Methodologies and Tools for BIM-Based Calculation of Dynamic Life Cycle Assessment towards Net Zero Emission Buildings

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IDEAS TO IMPACT

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General Objective - Contribute to the transition of the building and real estate sector towards Net-Zero Whole-life Carbon (NetZ-WLC) outcomes, through facilitating the integration of environmental aspects in the planning process and reduce environmental impacts.

nZEB

Focus of the project is particularly on integrating Dynamic Parameters into Whole Life Cycle Assessment

Dynamic LCA analyses environmental impacts over time, incorporating changes like technological advancements and shifting regulations, unlike traditional static LCA, which assesses impacts at a single point in time.

Static vs Dynamic LCA

Static Life Cycle Assessment
- Snapshot of environmental impacts at one point in time.
- Not account for changes in processes, technologies, or external factors, assuming constant input and steady-state conditions.

Dynamic Life Cycle Assessment
- Captures temporal changes in impacts over time,
- Considers evolving processes, technologies, and external factors.,
- Ideal for systems with changing life cycles or significant variability, enabling better decision-making.

BIM- Based Decision Support Systems and its application to global warming impact assessments

Integration of BIM and LCA
Enables accurate, early-stage material impact assessments.

Dynamic Analysis
Enables real-time environmental impact assessment for more accurate predictions.

Improved Decision-Making
Provides detailed insights for architects, engineers, and stakeholders,
Enhances sustainability in design and construction.

Automation and Efficiency
Streamlines data input, reducing manual errors and effort.

Holistic Environmental Impact Assessment
Evaluates impacts from all stages of buildings life
Considering temporal changes and future scenarios.

Motivation and Outline

EU Strategic Agenda - The EU aims for climate neutrality by 2050 and a 55% CO2 reduction, ensure all new buildings are Net-ZEBs, by 2030.

Building Emissions - Buildings account for 40% of energy use and 36% of EU CO2 emissions, from material production to disposal Life cycle emissions, which have not been adequately addressed so far.

Whole-Life Carbon - As operational emissions decrease with energy efficiency and renewable, embodied carbon becomes the main source of GHG emissions. Tackling it is key to reaching climate neutrality by 2050.

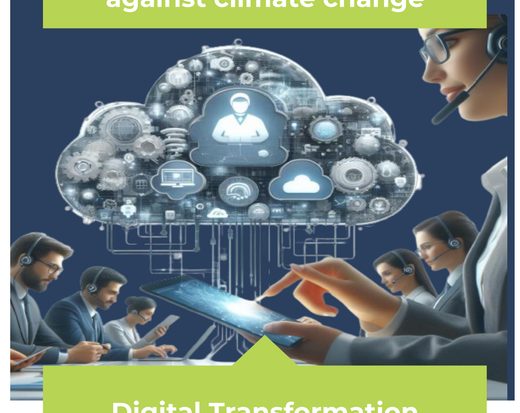
Why Dynamic LCA analyses matters - Due to the long-life span of buildings and potential for changes in usage patterns over time, a shift toward DLCA is essential.

BIM streamlines DLCA by facilitating collaboration among stakeholders, optimizing building design, and identifying emission reduction pathways. It enables real-time data sharing for accurate life cycle assessments.

Building-related Dynamic Parameters for Carbon Emission Reduction, over time

Energy evolution - Chenges in energy sources, transitioning to renewables.
Temperature change -Impact of fluctuating climate on building energy efficiency.
Technological advances - Improved technologies enhancing energy efficiency and material use.
Carbonization - Reducing carbon emissions by decarbonizing energy and materials.
Degradation of materials - Material wear affecting performance and carbon footprint over time.
Waste recycling rates - Efficiency of recycling processes reducing construction-related emissions.

Environmental and fight against climate change



Digital Transformation

Problem statement

Methods for assessing environmental performance must respond to current & foreseeable future challenge related to climate changes, applicable to digitally-driven workflows of smart cities.

UPDATE THE METHOD

The project work program

Uptake of NetZ-WLC Initiatives

Activity 1 State of the art
A comprehensive literature review on the state of the art in DLCA, WLCA, and the existing BIM-based LCA tools is being conducted. WLCA case studies of Net-ZEBs are being analysed. The gaps in the existing knowledge are being identified.

Activity 2 Framework Development
A systematic framework is being proposed to consider all the dynamic factors together during the life cycle of buildings, aligned with regulations, standards and targets.
Compatibility of the framework with the BIM- based tools and database is a priority to be considered.

Activity 3 Tool Development & Integration
An innovative, and simplified BIM-based LCA method, which can integrate with existing BIM-based tools and LCA databases will be implemented. The tool should be able to considers present and future decarbonization scenarios. It employs a plugin software, developed at CERIS.

Activity 4 Case Studies & Evaluation
To test and validate the functionalities of the developed tool, real Net-ZEBs projects will be used to identify the potential issues and areas for improvement. Besides, the feedback from stakeholders will be incorporated to improve the tool as needed.

Activity 5 Dissemination & Documentation

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