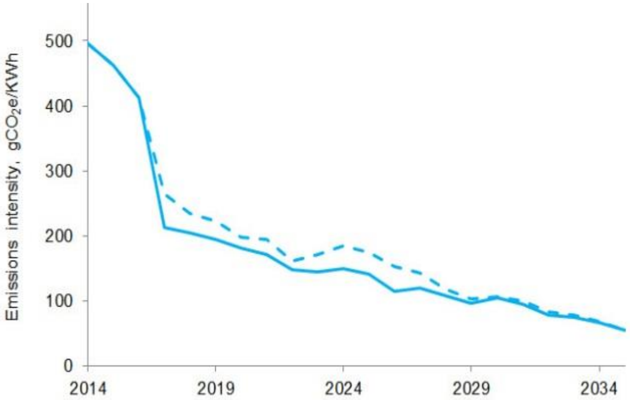
Common challenges and threats of data uncertainty for innovation projects



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Building the future 2020 - boosting innovation in the construction industry – 15th July 2020

Content

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- **Introduction to Life Cycle Assessment (LCA)**
- **Challenges and shortcomings of LCA**
- **Our approach in INNOVIP:**

  The impact of data uncertainty on innovative building solutions

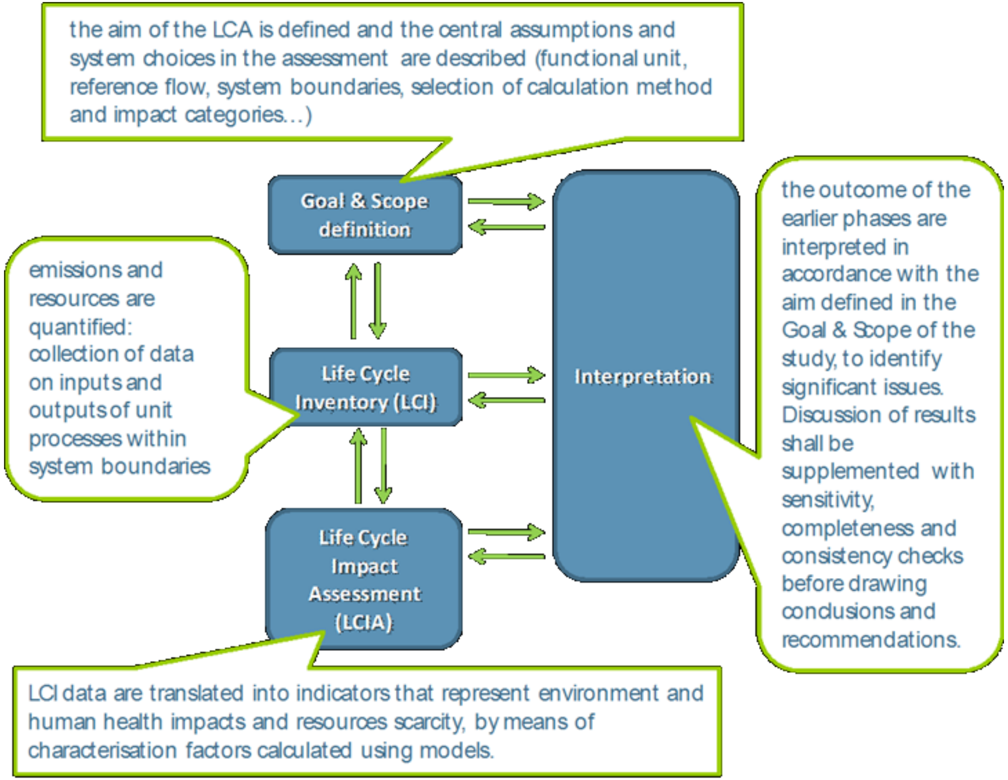
- **AMANAC Cluster**

Life Cycle Analysis and Its Objectives

- LCA analyses intend to ***transparently, accurately and Independently*** verify and ***communicate the environmental impact of different products and processes*** in compliance with codes such as ISO 14040, 14044, EN 15804 and ISO 14025

- Assist and inform ***decision makers***, whether ***consumers, industries*** and ***manufacturers or government policy makers***, in taking actions that will minimise environmental impacts of processes and materials while promoting other services.

Life Cycle Analysis and Its Components



LCA - Target Stakeholder Groups

Users of LCA span a wide spectrum of interests:

- **Process and Product developers:**
Incorporate environmental considertions into their design process to avoid potential pitfalls.

- **Consumers:**
Understanding the environmental impact of products and their alternatives hoping to bring market pressure to bear on producers.

- **Supply chain management and procurement:**
A Life Cycle Assessment can give anyone working in Supply Chain Management or Procurement actionable insights into which company they should source from.

- **Regulators and policy makers:**
Informing the development of environmental policies and mechanisms to enforce legislative objectives.

LCA - Technical and Methodological Challenges

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LCAs Technical and Methodological Challenges:

- **Availability of Data:**

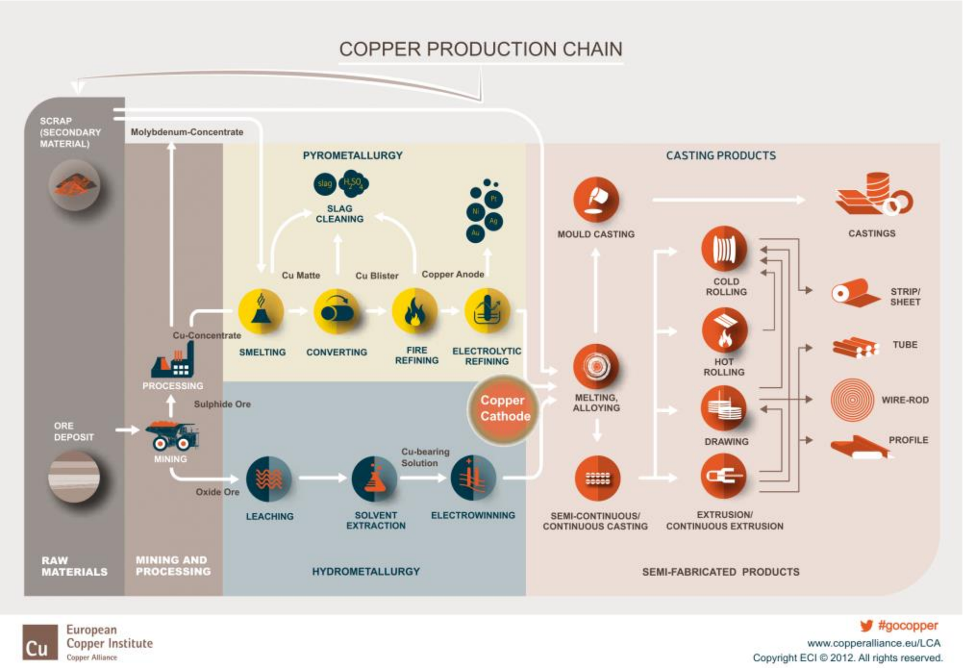
LCA is an intensively data-driven approach which relies on availability of adequate, high quality data

- **Inconsistent parameters of assessment:**

Different functional units, system, the LCI databases, the EoL scenarios.

- **LCI techniques:**

The available LCI techniques include process, input-output and hybrid methods.



procedures such as ISO 14040, EN 15804 or ISO 13315, although limit these modelling choices, do not facilitate mechanisms to ensure consistency.

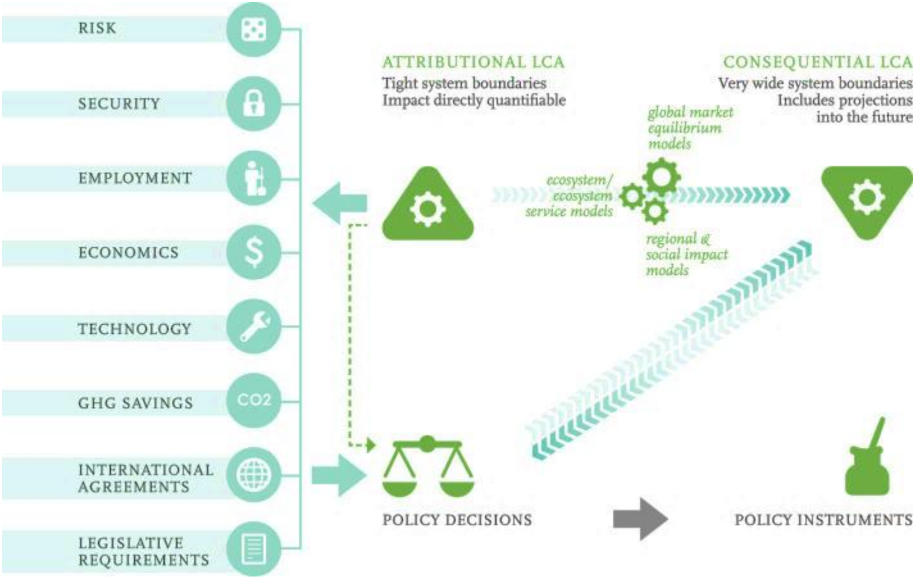
INNOVIP

LCA results – Significant Gaps

- Crawford (2011), Stephan et al (2013) and Stephan and Stephan (2014) have demonstrated that input-output-based hybrid analysis can produce embodied energy figures **four times higher** than process-based analysis, for the same building.
- Similarly, Wiedmann et al. (2011) studied wind turbines in the UK using process and hybrid analysis. They found that hybrid analysis data resulted in environmental impacts **double** that when using process data.
- Bontinck et al. (2017) have studied SIPS panels using hybrid technique with the hybrid coefficient calculated for these panels was composed of **25% process and 75%** input-output data. The resulting hybrid coefficient was demonstrated as 159% higher than its process equivalent and 46% lower than its input-output equivalent.
- Guan et al (2016) also demonstrate a **100% gap** between the process and hybrid LCAs for a building in China.
- Findings similar to the examples presented are also confirmed in Lenzen and Dey (2000), Omar et al (2014) and Jiang et al (2014).

Implications For The End Users of LCA Analysis

- Discrepancies of this nature simply draw attention to the fact that inconsistencies associated with LCA results can have significant implications for its end users when using it as a tool to assist in the early stages of building design, informing policy or planning future strategies for different stakeholders.



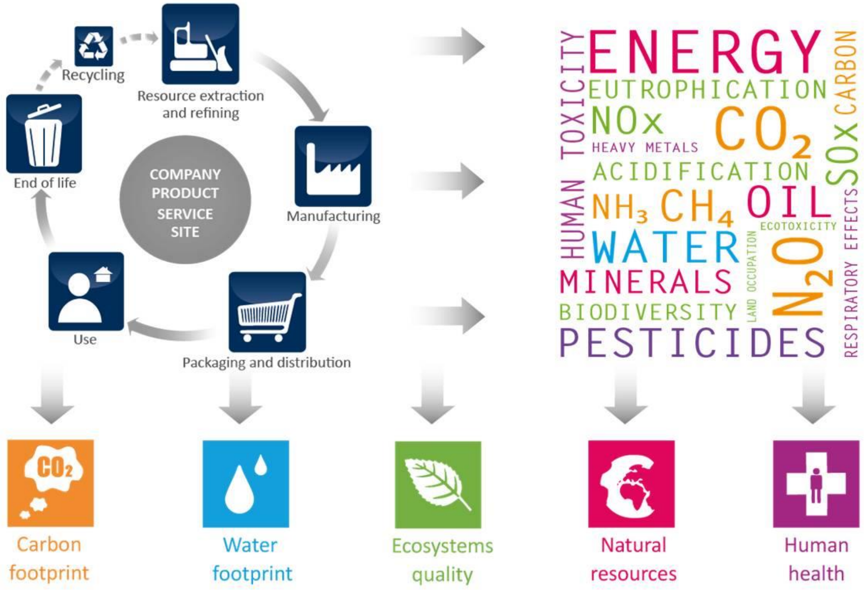
McManus & Taylor, 2015

Implications For The End Users of LCA Analysis

- Several studies have been conducted considering the uncertainties of embodied energy data including simplified approaches, data uncertainty and sensitivity analyses.

- Despite all efforts, the LCA based decision making is currently mainly limited to academic research.

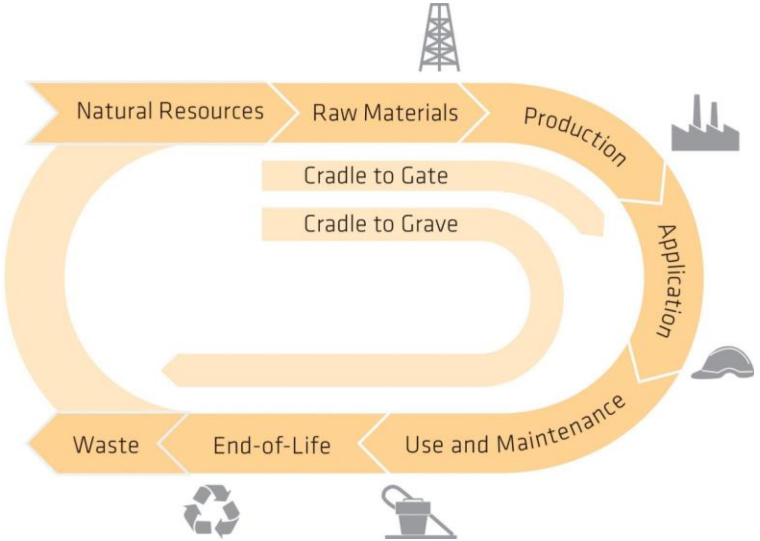
- This is attributable to various factors including the **lack of integration of LCA methodologies in commonly used building related tools**, the **high level of expertise** required to undertake LCA analyses and the **priority level LCA holds** for different stakeholders.



Implications For The End Users of LCA Analysis

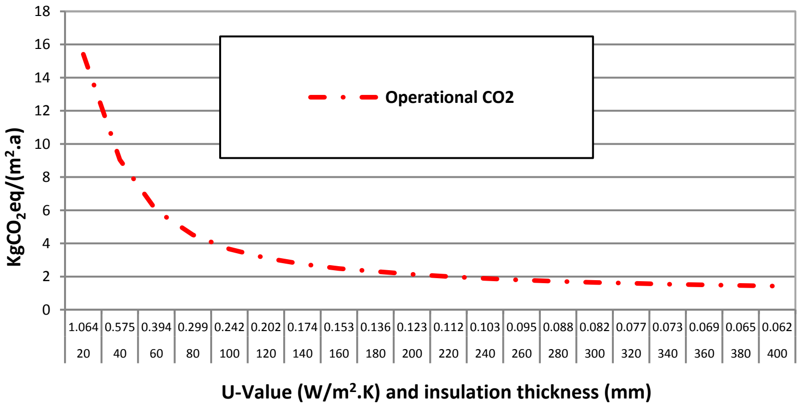
- Although there are several shortcomings associated with the existing approaches, the **Life Cycle Assessment of buildings will be part of the future assessment** of the environmental impacts of buildings.

- This adoption however needs to be informed and supported by **scenario based analyses** which could **generate clear and simple messages to the relevant end users/stakeholders** of the analysis, assisting them in making decisions to their best interest and in developing effective business models.



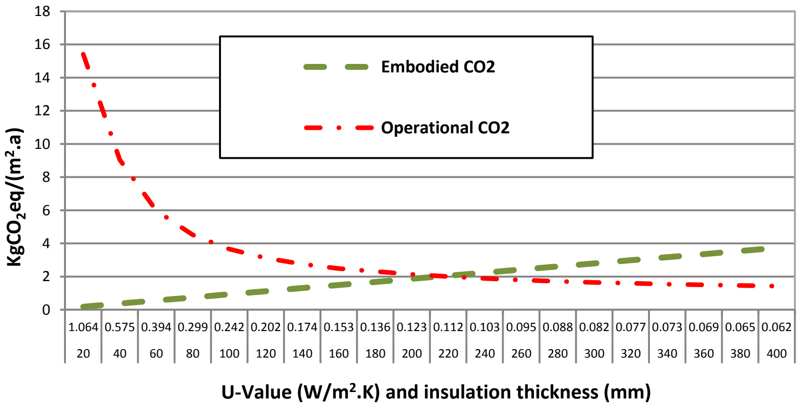
Our Approach in INNOVIP:
Implications For The End Users – Total carbon methodology

- The operational energy consumption reduces as we add to the thickness of insulation.



Our Approach in INNOVIP:
Implications For The End Users – Total carbon methodology

- The amount of energy that goes into manufacturing the insulation material starts to get significant moving towards lower U-values.

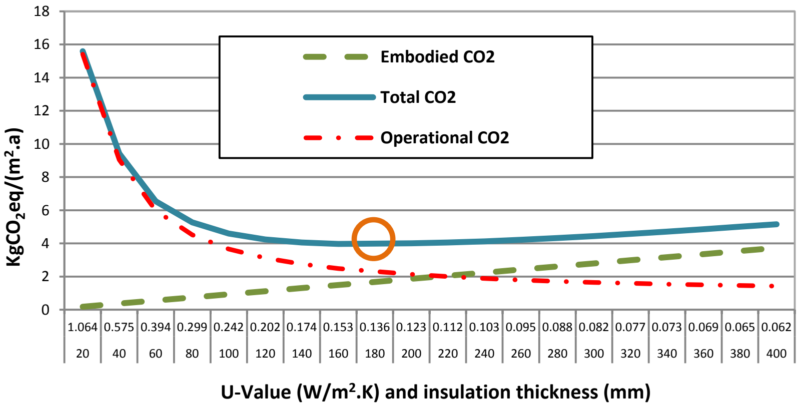


Our Approach in INNOVIP:

Implications For The End Users – Total carbon methodology

- The graph demonstrates that there are key points beyond which, and depending on factors such as material and building types, additional embodied energy investments in building materials exceed operational energy savings.

- This creates net carbon disbenefits.



Implications For The End Users – Total carbon methodology

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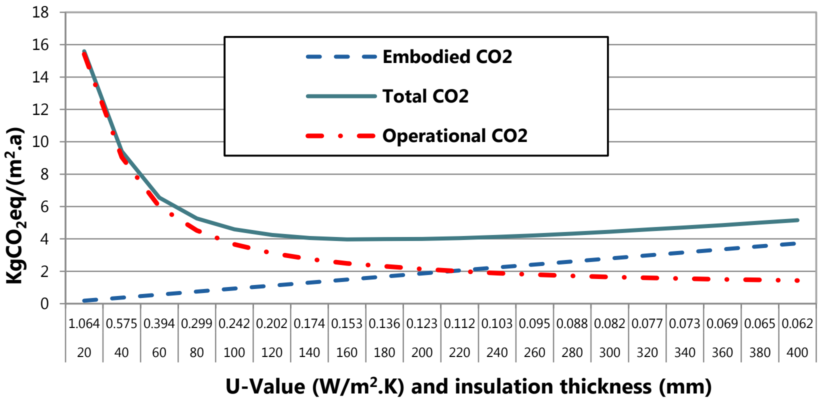
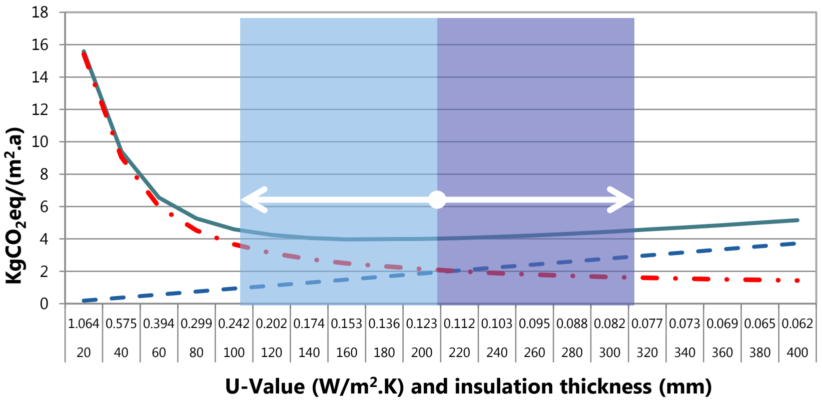
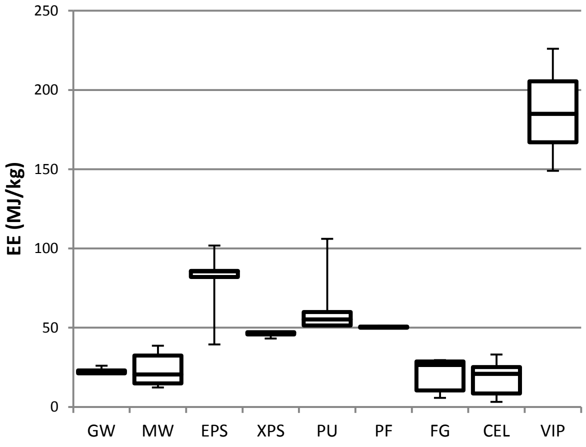


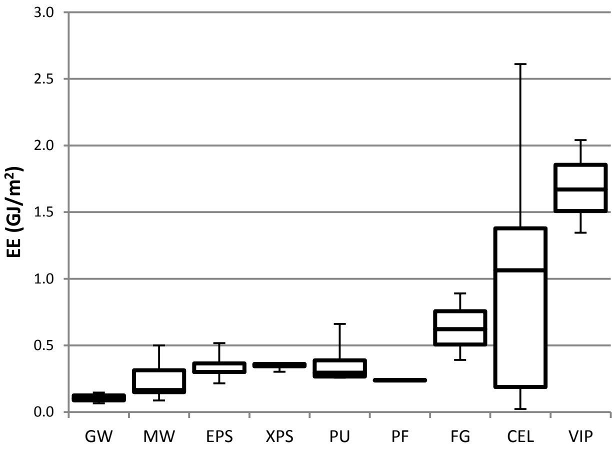


- The findings are applied to a **combined operational and embodied energy analysis** to identify the optimum design configurations associated with improved thermal performance of Vacuum Insulation Panels as a case study.

Implications For The End Users –
Case for mainstream insulation materials



Embodied Energy per unit weight of different insulation materials



Embodied Energy per unit area of different insulation materials for R=6.6 m^2.K/W

Implications For The End Users – Total carbon methodology

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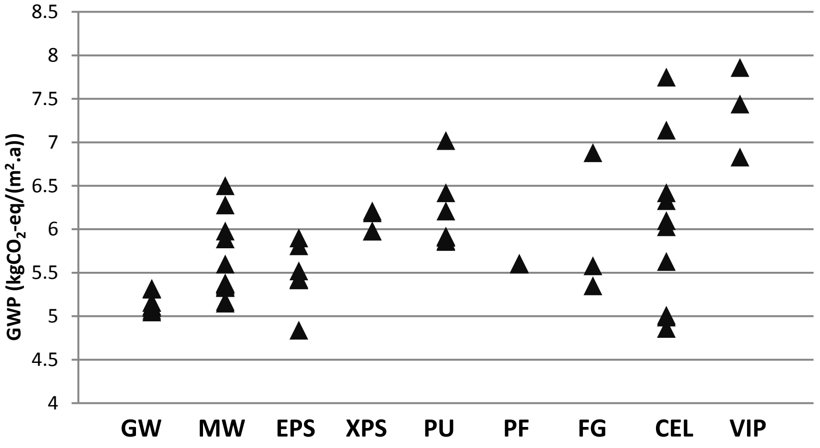
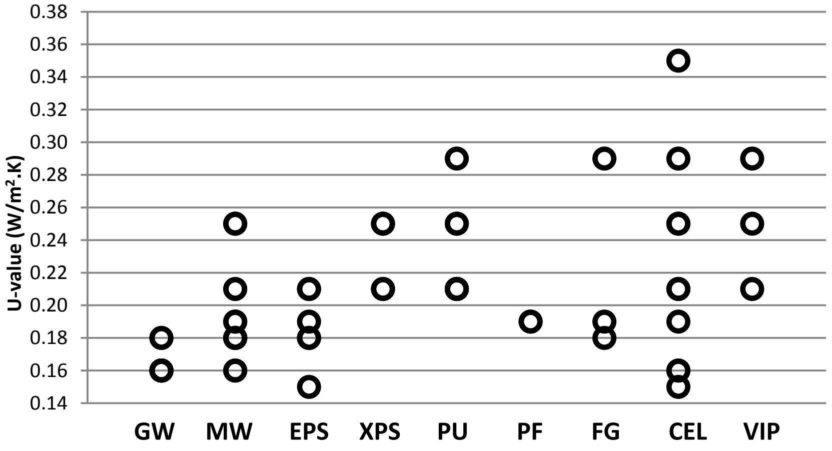


the range of optimum combined operational and embodied carbon points for each insulation materials based on the EPD values studied – **the optimum point on the total carbon graph**



Optimum U-value points associated with optimum combined operational and embodied carbon points

LCA Analysis – Challenges and Opportunities

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- Prior to effective application of LCA as tools assisting in policy making, **the fundamental methodological inconsistencies of LCAs** need to be addressed.

- currently the level of unreliability of data and inconsistency of methodological approaches in LCA analyses are to a level which cannot effectively and fully support decision-making in the building sector without further improvements (**in some cases larger than emissions reductions targets**)

- If LCA is to be used to **influence policy making**, the results of analyses must be **transparent and reproducible and effectively communicated.**

- In doing so, it is critical to realise that without consistent and harmonised data/methodologies, **uncertainties of data can have significant implications for the end users.**

- The analyses should inform designers and specifiers of environmental implications of their choices, and **assist decisions made during early design stages** which **practically determine the longer term environmental impact.**

- Although the current uncertainties associated with embodied energy values can potentially affect the analyses and provide the relative stakeholders with misleading messages, **the LCA thinking is finding its way** into standards and **regulations which will speed up** the **harmonisation and standardisation of LCA and LCI databases and methodologies**.

INNOVIP

The AMANAC CLUSTER

AMANAC WORKSHOP

Branding innovations beyond the technical
Life Cycle Assessment and the trade-offs of sustainable growth
Vienna, 29th of October

- We have started identifying and addressing some of the issues discussed here as part of an AMANAC LCA workshop in Vienna.

- An effective adoption of LCA as a decision making tool requires a collective collaboration from all the stakeholders.

ARE CURRENT LCA APPROACHES USED BY EU CONSTRUCTION SECTOR PROPERLY HARMONIZED TACKLING THE SOCIAL AND CIRCULAR ECONOMY PERSPECTIVES?

DOWNLOAD HERE

"Social performance of buildings in the context of circular economy"
Katherine Adams, Loughborough University

"LCA and Social LCA as a tool to support new products"
Giorgio Urbano, RINA Consulting S.p.A.

"Innovative insulation materials - specific problems concerning LCA in early product development phases"
Helen Luisa, USTUTT

"Uncertainties in LCA"
Callum Hill, NIBIO

DOWNLOAD HERE

"Service life of constructions and buildings as a key factor contributing to more reliable LCA"
Jakub Heller, Geonardo

"The needs for harmonised LCA standards for construction products in Europe"
Owen Abbe, BRE

DOWNLOAD HERE

"Implications of Uncertainty of Embodied Energy Data for Engaged Stakeholders"
Shahab Resalati, Oxford Brooks University Q&A Discussion Open forum

Thank you