# A BIM–BASED LIFE CYCLE ASSESSMENT TOOL OF EMBODIED ENERGY AND ENVIRONMENTAL IMPACTS OF TALL BUILDINGS

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## Abstract

Today 55% of the world lives in urban areas, which is expected to increase to 68% by 2050. In the cities, high-rise buildings as symbols of the modern cityscape are dominating the skylines, but the data to demonstrate their embodied energy and environmental impacts are scarce, compared to low- or mid-rise buildings. Reducing the embodied impacts is critical as about 42% of primary energy use and 39% of the global greenhouse gas (GHG) emissions come from the building sector, which is an overlooked area in tall buildings. This doctoral research aims to investigate the effects of tall buildings on embodied energy and environmental impacts by using process-based life cycle assessment (LCA) methodology within the Building Information Modeling (BIM) environment, which provides an architect-friendly platform to incorporate sustainability information in architectural design. It aims to enlighten the debate about whether high-rise buildings are sustainable.

A critical literature review is conducted on the current LCA methods in high-rise buildings and their environmental performance. It then develops a framework for BIM-based assessment of the embodied energy and environmental impacts of tall buildings. To achieve that, a case study of tall buildings is applied, by using ISO 14040 and 14044 guidelines with available database, Revit and Tally application in Revit. Finally, the association between design and construction variables with embodied energy and environmental impacts is explored.

A comprehensive study on embodied energy and environmental impacts of high-rise building will address a major gap in LCA literature. Researchers and environmental consultants can use this research to create design tools to evaluate environmental impacts of high-rise buildings and to develop insight into the environmental performance of tall buildings in early design stages. Architects and engineers can also use the results to optimize tall building design for low embodied energy and environmental impacts. Finally, the results of this research will enable architects, engineers and policy-makers to develop more sustainable built environments.