Bern University
of Applied Sciences

Greenhouse gas emissions of hotel cabins

Life Cycle Assessment (LCA)

System Description

In the research project with Heima, sustainable hotel cabins were developed using the eco-design methodology. The hotel cabin, with a living space of 24 m², is designed for two guests with a yearly occupancy rate of 60 %. The hotel cabin consists out of prefabricated elements that are either manufactured in India or Estonia and installed in a hotel resort in Italy (figure 1).

Figure 1: Visualization of the hotel cabins (Heima).

The conducted life cycle assessment (LCA) included the hole life cycle of a hotel cabin (figure 2). Two main scenarios were calculated: "Baseline" before eco-design (manufacturing in India and material sourcing mainly in India) and "EcoCab" after eco-design (manufacturing in Estonia and material sourcing from Europe). The scenarios also differed by the insulation (glass wool vs. wood fiber) and the window frame material (aluminum vs. wood-metal).

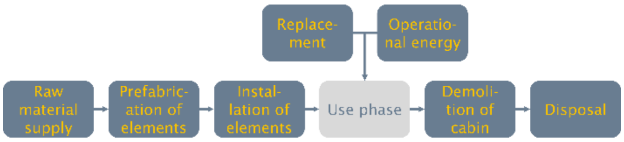

Figure 2: Assumed life cycle of a hotel cabin in this study.

Goal

The goal of this study was to conduct an LCA of the hotel cabin design to quantify the greenhouse gas emissions (GHG-emissions) over the whole reference service life. The results should highlight hotspots of GHG-emissions and effective leverages for their reduction.

Scope

This LCA was conducted according to the ISO 14040/44 and EN 15804+A2. GHG-emissions (IPCC 2021, GWP100, fossil) were calculated with the software Simapro (9.5.0.1) and the database ecoinvent (3.9.1). The functional unit was defined as one hotel cabin for two guests with a reference service life of 80 years. All the included life cycle stages are shown in figure 3. The assessed hotel cabin consisted of wooden roof, wall and floor elements including the materials metal sheet, wooden slat, OSB, insulation, duobeam, vapor barrier, plywood, wooden façade, parquet and fiber cement tiles. Additionally screw foundations, wooden terrace slats and windows were included. Different scenarios about the origin of electricity in the use phase were assessed: 100 % from Italian grid, partly from on-site photovoltaic and 100 % self-sufficient with photovoltaic and batteries (B6).

Results

One hotel cabin caused 113.9 t CO_2-eq. in the Baseline scenario and 97.1 t CO_2-eq. in the EcoCab scenario over the entire reference service life. With the eco-design measures, the GHG-emissions of the cabin could be reduced by nearly 15 % (by 16.9 t CO_2-eq.) Compared to the Baseline scenario, the main reductions came from the life cycle stages raw material supply (A1, -44.3 %, -8.8 t CO_2-eq.) and replacement (B4, -34.7 %, -9.1 t CO_2-eq., Figure 3).

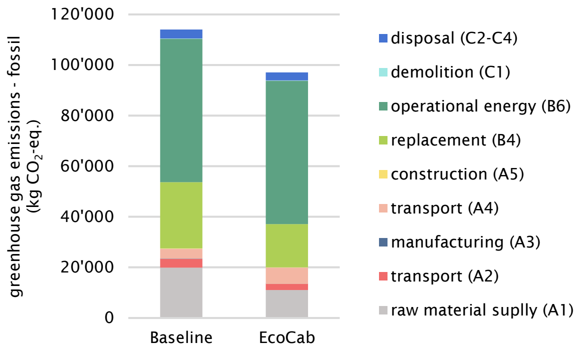

Figure 3: Greenhouse gas emissions for the two main scenarios Baseline and EcoCab, split in assessed life cycle stages.

Within the life cycle stage raw material supply (A1), 5 of the 14 assessed materials were responsible for more than 75 % of the total GHG-emissions, namely the insulation, metal sheet, screw foundation, duobeam and fiber cement tiles outdoor (listed with decreasing impact). This study also compared alternative scenarios for the life cycle stage operational energy (B6). The results showed a reduction of GHG-emissions in this life cycle stage by 77 % with the electricity supply partly from on-site photovoltaic instead of 100 % from Italian grid.

Conclusions & Outlook

Thanks to the eco-design approach during the Innosuisse project, the GHG-emissions of the cabin could be reduced by nearly 15 %, mainly due to the change from glass wool to wood fiber. In the final EcoCab scenario, the operational energy (B6) had the biggest impact with more than half of the total GHG-emissions. Also, the life cycle stage replacement (B4) and raw material supply (A1) were major sources of GHG-emissions and should be focused on future improvement activities.

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