Universität Basel
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WWZ

Energy storage in Switzerland:

A household model approach linking heat and electricity

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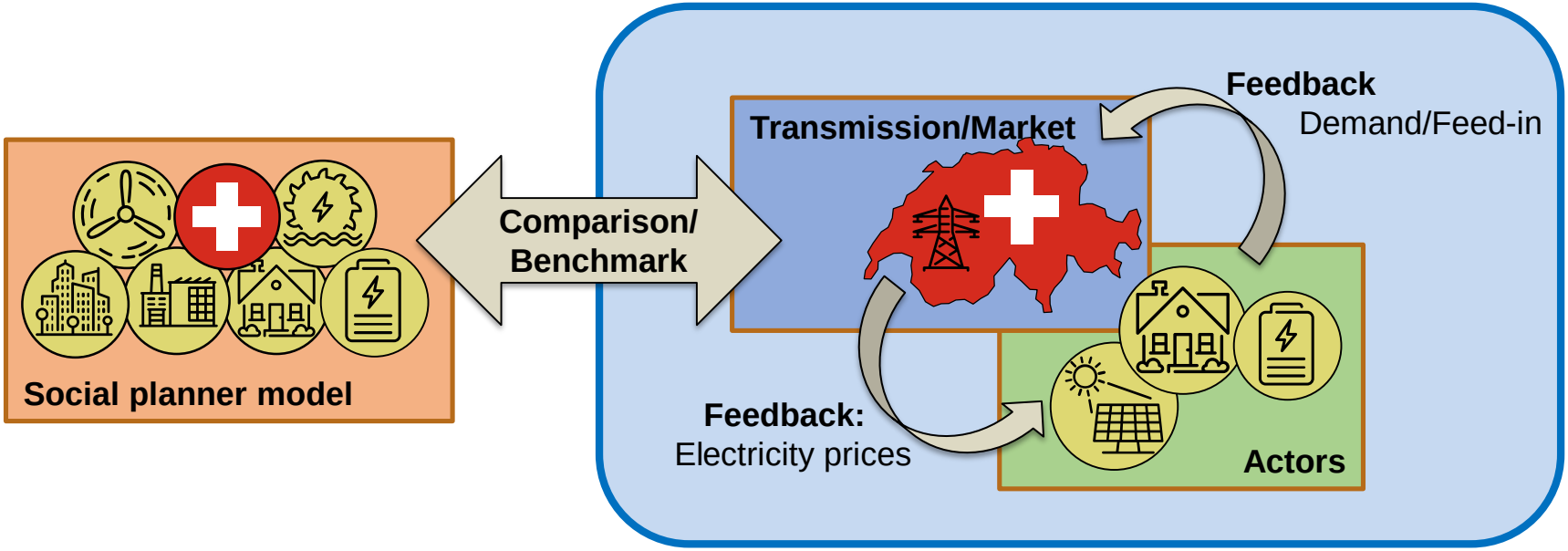
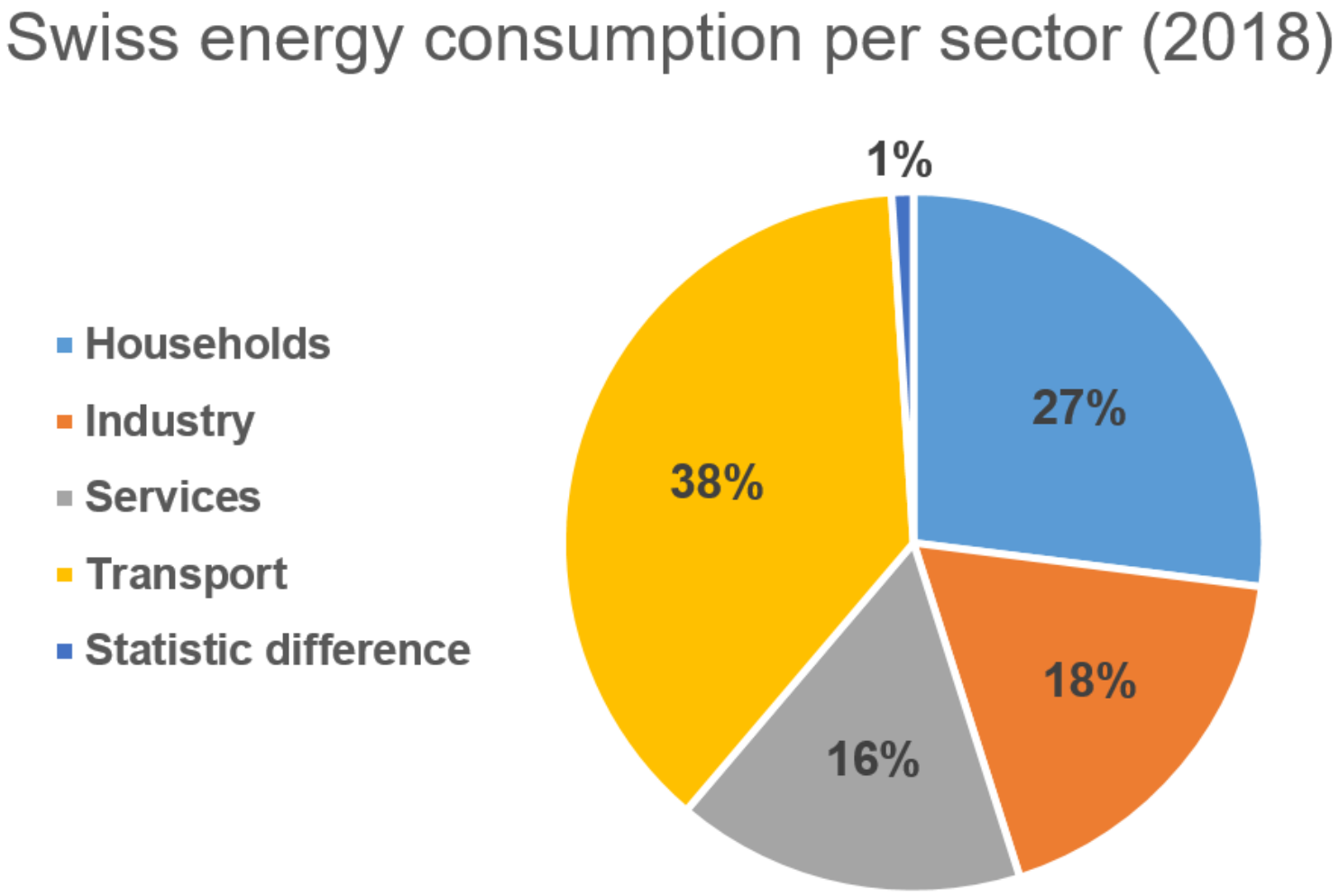
Bi-level actor-based model



Why are Swiss Households relevant?



Source: (BFE, 2018)

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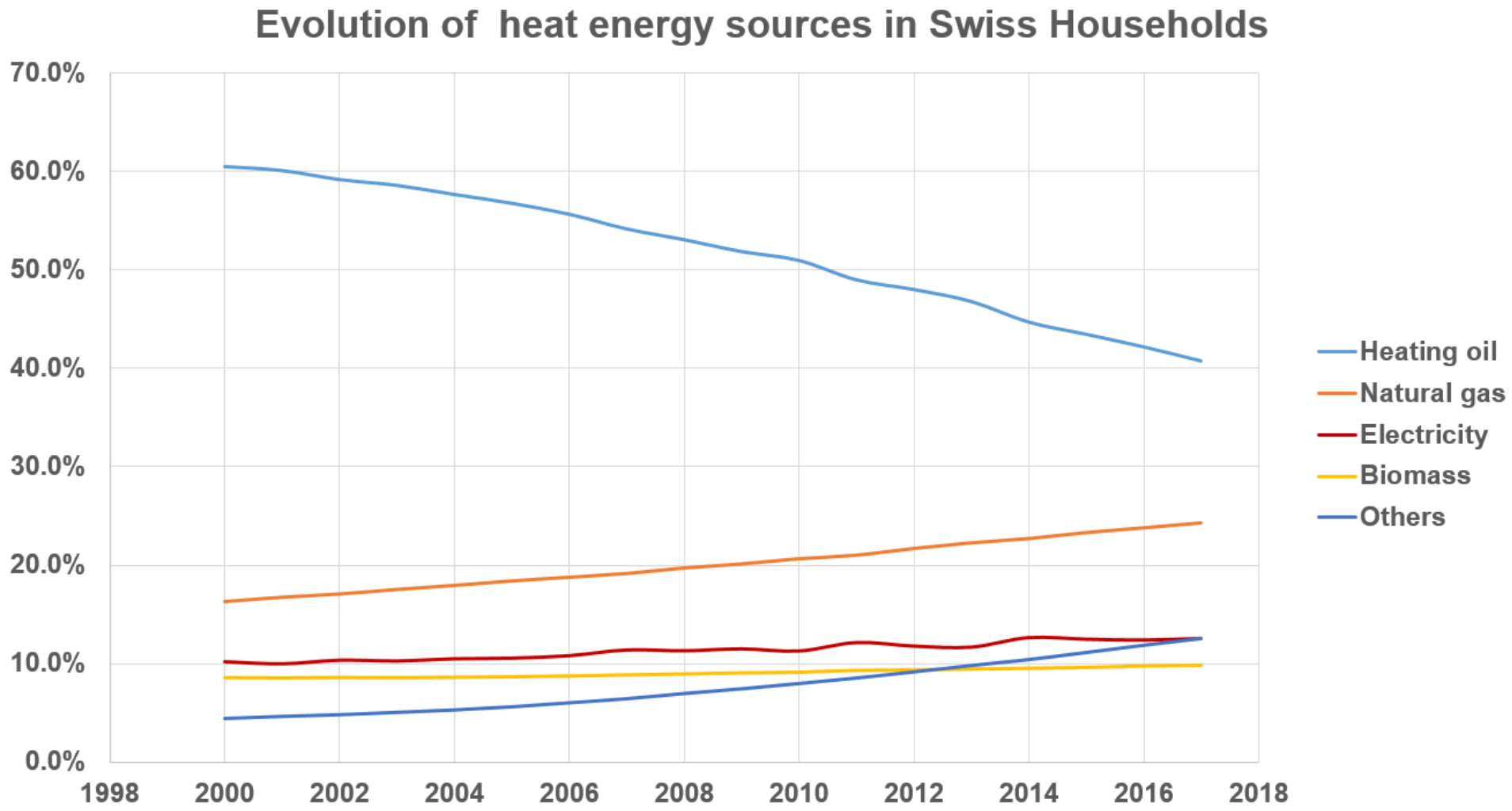


Source: (BFE, 2018)

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

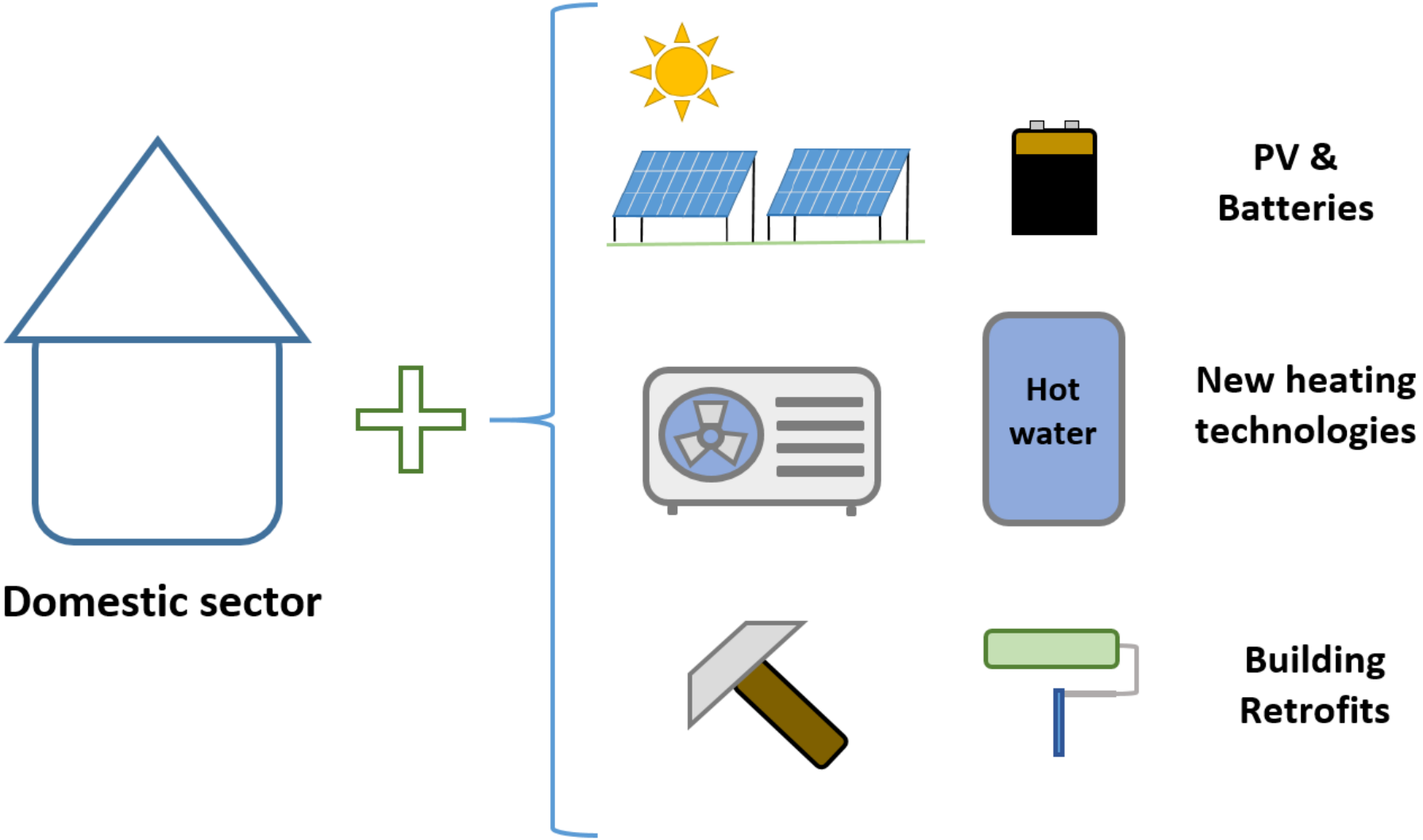
- This research will consider multiple technology options and will simulate different tariff schemes and support policies in a dynamic **cost-based scenario decision model**

Research questions

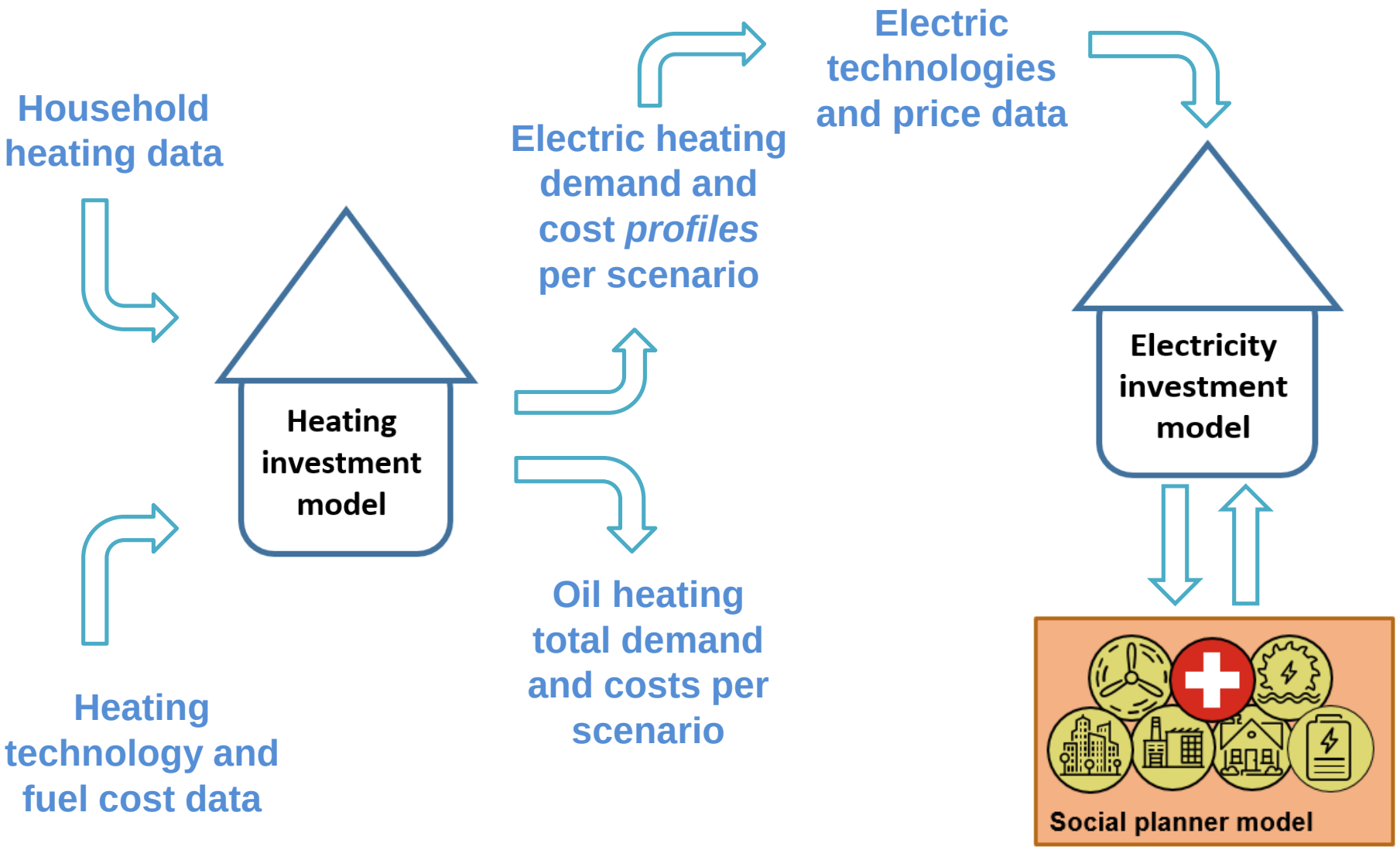
- What is the **role of energy storage technologies** in contributing to a **greater deployment of renewable energy technologies** and a more efficient and effective use of energy in the context of the Swiss Energy Transition?

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

The model - Current scope



The model - Structure



The model - Structure

A. Data processing

- Energy demand profiles
- Data parametrization of new technologies
- Solar generation data

Python

B. Fossil fuel based heating technologies

- Demand and costs calculation for fossil fuel heating technologies
- Geographical location

Python

C. HH electricity optimization model

- Optimization of the system's energy flows

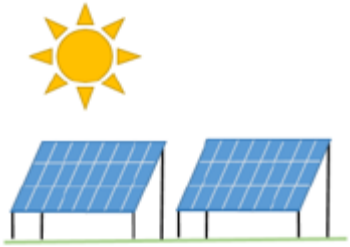
GAMS

D. Model integration

- Comparison of all scenarios
- Decision making process

GAMS & Python

Case study – Preliminary results



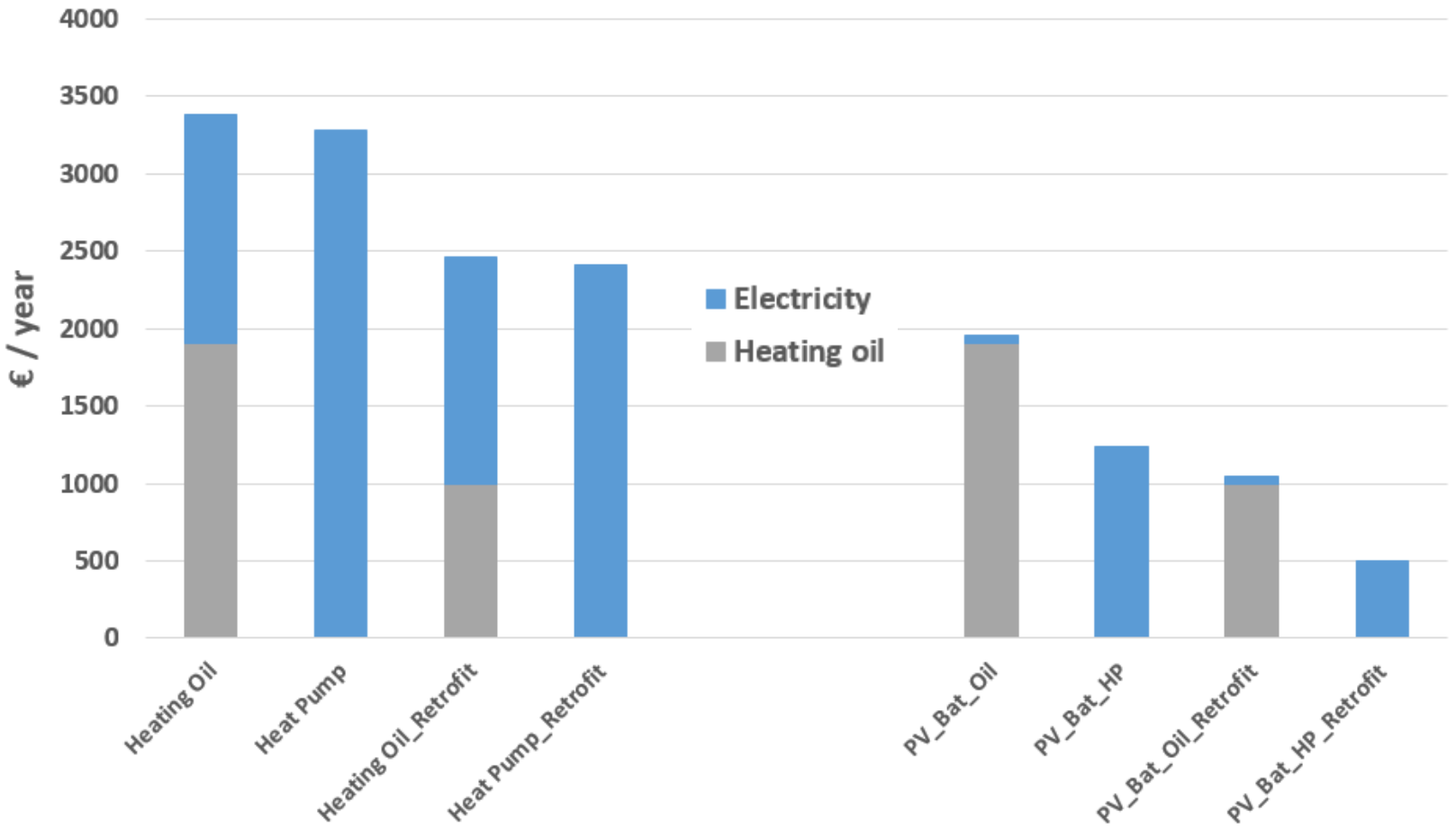
Photovoltaic (PV) system
10 kW
2300 € / kW

Heating system
Heat Pump (HP) 10 kW
Storage tank 7 kWh
27 300 €

Lithium Nickel Manganese Cobalt Oxide (LiNMC)
10 kWh
2550 € / kWh

Retrofits
Savings factor of 52,1%
428 € / sqm

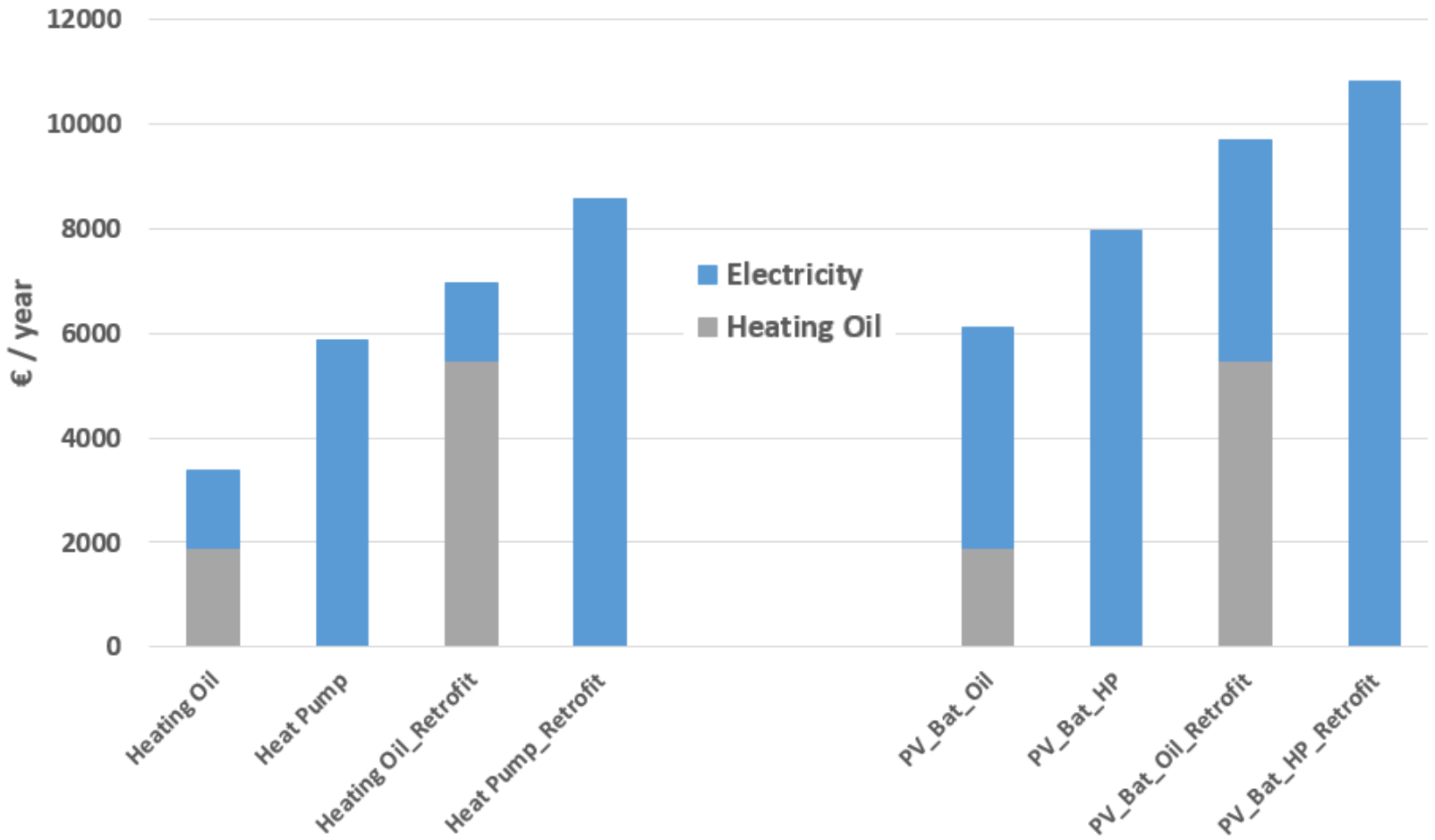
Operational expenditure for a selected HH



- Considering a double tariff of 36,98 Rp. / kWh at day and 27,7 Rp. / kWh at night
- The model will also includes other tariff and incentive schemes

Source: (iwb, 2019)

Annual total expenditure for a selected HH



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Source: (iwb, 2019)

Next steps

- **Modelling and integrating** the full set of demand and technology **data**

- **Include all household stock** (more than 300 thousand buildings) and **technology scenarios** into a single and **computing-efficient model**

- Simulate different **tariff schemes and support policies** in a dynamic **cost-based scenario decision model**

Thank you for your attention!

Preliminary results

Archetype	egid	canton	hvacrtype	area_m2	TH002.010.002		
					CAPEX + OPEX	Flat tariff cost	Double tariff cost
1980-MFH-Urban	733	ZH	HP	820	3146	10796.79	10350.27

TH002.010.002 + Retro			BAU + retro	
CAPEX + OPEX	Flat tariff cost	Double tariff cost	Flat tariff cost	Double tariff cost
12138.67	17356.51	17051.98	14983.54	14633.9

Swiss heating household data

304 632 buildings containing:

- Yearly heating demand profiles (daily resolution)
- Type, age and geographical location of the building
- Current heating technology
- Retrofit energy saving potential and cost

Swiss PV and electric storage technology data

- PV technical parameters and costs projected to 2050
- Battery technical and operational parameters and costs
- Household electricity demand profiles (dummy)
- Solar generation capacity factor profiles

Swiss heating technology data

- Thermal technology “packages” (in future versions it will include storage and domestic house water)
- Technical parameters and costs of heating technologies (efficient oil boilers, heat pumps) projected to 2050

Preliminary results

Building 733's heating demand for different scenarios (kWh)

	Demand BAU	Demand TH002.010.002	Demand TH002.010.002 + Retro	Demand BAU + retro
1	210.307157	183.170218	124.922089	143.429481
2	184.226865	160.455191	109.430440	125.642722
3	142.695735	124.283021	84.761020	97.318491
4	142.060278	123.729560	84.383560	96.885110
5	181.001885	157.646346	107.514808	123.443286
6	187.001464	162.871770	111.078547	127.534999
7	171.675854	149.523697	101.975161	117.082932
8	139.737993	121.706931	83.004127	95.301311
9	116.490835	101.459465	69.195355	79.446749