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Business dynamics of flexibility aggregators: Managing prosumer participation and steering clear of being “too small to bid"

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Research conducted at Zurich University of Applied Sciences, Switzerland

Now working at University of St. Gallen, Switzerland

In collaboration with Romande Energie *(electric utility company)*

The rise of the prosumer

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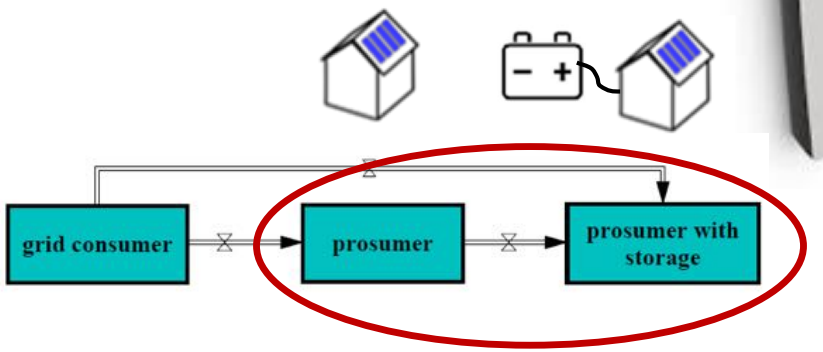
Prosumers act as investor, producers and consumers in the energy system.



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The diffusion of prosumers and its regional impacts: The case of Romande Energie

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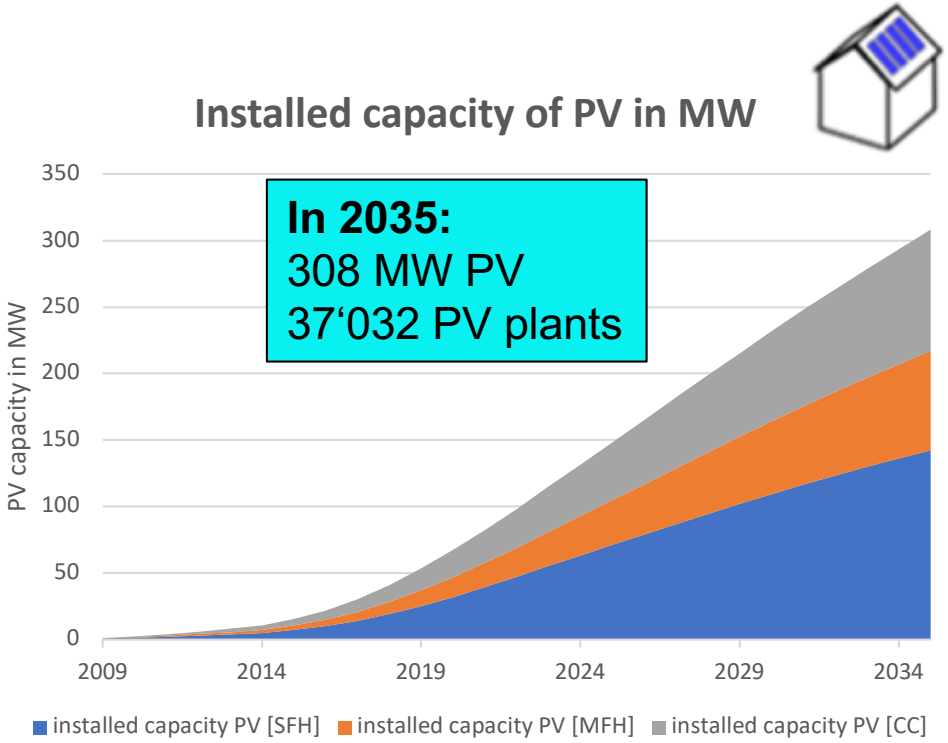

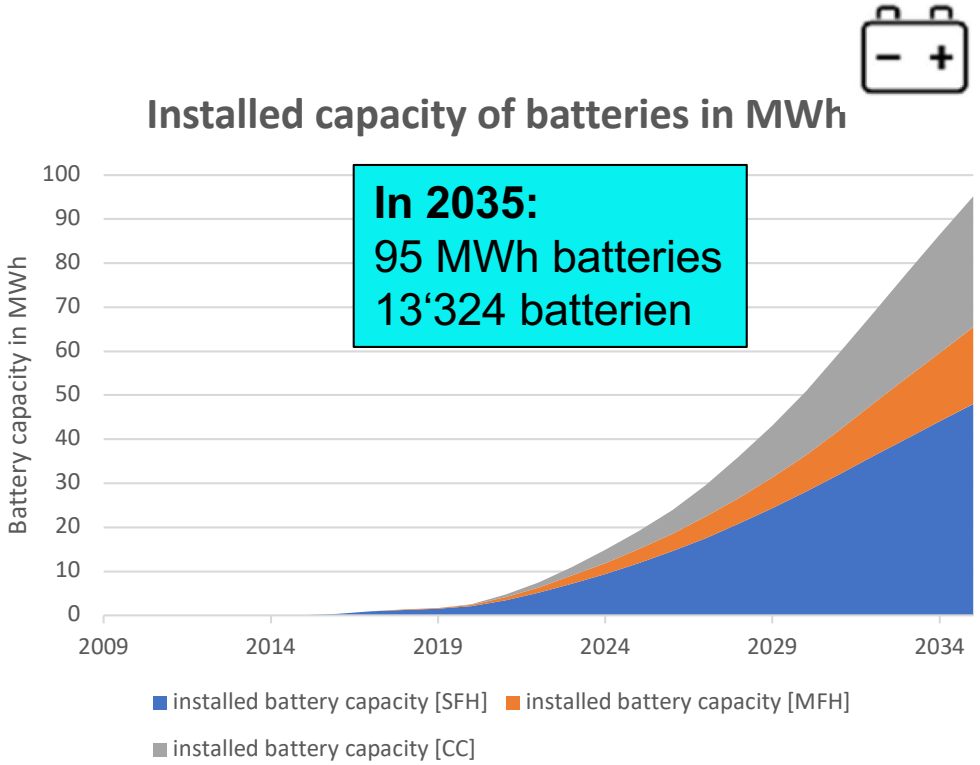

Romande Energie in the year 2035:

Consumers with PV: 28.9%
PV share in the electricity mix: 19.3%
PV electricity fed into the grid: 156 GWh/year (7.9% of total demand)
Increase of the grid tariff due to self-consumption: 10.5% (compared to 2009)

Need and search for flexibility in energy systems

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Trend towards **rooftop solar** and **home batteries**

Increasing **need for flexibility**

On-going search for **new flexibility solutions**

Unused **flexibility potential** from decentralized energy systems.

Battery swarm as one potential solution.

The battery swarm concept

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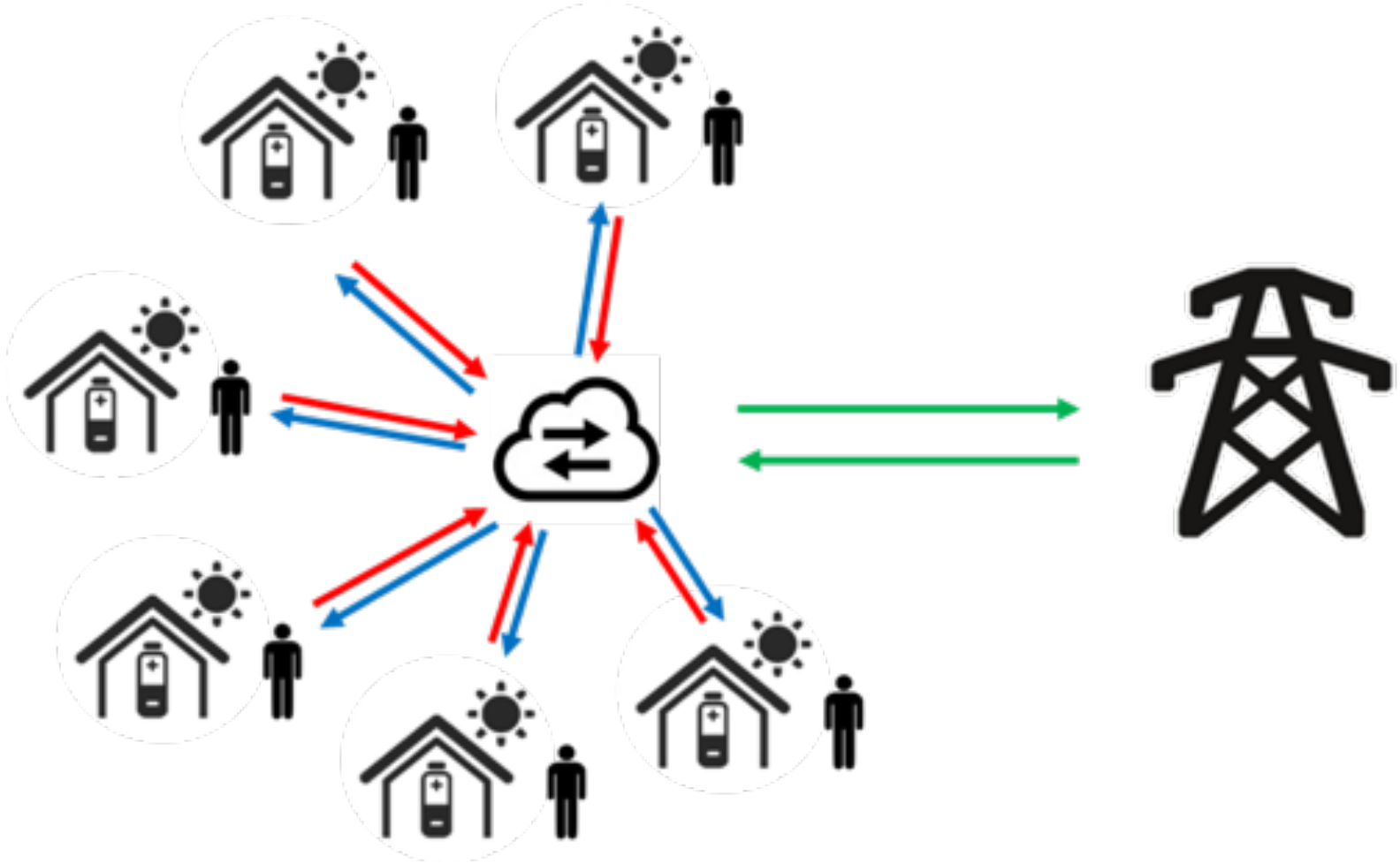

Investigating the battery swarm business case with Romande Energie

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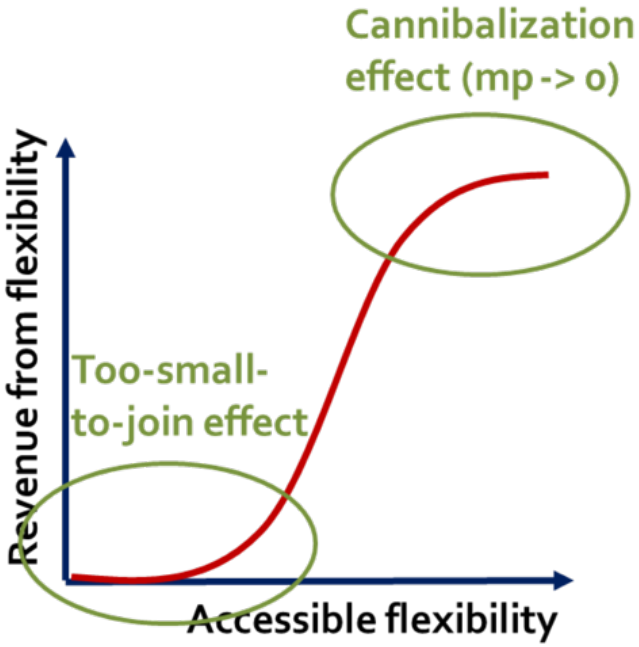
- **What are viable business models for battery swarms that attract customers to participate?**

- **What is the long-term value creation of a battery swarm?**
  - How can we overcome the **«too-small-to-join»** problem?
  - From when on do we run into the problem of the **«cannibalization effect»**?



mp = marginal price for flexibility

Research approach

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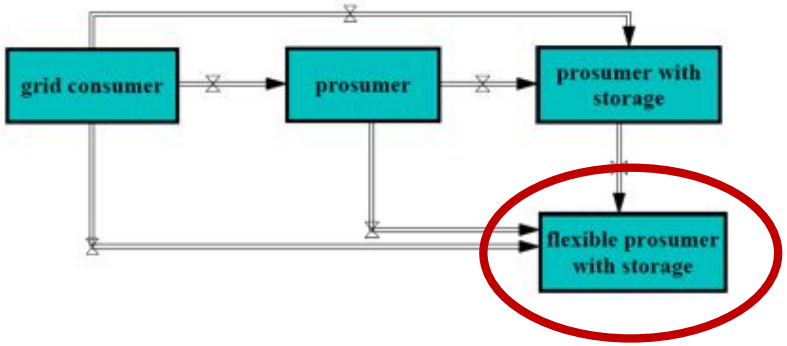
1. **Reference simulation of PV plants and home batteries** for the supply area of Romande Energie with the **TREES model** (Kubli & Ulli-Beer, 2016; Kubli, 2018)
2. **Model development** to capture the business dynamics of a **battery swarm**
3. Integrate empirical data on **customer preferences** from a choice experiment for prosumers' willingness to co-create flexibility (Kubli, Loock & Wüstenhagen (2018))
4. **Simulation analysis of business strategies**



All steps were conducted in close collaboration with the **SmartLab team of Romande Energie.**

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The model's core: Pathways to participate on the battery swarm

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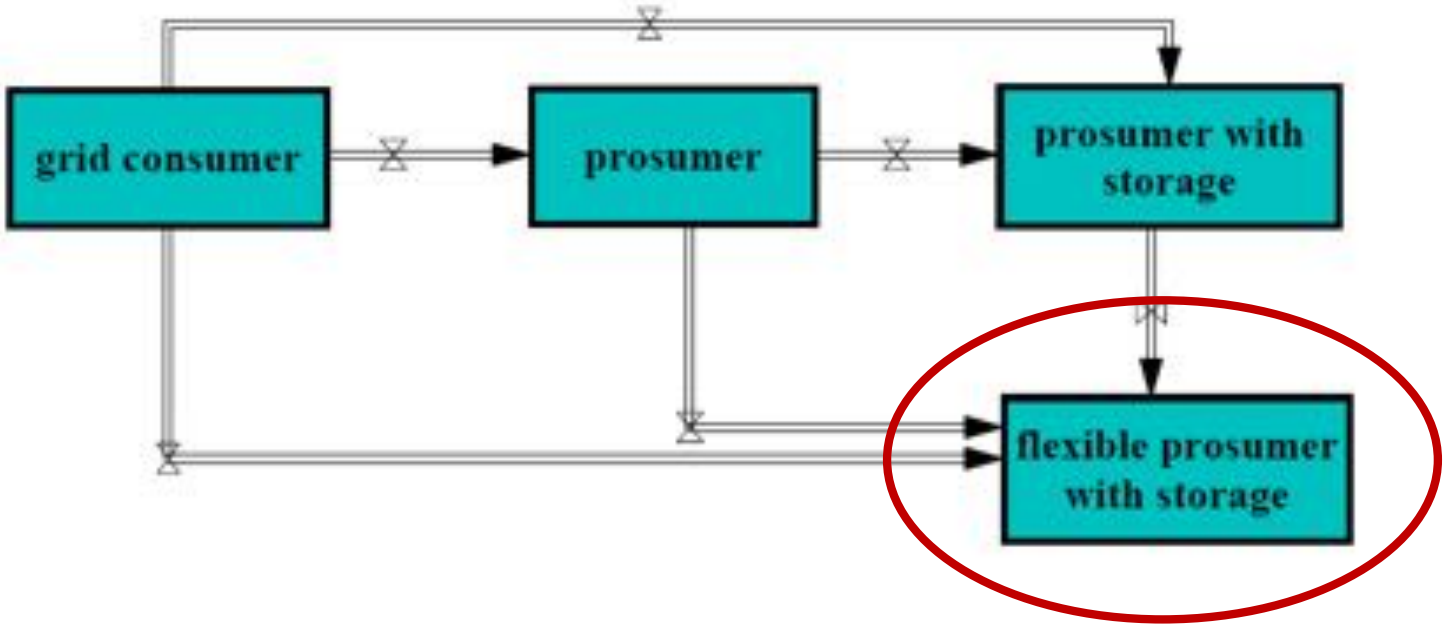

Key features of the battery swarm (business) model

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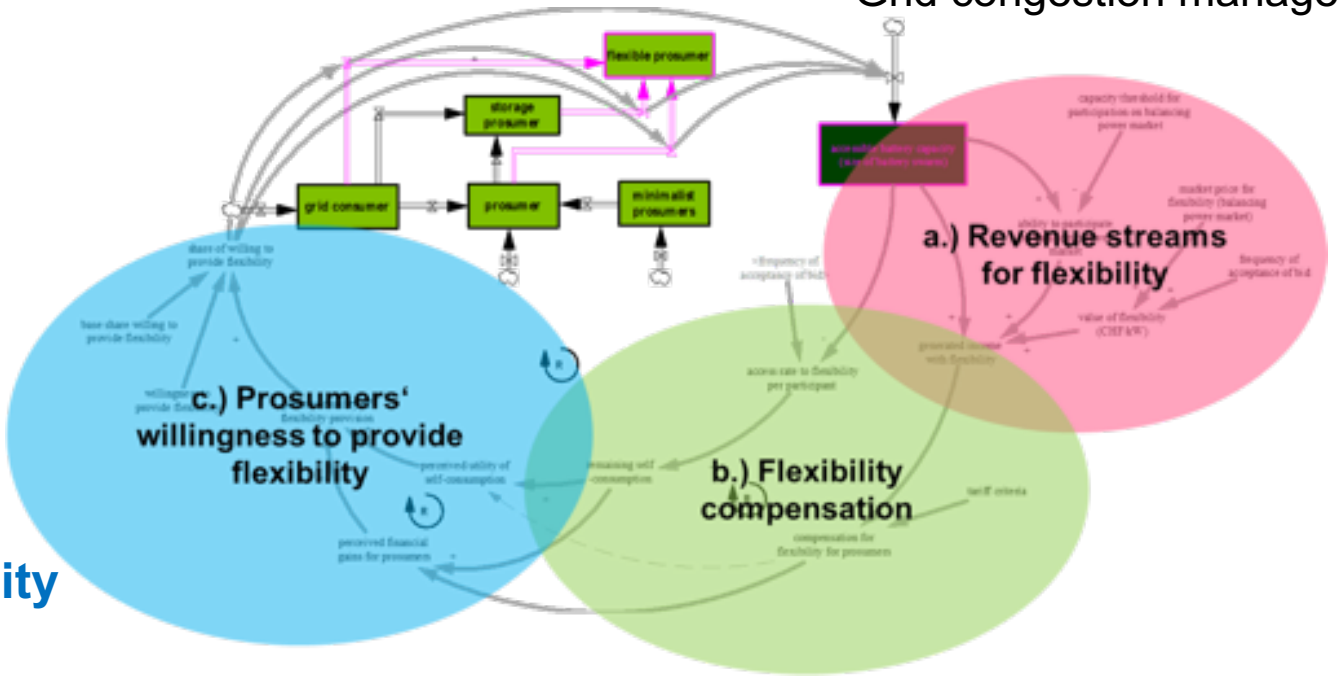
Revenue streams for flexibility

Balancing power markets (National)

DSO peak shaving (Regional)

Grid congestion management (Local)



Prosumers' willingness to provide flexibility

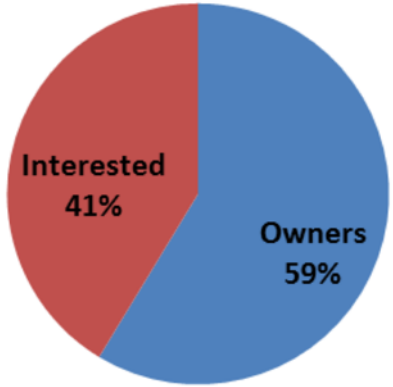
Empirical data on customer preferences

Flexibility compensation

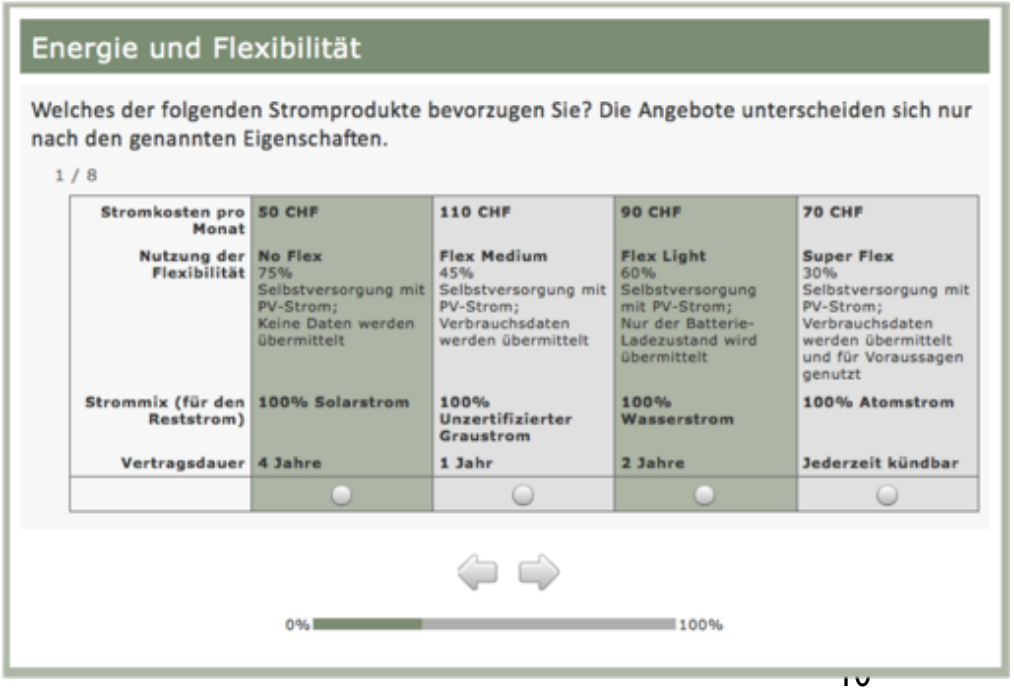
Profit redistribution across battery swarm participants

Prosumer preferences' to co-create flexibility

- Choice experiment (n=301, current and future solar prosumers) to test different electricity contract that include providing flexibility.

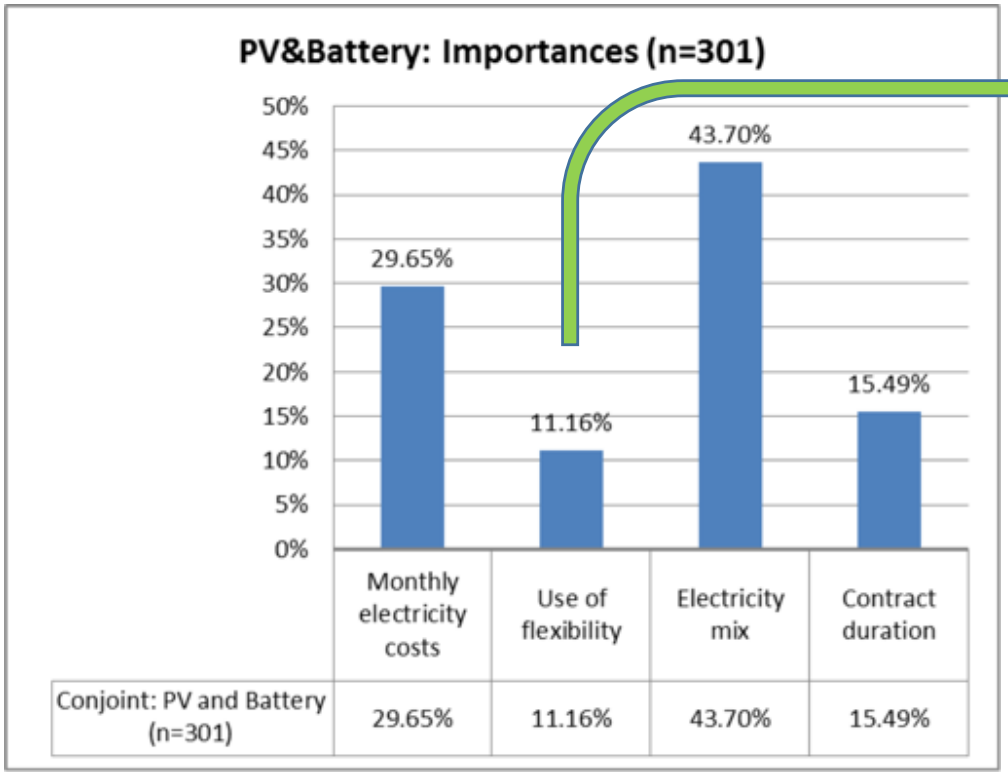


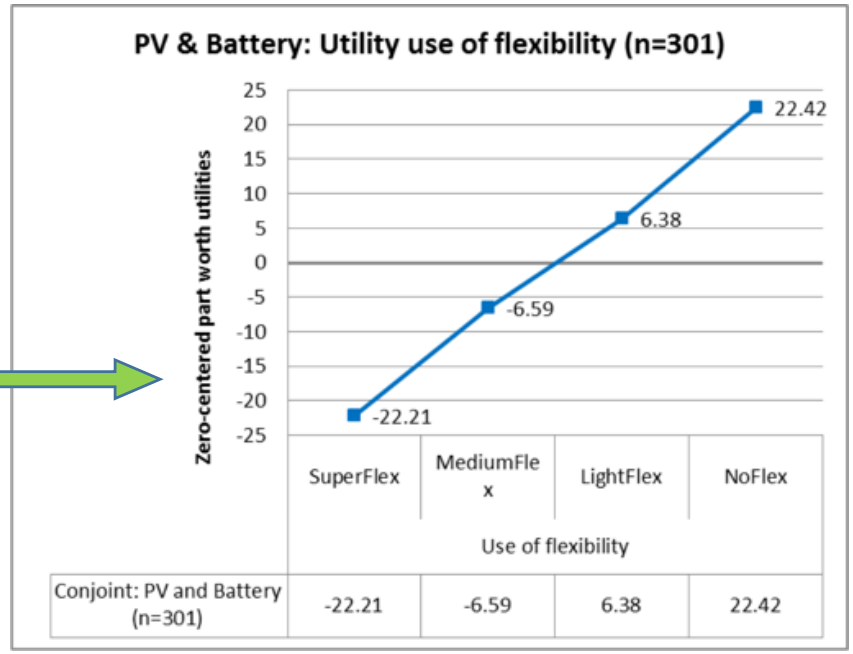
- The contracts were characterized by the following attributes:
  - Monthly electricity costs
  - Use/impact of flexibility
  - Electricity mix for residual demand
  - Contract duration



Published in: Kubli, Loock & Wüstenhagen (2018)

Prosumer preferences' for co-creating flexibility





Solar prosumers are willing to provide flexibility when they are compensated financially or by upgrading the electricity mix. WTA (costs of discomfort): 4.40 – 15.24 CHF/month

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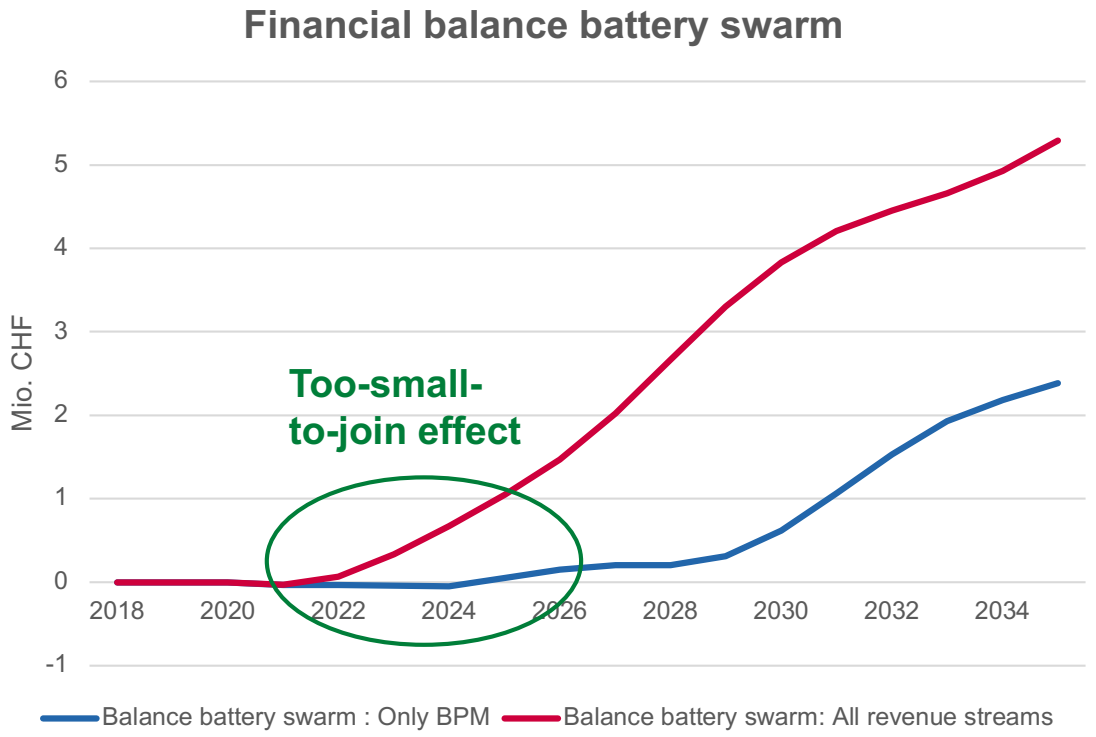
Published in: Kubli, Loock & Wüstenhagen (2018)

Insights (I/II)

Battery swarm is a **viable, robust business model** that attracts participants, when…

- **… profit is redistributed** among the participants of the battery swarm**,**
- **… local and regional revenues streams** are added to bridge the **«too-small-to join»** problem,
- And combining the revenue streams triggers the re-inforcing feedback loop and accelerated participation.



Only BPM = Only revenues from Balancing Power Markets

Insights (II/II)

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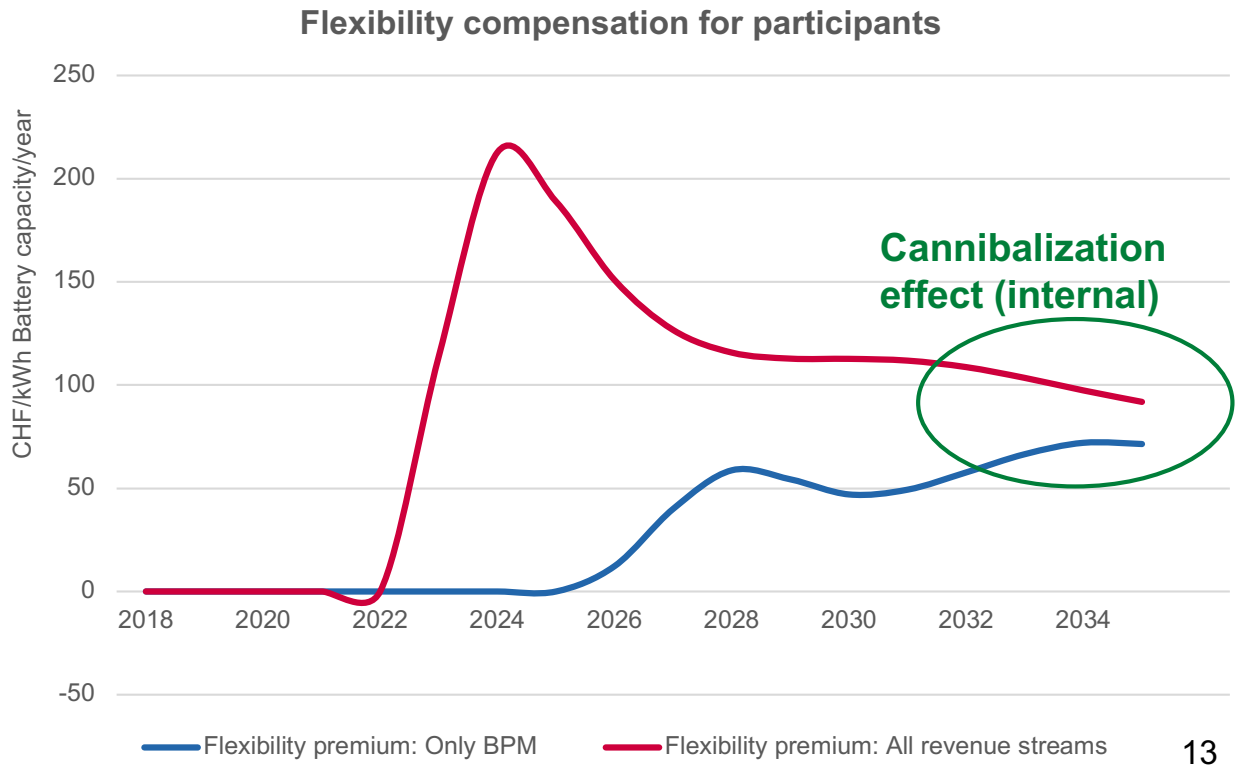
Battery swarm is a **viable, robust business model** that attracts participants, when…

- … additional **participants are attracted only as long as additional revenues seem feasible**, to avoid the **«cannibalization effect».**

Battery swarms help to smoothly **integrate decentral, renewable energies** into the electricity system, supporting the energy transition.



Only BPM = Only revenues from Balancing Power Markets

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