Effects of the integration of heat demands into a European energy systems model

(3) Sektorkopplung und Flexibilität

David Huckebrink[[1]](#footnote-1)(1), Valentin Bertsch(1)

(1)Lehrstuhl Energiesysteme und Energiewirtschaft, Ruhr-Universität Bochum

Motivation (100 Words)

The holistic decarbonisation of energy systems requires a switch from fossil to renewable energy sources in all energy sectors. However, energy system models (ESMs), used to optimise the design and operation of energy systems, often focus on the power sector exclusively.

Thereby, the heating sector, which is particularly relevant in terms of final energy demand and greenhouse gas (GHG) emissions is neglected. However, sector coupling through power-to-heat is a promising option, which can not only provide GHG emissions reductions but also valuable synergies. We therefore provide a coupled ESM of the power and residential heating sectors to analyse these potentials.

Methods and data (200 Words)

In this work, an energy system model will be developed for a geographical coverage of Germany and its neighbour states. The methodology of this work can be split into three steps.

The first step is acquisition and manipulation of data regarding the European transmission and electricity generation capacities. This data is acquired and spatially aggregated utilising an existing data-source [1]. The result of this step provides clustered regions within each country.

Second, data about heat demands and heat provision technologies is gathered from a publicly available dataset [2]. The aggregation from the previous step is used to aggregate demand data accordingly. In doing so, present heating technologies are used, and interconnections between the electricity and heat sectors are established.

Finally, the resulting model will be cost-optimised using a highly flexible energy systems modelling framework [3]. In doing so, a comparison between the status-quo and further decarbonised systems will be conducted. The status quo will be depicted by enforcing fossil fuel shares, while decarbonisation is achieved through GHG emissions limits. Further sensitivity analysis regarding fuel prices will be performed to account for potential price spikes.

Results, conclusion, and outlook (200 Words)

The results of this work will allow for the electricity and heating sector to be analysed in an integrated fashion, which is an enhancement to the separated analysis which has historically been common practice. The integration of the two data sources in a combined model is thus adding to the growing body of works focussing on an integrated analysis of these sectors. Furthermore, it should be noted, that the developed workflow allows for arbitrary selection of countries and their spatial resolution.

The results of this work will be publicly available on the projects website [4], which will be of great value to the scientific community to foster discussions in this field.

While the integration of the heating and electricity sectors is already an enhancement, relying on fixed timeseries for heat demands does not accurately reflect the inherent flexibility of that sector. In the future, the residential heating sector will therefore be depicted using a multi-node house model with temperature as a decision variable [5] instead of single nodes with a fixed demand, to better allow for analysis of the flexibility potential.

Literatur

[1]: <https://doi.org/10.1016/j.esr.2018.08.012>.

[2]: <https://www.hotmaps-project.eu>

[3]: https://doi.org/10.3390/en12173388

[4]: https://gitlab.ruhr-uni-bochum.de/ee/backbone-tools

[5]: <https://doi.org/10.1016/j.energy.2022.124605>

1. (Jungautor) Universitätsstr. 150 – IC2/177, 44809 Bochum, +49 234/25985, huckebrink@ee.rub.de, https://www.ee.ruhr-uni-bochum.de/ee/team/huckebrink.html.de [↑](#footnote-ref-1)