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## **Towards circular and energy-efficient management of building stock: an analysis of the residential sector of the Netherlands**

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## Propositions

### “Towards a circular and energy-efficient management of building stock: an analysis of the residential sector of the Netherlands”

by Chunbo Zhang

1. High eco-efficient technological routes for waste concrete recycling are through processing wastes on-site and producing high-value-added secondary products (this thesis).
2. Lifetime extension is the most desirable option for material circularity; element reuse is less preferable but still shows noticeably environmental and economic advantages; the benefits of material recovery are almost negligible compared with the first two options (this thesis).
3. Active energy efficiency approaches – replacing traditional gas-based systems with electricity-based systems and supplying them with 100% renewable electricity – are more important to realize the 2050 carbon-neutrality goal in the building sector than the passive approach (this thesis).
4. Building energy renovation shows clear trade-offs between environmental and economic impacts and between material- and energy-related impacts (this thesis).
5. The 2050 carbon neutral goal seems more important and urgent, while the 2050 circularity goal of the Netherlands - “raw materials will be used and reused efficiently without any harmful emissions into the environment” – might be much harder to realize (this thesis).
6. Concrete is a critical component of deep decarbonization efforts because of its scale of applications; changes in concrete production can lead to more than 50% reductions in associated GHG emissions by 2050 (Gregory et al., 2021).
7. The carbonation effect of cement products represents a substantial carbon sink that is not currently considered in emissions inventories (Xi et al., 2016).
8. Recycling can never prevent end-of-life disposal, it can merely delay it. The only way to reduce the amount of material for landfill or incineration is to reduce the amount of material we produce in the first place (Zink and Geyer, 2019).
9. Circular economy is a powerful narrative but should be defined accurately enough to avoid disappointing outcomes, including negative rebound effects (Birat, 2015).
10. The lowest possible interest rate should be used for discounting the far-distant future part of any investment project (Weitzman, 1998).