A NINE-STEP FRAMEWORK TO ASSESS THE IMPACTS OF ENERGY COMMUNITY ROLL-OUT ON A LARGE SCALE

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Overview

With the *Clean Energy for All Europeans Package* [1] of 2019, the European Union (EU) performed a thorough update of its energy policy framework. The objective is to move away from fossil fuels towards a cleaner energy future. The *Clean Energy for All Europeans Package* consists of eight individual directives. Amongst others, an important topic that is addressed in two of these directives -- the *Renewable Energy Directive* [2] and the *Electricity Market Directive* [3] -- is energy communities. The supranational legislative guidelines for energy communities need to be transposed into the legislation of individual EU member states within a timeframe of 1-2 years. To date, the status of transposing the supranational guidelines for energy communities into national legislation differs significantly throughout the EU. In this respect, Austria is a pioneer, having the complete legislation for the two types of energy communities, namely 'Renewable Energy Communities' (RECs) and 'Citizen Energy Communities' (CECs) already enforced. Nevertheless, rather sooner than later, the legislative basis to establish energy communities is expected to be available in all EU countries and possibly also beyond.

To date, there is little knowledge or empirical data available concerning the impact of energy communities. While it is to be expected that the implementation of individual, sporadically-implemented energy communities will not have much effect on different stakeholders or the energy infrastructure, a large-scale roll-out of energy communities might very well have a significant impact.

Methods

Energy community deployment is expected to gain momentum in the EU in the near future. Because of the fact that knowledge about the impact of energy community roll-out on a large scale does not exist, there is the need for a framework to assess said impacts. Therefore, a nine-step framework is developed to close this gap. The nine steps towards estimating the impacts of PV-based energy community roll-out can be summarised as follows:

1. Determining the number of buildings per type at a future point in time (future building stock)
2. Determining the number of buildings categorised by roof-tilts
3. Determining the theoretical and usable rooftop area
4. Determining the theoretical maximum and realistically installable PV capacity
5. Determining the number of PV systems and distribution among building types
6. Determining the shares of buildings equipped with PV systems
7. Setting up model energy communities based on the gained knowledge
8. Conducting calculations with the model energy communities (f.e. use a simulation model to determine costs and energy flows)
9. Estimating the large-scale impact of energy community roll-out by determining the actually participating building stock and upscaling results of Step 8

The nine-step framework is not only developed in theory, but calculations are conducted for the example of Austria, in order to proof its applicability. Moreover, the developed framework is not constrained to specific geographical regions, but can be applied to different regions or countries worldwide.

Results

In Austria, three different settlement patterns can be specified, namely rural areas, sub-urban areas, and urban areas. The following results are provided for a supposed energy community roll-out in rural areas only. With knowledge derived from applying the nine-step framework, a rural model energy community with the following characteristics can be defined: A rural model energy community consists of 15 single-family buildings, whereas 7 buildings are equipped with a rooftop PV system with an installation capacity of 4kWp each. Four of the installed PV systems are installed towards the directions east and west, while the remaining 3 are installed facing south (the northern direction is the one with the least solar irradiation in Austria). A simulation model is then used to calculate the total costs for the described individual model energy community, as well as according flows of electricity. These results are then scaled up to the rural areas of whole Austria. Here, it is assumed that out of all single-family buildings in rural areas in Austria, one-third are willing to participate in energy communities.

The impact of energy community roll-out in these rural areas is assessed for different stakeholders, namely (i) the energy community participants themselves, (ii) the grid operators and (iii) energy suppliers. If rural energy communities would be rolled-out in Austria, cost savings of approximately 106 Million Euros could be achieved. These cost savings due to participation in renewable energy communities are achieved with an according price structure (f.e. costs for electricity that is sold within the borders of the energy communities are lower compared to conventionally purchasing electricity from the conventional electricity supplier), and a variety of financial incentives that are applicable to renewable energy communities in Austria, such as a reduction of grid tariffs and the omission of certain levies. The reduction of grid tariffs is a positive aspect for REC particpants, but at the same time negatively affects grid operators. A roll-out of renewable energy communities in Austria's rural areas would lead to monetary losses for grid operators in the range of 4,5 Million Euros. Lastly, also energy suppliers are affected. For the described use case, electricity suppliers would sell approximately 397 GWh less electricity compared to the situation with no energy communties implemented.

Conclusions

Results showed that the impact of energy community roll-out can be significant, even if only one-third of the total building stock is assumed to participate. It needs to be kept in mind, that results are only provided for Austria's rural areas. If energy community roll-out would also be considered in urban and sub-urban areas, the already large impact of energy communities would be even more significant. Therefore, a future roll-out of energy communities is expected to severely concern different stakeholders, wherefore a realistic estimation of energy communities' potential impact is crucial in order to enable stakeholders to plan realistically.

References

[1] European Commission, 2019. Clean energy for all Europeans package; https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en

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[3] EUR-Lex, 2019. Directive (EU) 2019/944 of the European Parliament and of the Council of 5 june 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU; https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0944