# Emissions from building and construction can be halved with current technologies and practices

openaccessgovernment.org/article/emissions-from-building-and-construction-can-be-halved-with-current-technologies-and-practices/182760

25 September 2024

## Filip Johnsson and Ida Karlsson from Chalmers University of Technology argue that building and construction emissions can be halved with current technologies and practices in place

The Mistra Carbon Exit programme identifies and analyses the technical, economic and political opportunities and challenges for Sweden to reach the target of net-zero greenhouse gas emissions by 2045. The programme is multidisciplinary, addressing the technical, economic and political challenges associated with this transition. The programme takes the novel approach of focusing on supply chains – from the input of raw materials, through primary and secondary activities, to the final products and services demanded by the end-users.

The programme, which is now in its final stage, has been successful in terms of its substantial scientific output, such as numerous publications in high-impact journals and strong industrial cooperation with implementation projects.

An important part of the research programme has been investigating how to decarbonise the building and construction sector. In addition to the emissions linked to heating and electricity, building and construction emissions arise from the manufacture, processing, and transport of construction materials and activities at the construction site.

## A new PhD thesis investigates how to reduce embedded building and construction emissions

The PhD thesis of Ida Karlsson titled "Achieving net-zero carbon emissions in construction supply chains – analysis of pathways towards decarbonization of buildings and transport infrastructure", completed within Mistra Carbon Exit and presented in June 2024, provides a thorough exploration of the $CO_2$ emission reduction potentials across building and transport infrastructure construction supply chains.

The PhD thesis employed a scenario analysis and extensive literature reviews. It involved broad stakeholder participation in identifying and analysing key abatement options throughout the construction supply chain, using the Swedish building and construction sector as an example. Nonetheless, most of the results should be applicable to other industrialised countries. The work culminated in a detailed roadmap, delineating reduction potentials and implementation timelines with increasing ambition over five-year time steps towards close-to-zero $CO_2$ emissions by 2045.

## Building and construction emissions can be halved with current technologies and practices

The results indicate that it is possible to halve the $CO_2$ emissions associated with Swedish construction today using currently available technologies and practices. Moreover, the thesis concludes that this is possible and feasible if all the actors in the value chain play their part in reaching around 70% reduction in $CO_2$ emissions by 2030 and close-to-zero emissions by 2045.

Achieving these levels of reductions at the national level necessitates implementing comprehensive measures across the board, requiring extensive collaborations along the entire value chain.

Key strategies include enhancing resource efficiency and circularity measures, as well as adopting electrified industrial processes and heavy vehicles. Deep reductions in $CO^2$ emissions are possible through a comprehensive consideration of resource efficiency and circularity opportunities at all stages of the value chain. Optimisations of structures and concrete mixes are emphasised, alongside increased reuse and recycling, combined with substitutions with bio-based materials.

Digital and automated processes, strategic machine setups, and transport and on-site logistics optimisation for heavy transport and the construction process support progressive electrification.

## Need for tailored policy measures and procurement strategies

Policy measures and procurement strategies should be tailored to support the measures mentioned above, with a clear focus on the supply chain. This includes the early involvement of contractors and suppliers in planning and design processes, facilitating balanced risk sharing. The studies also underscore the importance of avoiding pitfalls along the way, such as over-reliance on materials or solutions that cannot be scaled up to the levels required to achieve deep emissions reductions on the national or international level.

## Active involvement of value chain stakeholders in research

The studies included in the thesis offer insights into how stakeholders can accelerate the climate transition in building and transport infrastructure construction and renewal to advance towards global climate goals. At the core of this are collective efforts, embracing solutions across the supply chain, and prioritising the climate transition in the development of the built environment.

By assessing supply chains that encompass the active involvement of value chain stakeholders and considering the time perspective, technical maturity, and scalability of emissions reduction measures, Mistra Carbon Exit’s research lays the foundation for actionable roadmaps towards decarbonising the embodied emissions of buildings and transport infrastructure.

The thesis is based on five scientific papers, three of which have already been published. The papers are listed below.

## Towards a broad implementation

Ida Karlsson states, “It is important to create knowledge that is easily accessible and can be used as a starting point for any project, small or large”. She concludes that, “To drive industry- wide change, knowledge of the carbon emissions reduction measures needs to be integrated into the stakeholders’ existing templates, tools and handbooks”.

To support this change, researchers in Mistra Carbon Exit and partners at the consultancy firm WSP in Sweden have laid a foundation for dialogue with municipalities and other agencies, such as the Swedish Transport Administration, which includes reduction requirements in all major projects. However, even when such requirements exist, supportive organisational processes and individual incentives are essential. Climate action is much more likely to be realised when committed and motivated people are involved.

### References


1. Karlsson, I., Rootzén, J., Johnsson, F., Erlandsson, Achieving net-zero carbon emissions in construction supply chains – A multidimensional analysis of residential building systems (2021) Developments in the Built Environment, 8, art. no. 100059, DOI: 10.1016/j.dibe.2021.100059
2. Karlsson, I., Rootzén, J., Toktarova, A., Odenberger, M., Johnsson, F., Göransson, Roadmap for decarbonization of the building and construction industry – A supply chain analysis including primary production of steel and cement (2020) Energies, 13 (6), art. no. 4136, DOI: 10.3390/en13164136
3. Karlsson, I., Rootzén, J., Johnsson, F. Reaching net-zero carbon emissions in construction supply chains – Analysis of a Swedish road construction project (2020) Renewable and Sustainable Energy Reviews, 120, art. no. 109651.
4. Karlsson, I. Rootzén, J., Johnsson, F., Uppenberg, S., “Accelerating Carbon Reduction in Transport Infrastructure Construction: Synthesis of Project-level Mitigation Strategies”, Submitted for journal publication.
5. Karlsson, I. Rootzén, J., Johnsson, F., “Decarbonizing Transport Infrastructure: A Supply Chain Action Plan towards Net-zero Emissions”, Submitted for journal publication.
6. Karlsson, I., Achieving net-zero carbon emissions in construction supply chains – Analysis of pathways towards decarbonization of buildings and transport infrastructure, PhD thesis, Chalmers University of Technology, 2024, https://research.chalmers.se/publication/540985