CHALMERS
UNIVERSITY OF TECHNOLOGY

Verena Heinisch
Department of Earth, Space and Environment
verena.heinisch@chalmers.se

Prosumers of electricity - Individually *vs* in a community electricity trading system

A comparative modelling study

BACKGROUND

- Decentralization, digitalization and democratization important for further developing our electricity system [1].
- Consumers value where electricity is bought and sold [2]-[4], studies look into integration of residential distributed generation and storage and consequent changes in load profiles [5]-[8].

AIM

This study aims to analyze the concept of a prosumer (peer to peer) electricity trading system, with focus on

→ Economic impact on prosumers & effect on local utilization of electricity

→ Importance of a diversified prosumer group – e.g. load profile (size, heating system etc.), solar PV orientation, geographical location

→ Possibilities to foster private investment in decentralized renewables

PROSUMER TO PROSUMER ELECTRICITY TRADING MODEL:

METHOD

Starting point. 2030 Swedish electricity system with an increasing share of electricity prosumers of various sizes and types.

- Optimizing prosumers' annual electricity costs and profits from selling, plus annualized investment cost in PV battery systems
- Residential prosumers investing in PV battery systems
- Economically beneficial operation of PV battery systems including arbitrage trading

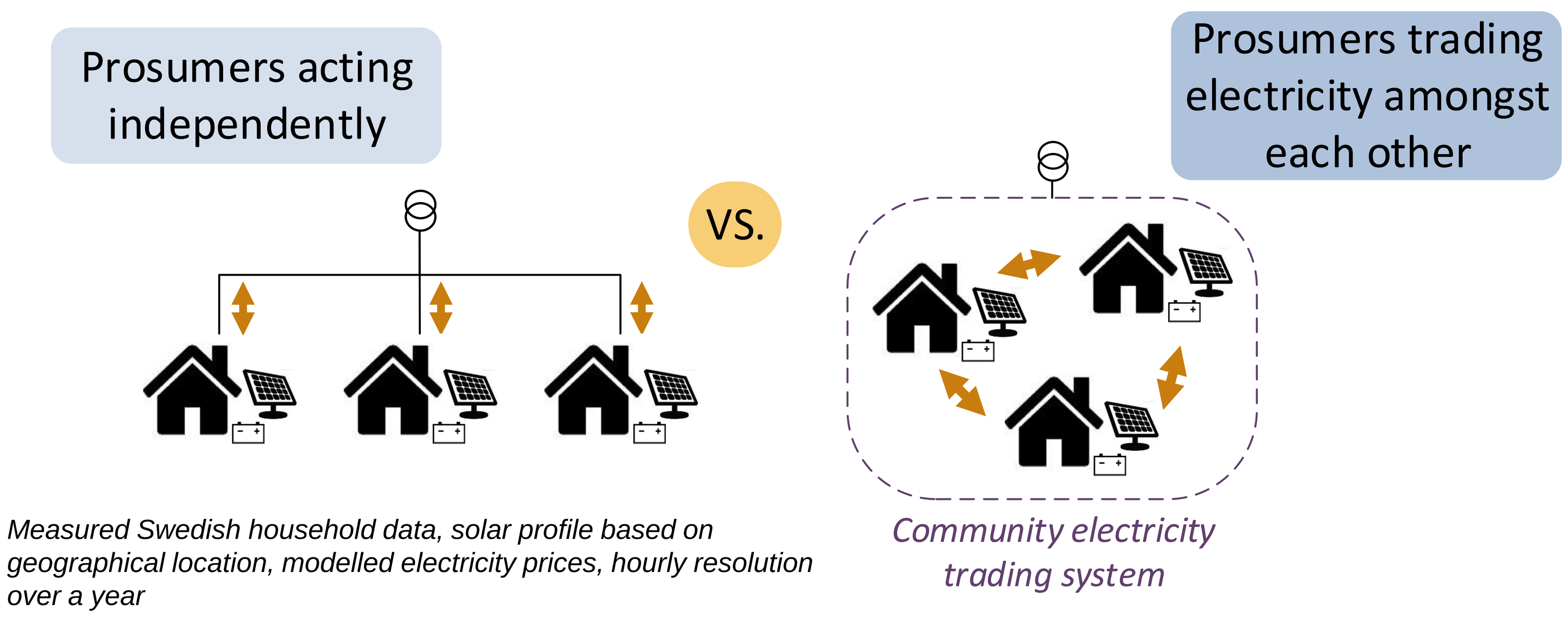

Fig. 1: Individual prosumers vs. community electricity trading system as represented in the model

Yielding results on e.g.:
- Economically optimal PV battery sizes
- Electricity and investments costs per household/for the prosumer group
- Amount and times of electricity bought and sold and thereby changes in (aggregate) load curves

For individual prosumers and prosumer trading systems

CASES

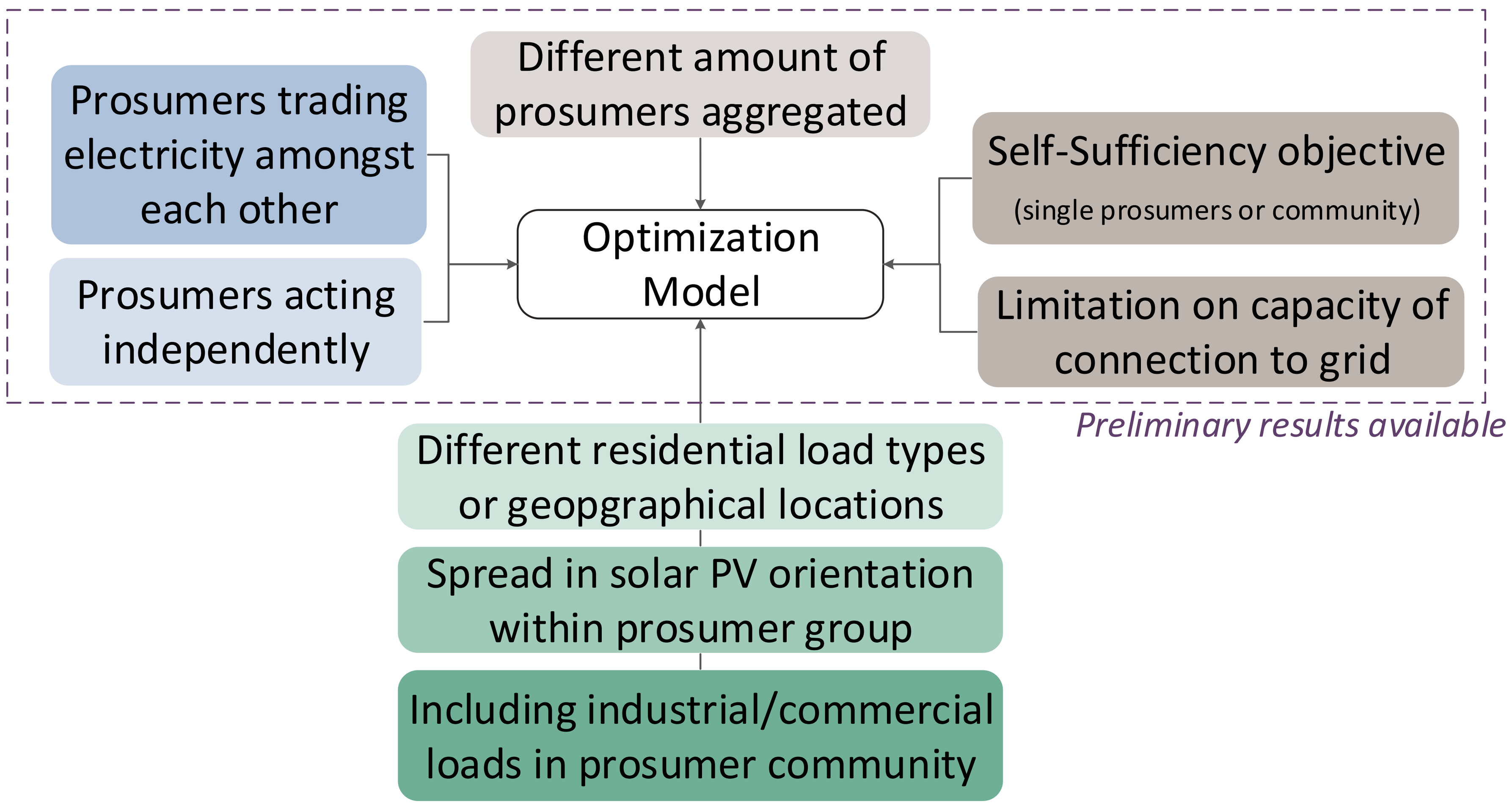

Fig. 2: Overview of cases to be investigated with prosumer electricity trading model

Investigation of cases:

Individual prosumers vs. prosumers in a trading system
Group sizes from 1,2,5,10,20 up to several hundreds

- ***Reduction of energy traded from supplier (kWh)***
  constraints on different levels of self-sufficiency
- ***Reduction of grid impact (kW)***
  constraints on hourly grid capacity
- ***Composition of aggregated consumer group***
  changes to in-data as in the green boxes in Fig 2

PRELIMINARY RESULTS & CONCLUSIONS

- The proposed model enables to quantify the economic difference per household to operate a PV battery system individually or within differently sized prosumer groups.
- We can identify how much less PV battery capacity is needed to reach various levels of self-sufficiency, individually or within a community electricity trading system.
- First test cases, with households geographically close to each other with same solar PV orientation, result in minor cost savings for prosumers within an electricity trading group - further focus will be put on investigating the importance of the group composition and geographical level of aggregation

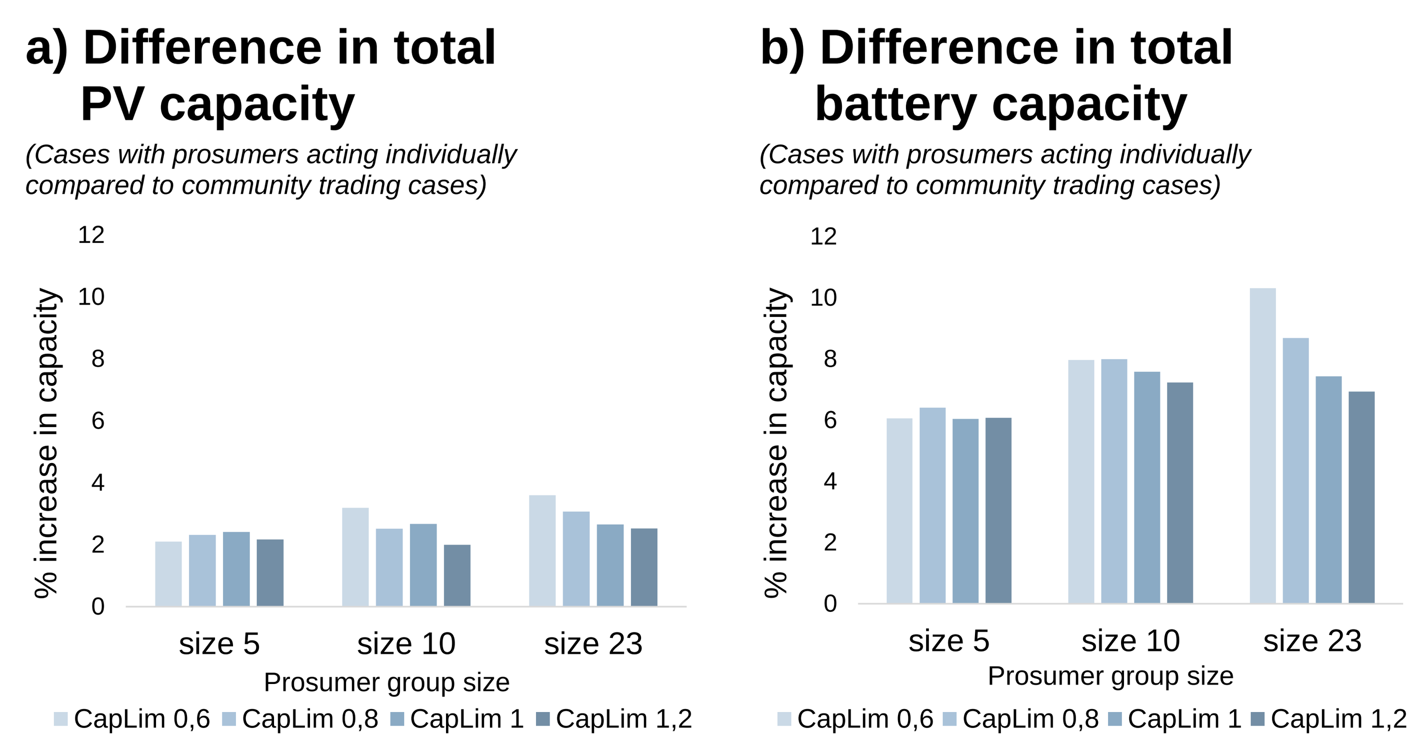

Fig. 3: First model test: optimal PV (a) and battery capacity (b) for differently sized prosumer groups, given as % increase from individual prosumers to within a group

[1] Agora Energiewende (2017):Energiewende 2030: The Big Picture. Megatrends,Ziele, Strategien und eine 10-Punkte-Agenda fürdie zweite Phase der Energiewende. [2] http://news.vattenfall.com/en/article/power-your-neighbours, [3] https://www.sonnenbatterie.de/en/sonnenCommunity, [4] http://brooklynmicrogrid.com/
[5] Yael Parag, Benjamin K. Sovacoo. Electricity market design for the prosumer era. Nat Energy 2016. doi:DOI: 10.1038/NENERGY.2016.32. [6] Sandra Bellekom, Kirsten van Gorkum, Maarten Arentsen. Prosumption and the distribution and supply of electricity. Energy Sustain Soc 2016 622 2016.
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