***LIFE CYCLE COST AND GLOBAL WARMING POTENTIAL OF A WOODEN DETACHED HOUSE IN FINLAND***

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## Overview

Today, the most critical challenge is to reduce greenhouse (GHG) emissions mitigate global warming. The emergence of energy efficient buildings could play a key role in the mitigation efforts. However, the transition involves massive use of materials and energy. In this study the issue is concerned with the main focus is on the emissions embodied in the construction materials used in a wooden low-energy detached house in Finland, both with and without carbon sequestration. The structure is made of wood, has two floors and a gross floor area of 149 m2 (each floor about 75 m2).

A life cycle cost (LCC) over the lifetime of the wooden detached house (production, operation and maintenance and end of life), and an embodied global warming potential (GWP) impact assessment were conducted. In particular, the GWP impacts of all building elements were calculated using two methods of ReCiPe and LCIA-CML 2001 (Nov.10). In addition the financial benefit of installing a solar PV system on the detached house rooftop was assessed.

## Methods

LCC is one of the commonly used tools to assess the financial viability of projects, and it has been widely used in energy-efficient building research (Standardized Method of Life Cycle Costing for Construction Procurement ISO15686, 2008). In order to compare different situations, the net present value (NPV) of all relevant life cycle costs is calculated according to the Standardized Method of Life Cycle Costing for Construction Procurement ISO15686, 2008 (Standardized Method of Life Cycle Costing for Construction Procurement ISO15686, 2008).

LCA is a tool to examine the impact of a product on the environment during its life cycle – from resource extraction, through the preparation of primary materials, the fabrication of the product’s elements and the product itself, and on to the employment of the product after it is discarded, either by reuse, recycling or final disposal (International Standard 14040, 2006; International Standard 14044, 2006).

## Results

The life cycle cost of the wooden low-energy detached house in Finland was estimated, based on two important assumptions that the house has a life span of 50 years and the discount rate is 3%, according to the Commission's cost optimal regulation (European Union, 2012). Since, the life cycle cost is expected to be sensitive to the discount rate, two scenarios, one with a low (-2%) and the other with a high (6%) discount rate, were defined in addition to the base case. These two cases were selected by the authors based on the literature. It is estimated that with the higher discount rate, the significance of capital cost in the total life cycle cost increases moderately. The total annual onsite electricity production from the renewable sources is 150 kWh/m2 (Pihlakivi, 2015), which can supply 23% of the annual energy consumption. The electricity price of 11 c/KWh is based on the average hourly electricity price in Finland during 2016, obtained from the Nord pool website (Nord Pool, 2018).

The GWP impact of the wooden house with and without sequestration potential were estimated to be 262 kg CO2 eq/m2 and 89 kg CO2 eq/m2, respectively. The main source of sequestration relates to the timber beams used in the frame and roof structure, as well as the wooden window frames.

## Conclusions

The life cycle cost of the wooden low-energy detached house in Finland was estimated and the financial benefit of solar PV was assessed. As expected, with a higher discount rate, the significance of capital cost in the total life cycle cost increases moderately. Considering the use of the timber in the frame and roof structure and woodern window frames in the detached house, the GWP impact of the house with sequestration pontetial was estimated to be 66% less than the impact without the sequestration.

## Acknowledgements

The authors would like to acknowledge the Landsvirkjun (The National Power Company) and Háskólasjóður Eimskipafélags Íslands/The Eimskip University Fund for supporting this study.

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