

New circular building composite material to upcycle building wastes

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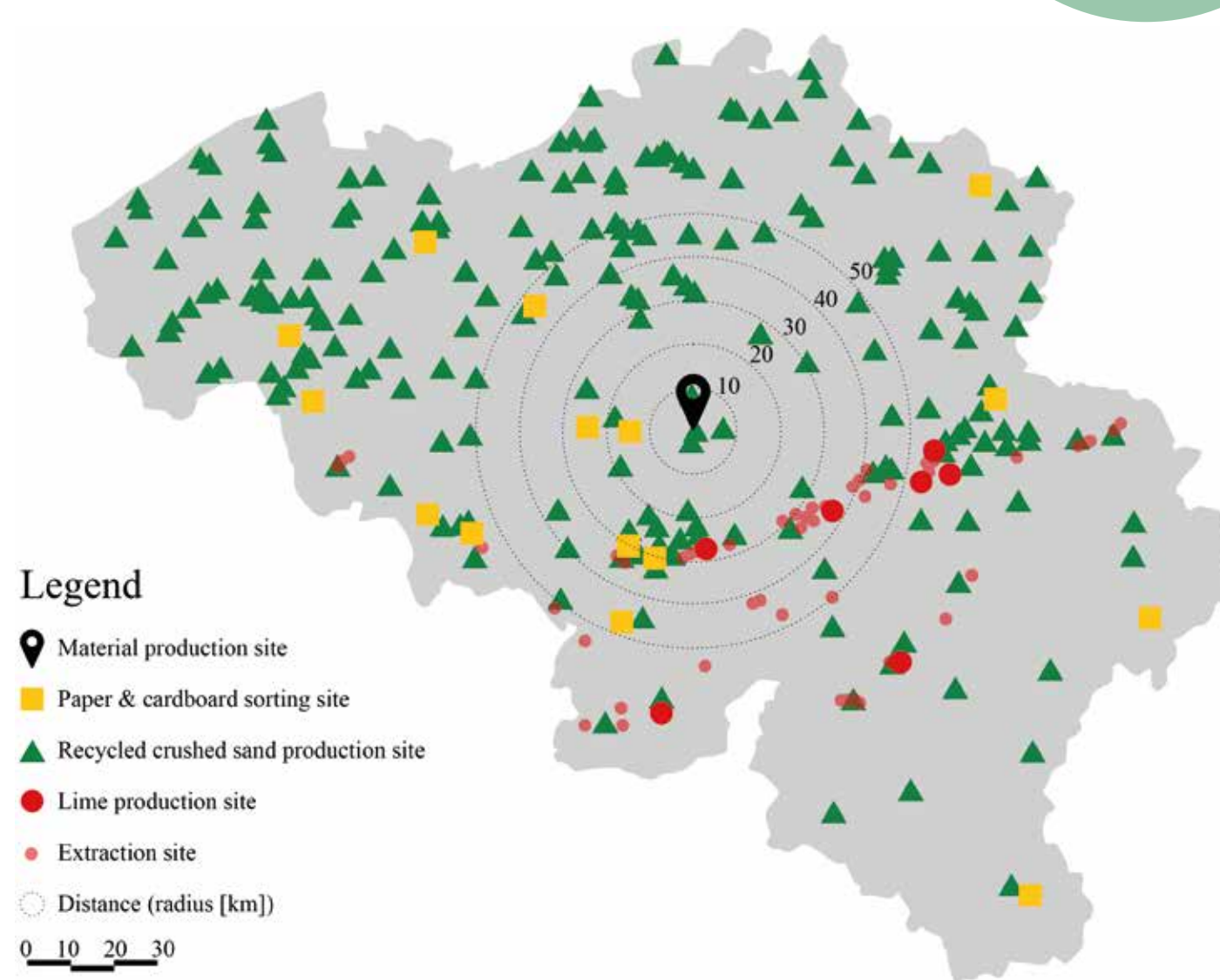
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Abstract

A new circular composite material for building applications is developed, made of two recycled raw materials, paper and sand. Hydraulic lime is added as binder. This new composite targets a low environmental impact thanks to benefits of upcycling buildings waste, a low energy production process, a lifetime up to 60 years and a high potential of reversibility, reuse and upcycling. The research has focused on mechanical and physical properties and an analysis of the microstructure by X-ray 3D microtomography and in-situ compression test. The mechanical and physical testing have shown good and unexpected properties: a density of 330 to 1300 kg/m³; a compressive strength between 0,12 and 4,3 MPa, a bending strength of 0,14 to 2 MPa, a thermal conductivity of 0,08 to 0,14 W/mK and a high sound reduction index. Further research will focus on construction and environmental aspects such as the applications at 1/1 scale, a life cycle analysis and a material passport for the manufacturer. Following the result obtained, three applications will be developed: a partition panel with adequate impact and acoustic resistance, a dry screed slab and a self-supporting block, both with proper thermal, acoustic and mechanical performances according the standards of the building sector.

Raw materials

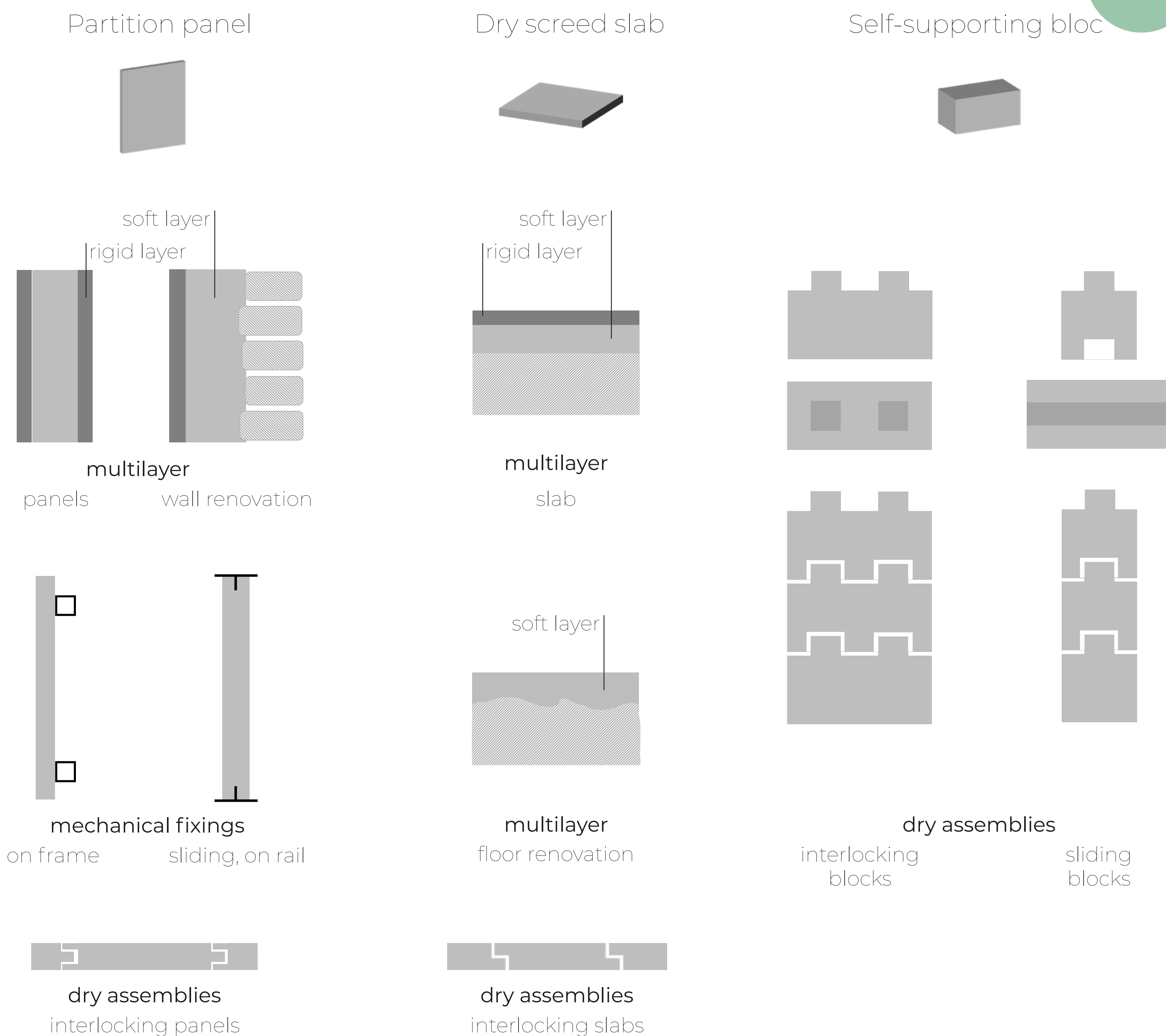


recycled raw materials, low transport, local

Samples

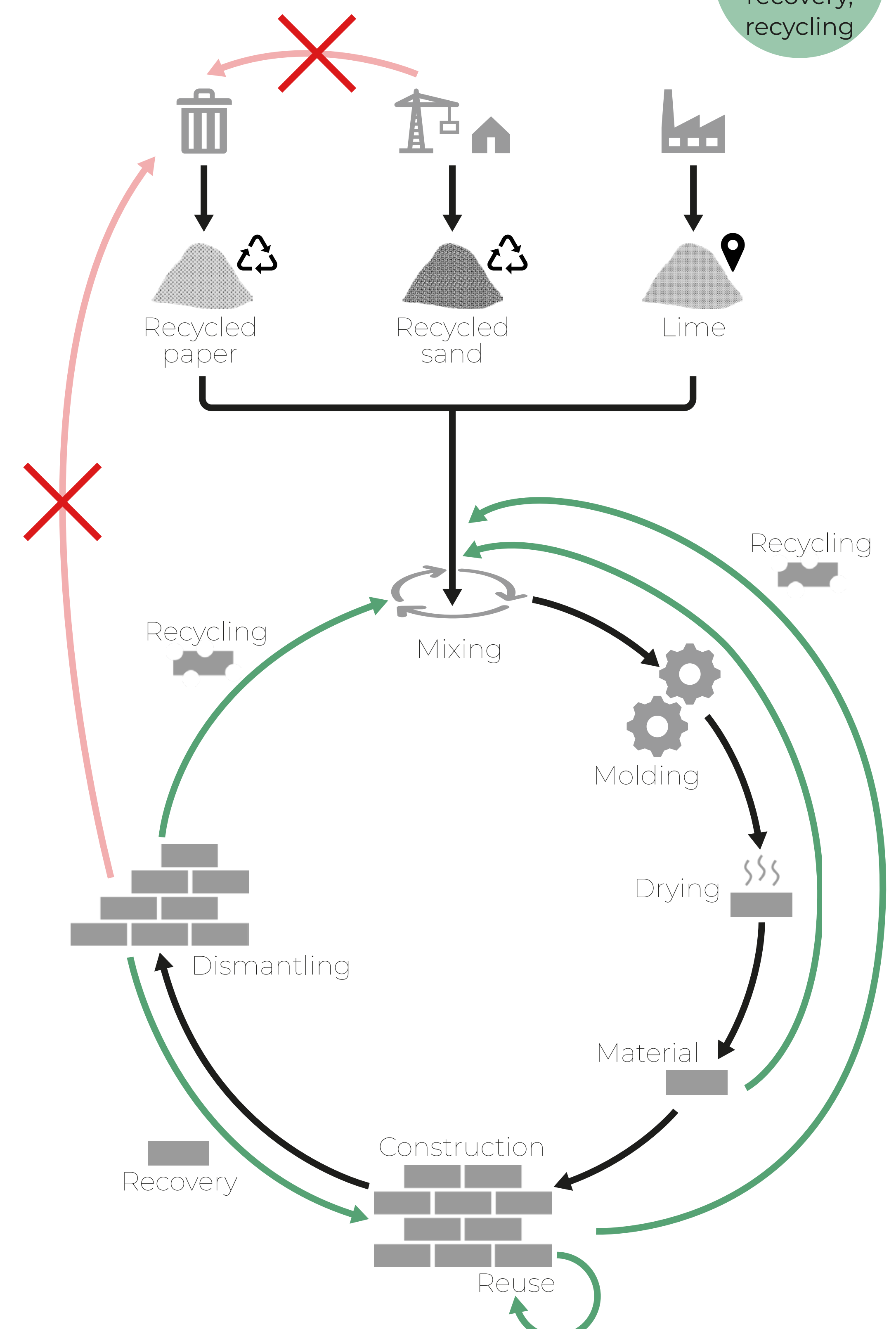


Applications



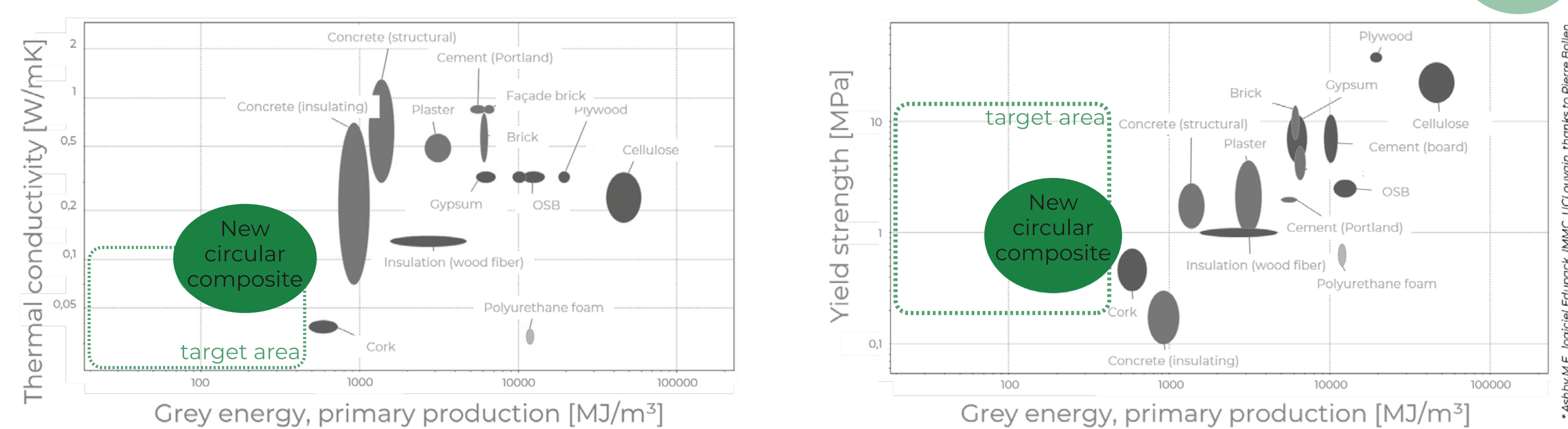
reversibility

Life cycle



low process, reuse, recovery, recycling

Properties maps



low impact

Properties

Materials	Density [kg/m ³]	Bending strength [MPa]	Compressive Strength [MPa]	Thermal conductivity [W/mK]
Concrete block	2200	3 - 5	10	1,42
Cellular concrete	500	0,44 - 1,10	1,8 - 5	0,10 - 0,52
Lime-hemp	340	0,23	0,22	0,071
PUR	32	-	0,12	0,022
New circular composite	332 - 1303	0,14 - 1,87	0,12 - 2,08	0,08 - 0,22

Further work

1. Applications at 1/1 scale (design, fixing, reparability, finishing, ...)
2. Life cycle analysis (LCA) (quantifying the impact of supply, raw materials, production, use, end-of-life, recyclability and transport.)
3. Material passport for manufacturers (treatment of the material.)

Acknowledgements

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