Electricity-only Positive Energy District analysis in climatically favored regions and glimpse on multi-energy extension of the analysis

Strom, Wärme-/Kälteerzeugung sowie Speicher
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Motivation and research question

Approximately 70% of the primary energy use in the European Union is demanded in urban areas (Rosales Carreón & Worrell, 2018). This stands in contrast to the small role that cities play in energy generation, especially by renewable sources (Groth, Fertner, & Grosse, 2016). Thus, a transformation is required that the European Commission initiated with the concept of Positive Energy Districts (PED) that shall generate more renewable energy annually than consume, while keeping a neutral CO_2 balance (JPI Urban Europe, 2020). The current research that aims directly at PEDs from a techno-economic perspective is still low and also studies towards related concepts such as net zero energy communities do rarely focus on the essential energy balance with the district. Thus, we would like to present our newest study that answers the questions of rural vs urban applicability of PEDs and how an hourly assessment of the primary energy factor (PEF) for the energy balance adds value to the concept.

Methodology

The methodology is a linear programming model that is publicly available and tailored around the energy balance for PED assessment. It includes PV power for energy generation, batteries for storage and grid connection to supply the load. The novelty is the hourly energy balance that guarantees an annual energy positivity of the district. For comparability, grid energy is valued according to the time dependent energy generation mix that is transferred to a PEF per time step.

Results and Conclusions

Results suggest that a PED is economically and spatially more attractive in an urban environment due to the lower energy demand density and higher availability of space for PV power generation. Furthermore, while grid power exchange reduction increases the expenses of the PED, it also adds flexibility and resilience to the power grid. The novel dynamic balance mechanism introduces flexibility to the grid as well as to the PED itself as results show when comparing a high and low renewable energy penetrated grid environment (Bruck, Ruano, & Auer, 2021).

Literatur

Bruck, A., Ruano, S. D., & Auer, H. (2021). A Critical Perspective on Positive Energy Districts in Climatically Favoured Regions: An Open-Source Modelling Approach Disclosing Implications and Possibilities. *Energies*, *14*(16). https://doi.org/10.3390/EN14164864

Groth, N. B., Fertner, C., & Grosse, J. (2016). Urban energy generation and the role of cities. *Journal of Settlements and Spatial Planning*, (5), 5–17. https://doi.org/10.19188/02JSSPSI052016

JPI Urban Europe. (2020). *White Paper on PED Reference Framework for Positive Energy Districts and Neighbourhoods*. Retrieved from https://jpi-urbaneurope.eu/ped/

Rosales Carreón, J., & Worrell, E. (2018). Urban energy systems within the transition to sustainable development. A research agenda for urban metabolism. *Resources, Conservation and Recycling*, *132*, 258–266. https://doi.org/10.1016/j.resconrec.2017.08.004

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