Dynamic participation in local energy communities over the horizon of several years

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Overview

With energy communities and local electricity markets on the rise, this paper addresses the following research question: How is it possible for an energy community to optimize the participation of its members over a longer time horizon?

Methods

For this purpose, the open-source model FRESH:COM – a bi-level optimization model for dynamic participation in local communities with peer-to-peer electricity trading – is applied. The model is able to select the most suitable new entrants into an energy community, based on the preferences of the members of the original community (e.g., environmental, economic, or mixed preference). Simultaneously, it is able to determine the optimal parameters of the new participants. The upper-level problem chooses optimal entrants by minimizing an objective function that includes the prosumers' cost-saving and emission-saving preferences, while the lower level problem maximizes community welfare by optimally allocating locally generated photovoltaic (PV) electricity between members according to their willingness-to-pay. The bi-level problem is solved by transforming the lower level problem by its corresponding Karush-Kuhn-Tucker (KKT) conditions.

Results and conclusions

The results show a sample energy community's decision-making process over a horizon of several years. Each year, the community is faced with the exit of existing members and a portfolio of possible new entrants with different characteristics. A number of optimal participants is selected, also considering a forecast of possible future developments within the community.

References

Perger T and Auer H. Dynamic participation in local energy communities with peer-to-peer trading [version 1; peer review: 1 approved]. Open Res Europe 2022, **2**:5 (https://doi.org/10.12688/openreseurope.14332.1)