DEVELOPING TRANSITION PATHWAYS FOR TRANSFORMATIVE CHANGES IN THE BUILDING SECTOR

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Introduction

The building sector is among the biggest emitters of CO_2. The significant challenges in its decarbonization make the development of effective strategies for its adaptation crucial for the fulfilment of the Austrian climate protection objectives. We present a comprehensive adaptation strategy for Austrian building stock with a focus on building and land use aspects. The approach consists of an analysis of the current CO_2 emissions, a derivation of detailed intermediate reduction targets for various time horizons and demand purposes, and the development of sets of effective adaptation measures. The adaptation measures incorporate the substitution of fossil fuels, renewable energy, energy efficiency improvements, thermal renovation to identify and highlight an effective spatially differentiated transformation strategy for the of the Austrian building stock. Additionally, accounting for embodied material-related emissions quantified through life cycle assessments provides a comprehensive analysis of the positive and negative effects of renovation strategies and allows for an improved comparison between them. TransBuild's analysis aims to produce an overview of quantifiable systemic measures and resulting recommendations to serve as a sound basis for stakeholders and decision makers.

Research Background

In the European Union, the building stock is responsible for 40% of the primary energy demand and for 37% of the CO_2 emissions [1]. Due to the significant investment costs, labor intensity and material demand, adaptations and renovations in the building stock require a long-term effort. Thus, the building stocks substantial share of the total CO_2 emissions and its resource and time intensive adaptation makes an efficient strategy for its decarbonization crucial for the fulfilment of the ambitious climate protection objectives [2]. We present a comprehensive analysis and development of an effective adaptation strategy for the building stock through a methodological synthesis of a back casting approach of the future admissible CO_2 emissions and remaining CO_2 budget and the development of sets of measures who ensure to meet the ambitious objectives. Modeling prospective pathways that stay within the CO_2 budget encompasses two perspectives on emissions. While there is broad consensus that measures to reduce demand and improve energy efficiency are crucial, the impact of these measures needs to be assessed. Renovation measures positively influence operational emissions through energy-efficiency improvements. In contrast, additional material demand during retrofit and renovation can account for a substantial share of life cycle emissions [3]. To present a comprehensive view on the development of renovations on building-related emissions, it is necessary to incorporate embodied and operational emission perspectives.

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Method

We conduct a detailed analysis utilizing the “Austrian Energy Mosaic” to assess the status of the energy consumption and CO_2 emissions detailed by sectors and demand purposes [4]. The registration of the current status allows a further derivation of detailed emission budgets for consumer groups and demand purposes which result in the definition of intermediate reduction goals for various future time horizons. Subsequently, we develop sets of spatially differentiated measures for the decarbonization of the building stock. The scenario includes the assessment of changes in main framework conditions like climate change induced changes in heating and cooling demand, changing lifestyles and an increasing building stock. Furthermore, the sets of measures will be developed which include the identification of a targeted and impactful thermal renovation strategy, the substitution of fossil fuels and increased production of renewables. In addition, various renovation strategies and practical measures are then quantified into material demand and scaled up to the previously defined scenarios. To incorporate current and future embodied emissions, we evaluate material-related emissions for the renovation strategies using prospective life cycle assessments [5]. TransBuild advances the role of buildings from an integrative systemic view, covering multiple scientific fields, which opens the possibility to assess the challenges of the decarbonization of buildings from multiple angles.

Preliminary and expected Results

The identified measures and sets thereof will be spatially differentiated under consideration of the local conditions to form a sound basis for decision makers, as demonstrated in Figure 1. Additionally, for each measure, the associated global warming potential due to additional materials will be assessed. Thus, our analysis aims to provide a quantitative overview of systemic measures, and their resulting recommendations and to highlight the importance of taking a life cycle perspective on renovation strategies by incorporating embodied emissions and operational effects. The results further enable an enhanced perspective on adaptation measures and the emissions their implementation may cause. While addressing Austria, the results may serve as a reference for other countries and regions with comparable characteristics in terms of the building stock and energy mix.

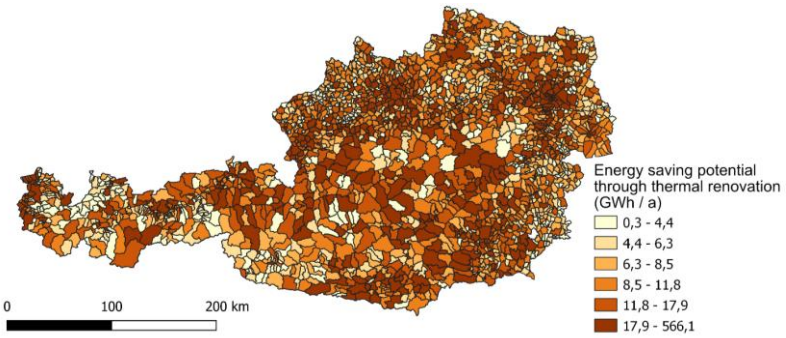

Figure 1: Energy saving potential through thermal renovation of the residential building stock per municipality in GWh/a.

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Referenzen

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