ANALYSIS OF THE VALUE OF ADDITIONAL FLEXIBILITY PROVIDED BY COMMUNITY BATTERY STORAGES FOR THE GERMAN ELECTRICITY SYSTEM

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Overview

With an increasing amount of volatile renewable energy production, there is also an increasing need for flexibility options. A part of this flexibility can be provided by community battery storages, which can be part of energy communities. In the research project InDEED an efficient labelling solution for electricity was developed. This solution enables a tracing of electricity in high temporal and regional resolution. By using this labelling solution community battery storages can be used like private ones. This paper presents the value of the flexibility provided by community storages, by analysing possible profits, reduced GHG emissions and increased degree of self-sufficiency.

Methods

In order to analyse the value of additional flexibility options a set of residual load data for all German municipalities in the year 2035 is used. In the first step a small storage with an energy content of 1 kWh and a energy to power ratio of one is placed in every municipality in order to comparably quantify the value of this flexibility. With this set up three simulations are run. In every simulation the operating characteristics are optimized for a different use case (maximizing profits, minimizing GHG-emissions or maximizing the degree of self-sufficiency). The different values added by the new flexibility options are shown and compared in boxplots and histograms. In addition to that methods are used to cluster the municipalities dependent on the simulation results. In the second step the size of the community storages are chosen in a more realistic way. Therefore the expected capacity for large-scale battery storages in 2035 in Germany is distributed over all municipalities using three different heuristic methods (installed volatile renewable energy capacity, produced volatile renewable energy and peak load). The heuristic distributing methods will be compared to the identified clusters from step one. For every heuristic distribution method two simulations are conducted using a GHG emissions and a degree of self-sufficiency optimized operating characteristic. In the final step the previous results are compared in order to rate the distributing methods of future storage capacity by taking a look at the value of flexibility they are providing.

Results

Taking a look at the first simulation results for the equally distributed storage capacity, great differences between the identified clusters can be recognised. The shape of the clusters also changes, depending on which parameter is used to quantify the value of the flexibility. Measuring the value by profits or reduced GHG emissions produced volatile renewable energy in the municipalities plays an important role. Looking at the degree of self-sufficiency the peak load becomes more important. These observations can also be seen analysing the second set of simulations. Where distributing the storage capacity by the produced volatile renewable energy the overall system GHG emissions can be reduced the most. The degree of self-sufficiency can be increased the most by distribution the storage capacity oriented to the peak load.

Conclusions

The value of flexibility can be measured in different ways. Depending on how the value is measured, a different distributing strategy for the capacity of the community storages should be used. In order to minimize the overall systems emissions especially the energy produced by the volatile renewable sources in the municipalities plays an important role.