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## **The energy and material related impacts of the transition towards low-carbon heating: a case study of the Netherlands**

Verhagen, T.J.

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Propositions with the dissertation:

# THE ENERGY AND MATERIAL RELATED IMPACTS OF THE TRANSITION TOWARDS LOW-CARBON HEATING: A CASE STUDY OF THE NETHERLANDS

By Teun Johannes Verhagen

1. Although reusing the existing natural gas infrastructure in the Netherlands for the distribution of hydrogen or biogas can avoid part of a considerable material demand, it still creates a potential lock-in with fossil fuel infrastructures. (chapter 2)
2. In addition to accumulating stocks, so-called 'stocks in decline' will increasingly play a role in MFA-related IE research. (chapter 2)
3. Without further government intervention, the transition towards low-carbon heating will increase the number of households in the Netherlands suffering from energy poverty. (chapter 3)
4. Implementing alternative heating solutions for existing and older homes on a district scale, instead of per household could significantly accelerate the transition to low-carbon heating technologies. (chapter 3)
5. The Netherlands tops all the recycling charts in Europe for C&DW with recycling rates up to 80%. As most of these materials are used as filler materials for road construction, we can call this downcycling at best. We should scale up high-quality recycling from C&DW to reach a recycling rate of 80% as soon as possible. (chapter 4)
6. The transition towards low carbon heating further integrates the heating system with the electricity system, which means that to achieve low-carbon heating of the built environment, the electricity system must also be low-carbon. (chapter 5)
7. When exploring the inflow and outflow of a material stock, the average lifespan of the product is more important than fitting the curve with the correct lifespan distribution function. (Miatto et al., 2017)
8. Hibernating stocks will gradually become a more important source of materials.
9. To further mitigate GHG emissions, the Netherlands should also focus on help developing countries with their low-carbon heating systems.
10. Environmental actions are only taken seriously by politics after a worldwide crisis has harmed our current lifestyle.
11. PhD candidates are more likely to have a cat than other people.