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Federal Department of the Environment, Transport, Energy and Communications DETEC

Swiss Federal Office of Energy SFOE
Energy Research and Cleantech Division

REEL Demo – Romande Energie ELectric network in local balance Demonstrator

Deliverable: 5e1 Workshop's minutes on business cases

Demo site: Rolle

Developed by
Merla Kubli; ZHAW Zurich University of Applied Sciences
Dr. Silvia Ulli-Beer; ZHAW Zurich University of Applied Sciences
in collaboration with
Romande Energie SA

[Winterthur/St Gallen, 22.03.2018]

1. Description of deliverable and goal

1.1. Executive summary

The here presented deliverable describes the workshop held together with the experts from Romande Energie on the 8th of November 2017. The minutes present the workshop elements discussed and elaborated together with the workshop participants: (a) the reference simulation of developments of the regional energy system, (b) the conceptual model for the business cases to be studied and (c) distinct aspects of the first business case "battery swarm".

1.2. Research question

What are likely developments of the regional energy system in the supply area of Romande Energie until 2030? How can we best represent the key logics of the decentral flexibility business cases in the simulation platform?

1.3. Novelty of the proposed solutions compared to the state-of-art

The deliverable addresses the early phase of the development of a novel simulation approach to assess the dynamics of the long-term value creation of decentral flexibility business models. In contrast to previous research, the simulation platform will enable assessing different business cases for decentral flexibility, linking multiple aspects of value creation (customer participation in the business model; valorization of flexibility, design and definition of the compensation for providing flexibility).

1.4. Description

The deliverable is presented in the form of the workshop material conducted with the workshop participants. The workshop was designed and facilitated based on the participative modelling approach for socio-technical transitions developed for the platform TREES, described in Ulli-Beer et al. (2017). The first part of the workshop addressed the reference simulation for the supply area of Romande Energie SA on the basis of the model developed by and presented in Kubli (2018). The facilitators integrated participative tasks to enhance the participant's understanding of the model structure and resulting model behavior. The second part addressed the conceptual model to capture the key logics of the business models for decentral flexibility. Lastly, specific aspects of the business case "battery swarm" were discussed to define future

modelling work. Also here, participative tasks were integrated to elicit the knowledge of the expert of Romande Energie and agree on the model boundaries and characteristics.

2. Achievement of deliverable:

2.1. Date

8th of November 2017.

2.2. Demonstration of the deliverable

The deliverable is provided in the form of the workshop material conducted with the workshop participants, held at the 8th of November 2017.

3. Impact

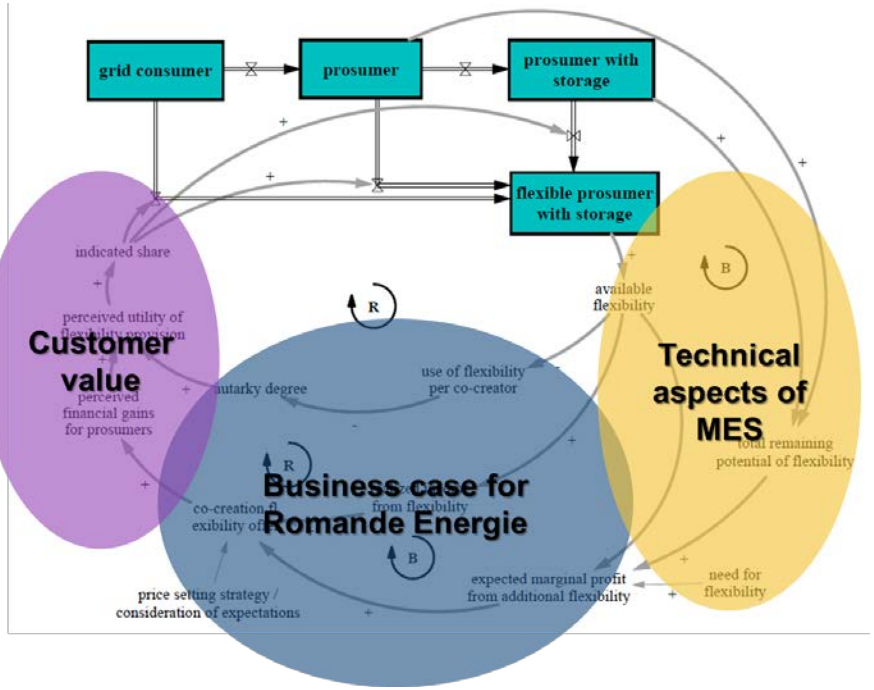
The workshop held on the 8th of November, reported here as a deliverable, was a highly crucial step in the process of the project development. It allowed eliciting important knowledge from the experts from Romande Energie, to discuss and align the particular interests and needs of the stakeholders and agree on the next steps to take. In particular the workshop increased mutual understanding and highlighted how important it is to develop the simulation platform for assessing decentral flexibility business models in an iterative process between the researchers and the experts from Romande Energie.

References

Kubli, M. (2018). Squaring the sunny circle? On balancing distributive justice of power grid costs and incentives for solar prosumers. *Energy Policy, 114*, 173-188.

Ulli-Beer, S., Kubli, M., Zapata, J., Wurzinger, M., Musiolik, J., & Furrer, B. (2017). Participative Modelling of Socio-Technical Transitions: Why and How Should We Look Beyond the Case-Specific Energy Transition Challenge? *Systems Research and Behavioral Science, 34*(4), 469-488.

Workshop Part 2
TREES – Reference simulation and battery swarm business model



Merla Kubli
(ZHAW, SCCER CREST)
8th of November 2017, Romande Energie SA

Workshop programm 8th of November

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School of Engineering
INE Institut für Nachhaltige Entwicklung

Time	Programm
13:00	Welcome
13:10	Reference simulation and battery swarm business model (Merla Kubli & Dr. Silvia Ulli-Beer, ZHAW)
15:00	Coffee break
15:15	Emerging business opoortunities (Dr. Emanuele Faccinetti, Dr. Benjamin Rohrbach, Prof. Dr. Christoph Imboden, HSLU)
17:00	End

Agenda - Overview

1. **Reference simulation** (35 min)
2. **Battery swarm business model** (60 min)
3. **Next steps** (10 min)

Reference simulation - Agenda

1. Recall last meeting, introduction of new model structure
2. Diffusion of solar prosumers and home batteries
3. Interpretation of problem situation

Recall last meeting: preliminary simulation

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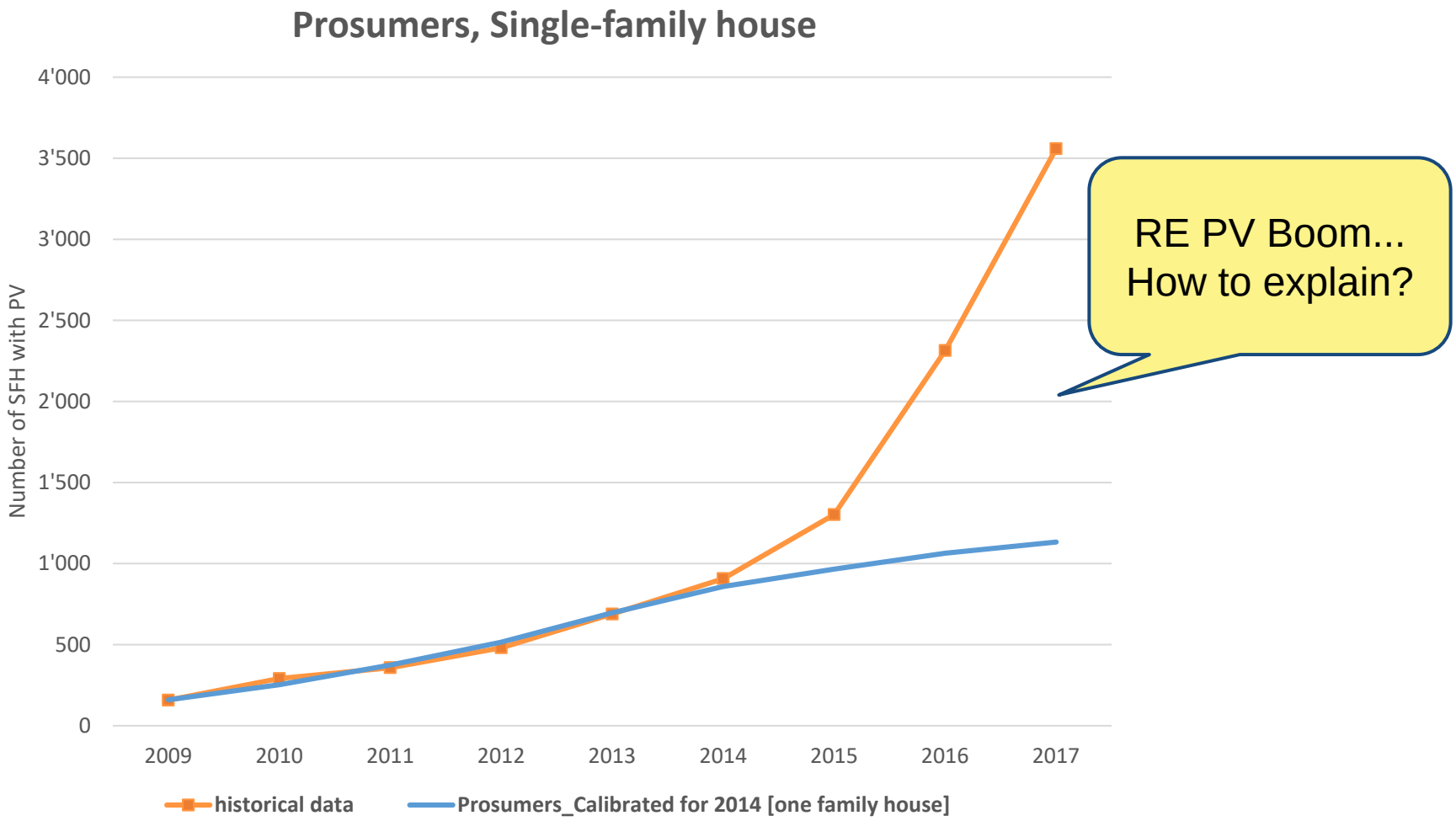

Model adaptions to explain „RE PV Boom“

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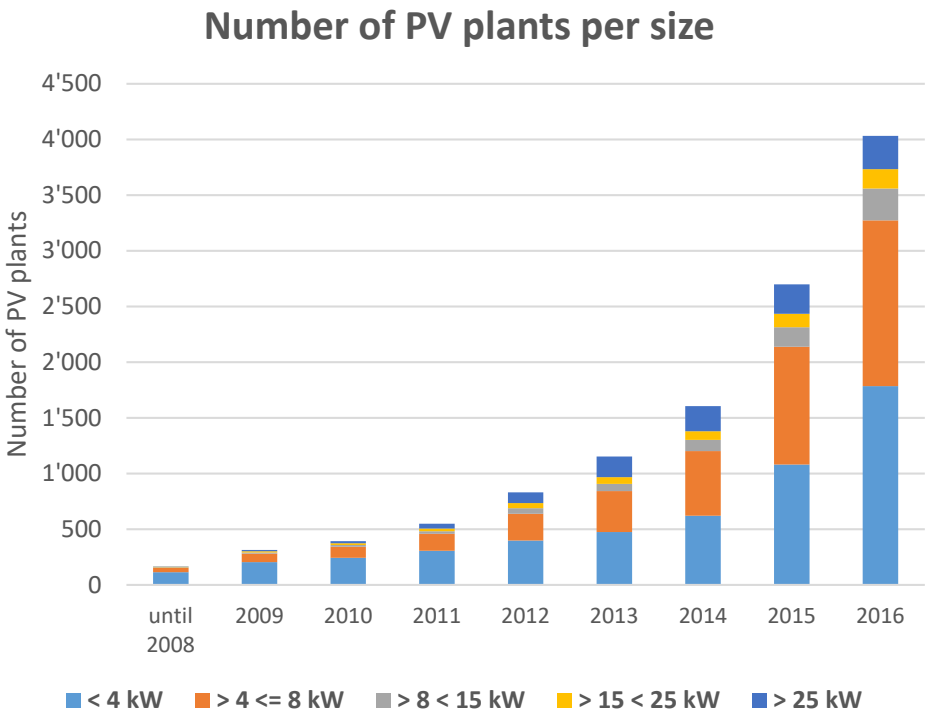
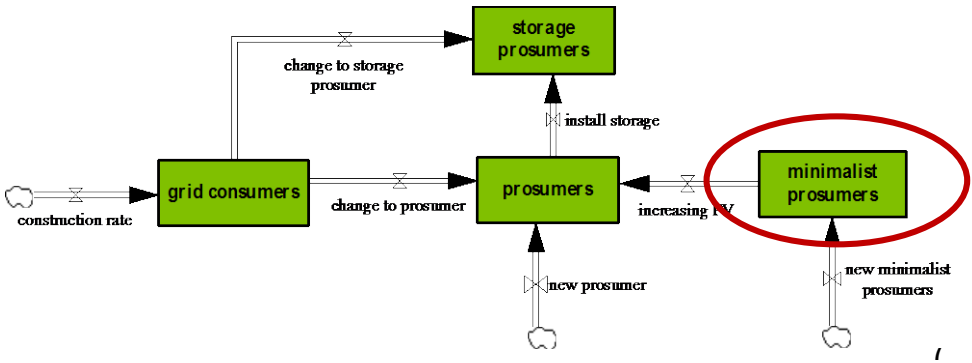
- Policy from Cantonal energy law (Art. 28b)
- Building construction rate and new buildings with PV
- “Minimalist prosumers”
- Dynamics regional potential of PV (with data from EPFL)
- Tax savings of PV investment
- Calibration for new circumstances
- Effect from investment grant on adjustment times





Model calibration – 2009 to 2016

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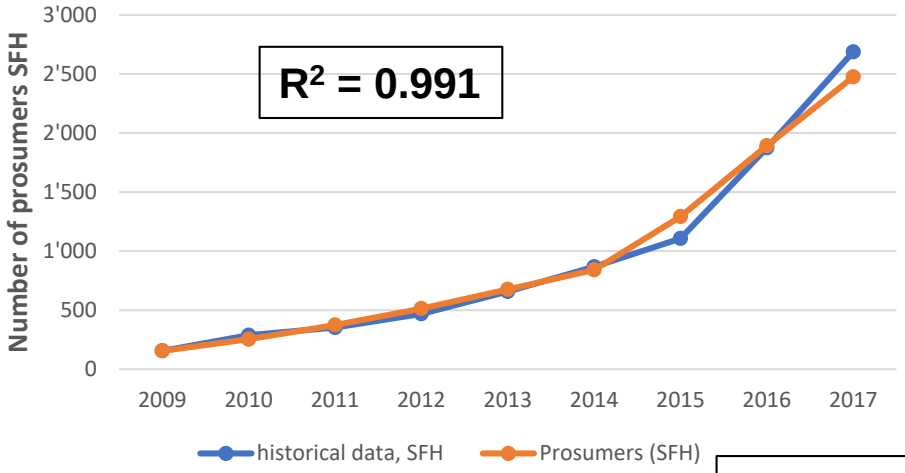
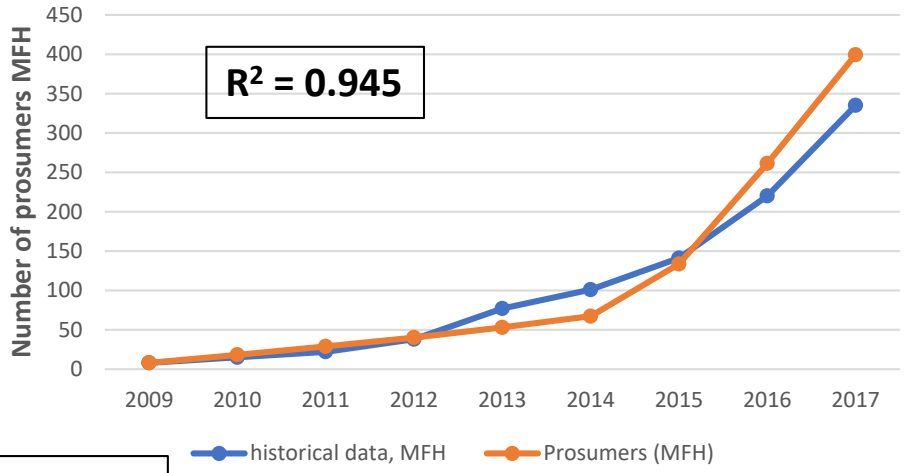
Calibration Prosumers, Single-family houses

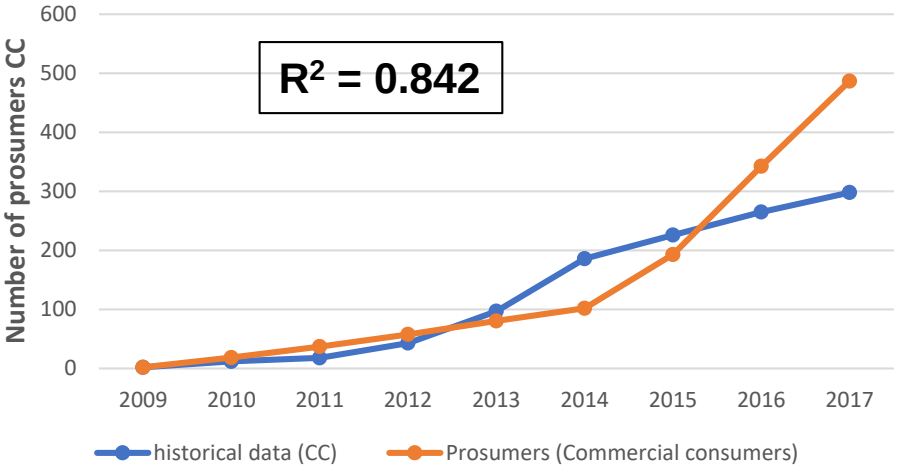


Calibration Prosumers, Multi-family houses

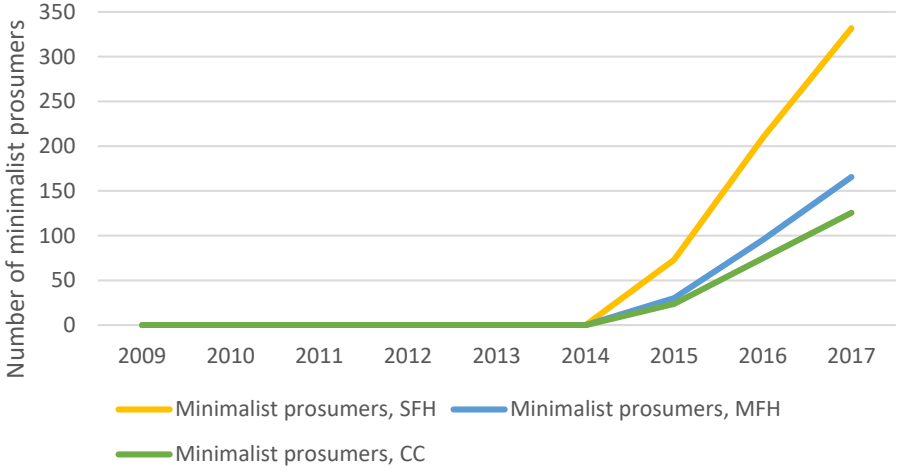


Overall R^2 = 0.926

Calibration Prosumers, Commercial consumers



Minimalist prosumers, SFH, MFH and CC



Simulation – single family houses

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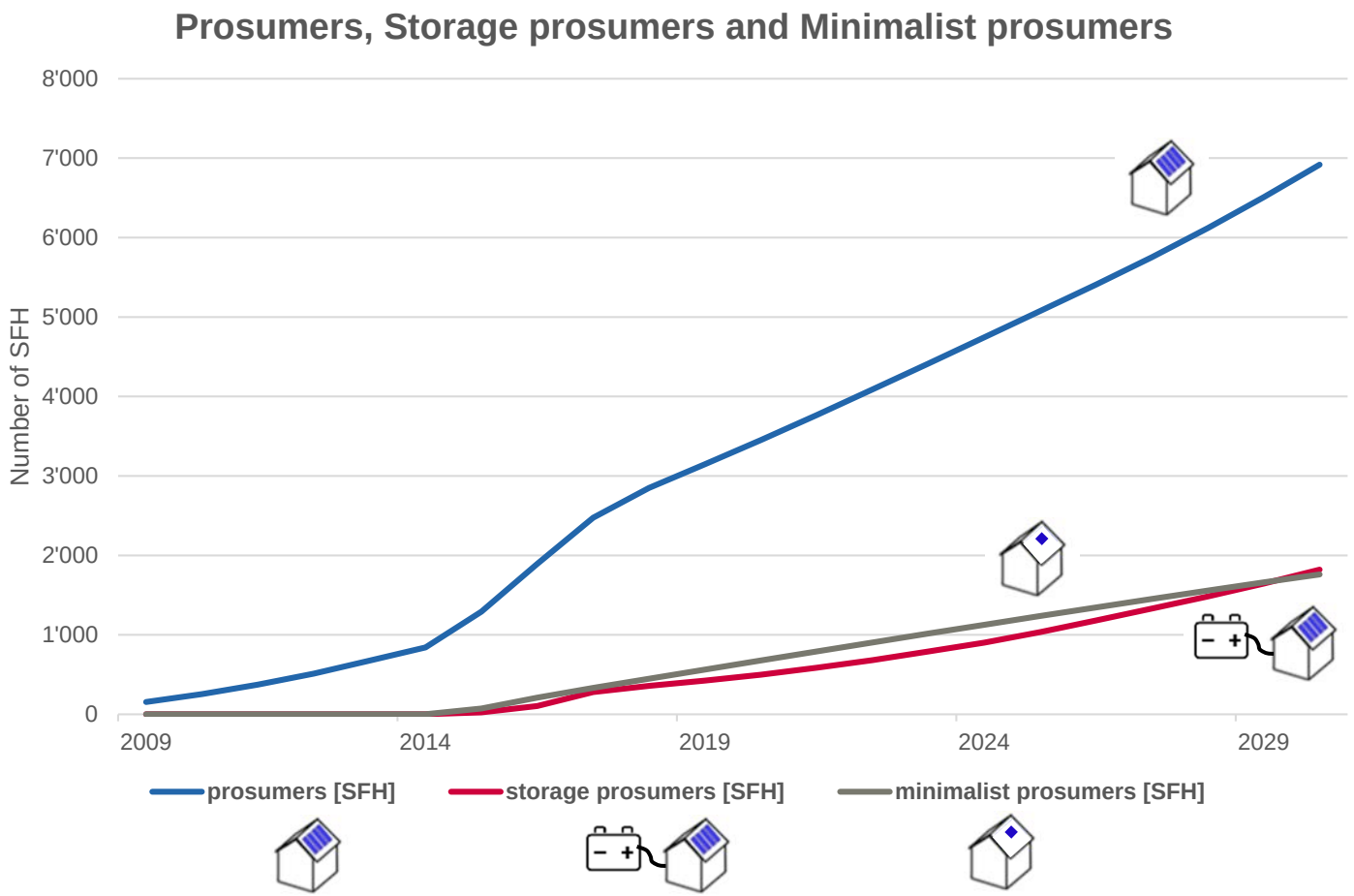

Diffusion of self-consumption concepts

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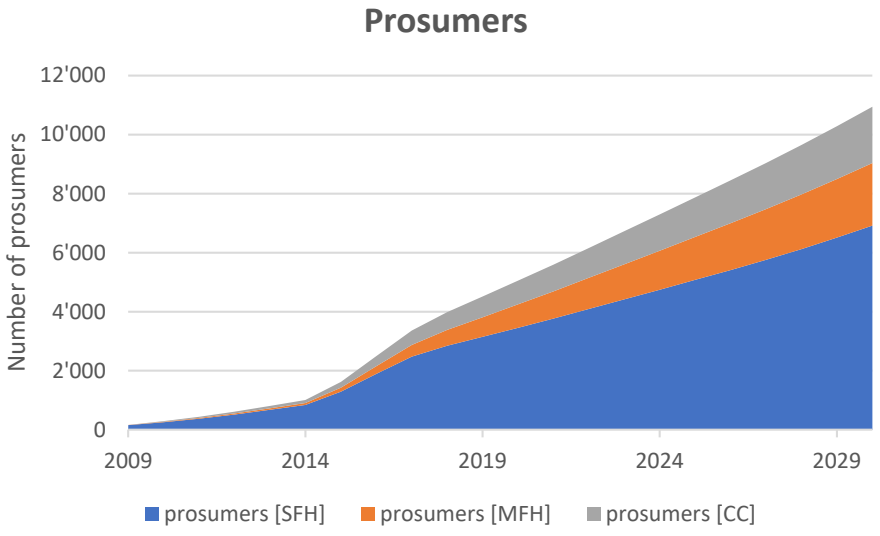

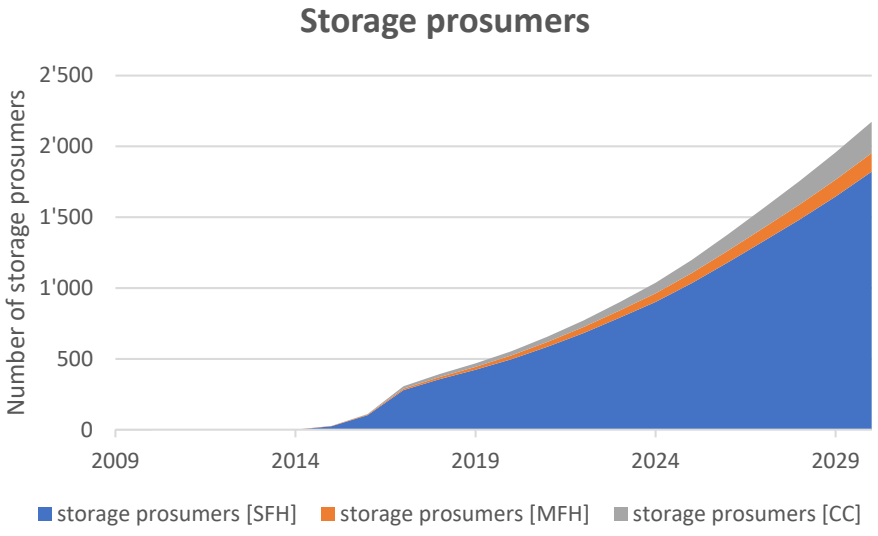

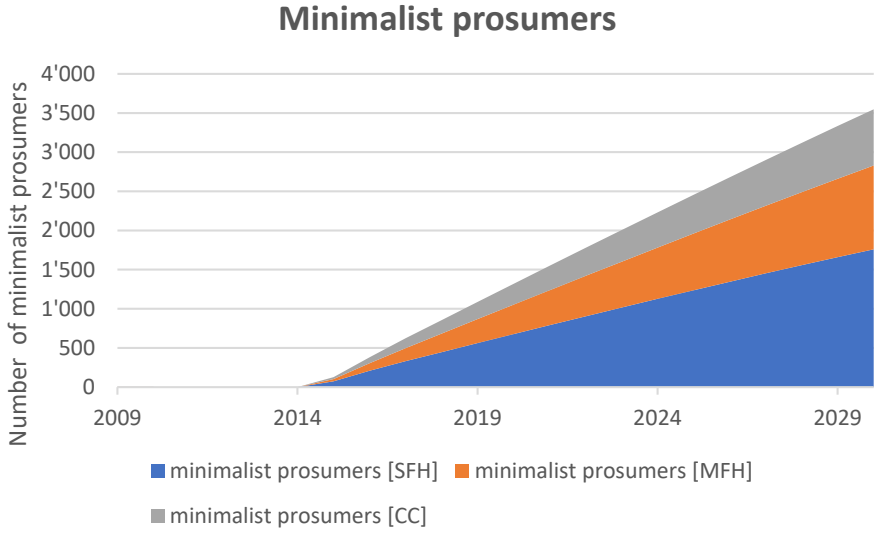

Task 1: Estimating change rates between concepts

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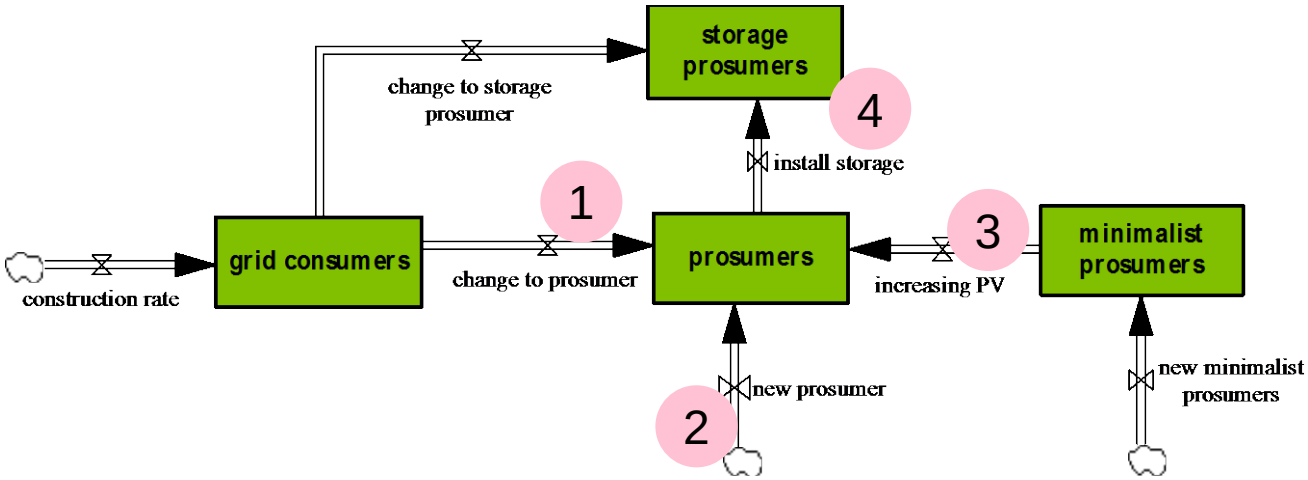
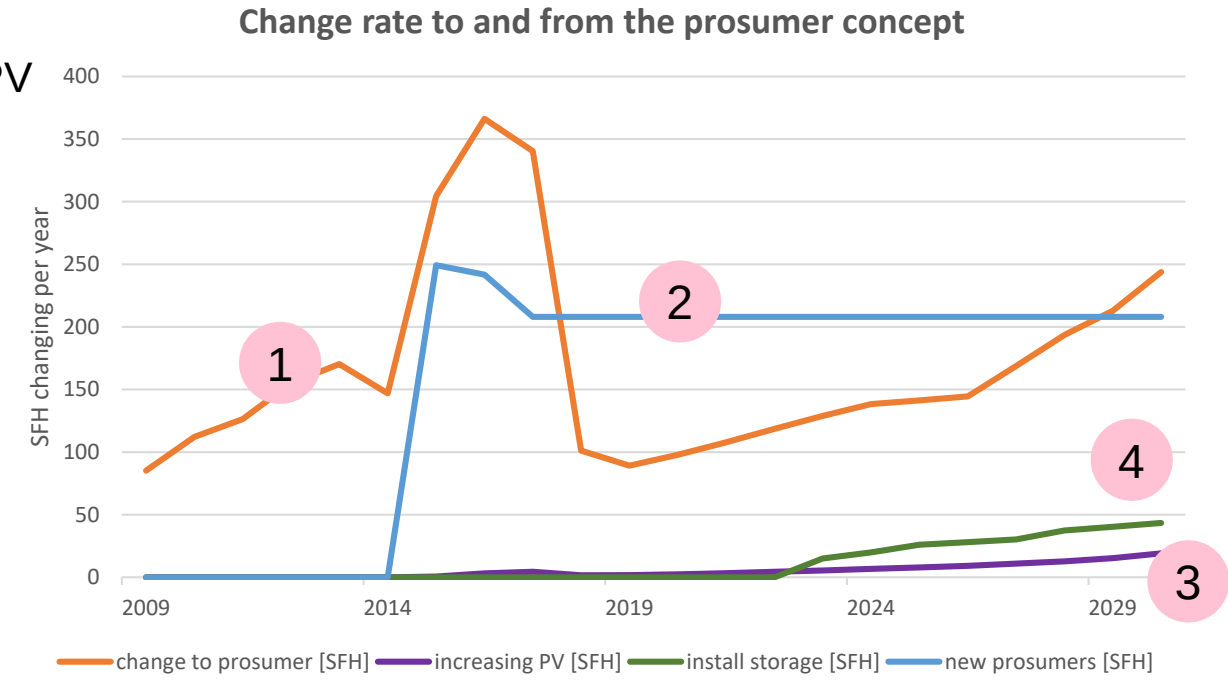


1 Grid consumers investing in PV

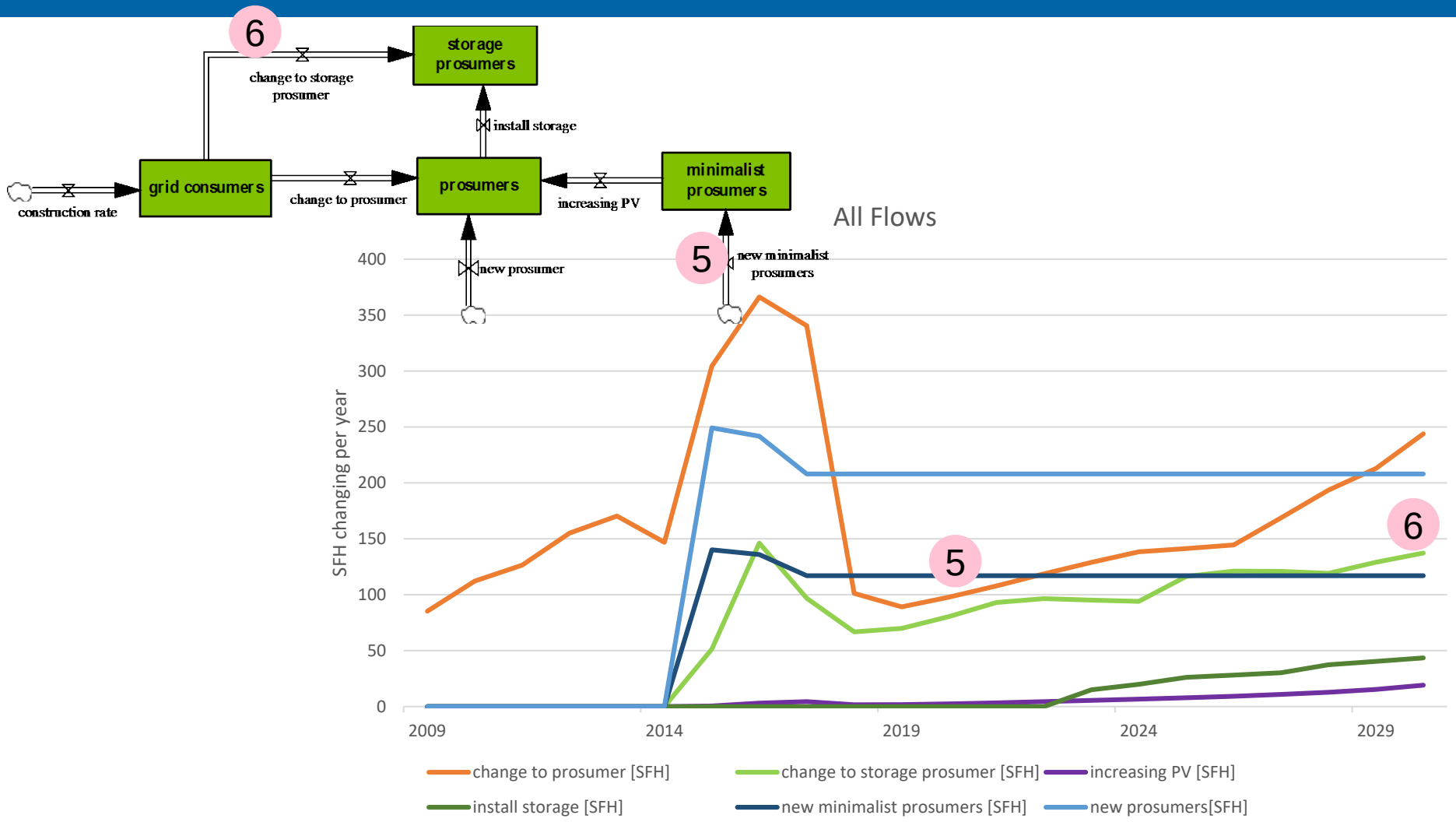
2 New constructions with PV

3 Minimalist prosumers scaling up their PV plant

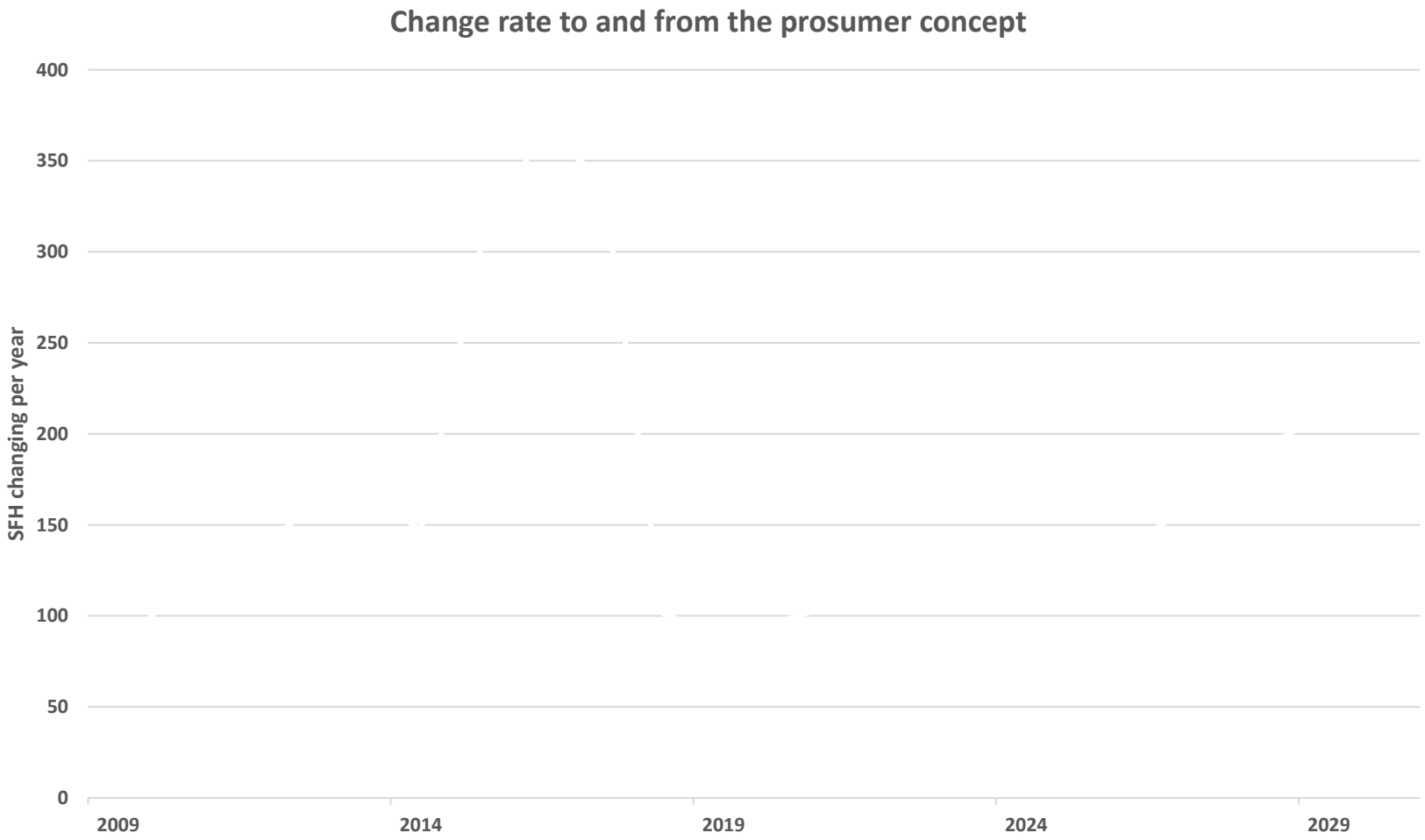
4 Prosumers investing in batteries



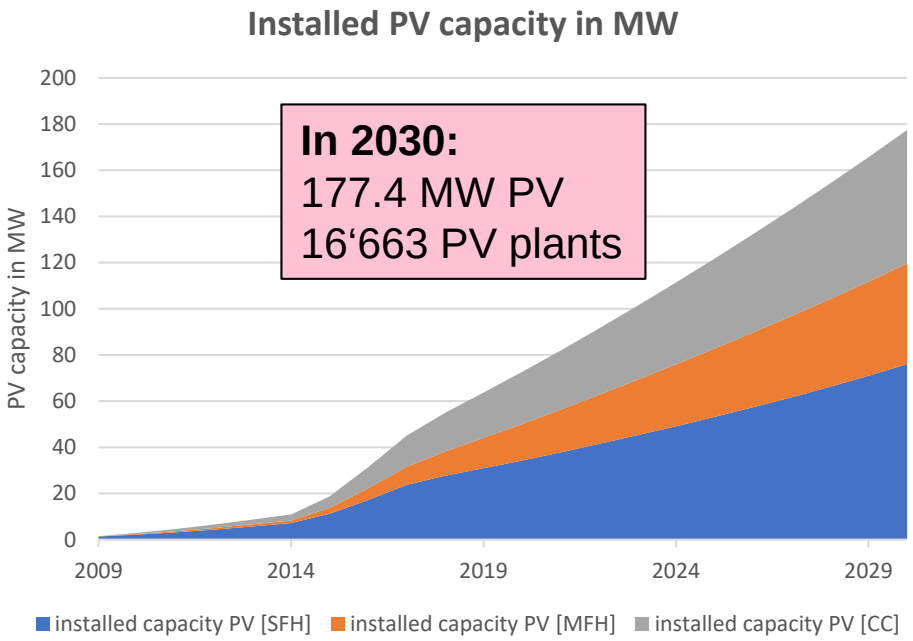
Graph with all flows

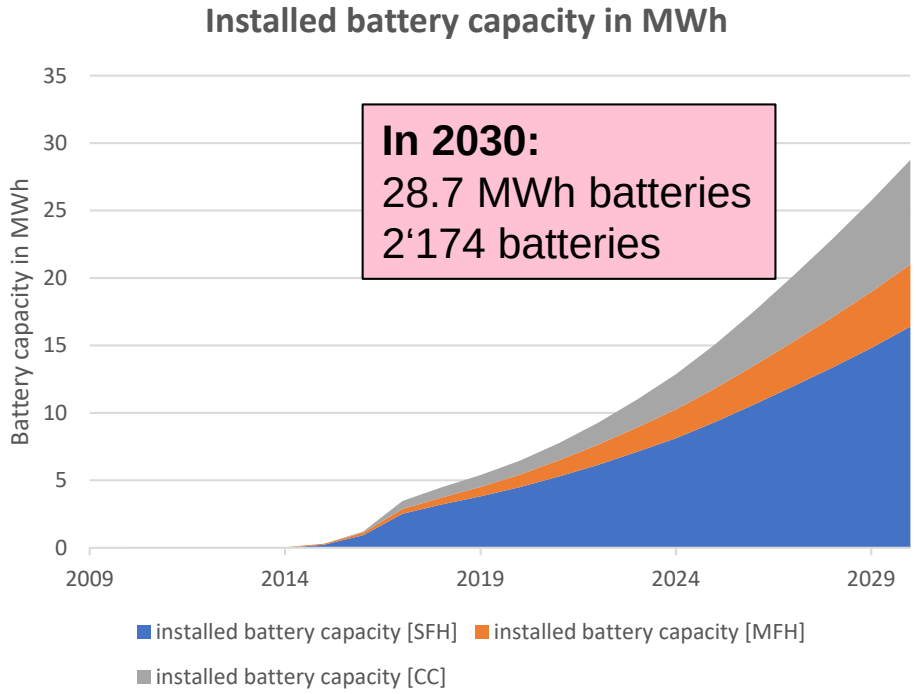


Task 1: Change rates



Installed technology





In 2030:
Reduction in demand through self-consumption: -3.02%
Consumers with PV: 11.41%
PV electricity feed-in in grid: 142 GWh/year (7.6% of total consumption)
Share of solar PV of consumption: 11.44%
Increase of grid tariff due to self-consumption: 2.9% (overall 13.5% compared to 2009)

Evaluation of reference simulation

- Understandable? Plausible?

- What is the impact of the simulated developments on your business area?
- Is it a problem? An opportunity? Too small to be considered?

Battery swarm business model

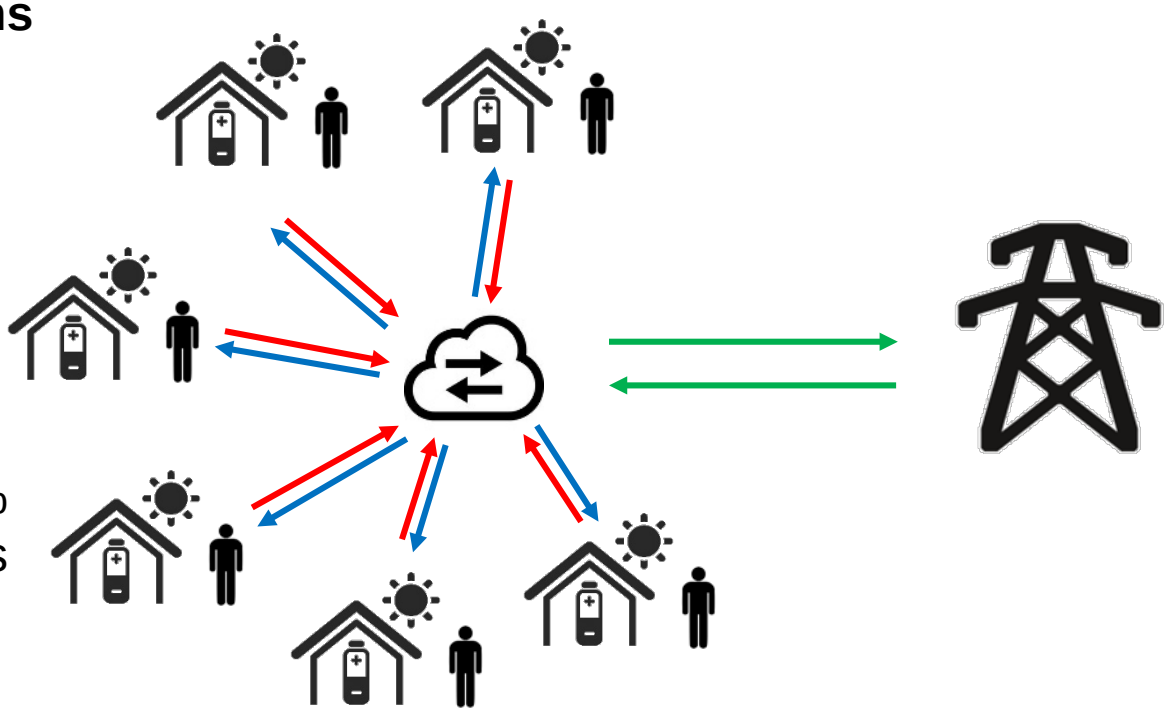
Battery swarm business model - Agenda

1. Definition of a battery swarm
2. Customer decision flows
3. Key logics of the business model
4. Evaluation criteria

Definition of the battery swarm

Key features of battery swarms

- Access to numerous small home batteries
- Pooling of flexibility
- Central control mechansim
- Frequently for provision of balancing power
- Contracts often include 100% solar electricity for prosumers



Current applications: battery swarms and virtual power plants

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Battery swarms

LichtBlick Generation reine Energie

ampard

BKW (Pilot project)

fenecon ENERGY ENGINEERING

caterva

Coulomb

tiko storage

sonnen

Virtual power plants (various sources of flexibility)

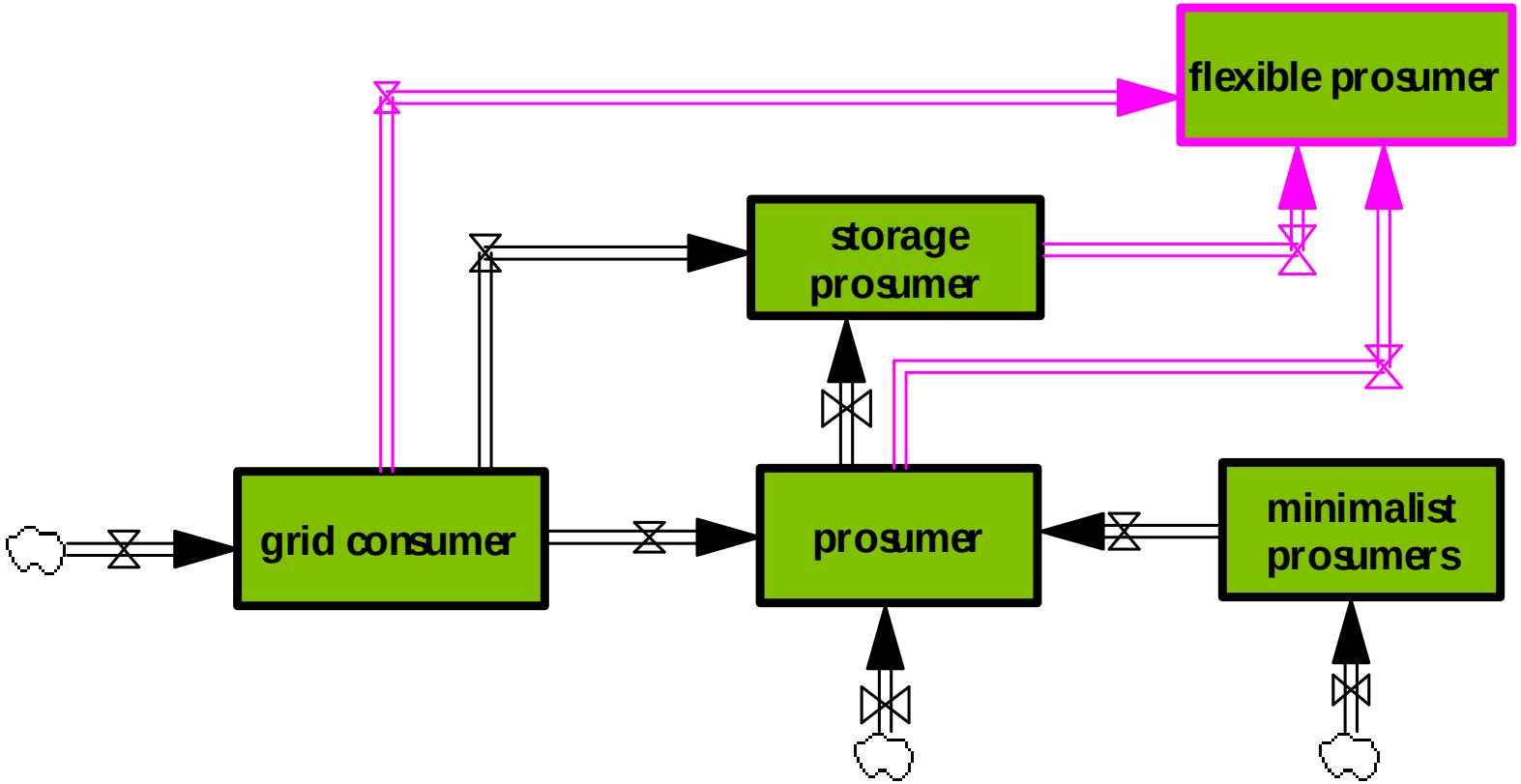
NEXT KRAFTWERKE

SUISSE NEXT

fleco POWER

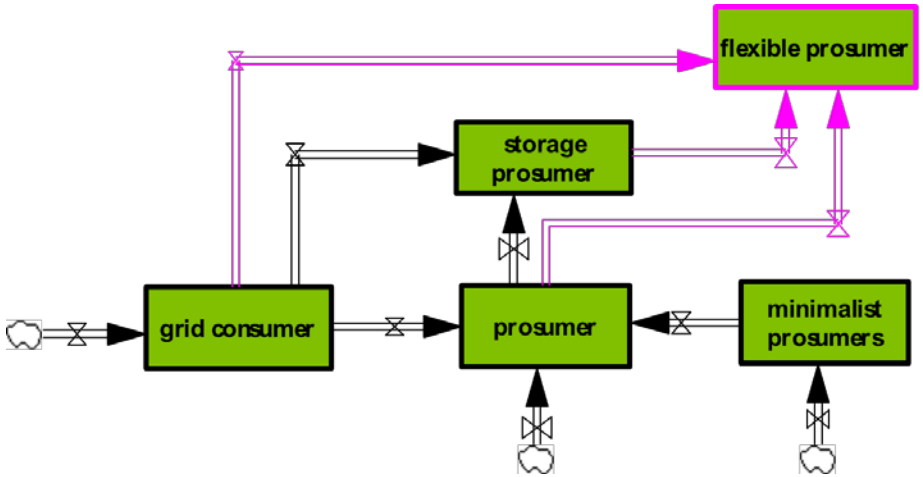
tiko power

New consumer type: Flexible Prosumer

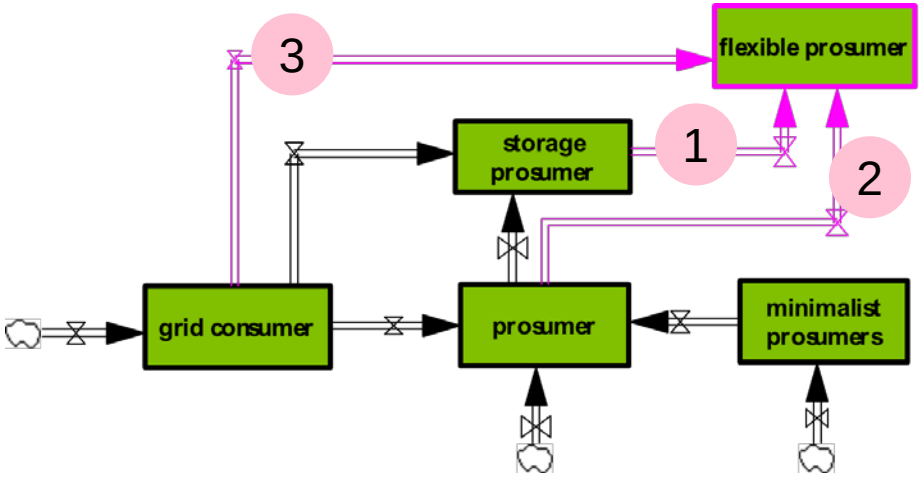


Task 2: What are the driving forces of the customer decision flows?

- Which actions are necessary on a **technology** level for these flows to happen (which technologies have to be installed)?
- What is the consumer's **motivation to change** the concept? Under which circumstances are they willing to change/invest?
- How can we **trigger the consumer's motivation**?



Task 2: Customer decision flows



	Technology	Motivation	Trigger
1			
2			
3			

Task 2: Customer decision flows

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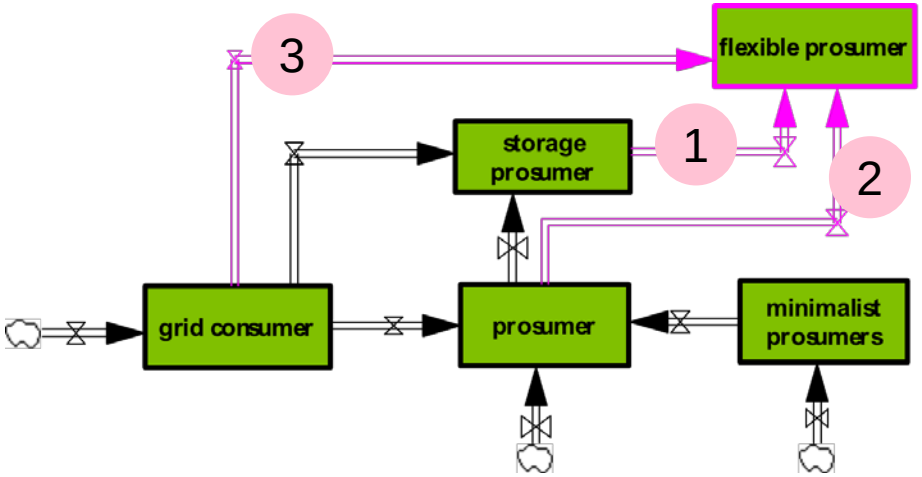

	Technology	Motivation	Trigger
1	ICT	Additional income	
2	Battery, ICT	Investment support, 100% solar power	
3	PV, Battery ICT	Full turn-key system, 100% solar power	

Key logics of the battery swarm business model – causal loop diagram

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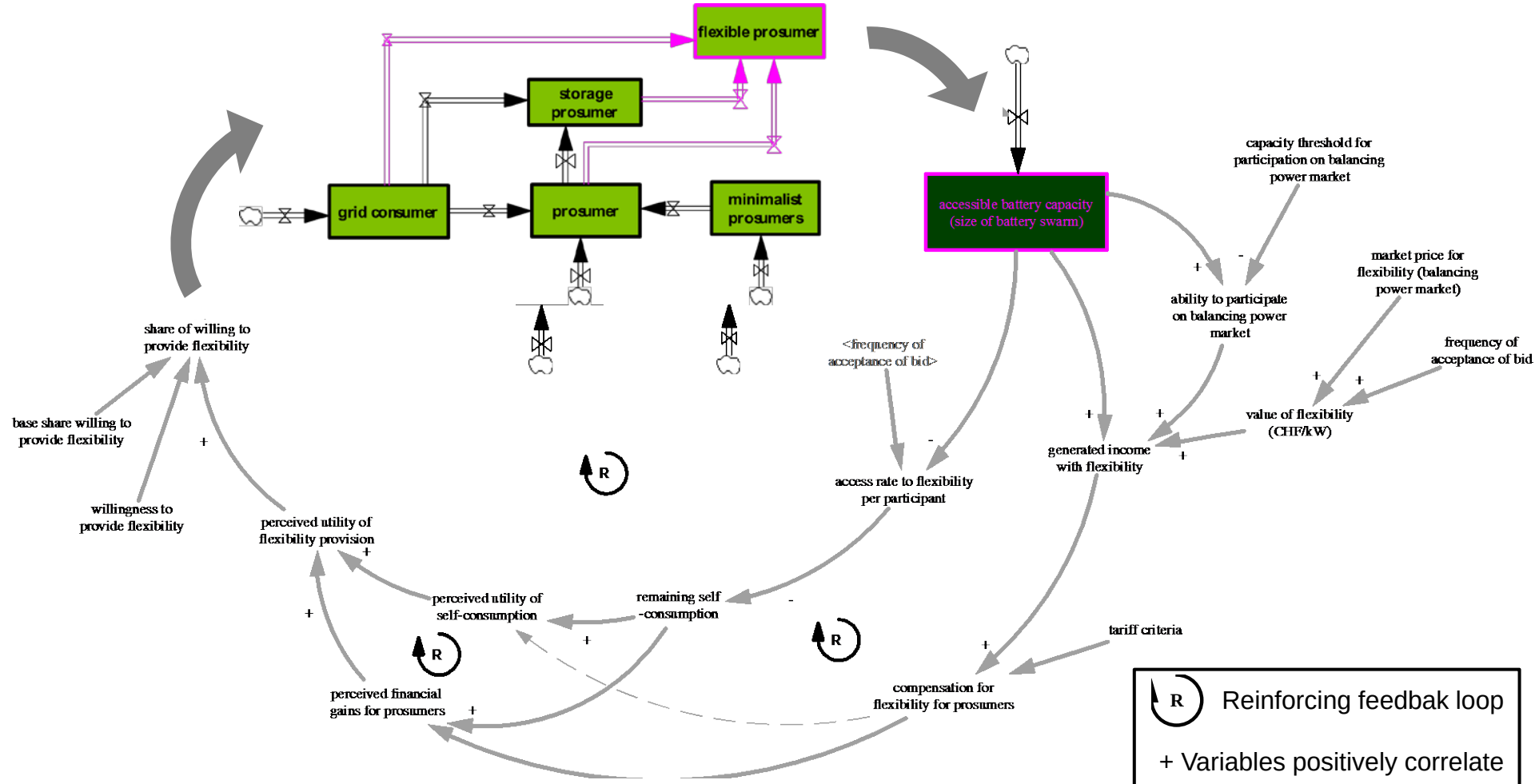
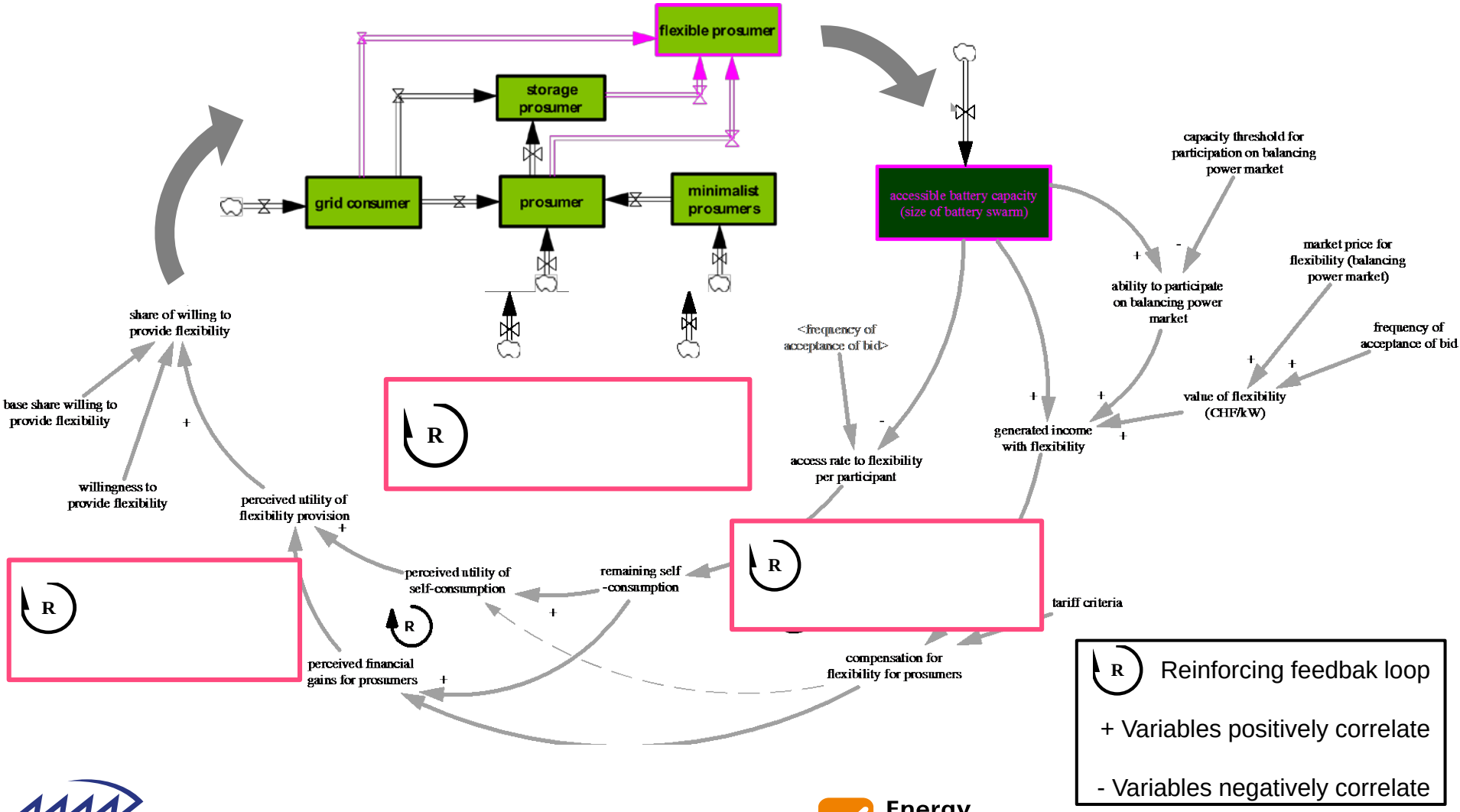


Task 3: Causal loop diagram

1. Understand the feedback loops that govern the participation of the battery swarm. Should there be additional effects or feedback loops?
2. Label (give them a name) the existing and new feedback loops

Key logics of the battery swarm business model – causal loop diagram



Key logics of the battery swarm business model – causal loop diagram

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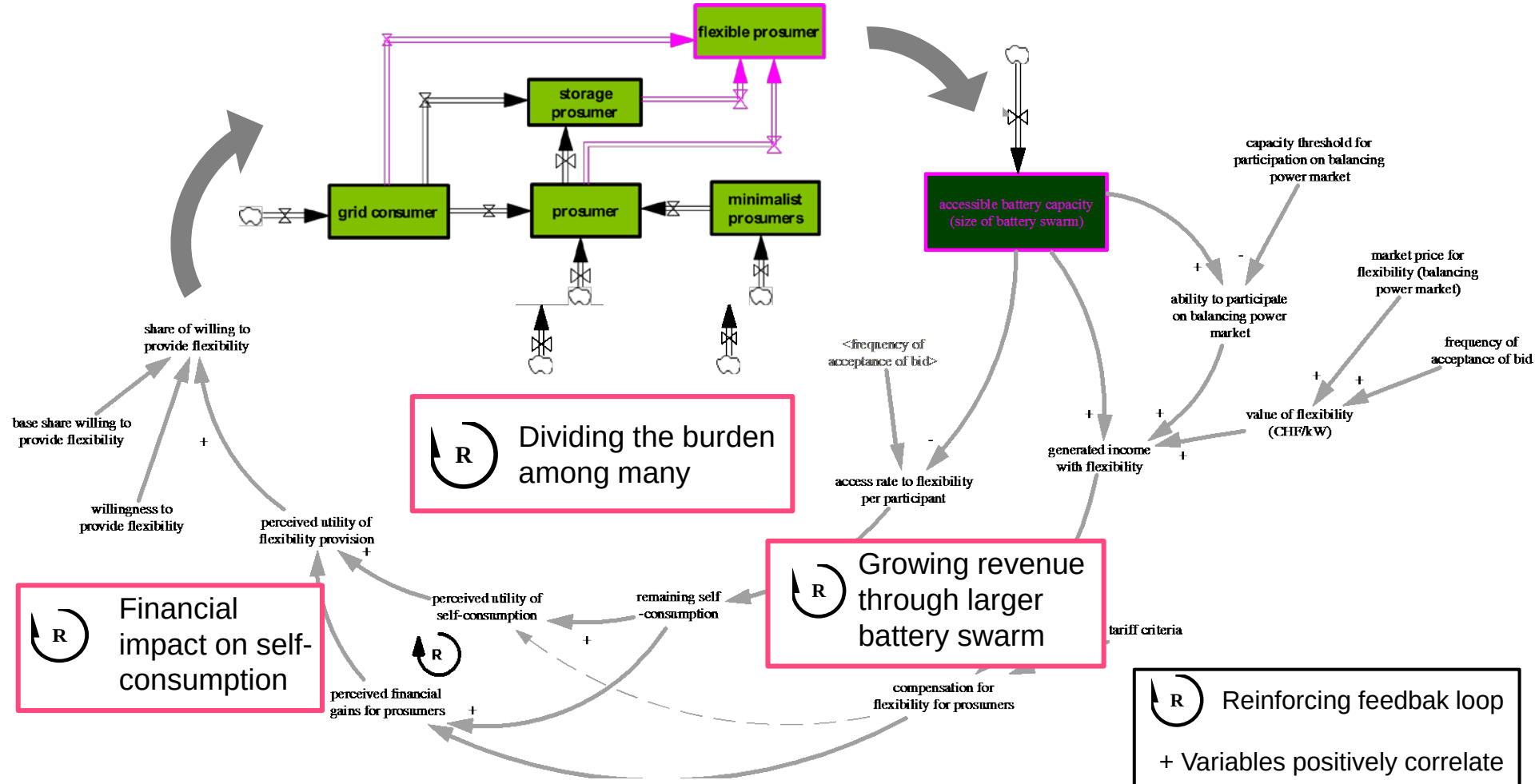

Key features of the battery swarm business model

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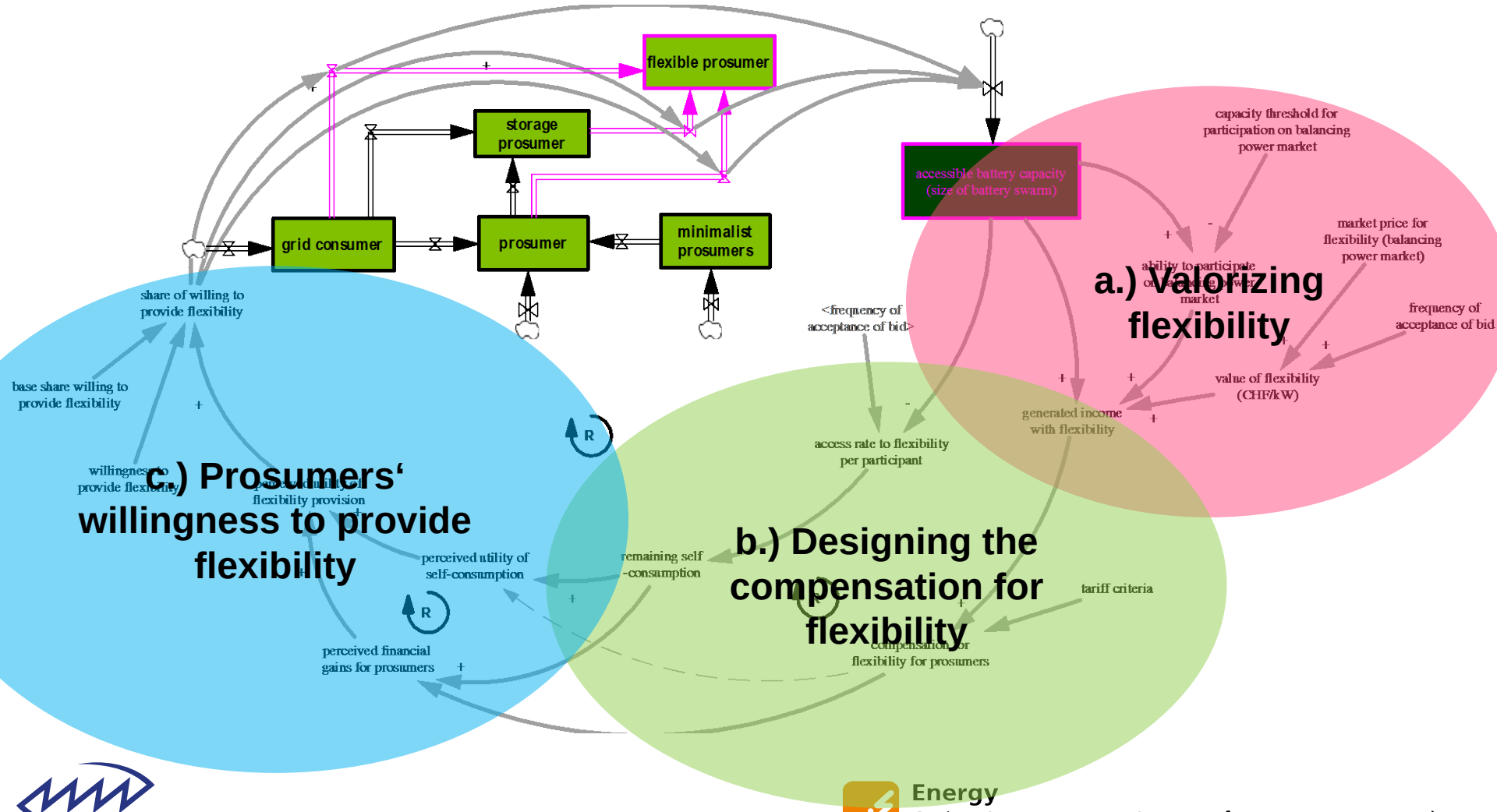


Task 4: Key features of the business model

Each group presents their findings, estimations and decisions.

-> What you select will be simulated.

a) Valorizing flexibility:

- Selected revenue sources
- Expected price/value range and frequency of acceptance of bid

b) Designing the flexibility compensation:

- Design of the product
- Target tariff range of compensation

c) Prosumer‘s willigness to provide flexibility:

- Estimation of base share of consumers willing to provide flexibility
- Prosumers‘ required premium for providing flexibility

Task 4A: **Valorizing flexibility**

- Where can we generate value with flexibility? For which value/price? -> Handout
- Can we meet the conditions to participate in the balancing power market?

- Selecte the revenue source(s) that we should further investigate and the expected price/value range and frequency of acceptance of bid

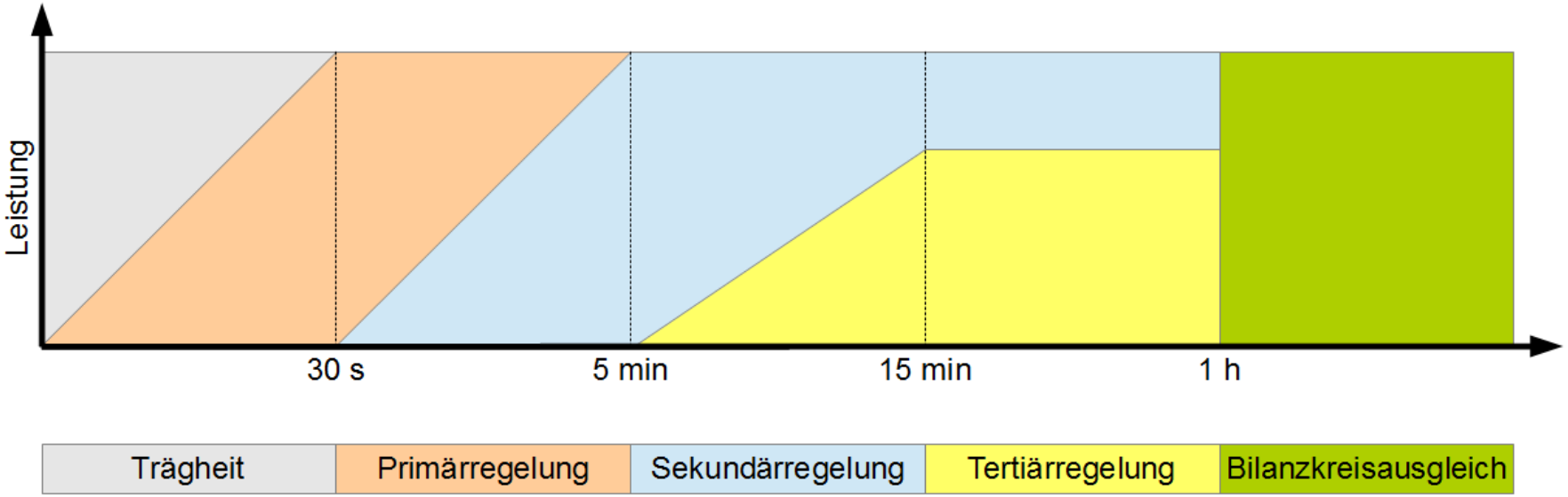
  Revenue source: _____

  Price range: _____

  Frequency of bid: _____

Value source	Condition	Price Range	Frequency
Primary balancing power (International (ENTSO-E), National (Swissgrid), total about 70 MW)	Ready in 30 sec. for 15 min. Min. +/-1 MW capacity Max. +/- 25 MW (modular) Capacity price defined by supplier		
Secondary balancing power (National (Swissgrid))	Ready in 5 min Min +/- 5 MW capacity (inc. of 1 MW) Max. +/- 50 MW		
Tertiary balancing power	Ready in 15 min 4h blocs & Week bloc Min. +5 MW / -5MW capacity (inc. of +1 MW/-1 MW) Max. 100 MW		
Balance energy (balance group)			
Spot market			
Local grid optimization / avoiding grid capacity expansions			
...			

Balancing power



a) Simulation results: Installed technology

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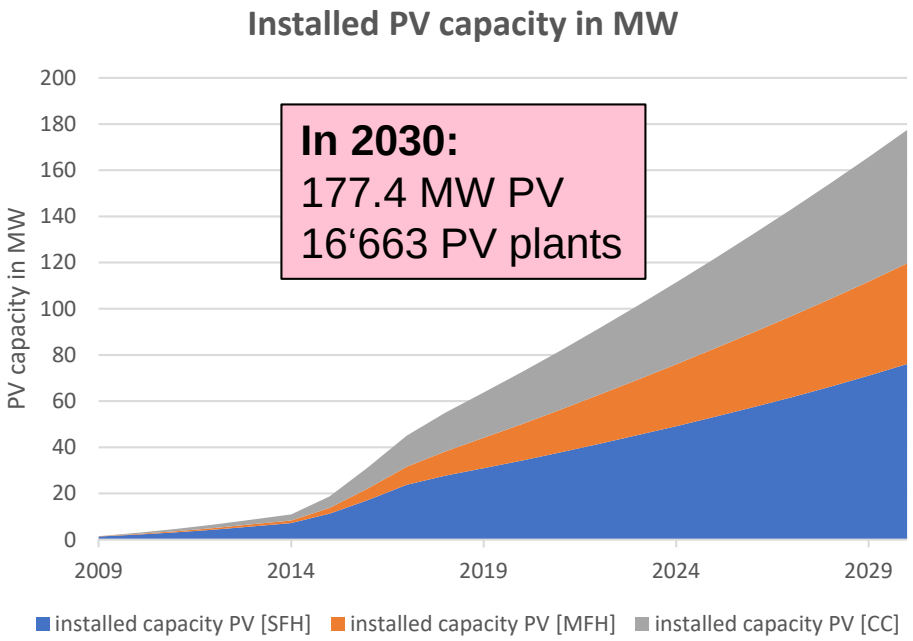

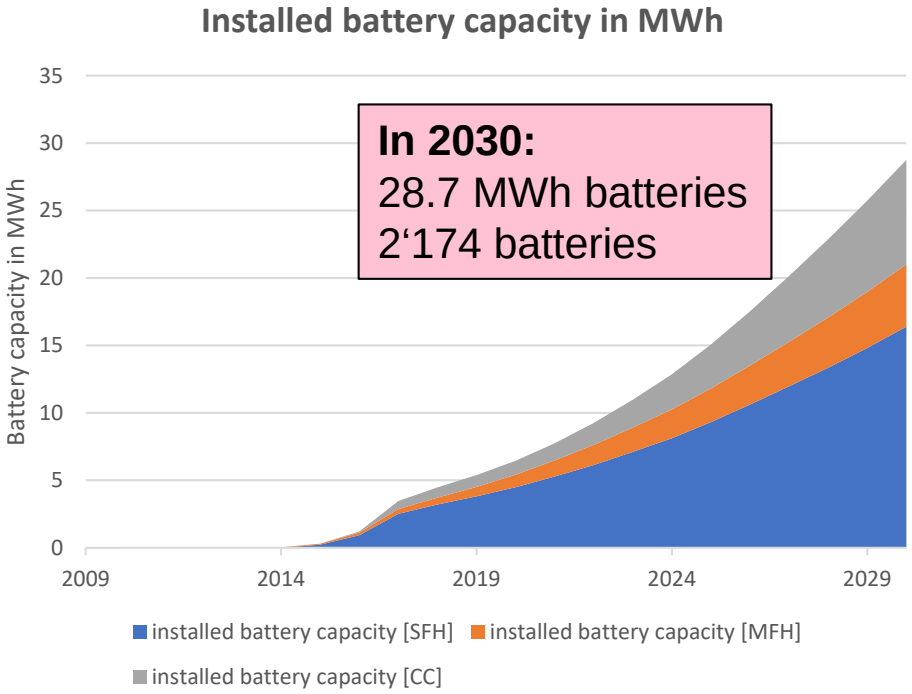

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Task 4B: Designing the flexibility compensation

Flexibility: How often do we access the batteries? Impact on the self-consumption share for consumer?

Compensation: Form of compensation? Range of compensation?

Investment: Who pays for the battery? Who owns it?

Options: Shoud there be different offers for the different situations of the consumers?

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b) Battery swarm competitor's offers

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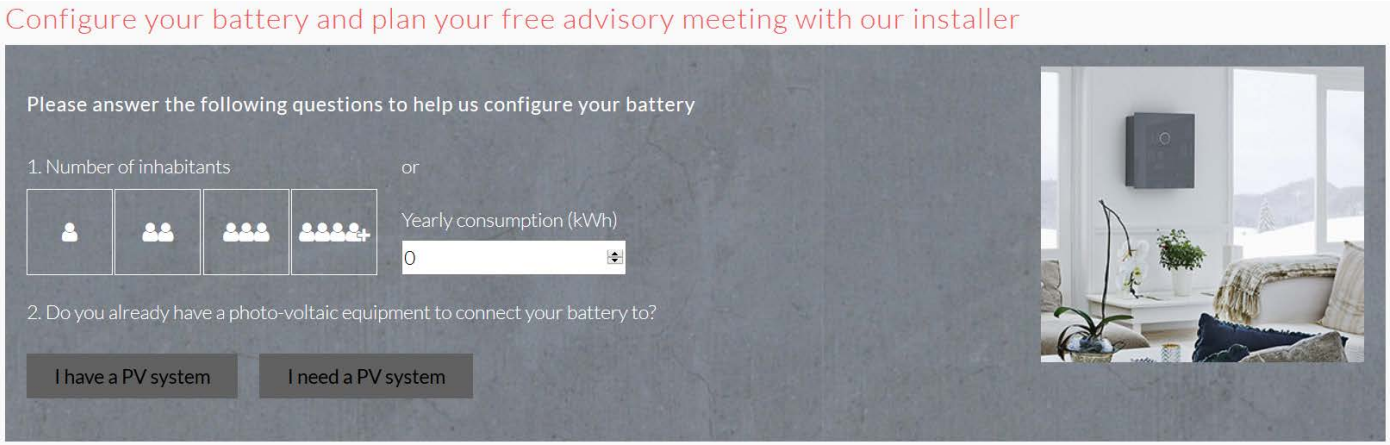
Tiko Storage (limited edition)

- Get independent for only CHF 39.-*/month!
- Upfront payment of 20% of the total price (battery, if needed PV), monthly fee for 10 years
- Up to CHF 250.- yearly financial rewards for your participation to the tiko network (min. 3 years)
- Your self-consumption has the highest priority over network stabilization.
- **Configurator and Source:**
- **https://tiko.ch/page/product_storage/**



Task 4C: Prosumer‘s willigness to provide flexibility

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- What gives us information on the base share of consumers willing to provide flexibility?

- What do you estimate the base share of consumers willing to provide flexibility?

- What is the consumer‘s required premium for providing flexibility?

- Discuss on the basis of the results from the choice experiment from St. Gallen

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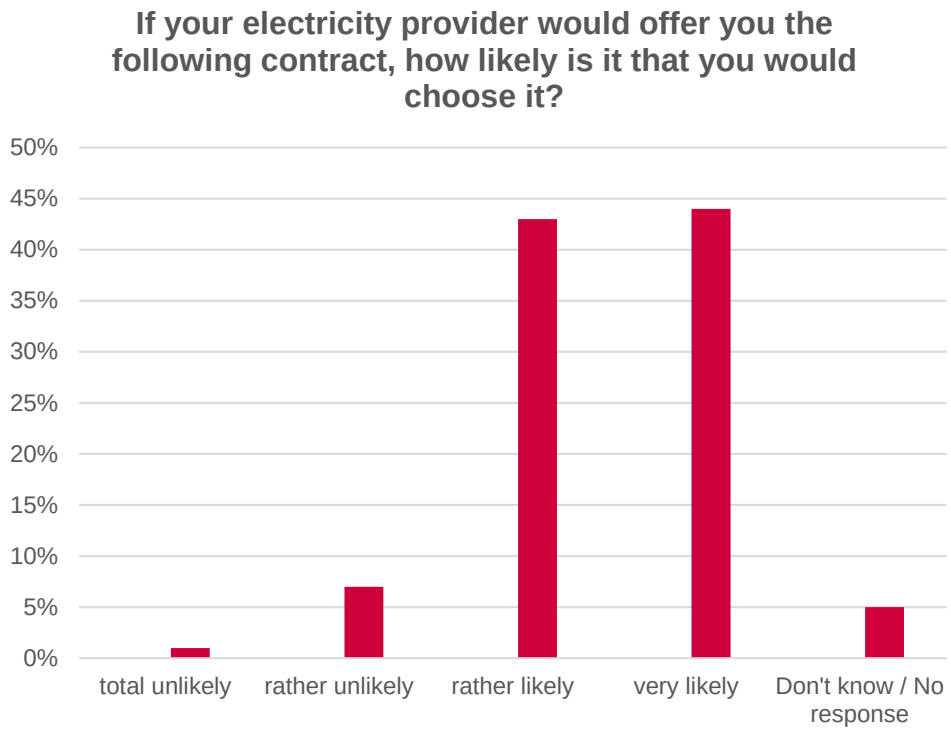
c) Relevant results from choice experiment

If your electricity provider would offer you the following contract, how likely is it that you would choose it?

Attribute	Level
Monthly electricity costs	50 CHF
Use of flexibility	FlexLight 60% PV Self-Consumption; only data on battery charging level transmitted
Electricity mix (for remaining consumption)	100% solar power
Contract duration	Cancellable anytime



Source: Kubli, Loock, Wüstenhagen (2017), University of St. Gallen

c) Relevant results from choice experiment

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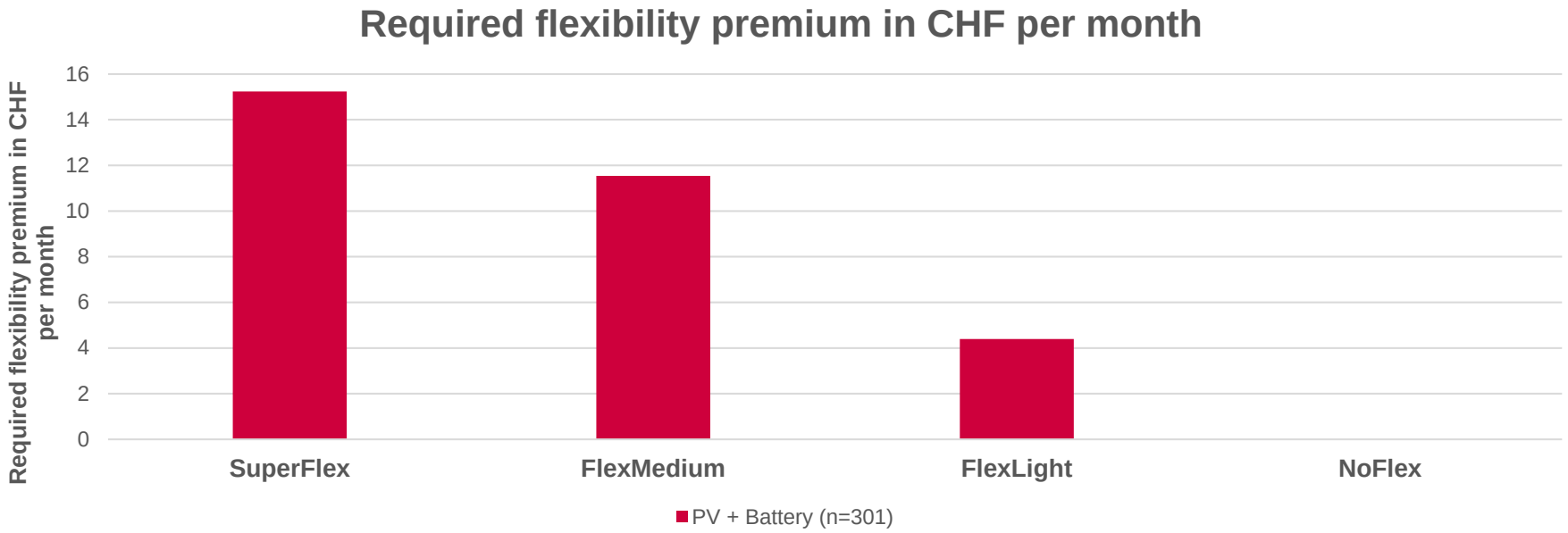

PV+Battery	Super Flex	Flex Medium	Flex Light	No Flex
	30% PV Self-Consumption; consumption data transmitted and used for forecasting	45% PV Self-Consumption; consumption data transmitted	60% PV Self-Consumption; only data on battery charging level transmitted	75% PV Self-Consumption; no data transmitted

The sample consisted of people already owning a PV plant, or who are interested in investing in PV within the next 3 years. We here investigated an electricity contract that included the rental of the home battery in the monthly electricity bill.

Evaluation criteria for business model

- Number of battery owners providing flexibility
- Quantified flexibility volume accessible by RE (accessible battery capacity)
- Cash-flow / profit for RE of the business model
- Tarif for flexibility compensation
- Share of self-produced power
- Customer retention
- Share of renewable electricity in the supply area
- …

Are there further evaluation criteria that should be considered / implemented into the model?

Next steps

Battery Swarm

- Incorporation of the selected key features of the battery swarm business model.
- Simulation and analysis
- Results ready for presentation and discussion in January (resp. end of December).

District battery

- Proposal from ZHAW for the business model design, until the end of November
- Internal discussion and agreement of Romande Energie (-> who evaluates and decides?)
- Incorporation into the model
- Simulation and analysis
- Results ready for presentation and discussion in end of January/February

Thank you for your attention!

Zürcher Hochschule für Angewandte Wissenschaften
School of Engineering
INE Institut für Nachhaltige Entwicklung

Merla Kubli
Institut for Sustainable Development
Zürcher Hochschule für Angewandte Wissenschaften
merla.kubli@zhaw.ch
058 934 72 59

SCCER CREST
Zürcher Fachhochschule , FES

Energy
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Emerging business opoortunities

Dr. Emanuele Faccinetti, Dr. Benjamin Rohrbach

A semi-structured interview was held with the experts from Romande Energie