Circular economy along the building value chain: Impact on material demand, energy demand and emissions

(8) Kritische Rohstoffe und Kreislaufwirtschaft
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Motivation und zentrale Fragestellung

The circular economy is gaining momentum for industry decarbonisation. Especially, the emission-intensive basic industry has to be addressed due to the challenging mitigation and high associated costs. Thus, it is crucial to reduce the future material demand [1]. This contribution focusses on buildings as one of the main users of the energy-intensive basic materials steel and concrete. Consequently, it aims to answer two research questions: How to model circular economy actions for buildings and what impact to these actions have on material demand, energy demand and greenhouse gas (GHG) emissions related to buildings?

Methodische Vorgangsweise

The scope of analysis are the member states of the European Union and United Kingdom until 2050. Firstly, we modelled a reference development for material demand. Secondly, the impact of selected CE actions was assessed.

For this purpose, a material flow model was applied, that directly links the building model Invert/EE-Lab and FORECAT-Industry (see Figure 1). Additionally, a data basis on material use based on residential and non-residential building archetypes was used [2, 3].

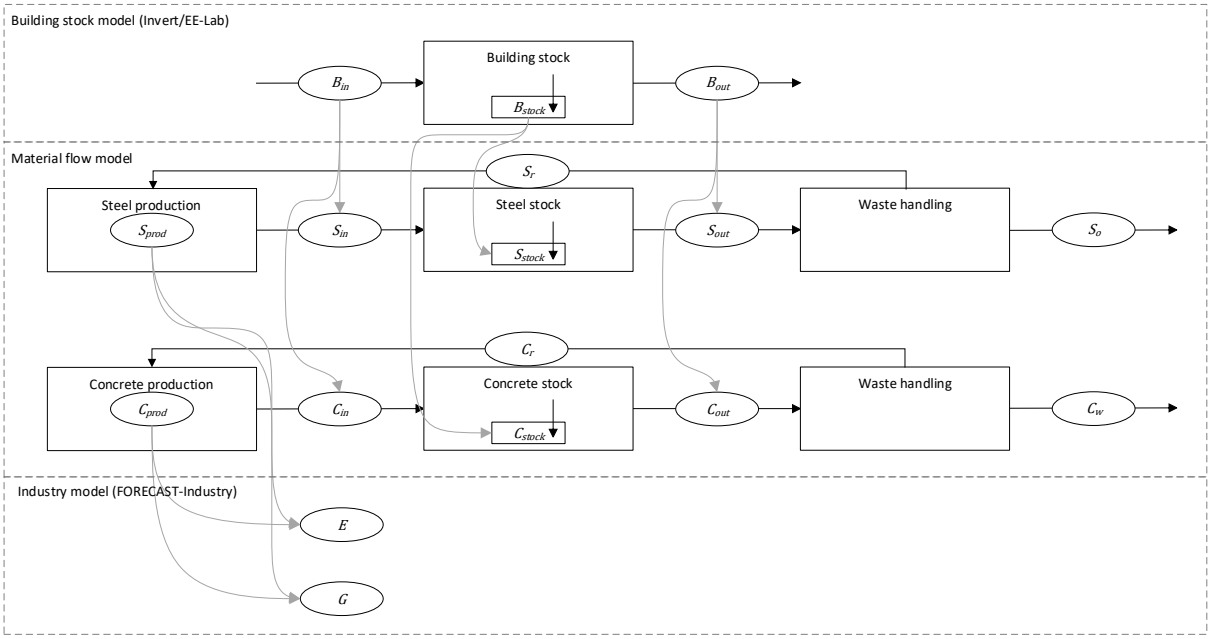

Figure 1 Modelling approach [3]

The circular economy measures including their parametrization presented in [2] were selected for modelling. The measures are shown in Table 1 and are structured according to the 9Rs [4].

Table 1 Considered circular economy measures [2]

9R strategy	**Circular economy measure**
R0-Refuse	Timber instead of (reinforced) concrete in residential buildings
R1-Rethink	Reducing floor space demand in residential buildings and offices
R2-Reduce	Reducing the over-specification of elements by volume

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9R strategy	**Circular economy measure**
R3-Reuse	Protection of cultural heritage buildings
R4-Repair	Renovation of existing buildings
R5-Refurbish	
R6-Remanufacture	Reuse of building elements
R7-Repurpose	Reuse of building materials
R8-Recycle	Recycling of cement

Energy demand and GHG emissions were allocated to the material flows. They were based on a reference development and do not take into account additional decarbonization efforts.

Ergebnisse und Schlussfolgerungen

The results of the reference show an increasing demand for steel and concrete in buildings. This is caused by an increasing demand for buildings. The circularity actions can significantly reduce the material demand and thus, the energy demand and GHG emissions. The reduced over-specification and the renovation of existing buildings have the highest impact. The lowest impact and also prioritization according to the 9R can be allocated to the reuse of steel and the recycling of cement.

The results could be improved by validating the input data on material use in buildings and the parametrization of the circularity measures. In addition, they could be enhanced by considering additional materials, further measures and alternative scenarios for stock development or energy demand and GHG emissions.

The results are the basis for further research on the contribution of a circular economy to industry decarbonisation. By combining this with other energy system models, it is possible to analyse varying GHG mitigation pathways.

Literatur

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