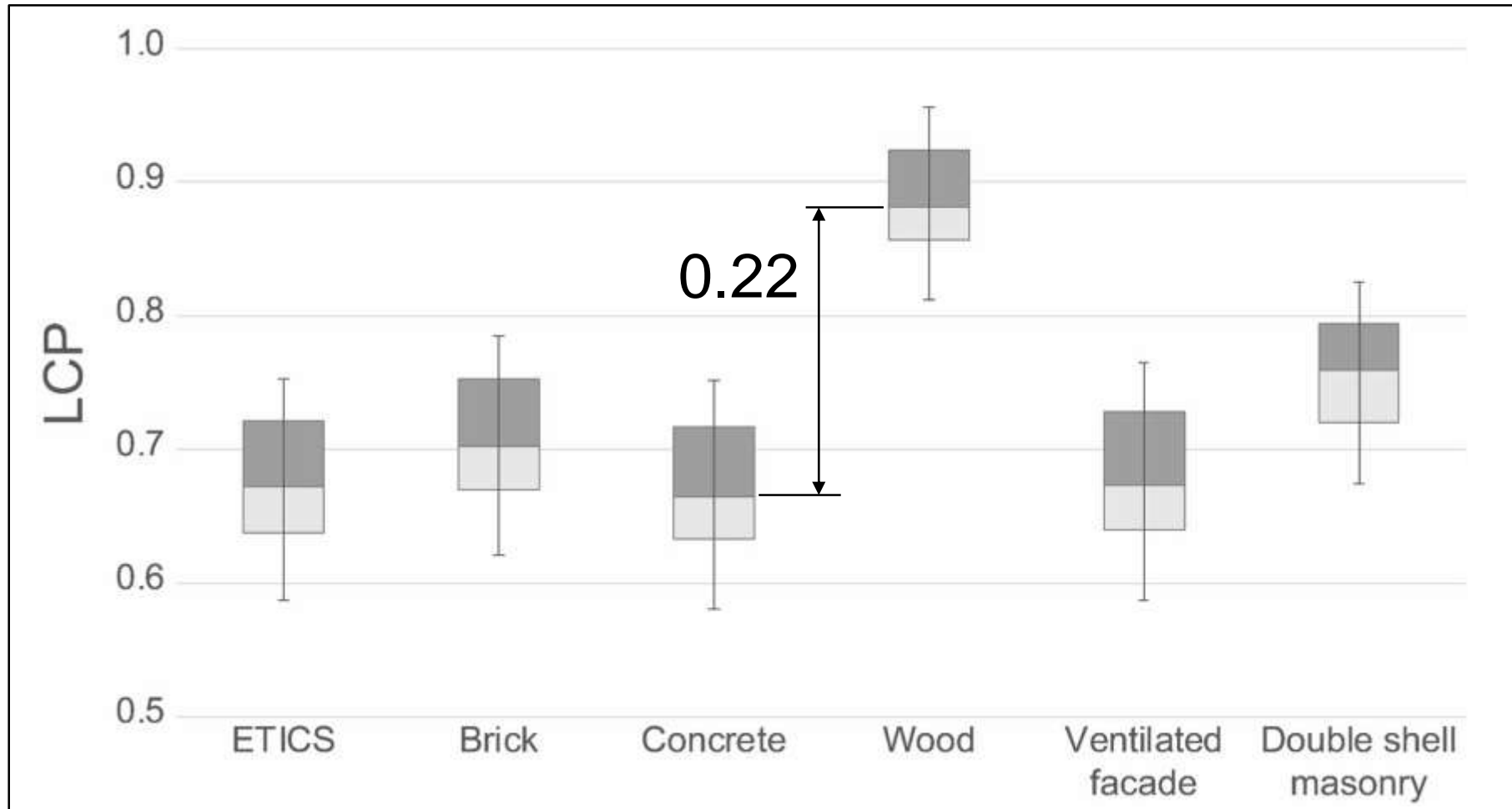
Results



Results



Results



Conclusions & recommendations

- Early BIM-LCA provides valuable information for decision-making
- Through quick variant comparison efficient optimization is made possible

- Single score indicator should be improved
- Integration of energy harvesting systems
- Combination with further analyses (daylight, LCC, ...)



Outlook

The screenshot displays the CAALA software interface, which is used for building energy analysis. On the left, a 3D model of a building is shown. The main interface is divided into several sections:

- Building construction:** This section provides details for three building components:
 - A01 Exterior wall load-bearing:** Area: 547 m². Exterior walls: CAALA_Hochlochtafel (Dübel) mit WEVE. Insulation: 12 cm. Total thickness: 37.00 cm. U-value: 0.201 (p-ref: 0.28).
 - A03 Roof:** Area: 281.32 m². Roofs: CAALA_Holzspanen, Ziegeldichtung. Insulation: 22 cm. Total thickness: 30.75 cm. U-value: 0.136 (p-ref: 0.2).
 - A09 Ceiling over outdoor air:** Area: 4.56 m². Ceilings: CAALA_Stahlbeton-GI mit unterseitig gedämmt. Insulation: (value not fully visible).
- Primary energy demand:** 66 kWh/m². A horizontal bar chart shows the energy demand scale from 0 to 300 kWh/m², with a reference value of 150 kWh/m².
- Primary energy non renewable (PENRT):** A donut chart showing 87% Operational energy and 13% Embodied energy. Unit: kWh/(m²·a).
- Global warming potential (GWP):** A donut chart showing 20% Operational energy and 80% Embodied energy. Unit: kg CO₂-e/(m²·a).

At the bottom, there is a 'Real time analysis' toggle switch (currently on) and an 'Update' button.



<http://caala.de/>



Thank you!



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Case study

		Combinations of main materials			
		Exterior wall	Roof	Ceiling	Interior wall
1	ETICS	ETICS	Concrete	Concrete	Lime-sand stone
2	Brick	Insulated brick	Concrete	Concrete	Brick
3	Concrete	Concrete	Concrete	Concrete	Concrete
4	Wood	Wood frame	Wood beams	Wood beams	Wood frame
5	Ventilated facade	Ventilated facade	Concrete	Concrete	Lime-sand stone
6	Double shell masonry	Double shell masonry	Wood beams	Concrete	Wood frame

Case study

- Hypothetical residential neighbourhood with 2500 m²
- Between two and four buildings on rectangular site in Potsdam, Germany
- Storey height 3 m, between two and four floors
- Glazing area is constantly 30% of the exterior wall area
- Functional unit: 1 m² NFA / 1 year
- Reference study period: 50 years
- Climate and user data: DIN V 18599-10:2011
- Heating system: gas-condensing boiler with an efficiency of 98%
- Natural ventilation, no cooling

