Schweizerische Eidgenossenschaft
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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: 5e3 Documentation of the user interface for the simulation model

Demo site: Rolle

Developed by
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in collaboration with
Romande Energie, Arbon Energie & Siemens

[Winterthur/St Gallen, 24.09.2019]

1. Description of deliverable and goal

1.1. Executive summary

The here presented tool is a user interface for the TREES simulation platform addressing the investigated flexibility business models. The user interface enables the industry partners to test their own scenarios in the TREES simulation model in an easy to use way with intuitive output graphs.

1.2. Research question

- What are attractive business model strategies for decentral flexibility?
- How can the TREES simulation model be made accessible in an intuitive way for industry partners?

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

For this deliverable we expanded the existing TREES simulation model that originally focused on simulating the diffusion of self-consumption concepts in energy systems with three different business models for decentral flexibility. The TREES simulation model now allows testing variants of business strategies for the business models "battery swarm", "district battery" and "multi-energy flexibility". With its focus on the long-term business dynamics of the flexibility aggregator business models, the TREES model also contributes in advancing the state-of-art in the international academic literature on flexibility aggregator businesses.

The developed user interface makes the platform easy accessible for our industry partners and enables them to test a broader range of scenarios than discussed in the project presentation. While simulation cockpits are not new in itself, we are convinced to provide a unique benefit to our project partners in combination with the advanced TREES model. The approach is also novel in respect that complex simulation models are made accessible to project partners and allows them to steer the model themselves.

1.4. Description

The advanced TREES platform and the gained results are presented in detail in the attached presentation "JA RED_District battery & Multi Energy Flexibility_Business Cases" for the progress made in the reporting period of 2018-2019.

The user-interface is web based and has the following core elements:

- An introduction page that illustrates the TREES model in a conceptual manner and at the same time highlights the parameters that can be changed in the cockpit and where they connect in the model (Fig. 1).
- A decision-setting menu that allows selecting between the three different business models and defining various aspects of the particular design to be tested (Fig. 2 & Fig. 3)
- The dashboard of output variables that is again split in multiple sub-dashboards for the respective sub model parts (e.g. consumers, revenues, characteristics for each business model). (Fig. 4).
- A run manager that allows selecting the simulation runs of interest. The cockpit allows testing and comparing variants of business strategies for a business case, as well as a comparison across different business cases.

The user-interfaces are each customized for the two applications for Romande Energie and Arbon Energie/Siemens and represent the supply areas of each study and the investigated business models.

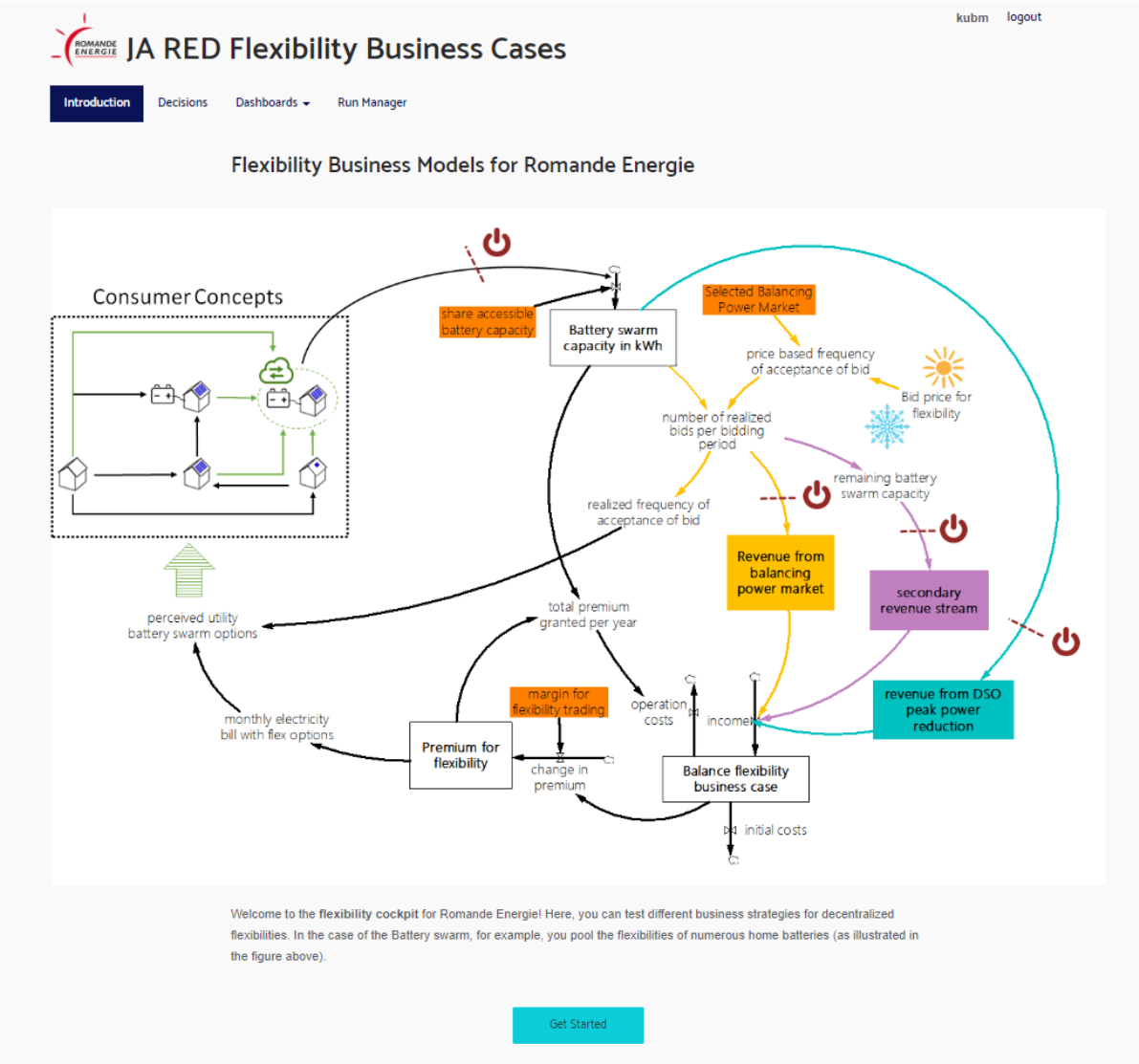

Figure 1: Introduction page of the user-interface for the TREES model.

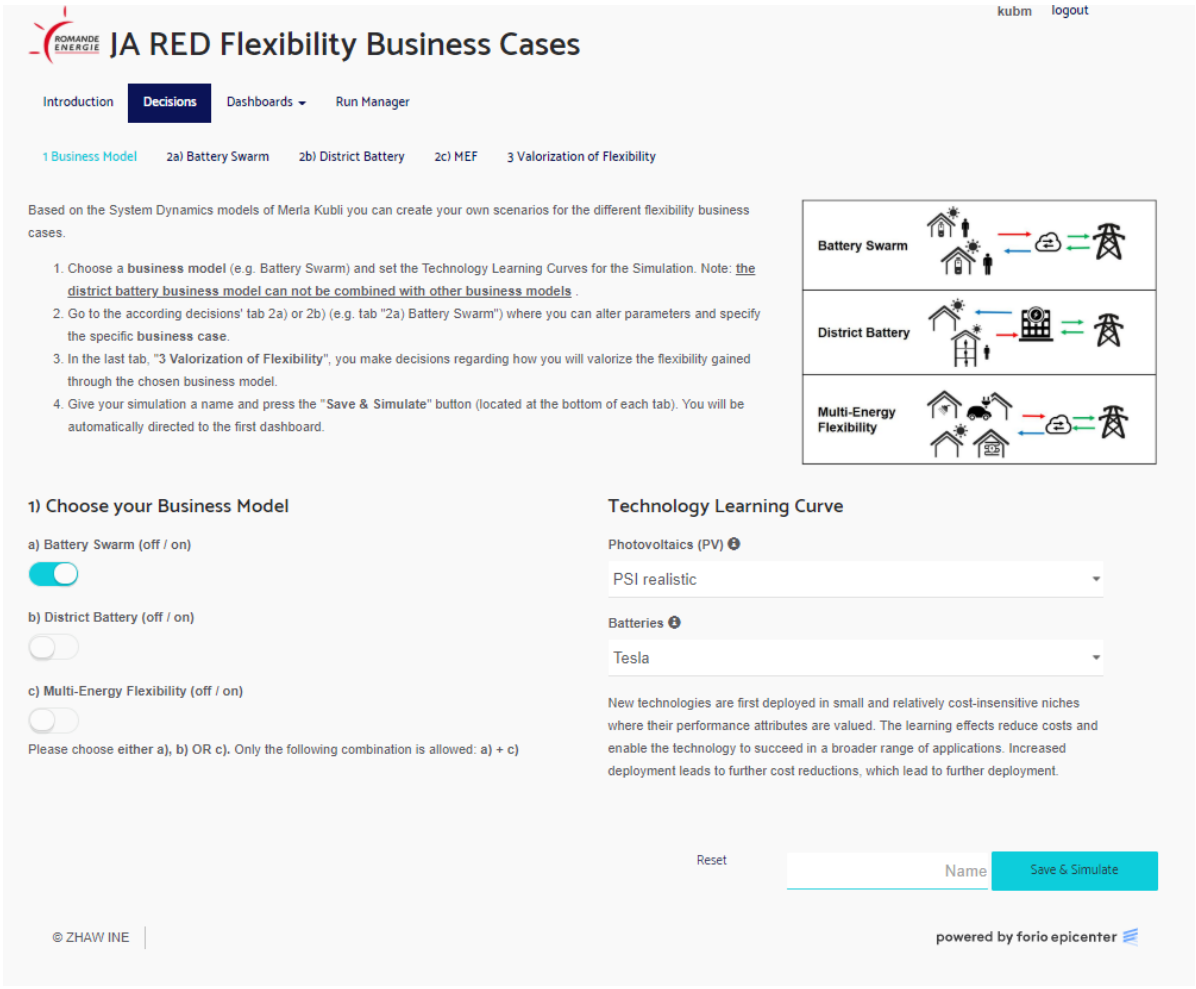

Figure 2: Front page for the decision options.

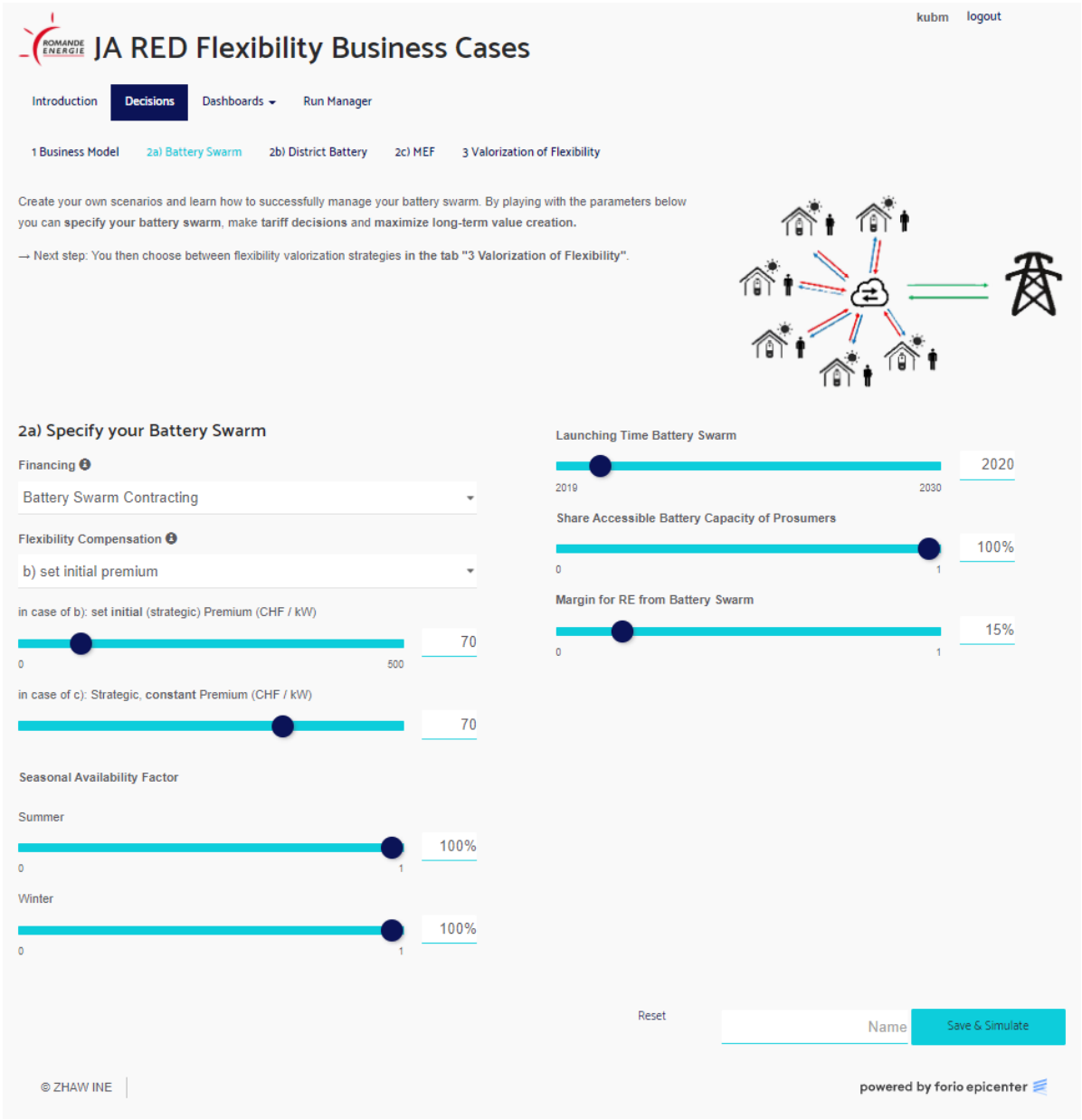

Figure 3: Decision options for the battery swarm business case.

Figure 4: Dashboard for the particular business case aspects of the battery swarm (selection).

2. Achievement of deliverable:

2.1. Date

July, 2019

2.2. Demonstration of the deliverable

Please see the description under point 1.4 that demonstrates the user-interface. In addition, the detailed simulation results and analysis are attached as a presentation (document "JA RED_District battery & Multi Energy Flexibility_Business Cases.pdf"). Furthermore, a comparative analysis between the two studied regions of Romande

Energie and Arbon Energie was conducted, also highlighting the synergies between the two partial projects. The results are documented in the presentation “Comparative analysis Romande Energie vs Arbon.pdf”.

3. Impact

3.1. Relevance to other activities

The advancement of the TREES simulation platform will enable using the same model structure with adaptation for testing flexibility business models for other regions, as well as testing new flexibility business models. The user-interface itself is a communications and user tool and therefore an end product. But the applied structure and software behind allow replicating this approach for other projects. This is also demonstrated by applying the same general principle for the user-interface for Romande Energie as well as for Arbon Energie.

3.2. Replicability

Both the advanced TREES simulation platform as well as the user-interface can be adapted for applications in other regions. Nevertheless, regional characteristics have to be taken into account as they influence the decentralization dynamics in a region as well as the profitability of the business models (as can be seen in the comparative analysis “Comparative analysis Romande Energie vs Arbon.pdf”). For these reasons some adaptions have to be made for replicating the conducted work.

3.3. Relevance to the energy transition

The TREES simulation platform along with its user-interface enable testing business strategies for decentral flexibility by energy actors. With this, a platform is provided to pre-test investments without facing the potentially wide reaching impacts, of both positive and negative nature. By doing so, we give the project partners a more solid basis for investment decisions in new business cases that will contribute to the Swiss energy strategy.

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Comparative analysis of Romande Energie vs. Arbon Energie

Decentralization dynamics and the business case of district battery renting model compared across two cases

Dr. Matthias Speich, Dr. Merla Kubli
(ZHAW, SCCER CREST)

SCCER CREST

In cooperation with the CTI
Energy
Swiss Competence Centers for Energy Research
Schweizerische Eidgenossenschaft
Confédération suisse
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Swiss Confederation
Commission for Technology and Innovation CTI

Objectives

- Comparative analysis of the business case of Romande Energie and Arbon demonstrators
- Hypothesis: Regional characteristics influence the decentralization dynamics of energy systems and the attractiveness of business models
- Research questions:
  - How do the decentralization dynamics of energy systems differ between the two regions in terms of the diffusion of prosumer concepts?
  - Which factors promote or hinder the success of the district battery renting business model in the two regions?

Outline

1. Characterization of the two regions
   - Historical growth of the number of prosumers
2. Comparison of the TREES reference simulation
   - Scenario where the utility does not offer a specific model for prosumers
   - Simulated market share of different prosumer concepts
   - Evolution of grid tariffs and electricity bill
3. District battery renting business model
   - Simulated market share of different prosumer concepts
   - Breakdown of the factors influencing pricing

Historical data

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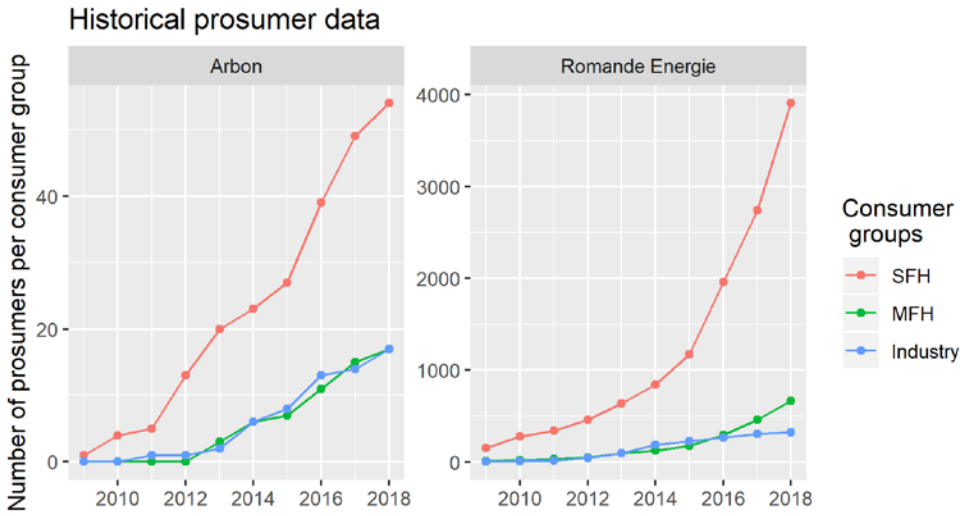
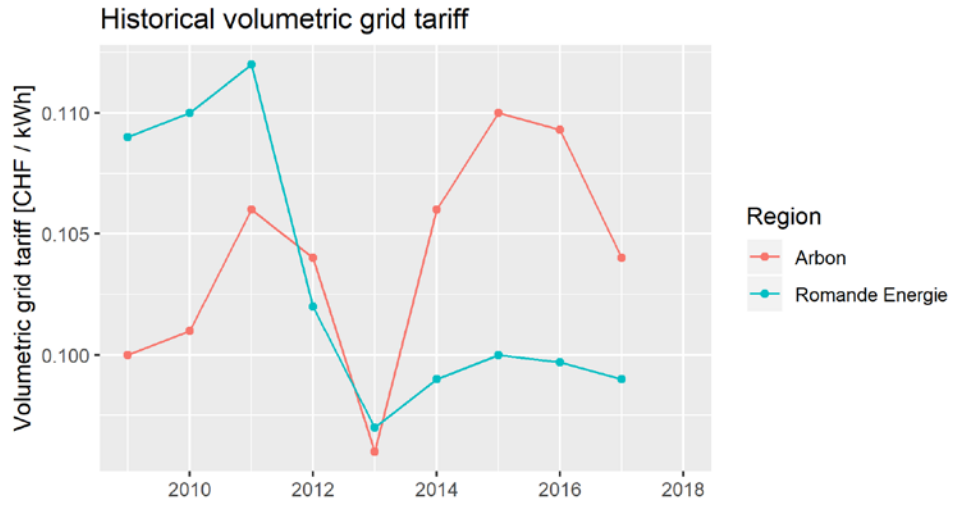
- In both regions, the number of customers with decentral PV production has grown steadily since 2009
- The two regions differ greatly in size (see Y-axes)
  - For the following comparison, the simulated number of prosumers are scaled by the total number of customers in each segment to enable a realistic comparison.



Source: KEV-Stammdatensatz, provided by Romande Energie and Arbon Energie



TREES reference simulation – Comparison with data

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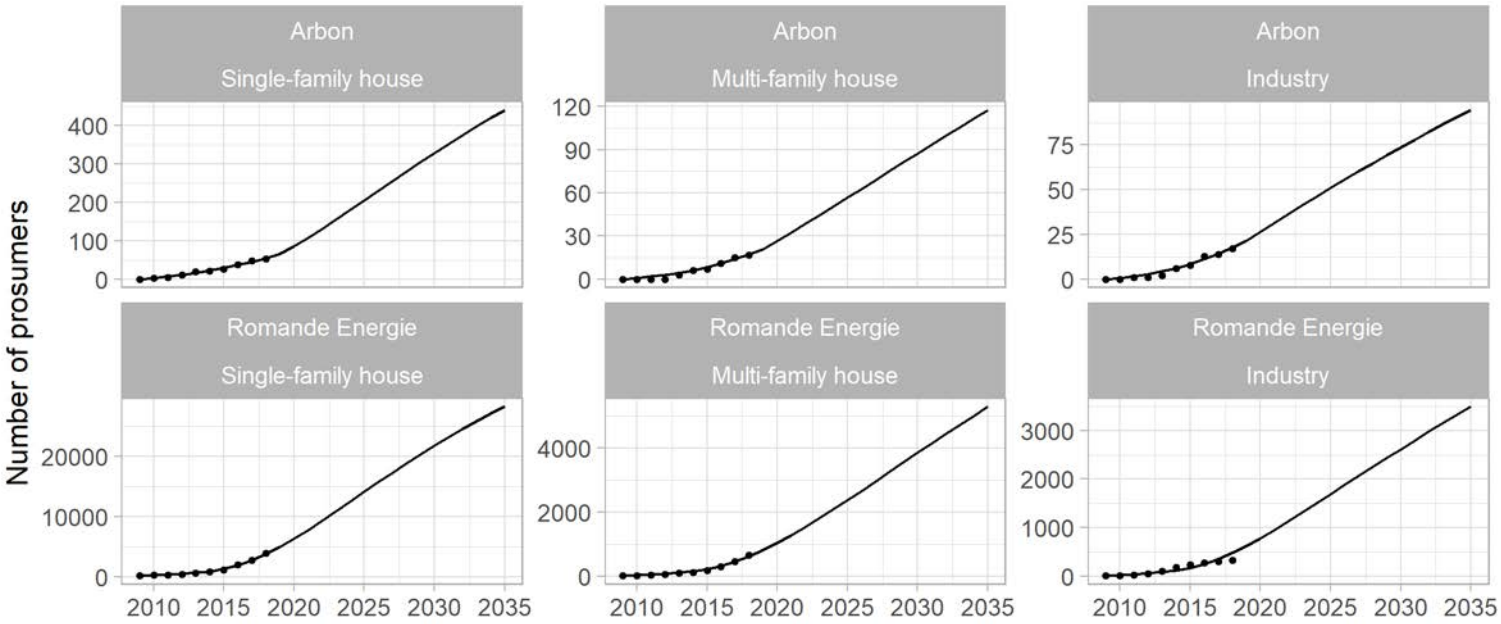
- In both regions, the model reproduces observed dynamics for the period 2009-2018
- Historical data includes all prosumer concepts (with or without storage)



Reference simulation – Diffusion of prosumer concepts

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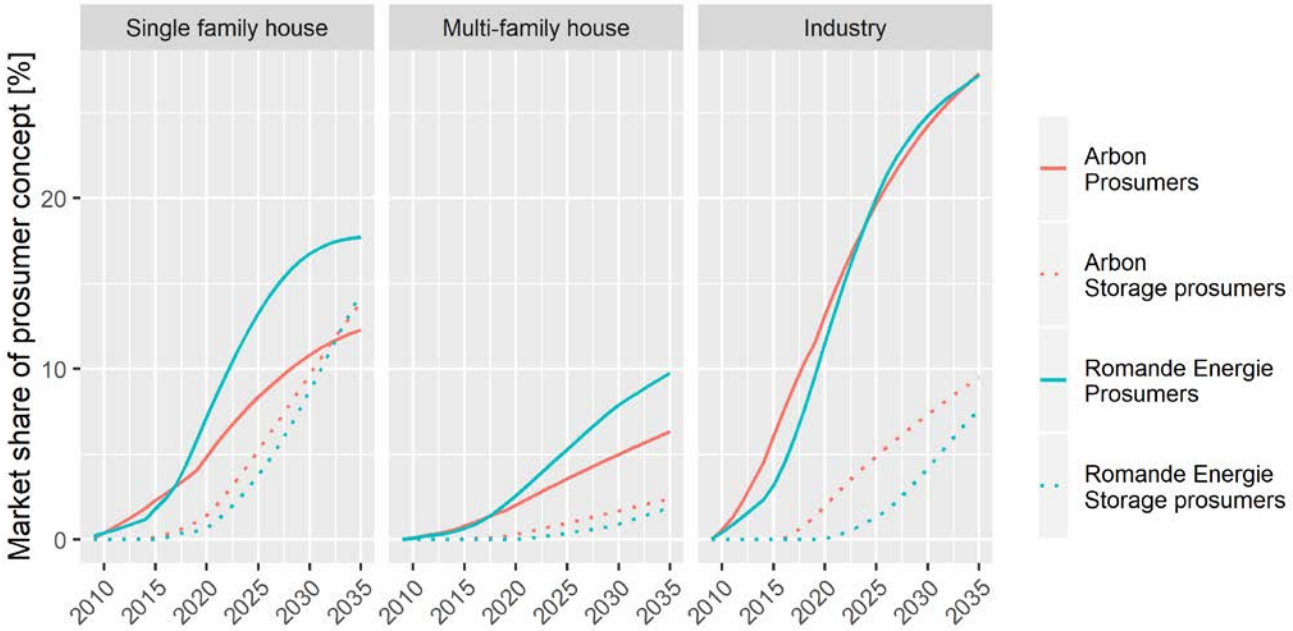
- Market share of (non-storage) prosumers is higher for Romande Energie than for Arbon among residential customers
- There are slightly more storage prosumers in Arbon. However, this effect does not offset the lower number of prosumers.



Reference simulation – Grid tariff

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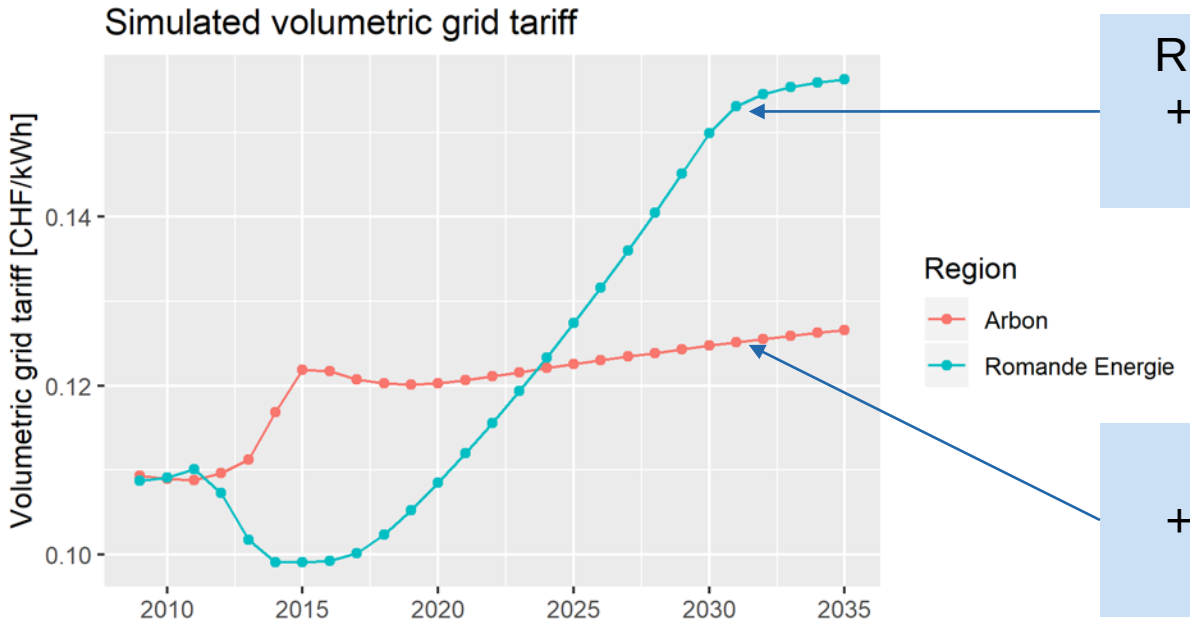

Romande Energie:
+ 4.8 Rp between 2020 and 2035

Arbon:
+ 0.6 Rp between 2020 and 2035

- Contributing factors
  - Assumed increase of grid costs:
    - no increase for Arbon (assumption by the project partner, due to extensive past investments into the grid infrastructure)
    - 3% per year for Romande Energie (standard assumption by the Swiss Federal Office of Energy)
  - Positive feedback between the number of prosumers and the grid tariff.

Reference simulation – Electricity bill

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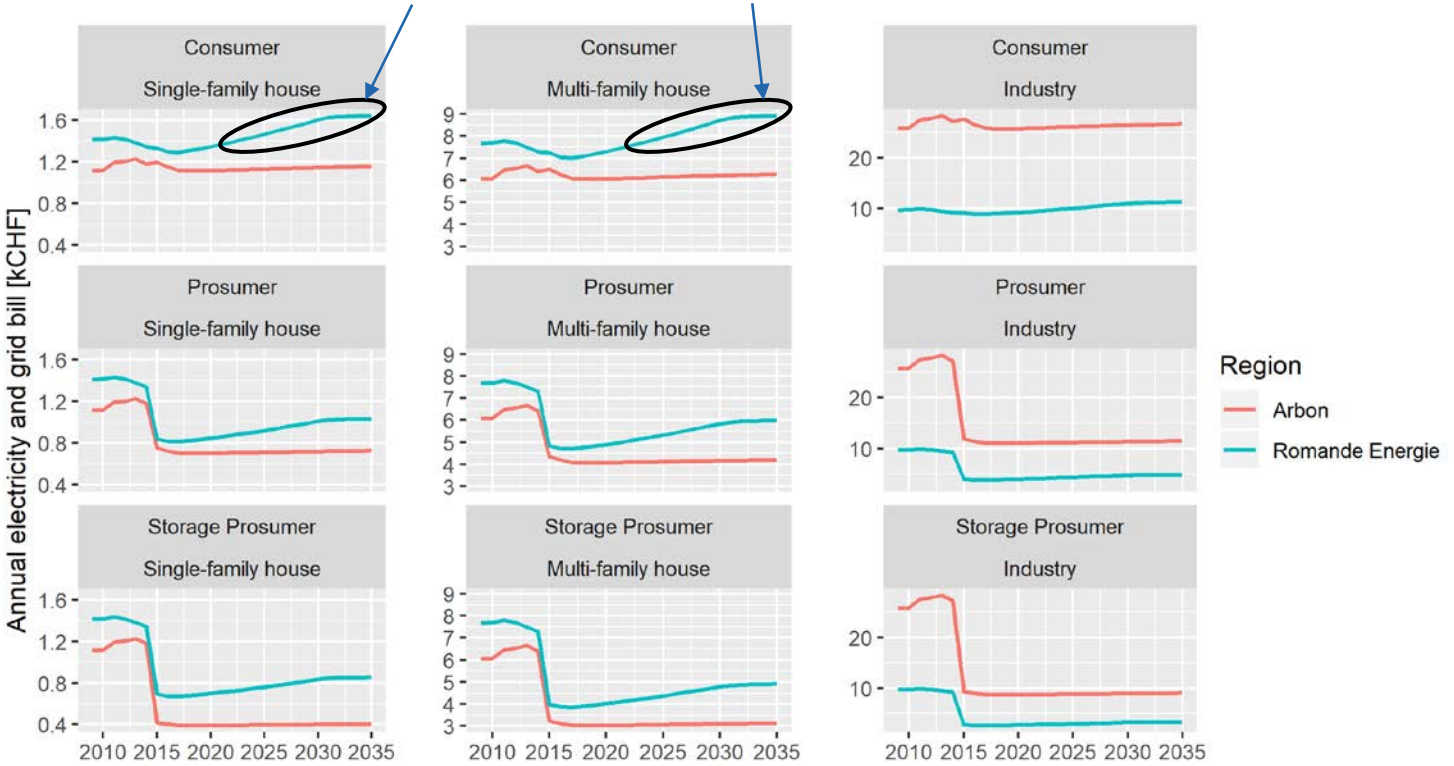
Increasing grid tariffs make it increasingly attractive to become a prosumer in the Romande Energie area. But also the electricity tariff and PV feed-in tariff incluence the attractiveness in a positive manner.



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District battery – Diffusion of prosumer concepts

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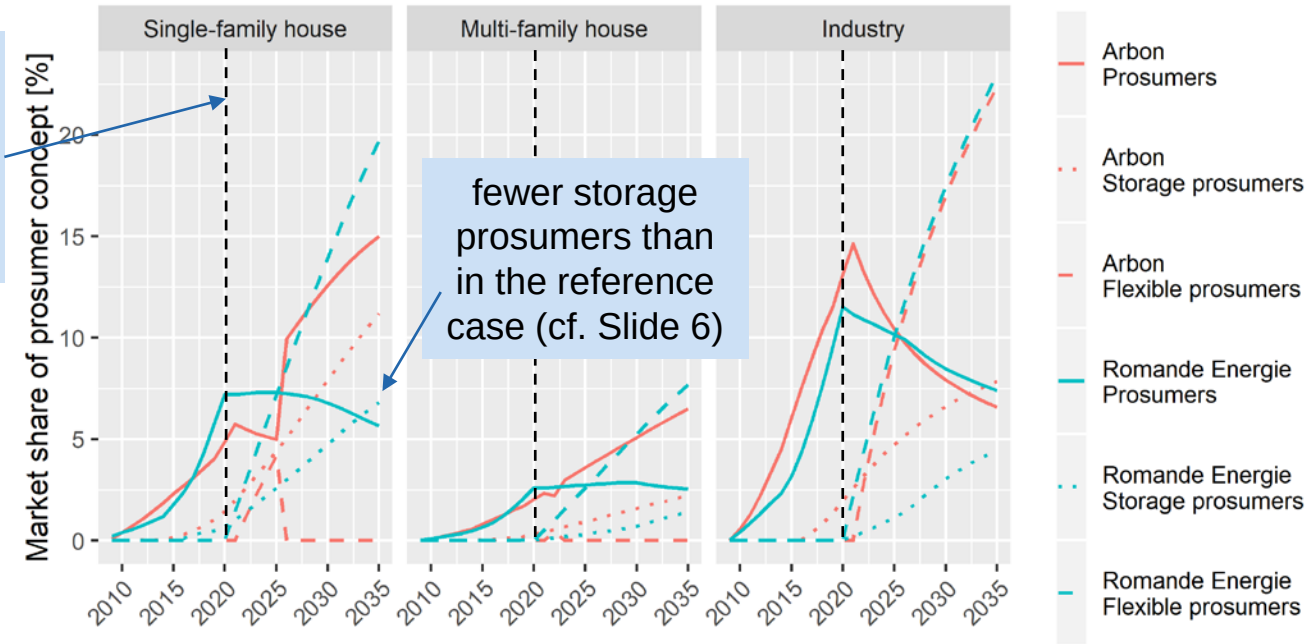
- The district battery offer is…
  - … attractive for all customer segments in the Romande Energie area
  - … only attractive for industrial customers in Arbon

Launch date of the district battery renting offer: 2020



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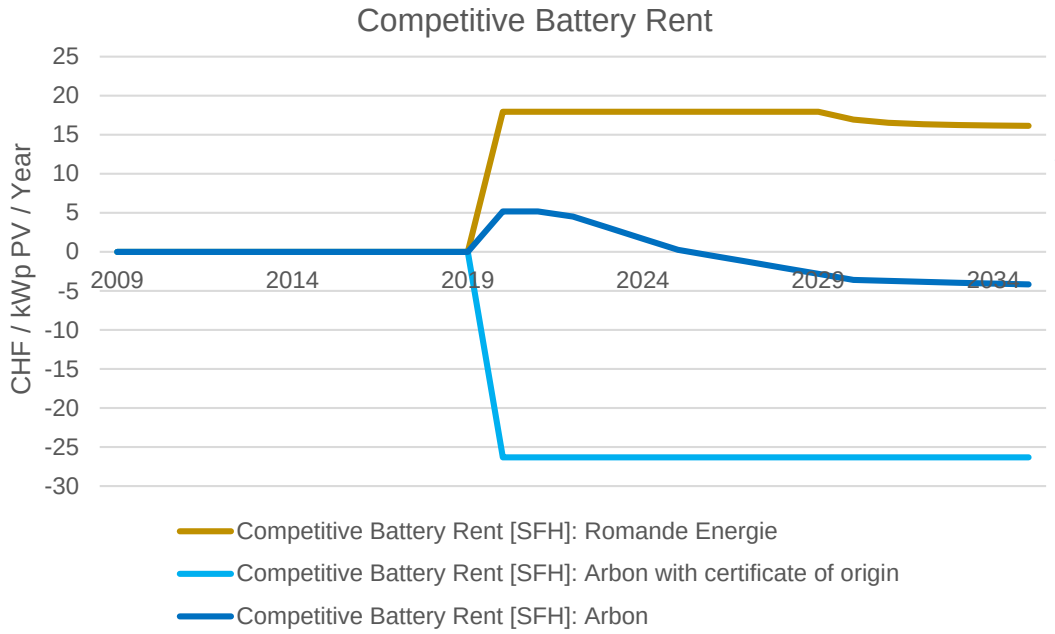
District battery – Competitive battery rent

- Competitive battery rent:
  - The price that the utility can charge for renting battery capacity, so that the offer is more attractive to the customer than the prosumer or home battery concepts
  - Negative values mean that the offer cannot compete with the alternatives



The competitive battery rent strongly depends on external factors (see next slides).

District battery – Customers' perspective

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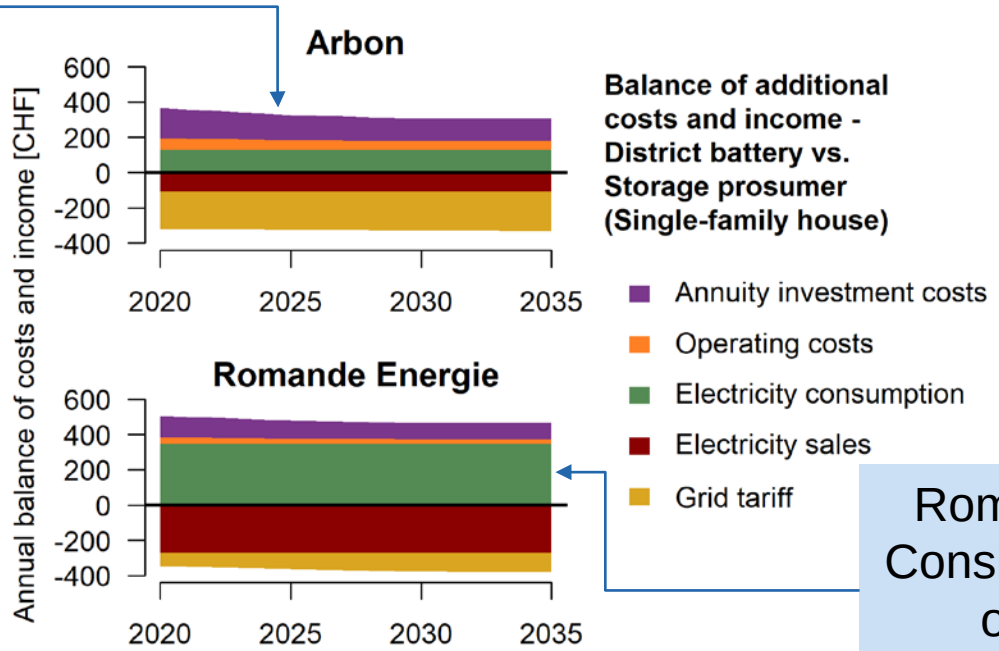
- Comparison of customers' costs and revenues for the district battery vs. home battery cases (for the case of a single-family house)
- District battery is attractive if: additional income > additional costs

Arbon: The offer becomes unattractive as home battery prices fall



Romande Energie: Considerable savings on electricity consumption

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Background information to the comparison

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	Arbon	Arbon with certificate of origin	Romande Energie
Battery size Storage Prosumer	7.44 kWh	7.44 kWh	4 kWh
Electricity price (inkl. taxes)	5.82 Rp/kWh	5.82 Rp/kWh	10.65 Rp/kWh
Grid tariff (in 2020)	12.06 Rp/kWh	12.07 Rp/kWh	10.85 Rp/kWh
Autarky degree Prosumers	37%	37%	37%
Autarky degree Storage Prosumers	65%	65%	48%
PV-feed in price	5.05 Rp/kWh	10.05 Rp/kWh	8.16 Rp/kWh

Supportive for the district battery renting model (high competitive battery rent)

Hindering for the district battery renting model (low competitive battery rent)

Insights from the comparison of the competitive battery rent across different cases

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The competitive battery rent….

- … is defined, depending on the situation, by the opportunity costs of prosumers respecitvely the storage prosumers.
- … reacts very sensitively to external factors (battery size capacity of storage prosumers (resp. Investment volume), electricity price, grid tariff, autarky degree and PV feed in tariff).

Summary – Comparative analysis Arbon vs. Romande Energie

- TREES reference simulation
  - In the area of Romande Energie, we observe a stronger decentralization trend, as compared to the area of Arbon Energie.
  - One essential factor, among others, is the substantial increase of the grid tariff in the case of Romande Energie, which incentivizes the adoption of prosumer concepts.

- District battery renting model
  - The district battery renting business model is successful for Romande Energie, in all customer segments.
  - For Romande Energie, the district battery renting offer reduces the number of prosumers with home batteries.
  - In Arbon, joining the district battery is financially less attractive than investing in a home battery for single-family and multi-family houses. With the industry consumers the most relevant target customer segment however still shows a lasting positive customer value.