Low carbon renovation solutions in the Northern climate

Summary

The PhD project examines the GHG emissions of the alternative renovation solutions in the Northern climate, where the energy demand for heating of spaces is a dominating component in energy consumption of buildings. In order to adapt to climate change and the expected extreme weather conditions of the future, more attention needs to be paid on the control of the external heat load in residential buildings. The PhD project applies the LCA methodology to examine the climate impacts of renovation, with a specific focus on the solutions of architectural design, including critical evaluation of the methodology and its limitations. Long-term renovation goals should not only concentrate on the operational energy use, but apply a holistic approach for aiming to reduce the GHG emissions considering renovation life cycle impacts.

Research field:	Building and civil engineering and architecture
Supervisors:	Prof. Dr. Targo Kalamees Prof. Dr. Kimmo Sakari Lylykangas
Availability:	This position is available.
Offered by:	School of Engineering Department of Civil Engineering and Architecture
Application deadline:	Applications are accepted between September 01, 2021 00:00 and September 30, 2021 23:59 (Europe/Zurich)

Description

Several EU member states (for example the Nordic countries, France, Germany, the Netherlands) have developed national regulation on the carbon footprint of construction works. The new regulation is typically applied to new construction, as part of the building permission procedure. The process which aims at introducing the Estonian carbon footprint regulation was launched by the Estonian ministry for economic affairs and communications in 2021.

In order to achieve the climate targets, it is crucial to systematically quantify the climate impact of built environment, not only in new construction but also in renovation. As part of the commitments in the European Green Deal, the European Commission is preparing a ‘Renovation Wave’ for public and private buildings to address the twin challenge of energy performance and affordability.

The carbon footprint quantifies the greenhouse gas (GHG) emissions through a life cycle assessment (LCA), usually in accordance with the standards ISO14044, EN15804 and EN15978 as well as the European Level(s) framework. The LCA methodology is well-established. It systematically covers all stages of the life of a building, but has its limitations. The impacts on the transport (location), infrastructure and land use are excluded. The GHG emissions are usually not announced per resident but per square meter of floor area, which excludes the climate impact of the building stock volume per capita. Furthermore, some assumptions, such as the future scenarios for the CO_2 emission factors of the grid electricity and the expected service life of the building, include high uncertainty.

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The preliminary tasks of the PhD project are:

1. Review on the methods and tools for estimating the carbon footprint in renovation. Application of standards and national calculation methodologies in renovation.

2. Carrying out parametric study of carbon footprinting of renovations. Specifying national generic carbon footprinting methodology to renovations. The parametric study will be basis to establish a baseline or reference carbon footprint for a number of standard renovation types in Estonia. Taking into account energy consumption and construction materials carbon impacts.
3. Case studies: quantification of the carbon footprint for case study renovations and a comparison of alternative renovation solutions. Estimation of adequate target levels for renovations.
4. Compare renovation solutions based on cost-optimality, carbon-optimization and total energy-optimization criteria
5. Critical examination of the LCA methodology and carbon footprint regulation as a steering mechanism for renovation. Limitations, data gaps and inaccuracies of the methodology.

Funding:

The PhD project is funded by the research project “Estonian carbon footprint regulation”, directed by prof. Kimmo Lylykangas, 2021 and “Pursuing Estonian national climate ambition through resilient renovation” (BUILDEST), directed by prof. Targo Kalamees, 2021–29.

Time and place:

2021–2025, Academy of Architecture and Urban Studies in cooperation with Nearly Zero Energy Buildings Research Group, TalTech.

Supervisors:

Prof. Kimmo Lylykangas, Department of Civil Engineering and Architecture, Academy of Architecture and Urban Studies
Prof. Targo Kalamees, Department of Civil Engineering and Architecture, Nearly Zero Energy Buildings Research Group.

Qualifications:
The applicants should fulfil the following requirements:

- Highly motivated, independent work ability, ability to work in a team;
- Research experience in architecture (EstQF Level 7 or equivalent), renovation, and carbon footprint / energy performance of buildings;
- Excellent organizational skills;
- MSc in architecture
- Estonian language skills level C1 (case study buildings are located in Estonia; the research methods also include interviewing designers, builders and clients as well as analysing of drawings).

Prior knowledge on LCA, building physics and energy performance of buildings will be appreciated.

To get more information or to apply online, visit https://taltech.glowbase.com/positions/398 or scan the the code on the left with your smartphone.