IMPACT OF DEMAND-RESPONSIVE INDUSTRIAL SECTOR ON THE ENERGY SYSTEM: A DETAILED DISAGGREGATION OF THE INDUSTRIAL SME'S SECTOR IN GERMANY

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Overview

The high shares of renewables and the phasing-out of conventional energy sources present new challenges to the current energy system and the typical sources of flexibility. The German government announced that the country will be climate-neutral by 2045 [1]. Huge amounts of renewable energy resources (RES) will be therefore integrated into the system. This massive addition is accompanied by the complete absence of conventional flexibility sources, which are responsible for the emissions. An increasing mismatch between renewable energy generation and consumption profiles poses severe challenges for system operators. Thus, temporal load shifting may supplement the flexibility options within the energy system. This paper presents a way forward on analyzing flexibility needs in the future energy system and how the flexibility from small and medium-sized industrial enterprises (SME) affects the overall demand for flexibility with their participation in network congestion management.

Methods

The challenge in this research is to adequately integrate the diverse and different characteristics of the medium-sized industrial sector in an energy system model. In order to be able to take a first step in assessing the relevance of the industrial sector in Germany for climate protection goals, the industrial sector will be mapped in the open-source energy model MyPyPSA-Ger [2], by detailing the demand for different types of industry and assigning flexibilities to the industrial types. Synthetically generated load profiles of various industrial types are available [3]. Using a scenario analysis, the development of the industrial sector and the use of flexibilities are then assessed quantitatively.

Results

The preliminary analysis outlines huge changes in the future energy system, in terms of renewable generation technologies as well as storage flexibilities from hydrogen facilities and central batteries. The results showed that employing even a small share of flexibility from the industrial load can greatly help the system operators with high shares of renewables.

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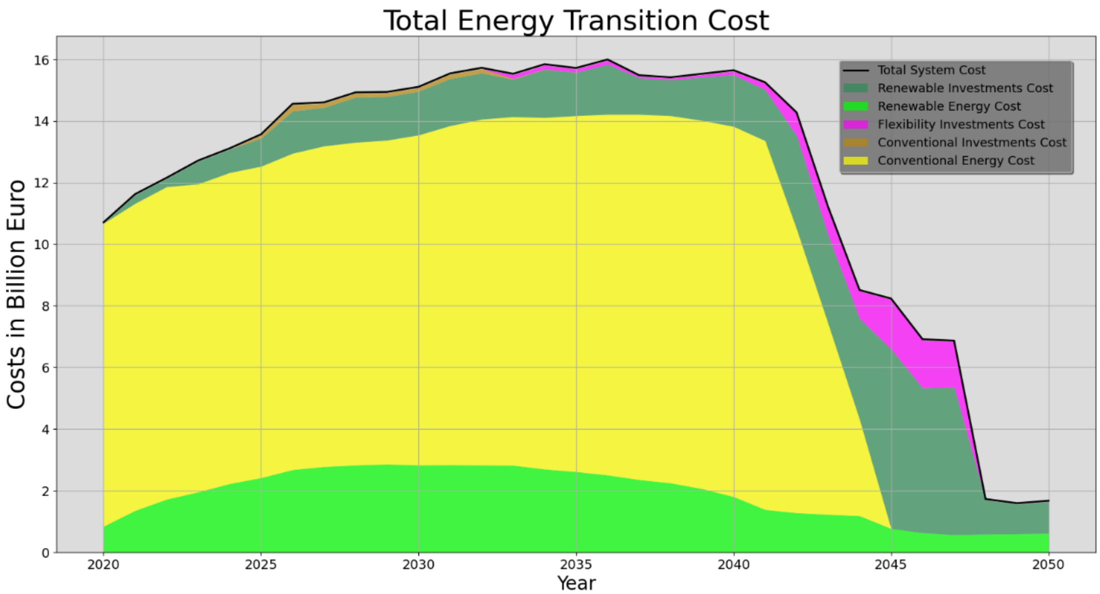

Figure 1: Annual energy transition cost over the optimization period.

The analysis showed that flexibilities with shorter time spans are not fully utilized. Even with higher flexibility potentials longer flexibility durations were prioritized and fully utilized to to their maximum capacity. The longer flexibility duration resulted in more SME's flexibility being used within the system, and much less investments from other flexibility sources. This indicates that defining flexibility only as a proportion of the actual demand while neglecting the flexibility call-off duration can be viewed as a misleading concept to define flexibility measures

Conclusion

The desperate need for high flexibility measures will significantly increase in the future with the absence of fossil-fuel-based power plants. This is where flexibility from SMEs come into effect. However, after the system achieves climate neutrality by 2045, the system will have already enough sources of flexibility and will therefore not use any SMEs. This suggests that although smaller amounts of flexibility (SMEs) can greatly help the system, but will not be enough to achieve climate-neutrality on a national level. Industrial flexibility from huge consumers can be therefore beneficial and must be further investigated.

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