UPSCALING ENERGY COMMUNITY POTENTIAL TO EUROPEAN LEVEL

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Overview

As decentralized generation in our energy system increases, local energy communities (ECs) become more and more prevalent. The participants (prosumers) consume and/or produce electricity from renewable sources. The locally generated electricity can be traded, e.g., directly between the participants, so-called peer-to-peer trading. Within the H2020 project openENTRANCE [1], a case study evaluates the potential of energy communities with peer-to-peer trading in five European reference countries. Then, the potential in Europe as a whole is estimated.

Methods

This paper's proposed method starts with the selection of one of the following reference countries: Austria, Greece, Norway, Spain, or UK (England), see flow chart in Figure 1. The building stock is assigned to different energy community types according to settlement patterns (city, town, sub-urban, rural). With country specific data matching building stock and residential electricity consumption, the input data for each settlement pattern's energy community type is prepared. The energy community model FRESH:COM developed by the authors [2] is applied to all EC types and up-scaled knowing the number of ECs per settlement pattern. The following results are discussed: the number of energy communities (theoretical potential) for each country, collective self-consumption, and the emissions and costs saved on a local level due to energy sharing within a community. The corresponding open-source model "ASCENDEMUS" is available on GitHub [3] under the Apache 2.0 license.

This case study is part of the H2020 project openENTRANCE, where four different story lines (Refer to [4] for more information on the story lines.) describing low-carbon transition pathways for the European energy and transport systems are developed. One of the story lines is “societal commitment”, which describes a society characterized by a sustainable lifestyle. Some of the main assumptions in this scenario are: significant share of self-consumption, demand shifting to peak production hours, circular and sharing economy especially in the transport sector, and high penetration of renewable technologies. In this work, the “societal commitment” storyline serves as a baseline to evaluate the potential for energy communities in Europe in 2050.

Results

The results show that the highest potential of energy communities in terms of increased (collective) self-consumption as well as annual electricity cost and emissions savings are found in rural settlement patterns. Due to less solar irradiation compared to the other reference countries, the benefits of energy communities are lowest in Norway. Comparing two Southern European countries, Greece has more favorable settlement patterns than Spain. When evaluating the results on a local level, i.e. per prosumer, it is noted that the costs savings per prosumer mainly depend on the countries’ electricity prices for residential customers. In a similar way, emission savings per prosumer are

strongly influenced by the electricity mix of a country (e.g. much higher in Greece with losts of fossil-based electricity generation than in Norway with mainly hydro generation).

Next, based on the five reference countries, we want to find a theoretical potential for energy communities for Europe as a whole. The remaining European countries are each assigned to one of the reference countries and the results are scaled considering population, electricity costs and average emission factor.

Conclusions

Based on the reference countries, a potential for Europe as a whole can be estimated. The results strongly depend on the accuracy of building stock data that is available for a country. Certain factors such as dwelling occupancy rate, data on dwelling sizes, etc. are very important and inaccurate data or assumptions can heavily distort the results.

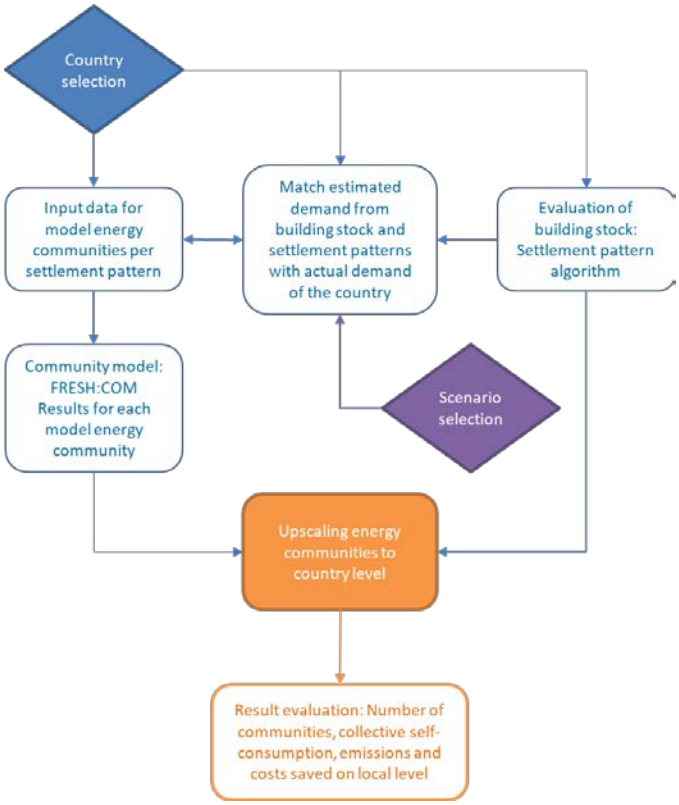

Figure 1: Flow chart of the proposed method

References

[1] openENTRANCE project: https://openentrance.eu/

[2] T. Perger, L. Wachter, A. Fleischhacker, H. Auer, PV sharing in local communities: Peer-to-peer trading under consideration of the prosumers' willingness-to-pay, In: Sustainable Cities and Society (2021), DOI: https://doi.org/10.1016/j.scs.2020.102634

[3] T. Perger, ASCENDEMUS, 2022. URL: https://github.com/tperger/ASCENDEMUS.

[4] Auer, H., Crespo del Granado, P., Oei, PY. et al. Development and modelling of different decarbonization scenarios of the European energy system until 2050 as a contribution to achieving the ambitious 1.5 ∘C climate target—establishment of open source/data modelling in the European H2020 project openENTRANCE. Elektrotech. Inftech. 137, 346–358 (2020). https://doi.org/10.1007/s00502-020-00832-7