Universität Basel
Wirtschaftswissenschaftliche Fakultät
WWZ

Energy storage in Switzerland:

A household model approach linking heat and electricity

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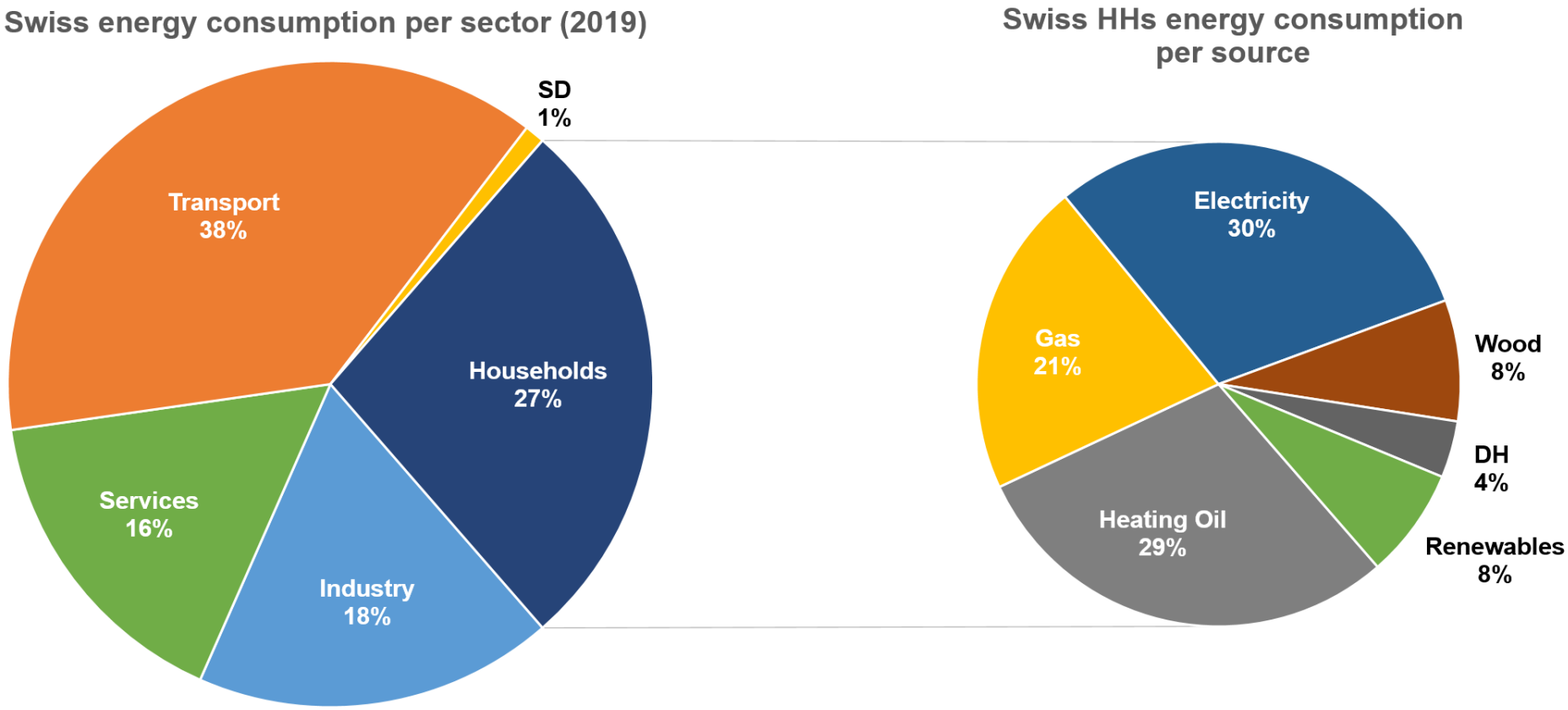
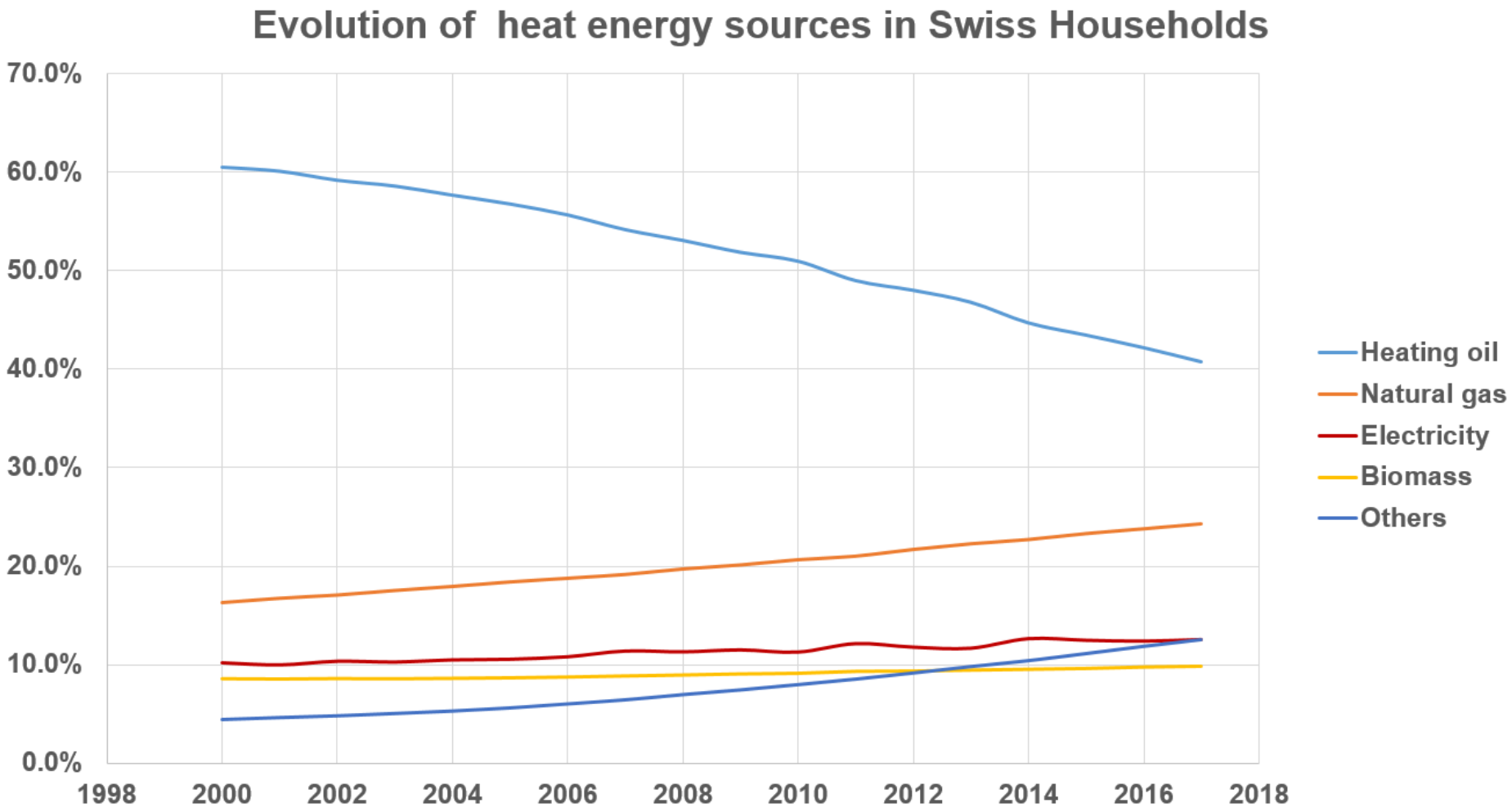
Relevance



Source: (BFE, 2020)

Relevance



Source: (BFE, 2020)

Relevance

- Energy Perspectives 2050+
  - **34 TWh** generation from **PV systems** (curr. 2 TWh)
  - Future investments in **electric battery systems**
  - **1,5 million** installed **heat pumps** (curr. 0,3 million)
  - **Well insulated buildings** with low heating demand

Research gap

- There is a research gap in combining:

  - **Sector coupling** between electric and heating storage models

  - **Technical and regulatory drivers** for energy storage systems

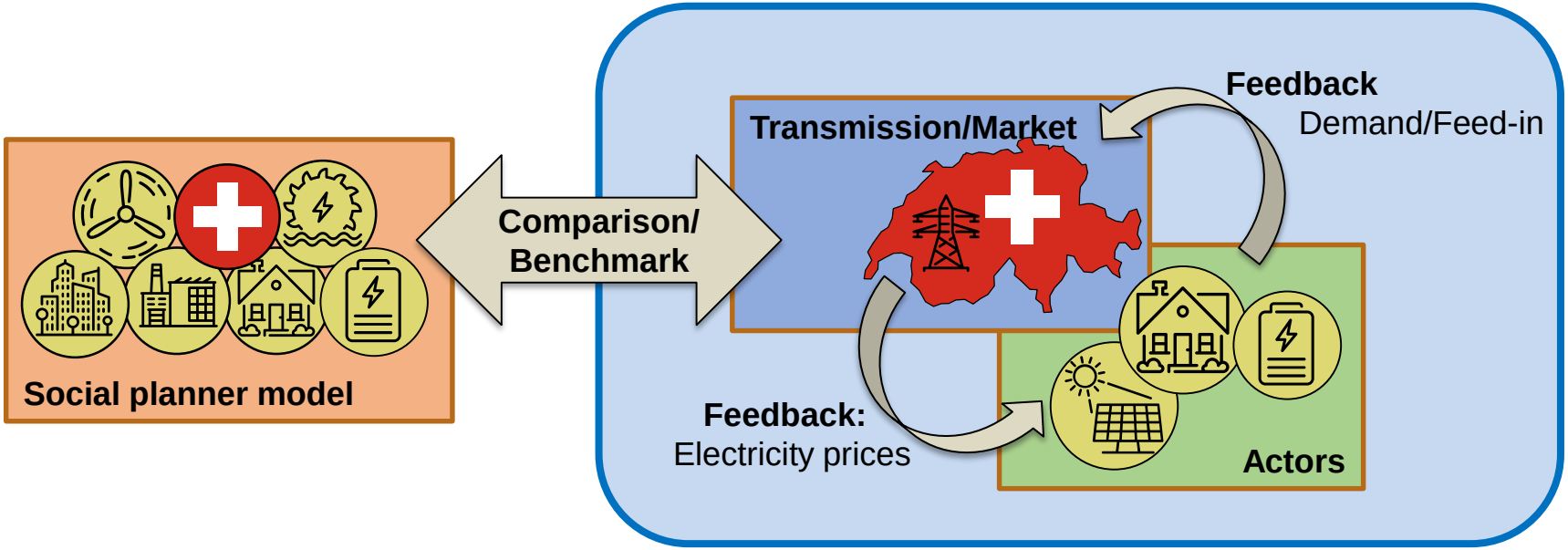
- This research will consider multiple technology options and will simulate different tariff schemes and support policies in a dynamic **cost-based scenario decision model**

Research questions

- What is the **role of energy storage technologies** in contributing to a **greater deployment of renewable energy technologies** and a more efficient and effective use of energy in the context of the Swiss Energy Transition?

- How do **energy storage technology** deployment based on individual actors' decisions **compare to the techno-economic / environmental optimal**?

SwissStore Project



Investment model's structure

A. Archetype description

- Building archetype definition
- Geographical location (COP, solar generation data)
- Energy demand profiles

Python

B. Technology description

- Technical and operational data of new technologies
- Costs (CAPEX, OPEX, replacement)
- Archetype compatibility

Python

C. HH electricity optimization model

- Minimization of the system's energy costs for different technology configurations

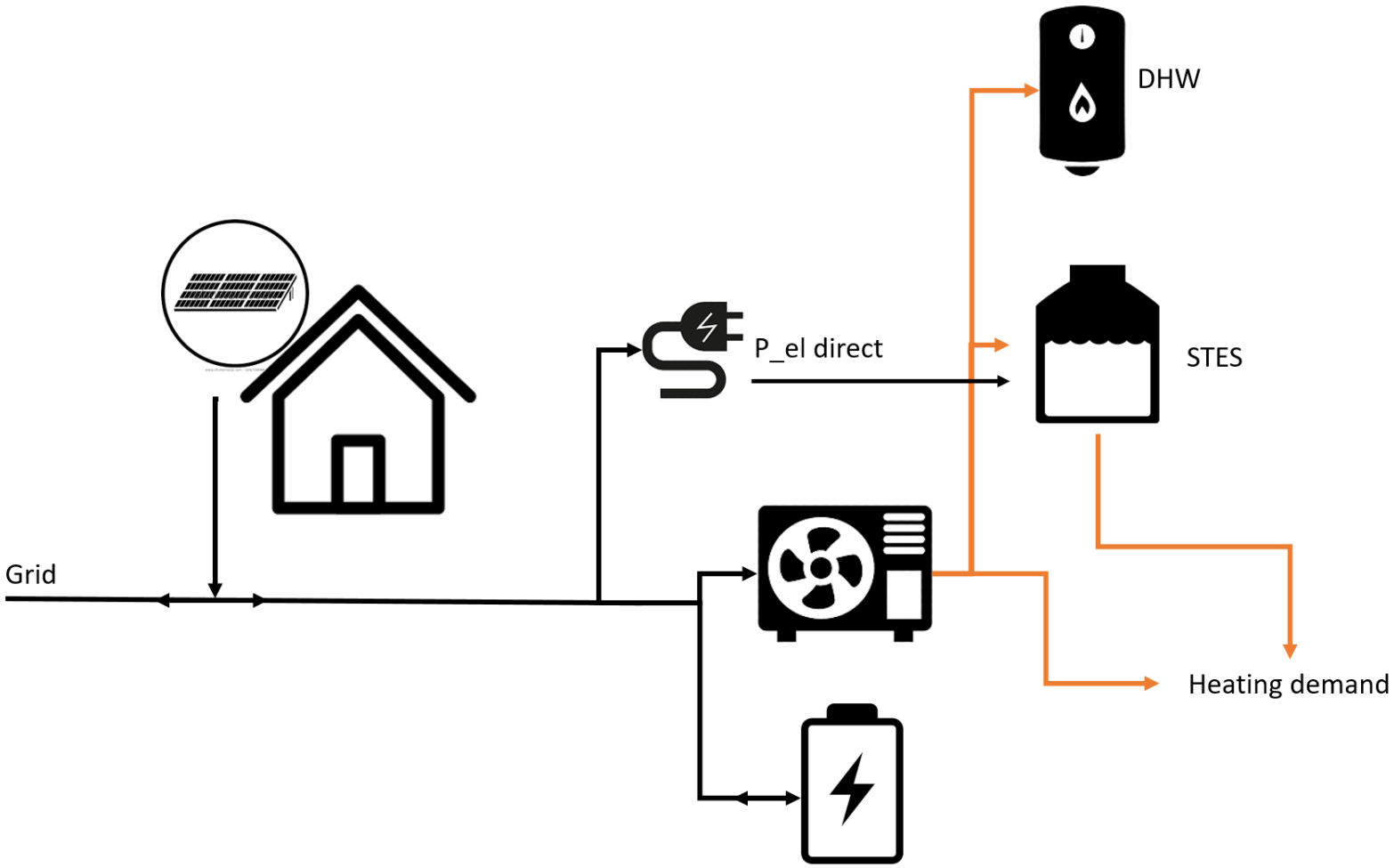
GAMS

D. Model integration

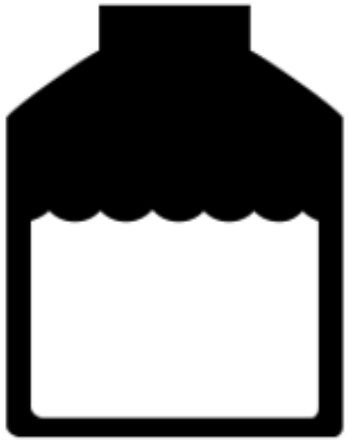
- Scenario definition and comparison
- Decision making process

GAMS & Python

Model's setting



Seasonal Thermal Energy Storage (STES)



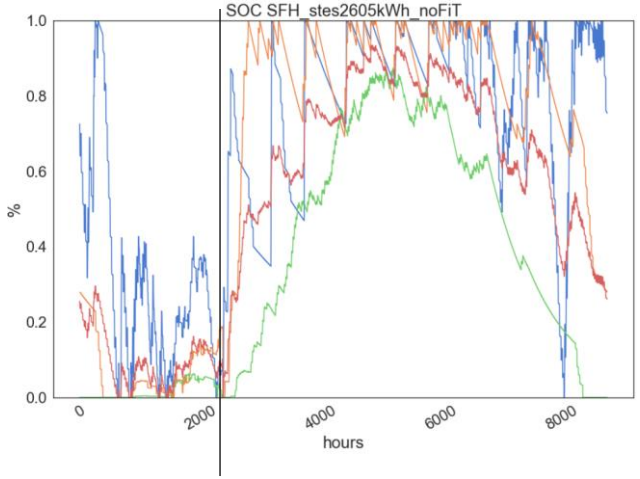
Parameter	Level 1	Level 2	Level 3
Temperature	35 °C	60 °C	90 °C
Efficiency	COP30	COP60	1
Volume	Small	Medium	Large
Charge / Discharge	Independent	Independent	Independent

STES simulation

Parameter	Scenario		
	No FiT	Low FiT	High FiT
Tariff (CHF / kWh)	0,35	0,35	0,35
Feed-in Tariff (CHF / kWh)	0	0,01	0,3
STES Relative capacity (%)	32%	32%	32%
PV Relative Capacity (%)	100%	100%	100%

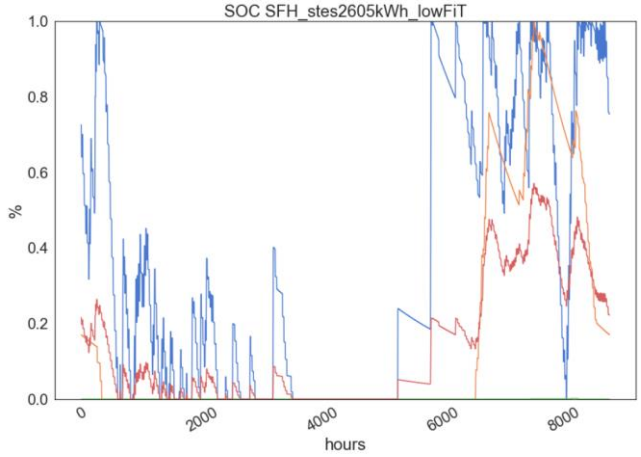
STES simulation

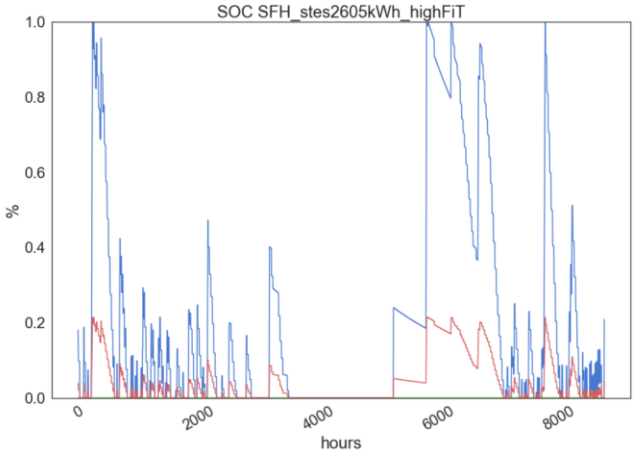
No FiT – 0 CHF/kWh



Start of Simulation

Low FiT – 0.01 CHF/kWh





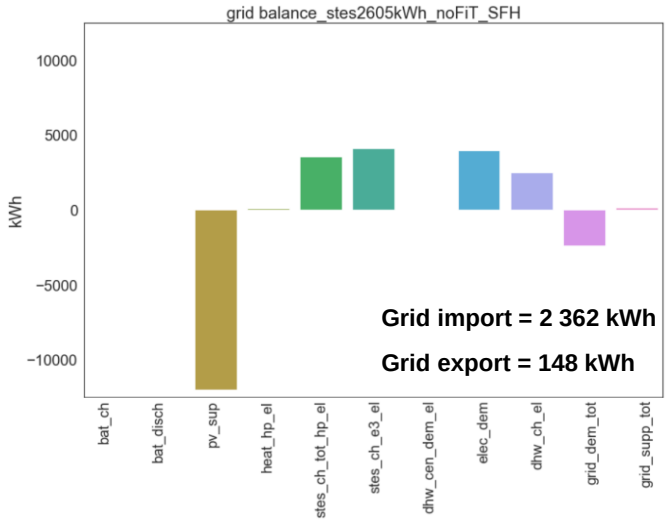
High FiT
0.3 CHF/kWh

STES – SOC

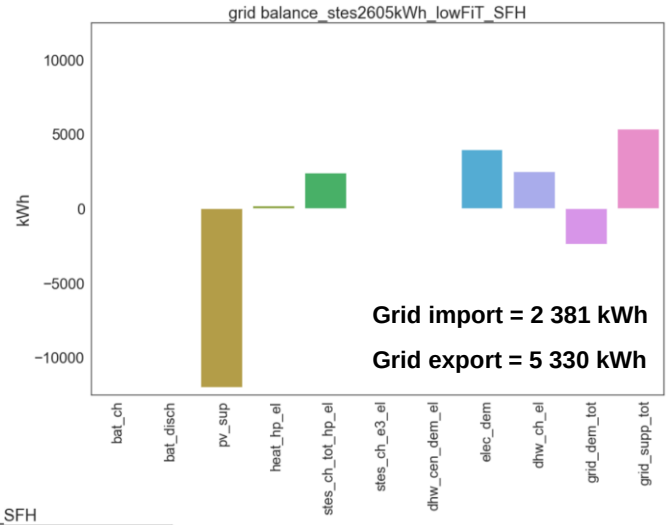
- PVmax
- STES 2605 kWh capacity (32%)
- Electricity price = 0,35 CHF/kWh

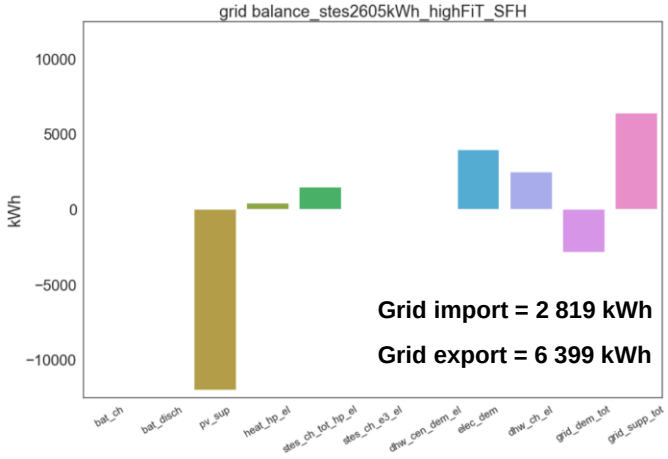
STES simulation

No FiT – 0 CHF/kWh



Low FiT – 0.01 CHF/kWh





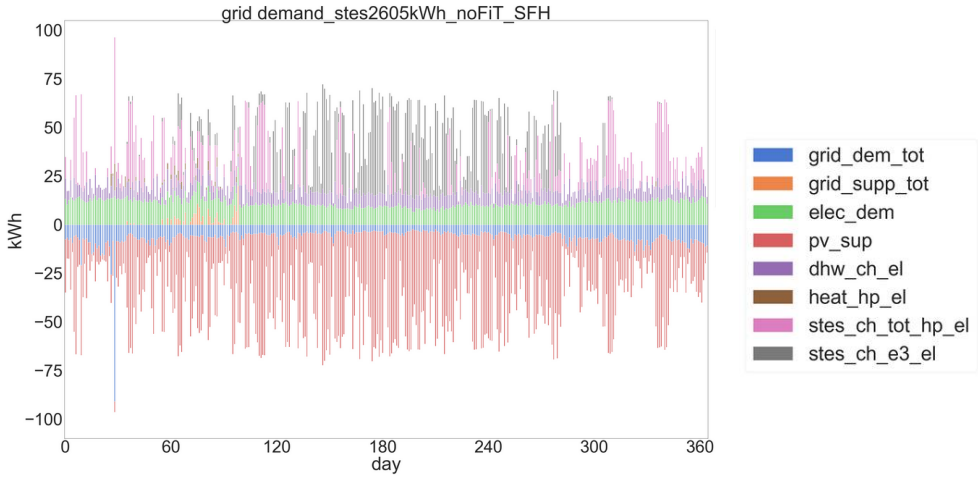
High FiT
0.3 CHF/kWh

Energy Balance – Electricity

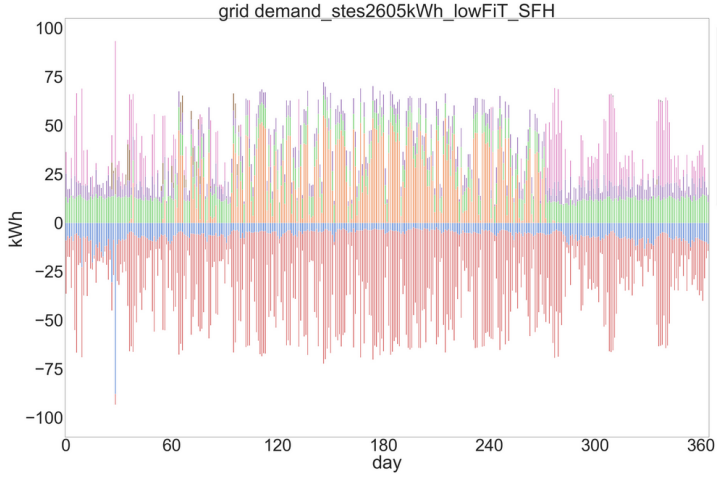
- PVmax
- STES 2605 kWh capacity (32%)
- Electricity price = 0.35 CHF/kWh

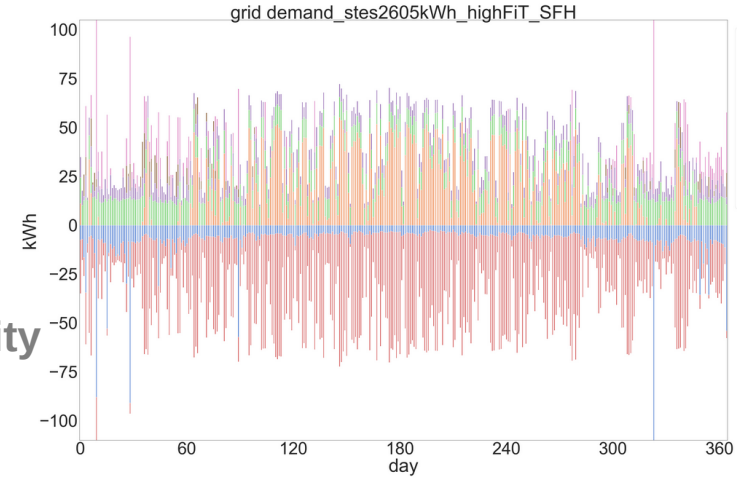
STES simulation

No FiT – 0 CHF/kWh



Low FiT – 0.01 CHF/kWh





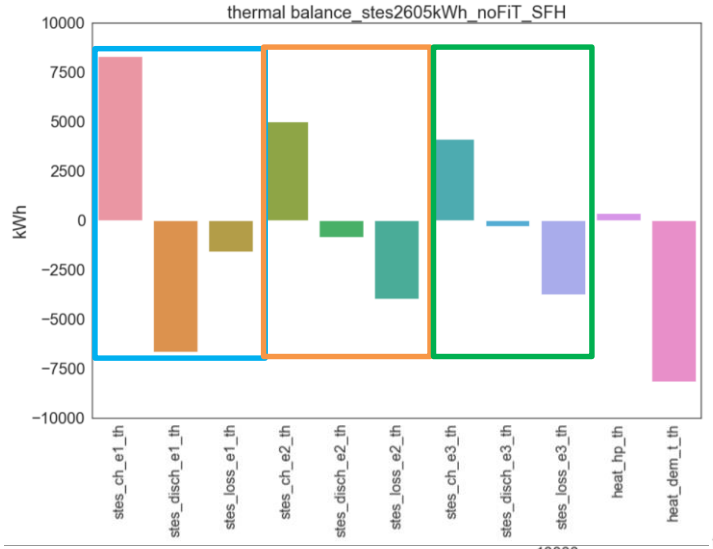
High FiT
0.3 CHF/kWh

Energy Balance – Electricity

- PVmax
- STES 2605 kWh capacity (32%)

STES simulation

No FiT – 0 CHF/kWh

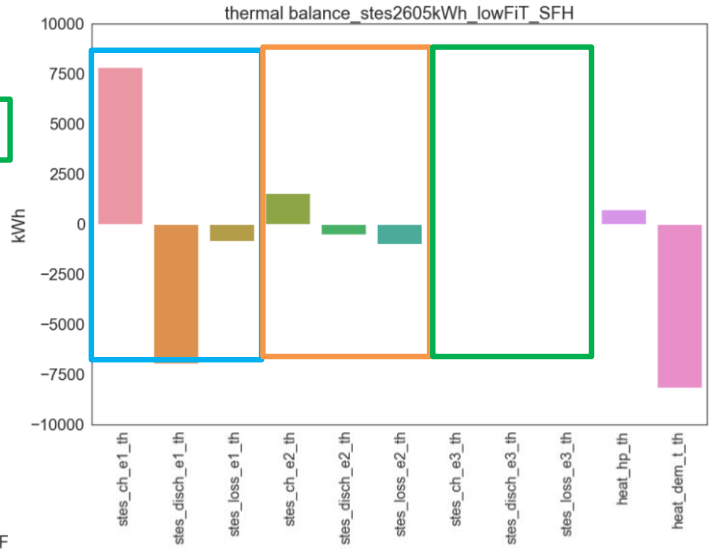


Level 1 Level 2 Level 3

Relative losses = 54%

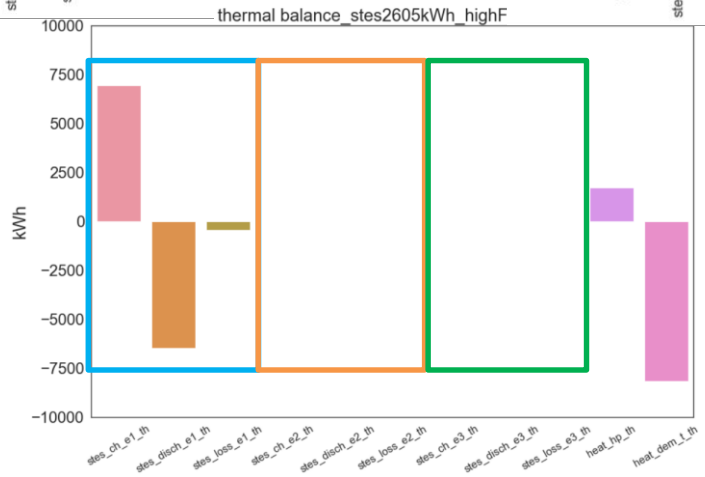
STES heat coverage = 96%

Low FiT – 0.01 CHF/kWh



Relative losses = 20%

STES heat coverage = 91%



High FiT
0.3 CHF/kWh

Relative losses = 7%

STES heat coverage = 79%

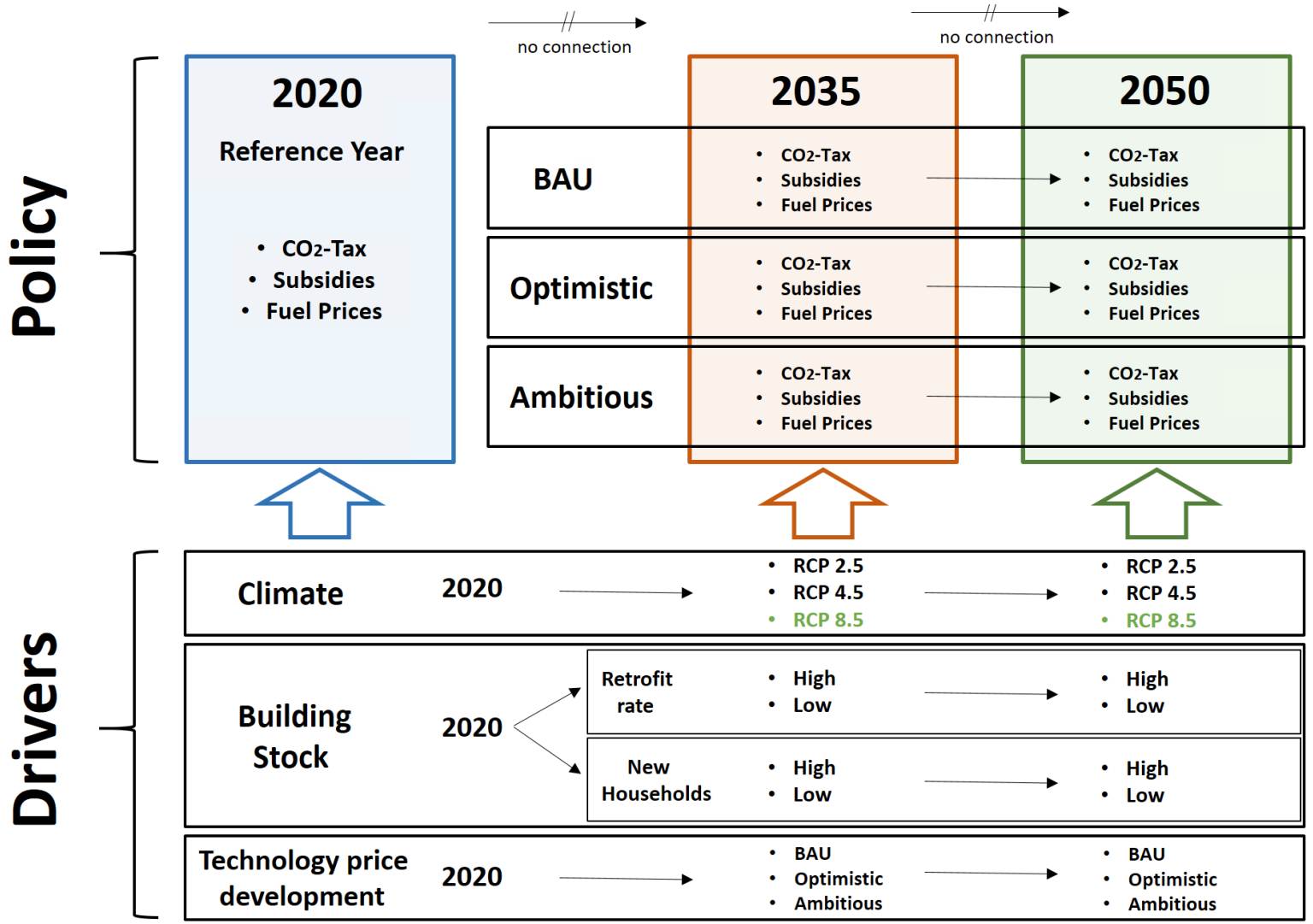
Energy Balance – Thermal

- PVmax
- STES 2605 kWh capacity (32%)
- Yearly Balance

STES simulation

- The operation of **the PV system and STES** is extremely **sensitive** to the **tariff** structure and installed **PV capacity**
- Without a FiT scheme, the STES **burns** energy **during summer**
- In the presence of a **FiT**, the STES is **charged** only **briefly before** the heating season starts
- If the **FiT is high enough**, the system will **feed into the grid** even during **winter**
- For the selected STES, energy **level 3** is **no longer used** when there is a **FiT**

Scenario development



Next steps

- Finalize the **scenario definition** for both the ***Policy*** and the ***Drivers*** dimensions

- Integrate the **investment** and **social planner** models

- Run the **integrated model** for the **full data set and scenarios** and analize the results

Thank you for your attention!