

Environmental assessment of the Urban Mining and Recycling (UMAR) unit by applying the LCA framework

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Agenda

1. Introduction

2. General approach

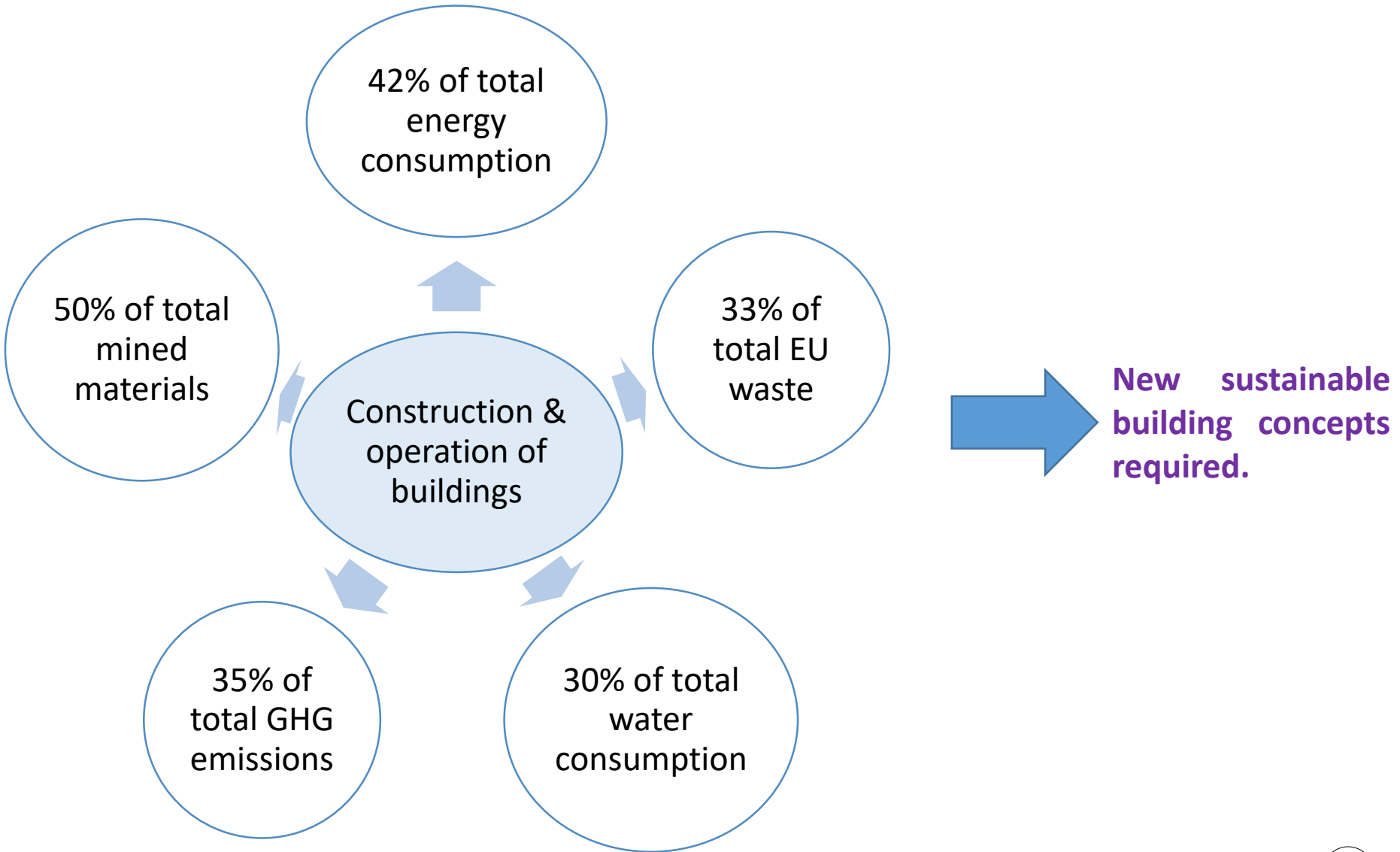
3. Life Cycle Assessment

4. Results

5. Conclusion & Outlook



1.1 Introduction – Issues in the building sector



Data from: European Commission (2011) Roadmap to a resource efficient Europe

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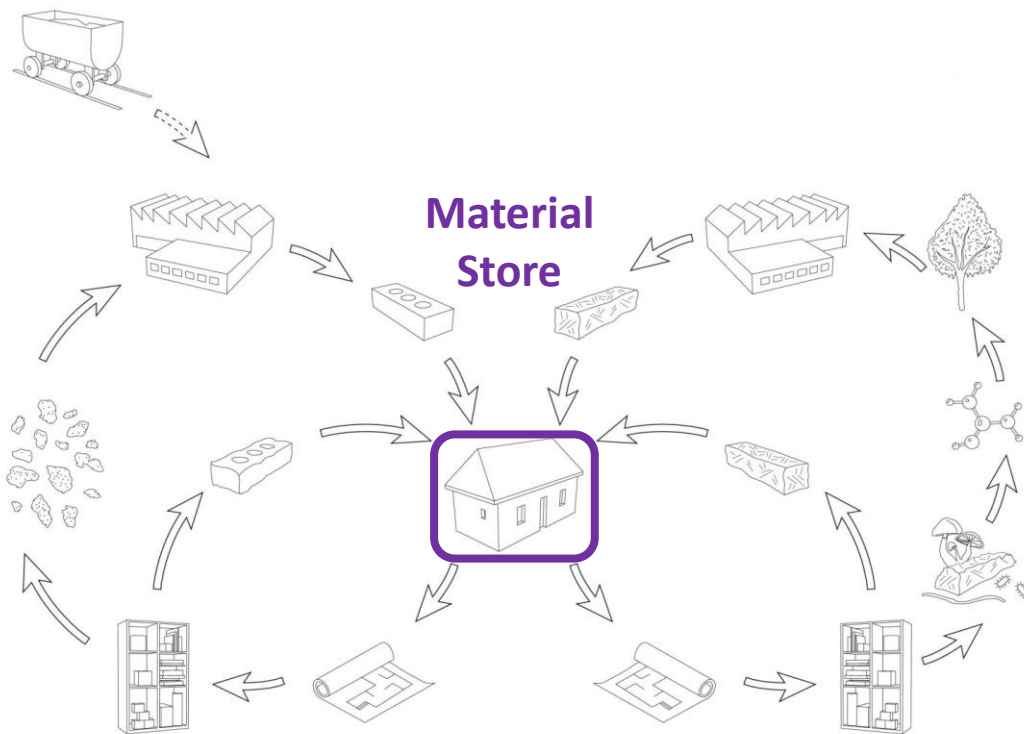
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1.2 Introduction – One possible solution (Urban Mining)

“A young discipline that identifies the building stock as a unified system and waste (whether from the dismantling of houses or from other sources) merely as a transitional state from which something new can emerge.”



1.3 Introduction – Advantages of Urban Mining

- Stocked materials quantities comparable to or exceed those in natural stocks.
- Secondary material stream through recovery and remanufacturing / reuse of urban mined materials.
- Reduction of GHG emissions through reduced energy input and avoided waste treatment processes.



1.4 UMAR unit



Recyclable
Reusable
Compostable

Copyright Werner Sobek with Dirk E. Hebel and Felix Heisel (2018)

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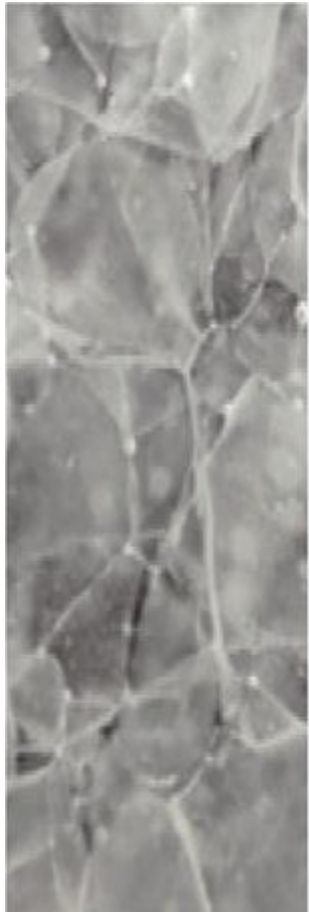


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1.5 UMAR unit – Innovative materials



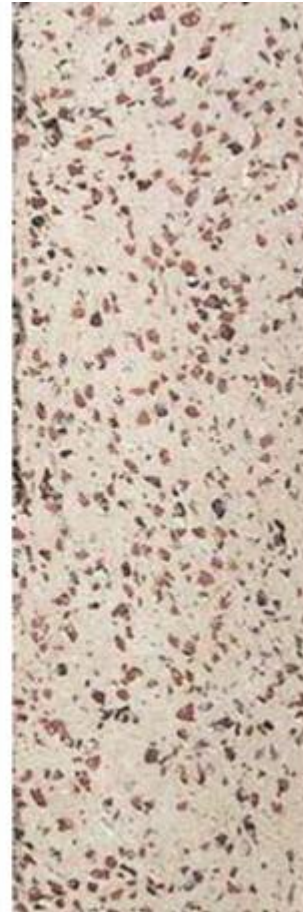
Glass plate



HDPE plate



Mushroom
plate

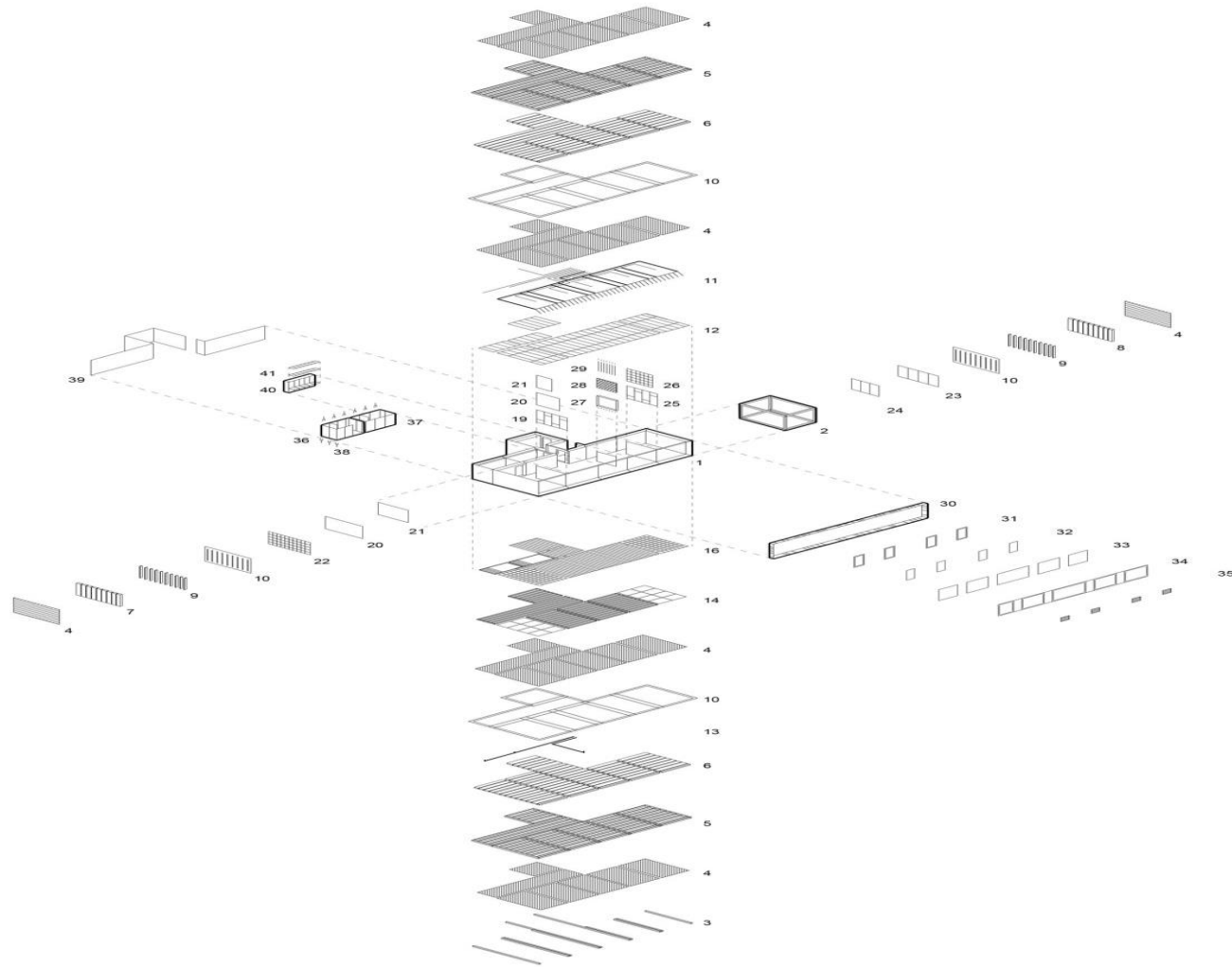


Recycled
bricks



Denim
Insulation

1.6 UMAR unit – Design for Disassembly



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2.1 General approach - 2-step process description

1. Building element level

Comparison of the **wooden individual UMAR elements** with the conventional elements used in Swiss construction practice.

| Type of Element | Conventional Elements |
|-----------------|-----------------------------------|
| Outside wall | Sand lime Brick wall |
| Inside wall | Concrete wall |
| Floor | Gypsum dry wall Concrete floor |

2. Building level

Comparison of UMAR unit with a hypothetical concrete one, with the same size, same assumed lifetime, roughly same energy consumption.

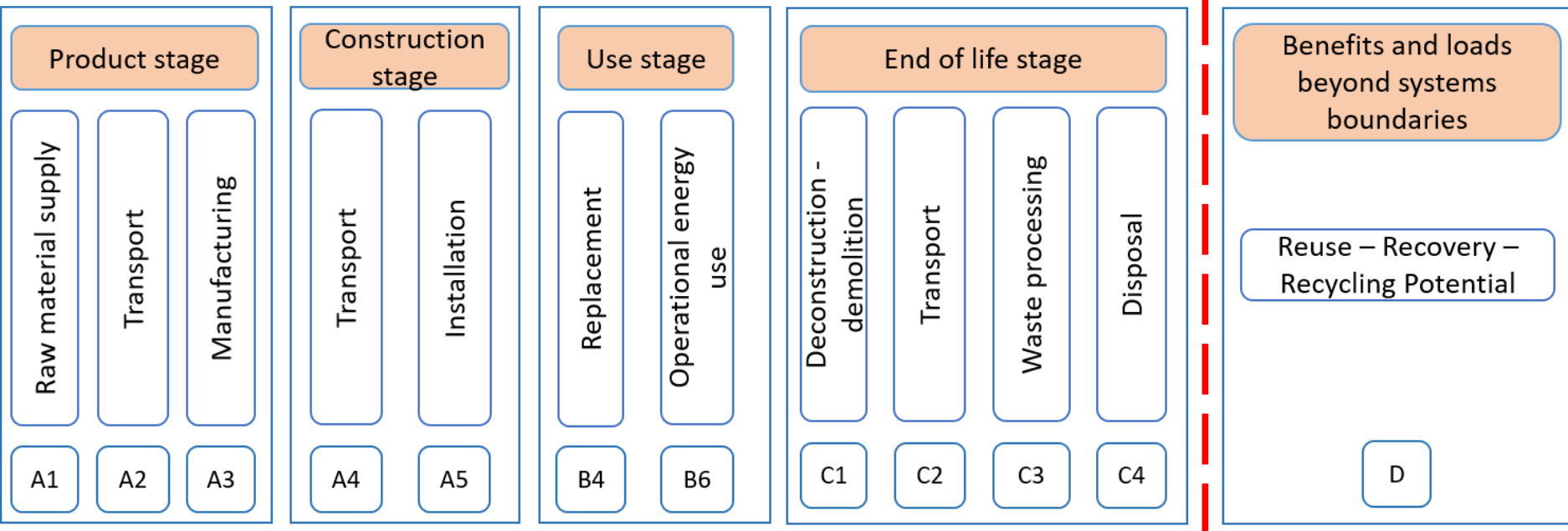


3.1 LCA – Standard & Software

➤ Standard: EN15804 Sustainability of construction works



Inputs (Energy, Materials)



Outputs (Exhaust gas, Waste water, waste ...)



3.2 LCA - framework

Building element level

Building level

1. Goal and scope

Compare the most important wooden UMAR unit elements with the respective conventional ones.

Assess and compare the annual impacts of the Umar and concrete unit over the entire 60-year service life.

1a. Functional unit

1 m² of building element under examination.

1 m² of gross floor area **per one-year of building lifetime.**

1b. System boundaries

Product stage (A1-3)

All stages reported in previous slide.

2. Life cycle Inventory

As presented in the previous slide.

3. Impact assessment

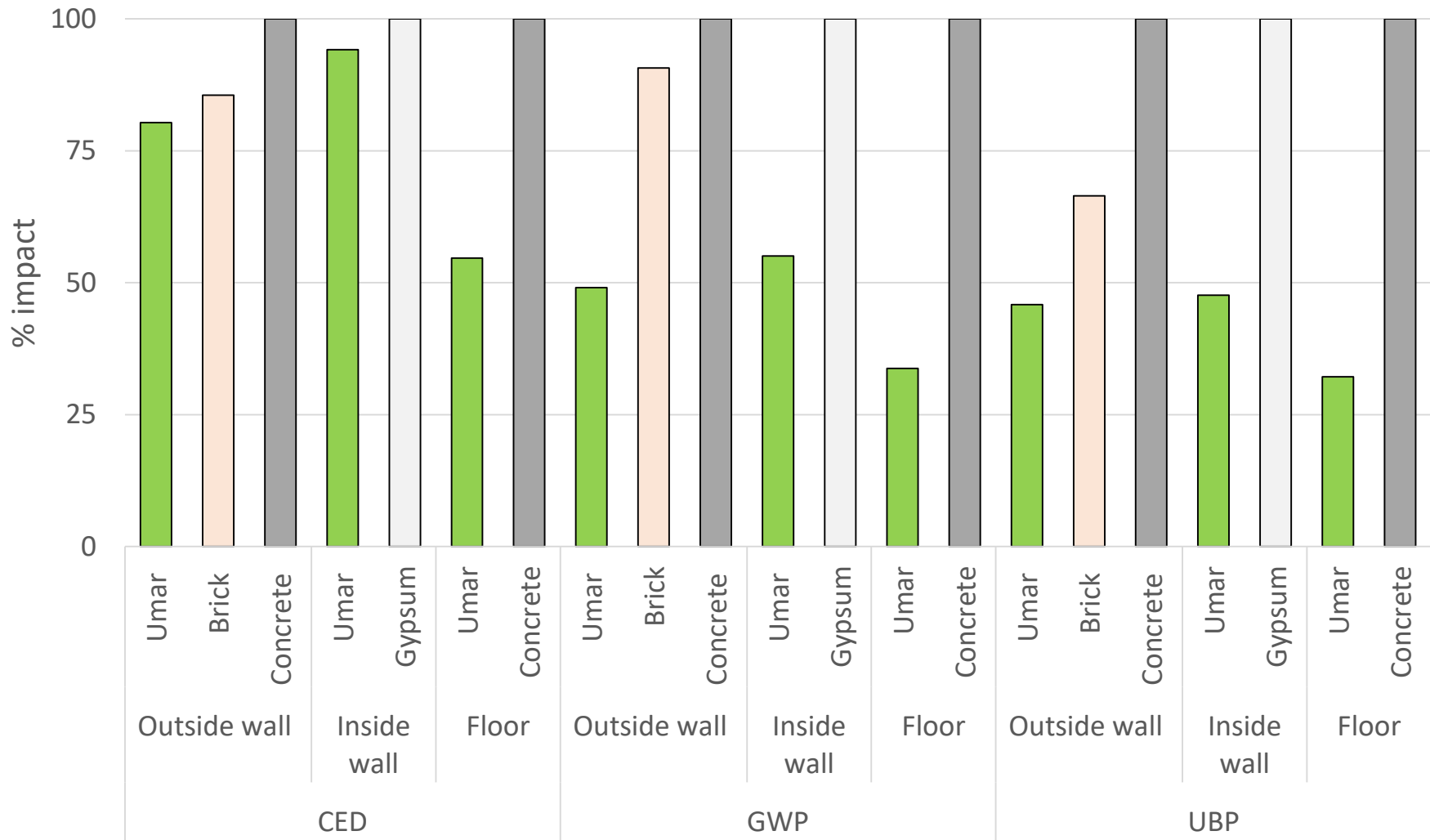
(Non-Renewable) Cumulative Energy Demand (CED) - MJ
Global Warming Potential (GWP) - kg CO₂-eq
Swiss Ecopoints - UBP

3.3 LCA - Basic assumptions

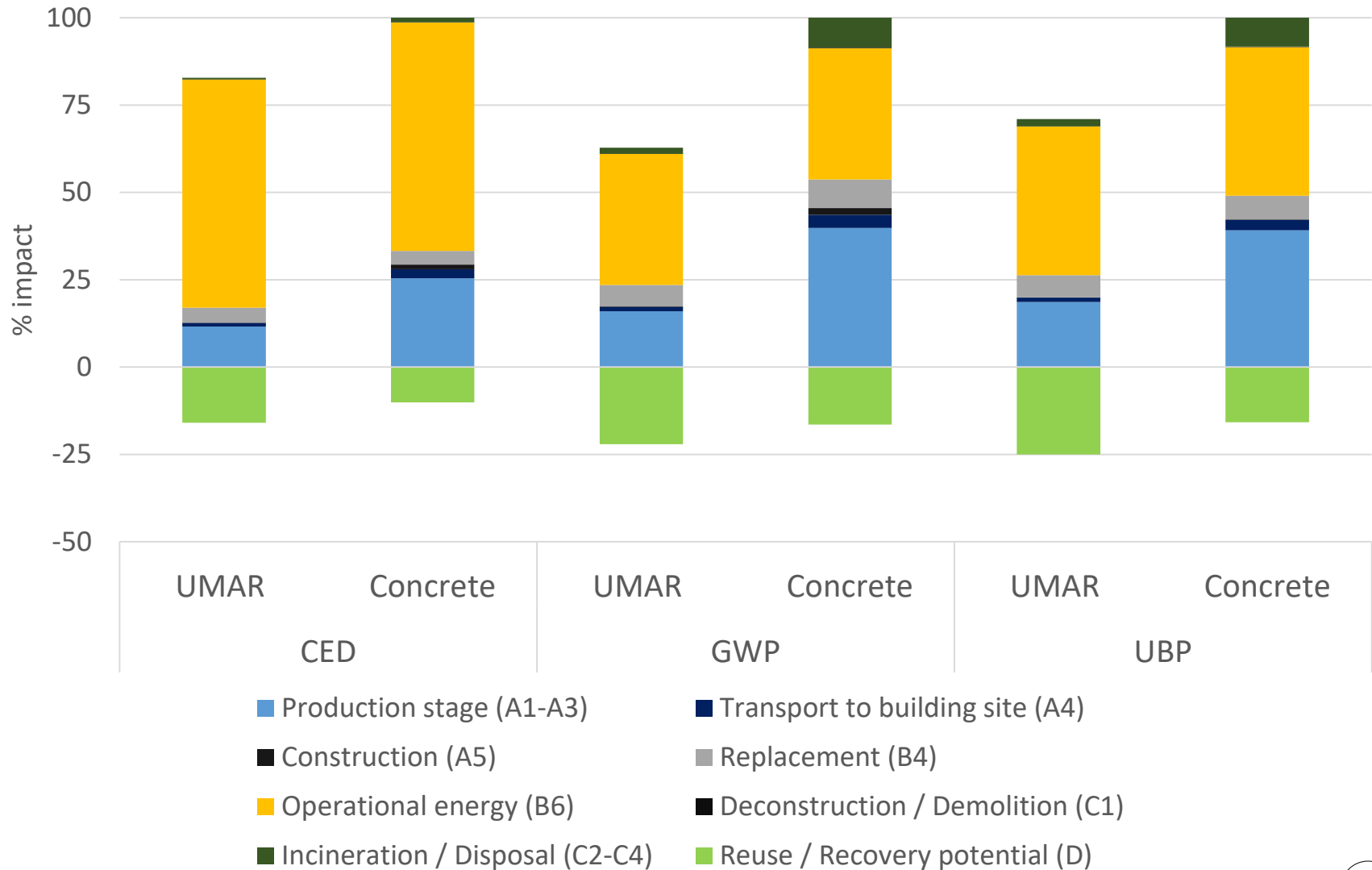
- **Natural resources** have been used as a starting point (first lifecycle of materials).
- **Replacement** of all wooden parts considered for UMAR unit + windows. Only window replacement considered for the concrete unit.
- **Stage D:** Direct reuse of all UMAR materials. Recycling of Concrete and steel, Heat recovery from incineration of wooden materials and insulation + reuse of all other materials for concrete unit.



4.1 Results - Building element level



4.2 Results - Building level



5.1 Summary & Outlook

Key Points

- Reduction of primary energy used, global warming potential and overall environmental impact.
- Reuse / Recovery potential of UMAR materials higher than that of the conventional ones.

Next steps

- Modelling of further life cycles of UMAR materials should be considered.
- Embeddedness and evaluation of the UMAR concept at city, national or even a global level.



Thank you for your attention

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