Spatiotemporal building stock modeling for residential decarbonization in the Netherlands

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Propositions

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1. Including information on past refurbishment and occupant behavior in bottom-up building stock energy modeling is important for achieving reliable results (Chapter 2).

2. The residential space heating demand in the Netherlands can be significantly reduced by extensive renovation. (Chapter 3).

3. Closing material loops in the Dutch residential building sector is challenging due to the temporal mismatch between material demand and secondary material supply from Construction and Demolition Waste (CDW) recycling (Chapter 4).

4. The heat transition and greening the electricity mix are key strategies for achieving a low-carbon residential building stock in the Netherlands (Chapter 5).

5. The main barriers to decarbonizing buildings are the high investment costs and inconvenience for residents (CE Delft, 2020).

6. Following an early and steady path in which emissions are strongly reduced in the first decade is more cost-effective than following a late and rapid path in which low initial reduction targets quickly deplete the carbon budget and require a sharp reduction later (Victoria et al., 2020).

7. Enhancing energy efficiency can give substantial savings on the life cycle costs of most products (IEA, 2021).

8. There is no unique optimal 'silver bullet' solution for prioritizing between investments in building renovations and in the provision of decarbonized energy supplies. So policy and investment decisions aiming to decarbonize buildings must be taken on a case-by-case basis for the foreseeable future (EASAC, 2021).

9. The challenges to reaching a net zero, energy-efficient and resilient build environment are considerable, with 82 per cent of the population that is to be added by 2030 in residential areas living in countries without any building energy codes or only voluntary codes (United Nations Environment Programme, 2021).

10. Finding answers to a research question is also a process of coming up with many new research questions.