ENVIRONMENTAL SUSTAINABILITY IN THE BUILT ENVIRONMENT

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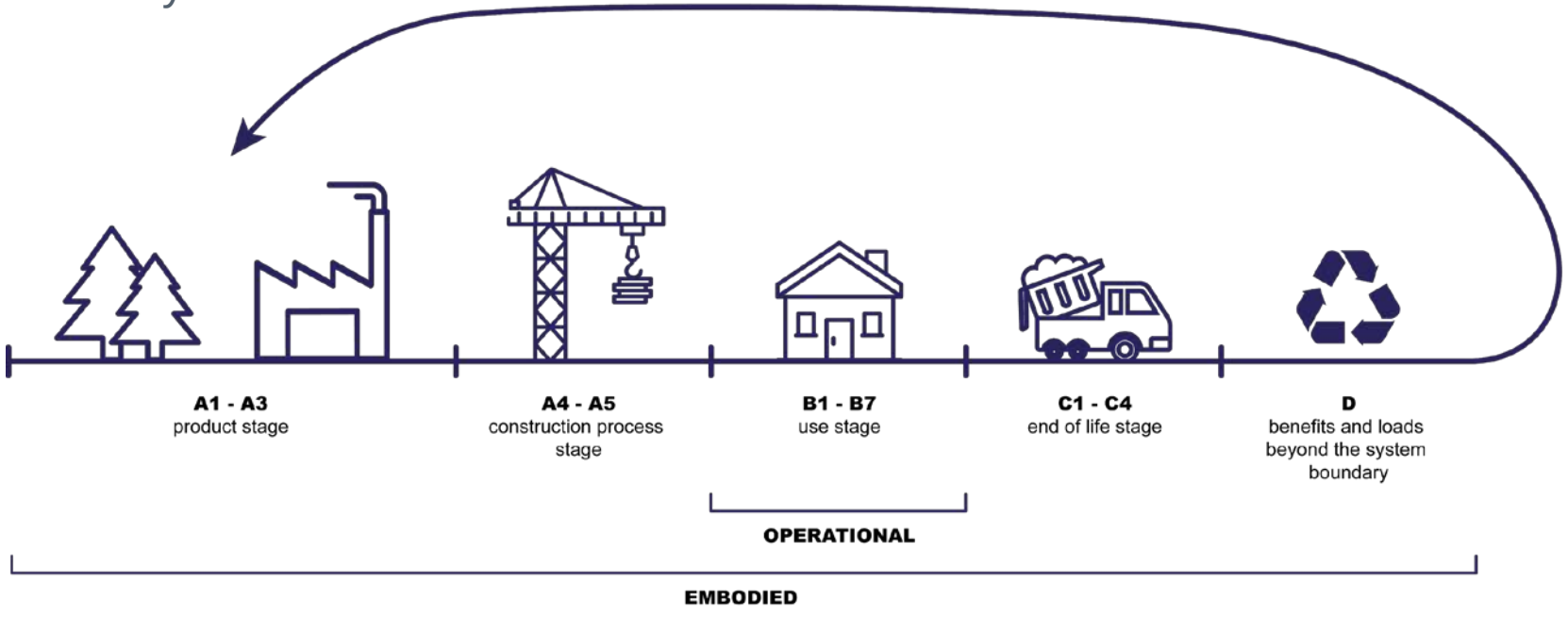
LIFE CYCLE ASSESSMENT (LCA) OF BUILDINGS

Tool to quantify the environmental impact of a product or a building throughout the life cycle



APPLYING LIFE CYCLE ASSESSMENTS

Wood in construction

Renovating rather than building new

Circular economy

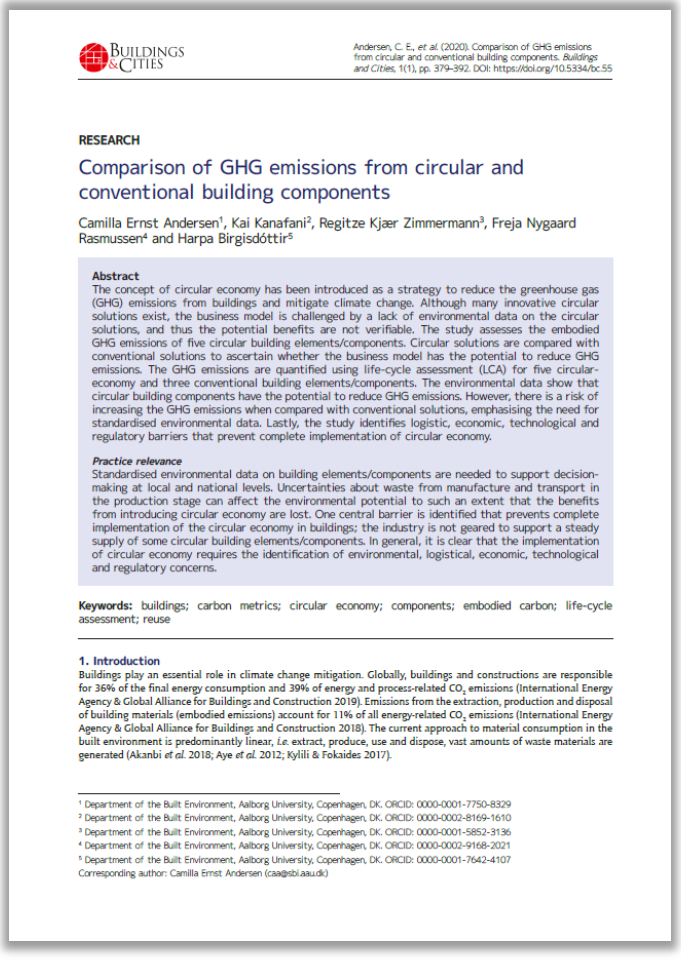
EXAMPLE – ASSESSING CIRCULAR BUILDING PRODUCTS

Aim:

*To assess the potential **reductions in greenhouse gas emissions** achieved through circular economy*

Method:

*Apply LCA to quantify the greenhouse gas emissions (GHG) of **conventional building products** and **circular building products** and compare these*



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RESEARCH

Comparison of GHG emissions from circular and conventional building components

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Abstract

The concept of circular economy has been introduced as a strategy to reduce the greenhouse gas (GHG) emissions from buildings and mitigate climate change. Although many innovative circular solutions exist, the business model is challenged by a lack of environmental data on the circular solutions, and thus the potential benefits are not verifiable. The study assesses the embodied GHG emissions of five circular building elements/components. Circular solutions are compared with conventional solutions to ascertain whether the business model has the potential to reduce GHG emissions. The GHG emissions are quantified using life-cycle assessment (LCA) for five circular-economy and three conventional building elements/components. The environmental data show that circular building components have the potential to reduce GHG emissions. However, there is a risk of increasing the GHG emissions when compared with conventional solutions, emphasising the need for standardised environmental data. Lastly, the study identifies logistic, economic, technological and regulatory barriers that prevent complete implementation of circular economy.

Practice relevance

Standardised environmental data on building elements/components are needed to support decision-making at local and national levels. Uncertainties about waste from manufacture and transport in the production stage can affect the environmental potential to such an extent that the benefits from introducing circular economy are lost. One central barrier is identified that prevents complete implementation of the circular economy in buildings; the industry is not geared to support a steady supply of some circular building elements/components. In general, it is clear that the implementation of circular economy requires the identification of environmental, logistical, economic, technological and regulatory concerns.

Keywords: buildings; carbon metrics; circular economy; components; embodied carbon; life-cycle assessment; reuse

1. Introduction

Buildings play an essential role in climate change mitigation. Globally, buildings and constructions are responsible for 36% of the final energy consumption and 39% of energy and process-related CO_2 emissions (International Energy Agency & Global Alliance for Buildings and Construction 2019). Emissions from the extraction, production and disposal of building materials (embodied emissions) account for 11% of all energy-related CO_2 emissions (International Energy Agency & Global Alliance for Buildings and Construction 2018). The current approach to material consumption in the built environment is predominantly linear, *i.e.* extract, produce, use and dispose, vast amounts of waste materials are generated (Akanbi *et al.* 2018; Aye *et al.* 2012; Kylili & Fokaides 2017).

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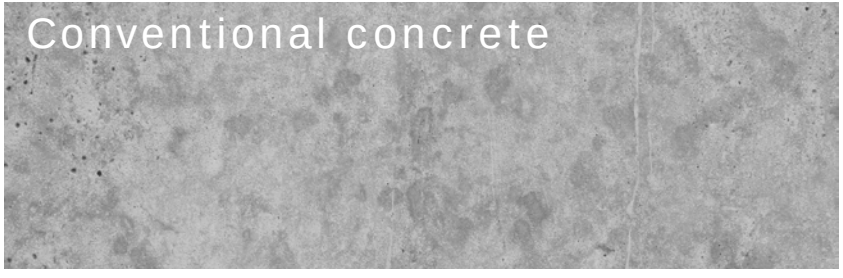
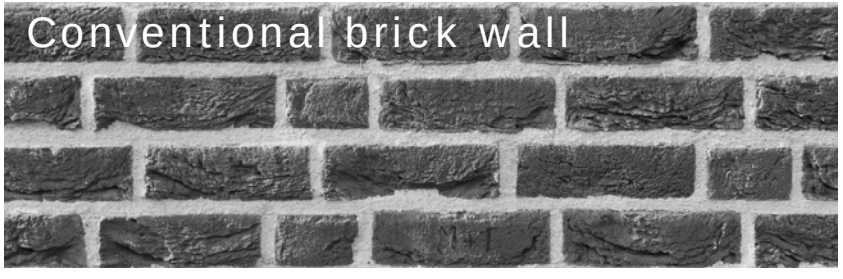
EXAMPLE – ASSESSING CIRCULAR BUILDING PRODUCTS

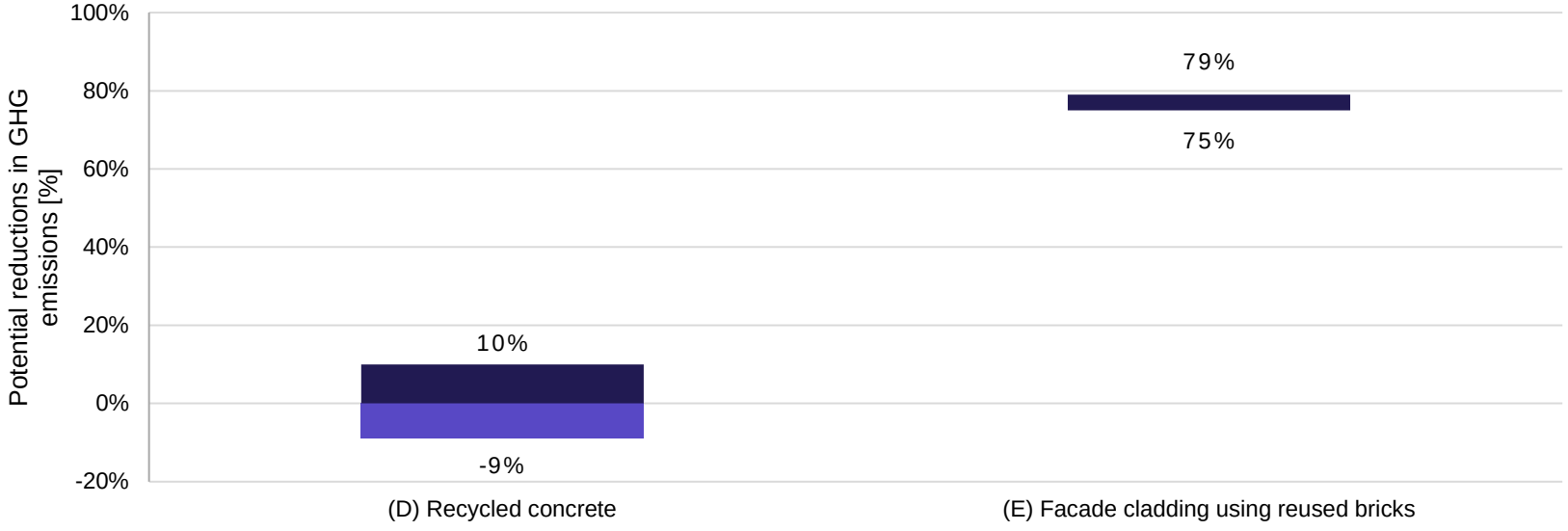
Compare the GHG emissions of conventional building products to the GHG emissions of circular building products





EXAMPLE – ASSESSING CIRCULAR BUILDING PRODUCTS

Life Cycle Assessment results when comparing GHG emissions of conventional building products to GHG emissions of circular building products



EXAMPLE – ASSESSING CIRCULAR BUILDING PRODUCTS

Life Cycle Assessment results when comparing GHG emissions of conventional building products to GHG emissions of circular building products

Large variations in GHG emission reductions

Risk of burden shifting

Lack of environmental data on circular building products