



PhD: Integrating Local Energy Communities into the Distribution Grid

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Challenge and objectives

- EU has issued two official definitions on energy communities, which member states must comply with.
- Local energy communities can be a way to share locally produced energy between members. But it is unknown how energy communities will impact the distribution grid

Research tasks

1. Modelling and optimization of local energy communities
2. Flexibility services and interaction with DSO

Approach

- Create optimization models to minimize costs for energy community, including load and PV generation profiles, model for general load shifting and model for common battery system including degradation.
- Perform power flow analysis, either in optimization model or post-optimization.
- Run optimization models for one year to quantify:
 - costs and benefits for energy community.
 - impact on the distribution grid (maximum import and export, losses, voltages).
- Perform extensive sensitivity analyses on input parameters.

Significant results

- Community battery systems can provide voltage services to the DSO, by slightly changing the original battery operation.
- Battery systems in energy communities might create new load spikes due to energy arbitrage. When battery degradation was considered in the optimization, the battery operation was drastically altered, and load spikes were reduced.
- Optimal control of domestic hot water tanks in housing cooperatives can reduce the peak demand to the cooperative with 10%.
- In a Norwegian context, the most grid-friendly energy communities consist of commercial members, since their load profiles correlate well with PV generation.

Illustration

