RP2007

INTEGRATED OPTIMISATION OF LIFE CYCLE ENVIRONMENTAL AND FINANCIAL PERFORMANCE OF BUILDINGS

Research Aim

Develop a comprehensive integrated life cycle analysis (LCA) and life cycle cost (LCC) framework so as to better inform decision-making so that building strategies get selected based carbon emissions reduction potential.

Methodology

In order to address the research aim of developing an integrated LCA and LCC framework the following research mythologies were used:

- Integrate existing LCA, LCC and multi-criteria decision-making frameworks
- Identify and address the gaps of previous frameworks (Fig. 1)
- Identify and select LCA and LCC quantification techniques
- Apply framework to case study buildings in order to demonstrate its potential.

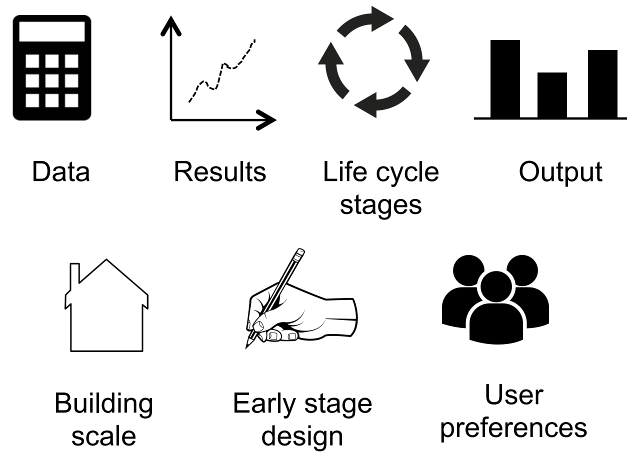

Figure 1: Gaps and weaknesses in previous LCA and LCC frameworks

Results

Integrating life cycle perspective tools such as LCA and LCC can help address this financial uncertainty and demonstrate the trade-offs between economic and environmental considerations and ultimately aid the decision-making process.

This study describes the development of a comprehensive integrated LCA and LCC framework for building evaluation and demonstrates its potential by applying to built environment examples.

This demonstration highlights the fact that more sustainable solutions are not always the most expensive, as previously perceived, especially when assessing the buildings performance from a life cycle perspective. It also emphasises that building design strategies that aim to decrease the environmental impact also have a beneficial impact on the financial performance of buildings.

This study further demonstrated the large amount of uncertainty associated with life cycle studies and highlighted the various sensitivity parameters, such as period of analysis (POA), material service life (MSL) and discount rate (DR), which needs to be taken into account when using the integrated framework.

Fig. 2 provides an example of the great amount of variability surrounding life cycle results. The shaded areas demonstrate the range of results for different glazing options (such as single glazing (SG), double glazing (DG), triple glazing (TG)) applied to a detached dwelling. The graph includes the life cycle greenhouse gas emissions (LCGHGE) and life cycle cost (LCC)

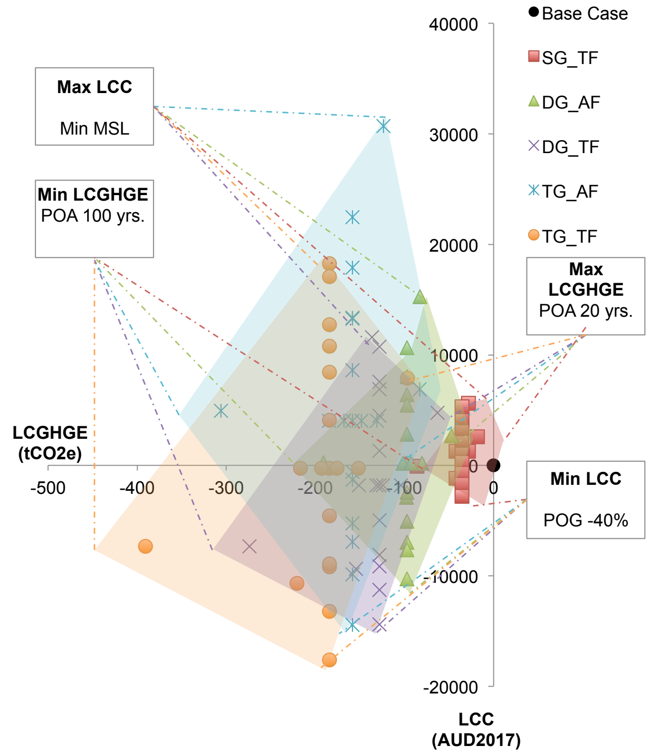

Figure 2: Integrated LCA and LCC results for a residential case study building testing different glazing options

Conclusions

There is a great amount of difficulty providing exact figures for the amount of LCGHGE or LCC due to the great amount of uncertainty surrounding life cycle studies. However, regardless of these limitations, the study did develop a sophisticated and comprehensive integrated framework. The framework helped to demonstrate the relationship and trade-offs between environmental and financial performance and in most cases it did in fact suggest which option would be the most ideal to select for the greatest LCGHGE reduction. The use of the developed framework will allow building designers and other users to investigate different design options and base final selection on options that aim to optimise the carbon emissions whilst providing an understanding of the financial implications of this optimisation.

Future Research

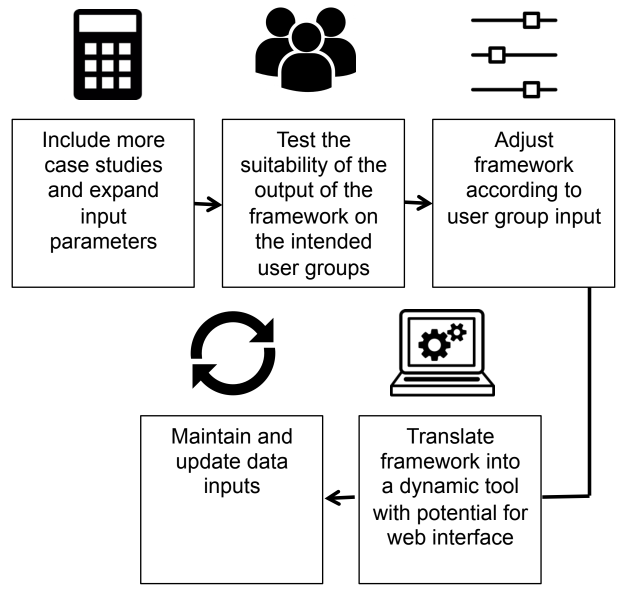

Figure 3: Future research and development of the integrated framework

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