

Whole Life Carbon Assessment of Residential Building Renovation

Aurora Bertini^{1,2*}, Shady Attia¹

¹ Sustainable Building Design Lab, Dept. UEE, Faculty of Applied Sciences, Université de Liège, Belgium

² Louvain research institute for Landscape, Architecture, Built environment (LAB), Faculty of Architecture, Architectural Engineering, and Urban Planning (LOCI), UCLouvain, Belgium

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* Correspondence: Email: aurora.bertini@uliege.be ; Tel: +32 490 25 81 43 (Belgium);

Address: Building 52. Quartier Polytech 1, Allee de la Decouverte 13A, 4000 Liege, Belgium

Abstract:

This report presents a method for assessing the whole-life carbon impacts of residential building renovation during early design. It combines building performance simulation with life cycle assessment to compare an unrenovated reference building with six retrofit scenarios. Sensitivity and uncertainty analyses examine how material quantities, service lives, climate change, and electricity grid decarbonization affect the results. In the modeled case, a low-energy renovation using biobased materials has the lowest whole-life emissions and an environmental payback period of three years. The findings show why retrofit choices should be evaluated across both embodied and operational emissions.

Keywords: residential renovation; whole-life carbon; building performance simulation; dynamic life cycle assessment; embodied emissions; uncertainty analysis.

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