FLEX+

Market participance of retail customer flexibility by pooling

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Das Projekt Flex+ (864996) wird im Rahmen der 4. Ausschreibung des Energieforschungsprogrammes der Forschungsförderungsgesellschaft (FFG) und dem Klima- und Energiefonds gefördert

FLEX+

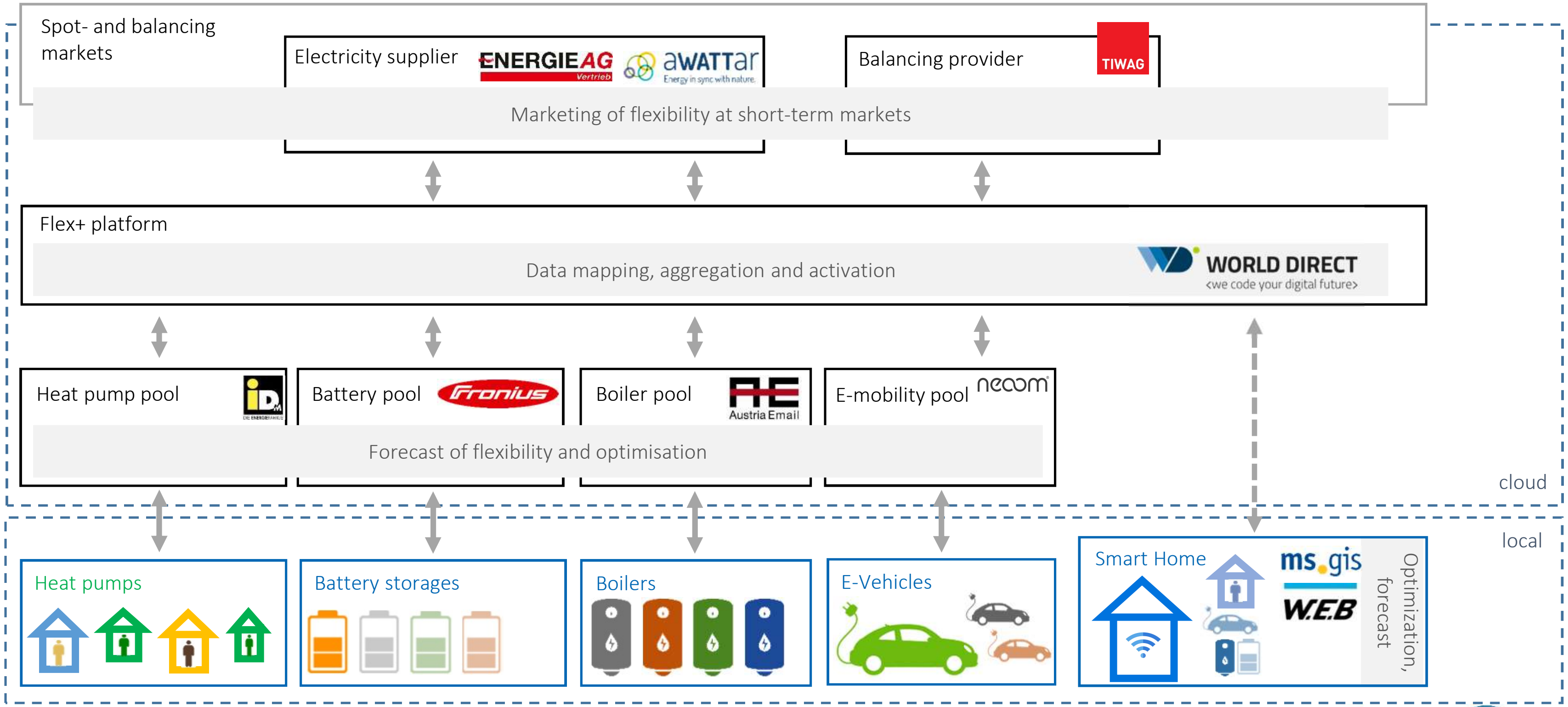
Key Facts Flex+

Key Facts

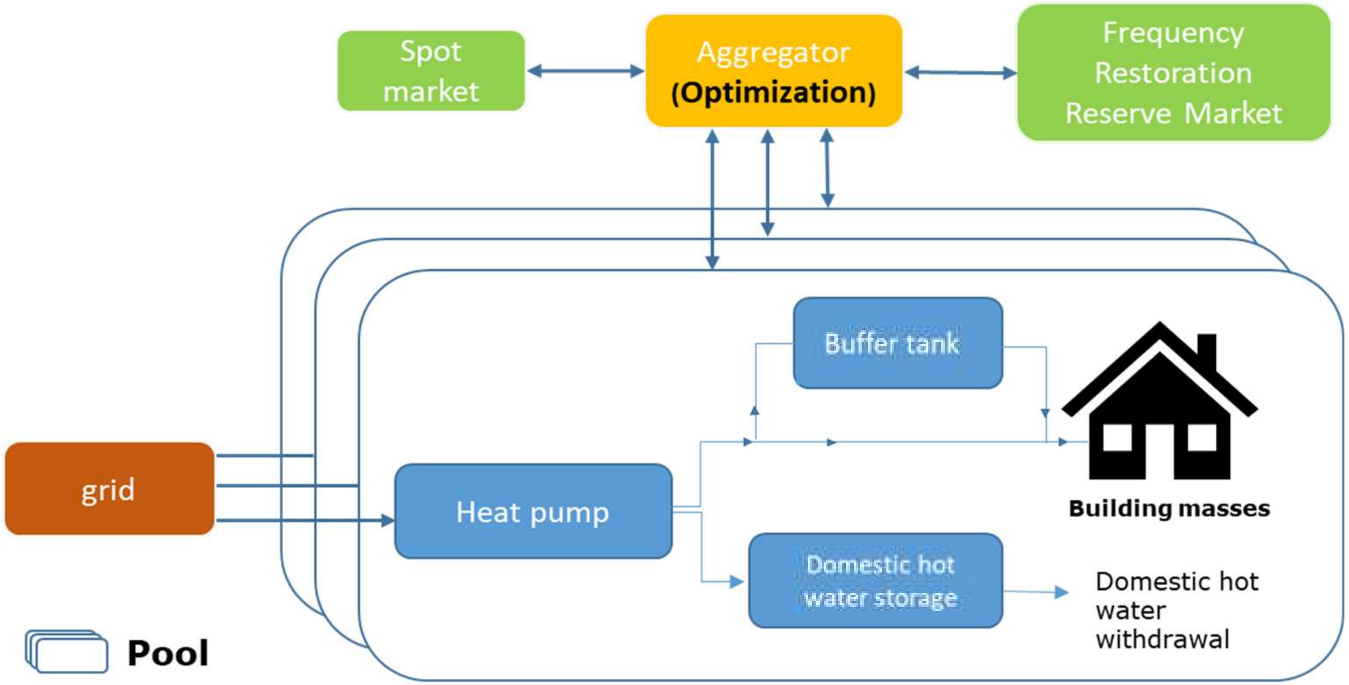
- Project runtime: 3.5 years (05/2018 – 09/2021)
- Sponsored within the scope of the program „4. Energieforschungs-Ausschreibung"
- All project partners for a potential „flexibility value-chain"

Project partners				
Market access	**IT**	**Component manufacturers**	**Customers**	**Research Institutes**
TIWAG	World Direct	Fronius (batteries)	W.E.B.	AIT
aWATTar		iDM (heat pumps)	Sonnenplatz Großschönau	FHTW
Energie AG		Austria Email (boilers)		EEG
		neoom (e-mobility)		SCCH
		MS.GIS (Smart Home)		

Commercialization of flexibility



Structure of heat pump pool



Use Case	Balancing market	Spot-markets	Description
Reference	-	day-ahead	Optimisation with a flat-price, therefore a technically optimal (=most energy efficient) schedule is calculated. This schedule is evaluated with variable Day-ahead-prices. This scenario serves as a reference scenario.
DA	-	day-ahead	Minimization of costs when using day-ahead-prices, no offering of balancing reserve.
PRL+DA+ID	Primary balancing reserve	day-ahead + intraday-rebuy	The flexibility is provided at times of marketable products (4h) for control power provision on the PRL market. The supply must be symmetrical in positive and negative direction, therefore this use case is only realized with the battery.
SRL+DA+ID	Secondary balancing reserve	day-ahead + intraday-rebuy	Flexibility is provided at times of marketable products (4h) for control reserve provision on the SRL market. If no SRL is marketed, the day-ahead schedule is applied. Any changes in energy demand due to the SRL provision are compensated by ID rebuy.
TRL+DA+ID	Tertiary balancing reserve	day-ahead + intraday-rebuy	The flexibility is provided at times of marketable products (4h) for the provision of control reserve on the TRL market. If no TRL is marketed, the day-ahead schedule is applied. Any changes in energy demand due to the TRL provision are compensated by ID rebuy.
DA+ID	-	day-ahead + intraday	Based on the DA schedule for that day, the optimization is done at each full hour for the following three hours, with new ID buy and sell prices every hour.
CO_2	-	day-ahead	The optimization is done according to CO2 production forecasts rather than prices. This schedule is evaluated with day-ahead prices to obtain the actual costs.

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Balancing reserve

- 4h- products
- Power is reserved the day before for different timeslots
- Component has to reserve energy amounts (represented as T_{max}, T_{min}) as well as power
- Call probabilities for each 4-h-product
- Two merit-order-list-positions (high price – low call probability, low price – high call probability)
- Reduced grid costs
- Which revenues can be achieved with this call probability?

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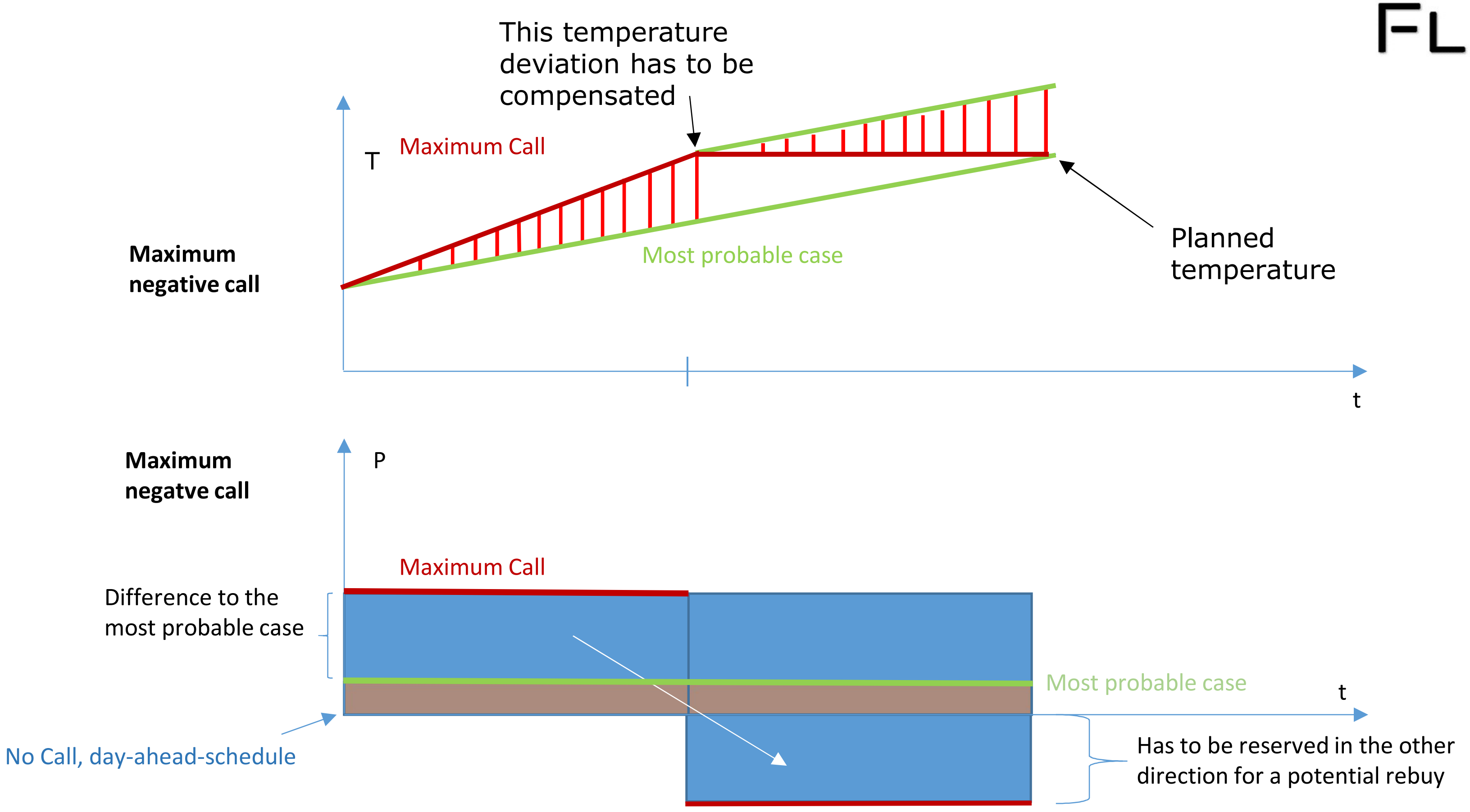
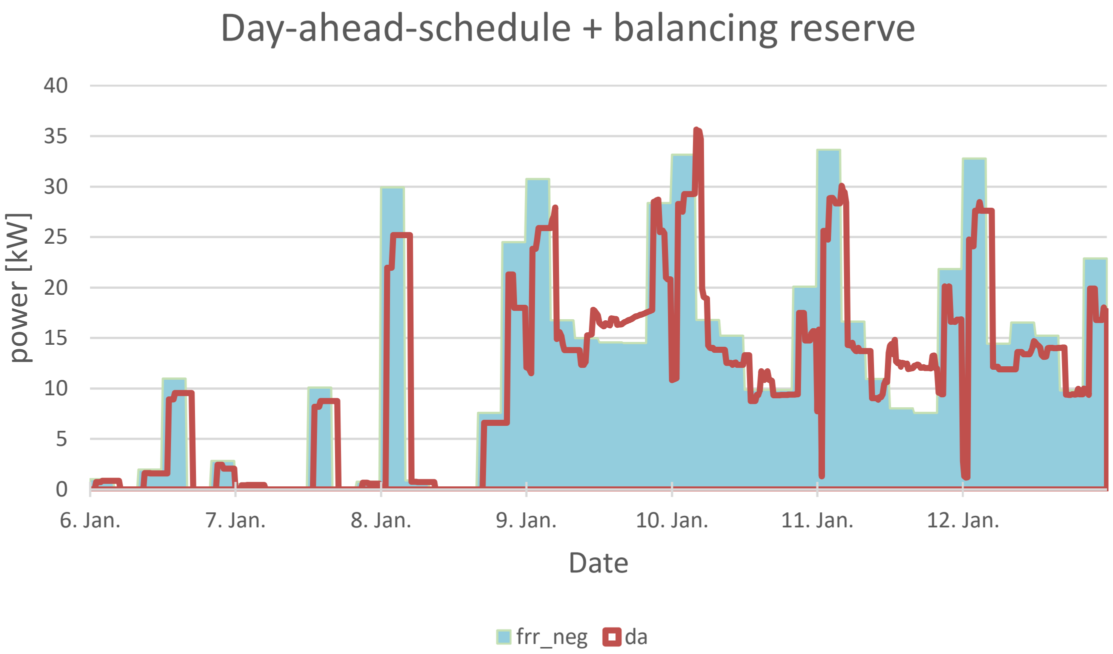
Rebuy at the ID-market

- Hourly purchases at the ID-market
- Due to call probabilities there‵s an expected/most probable schedule
- To not having to reserve the maximum and minimum storage limits all day, a „rebuy“ at the ID-market takes place every hour
- A certain power range has to be reserved in advance for ID-rebuy


This temperature deviation has to be compensated
T
Maximum Call
Maximum negative call
Most probable case
Planned temperature
t
Maximum negatve call
P
Maximum Call
Difference to the most probable case
Most probable case
t
No Call, day-ahead-schedule
Has to be reserved in the other direction for a potential rebuy

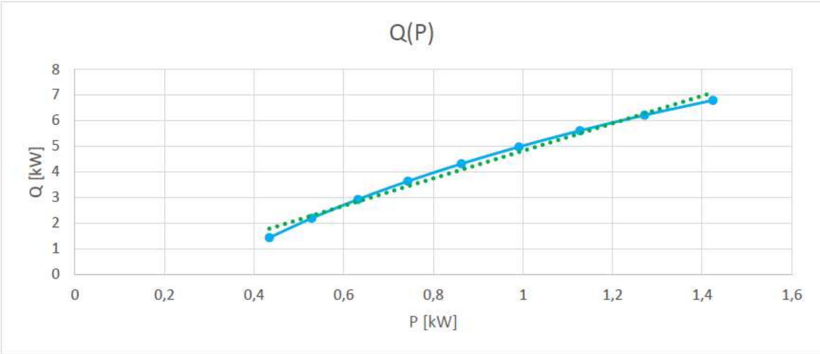
Example



Day-ahead-schedule + balancing reserve
40
35
30
25
20
15
10
5
0
power [kW]
6. Jan.
7. Jan.
8. Jan.
9. Jan.
10. Jan.
11. Jan.
12. Jan.
Date
frr_neg
da

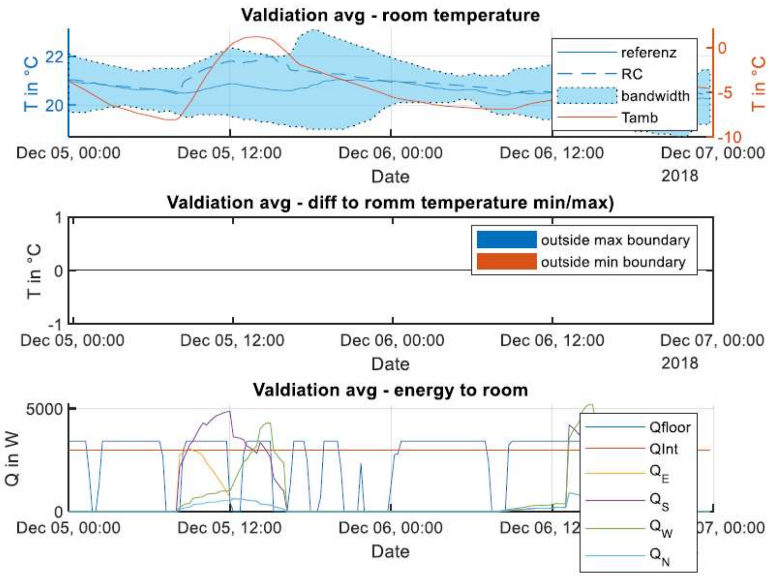
Physical components: Heat pump

- Polynoms for Q (thermal Power) and P (electrical power), each dependent on rps (rounds per second)
- Linearization Q(P)
- rps: $rps = 0$ or $30 <= rps <= 100$
- Implementation in optimization model:
  - $Q(P[t]) = k[t] * P[t] + d[t] * binary[t]$
  - $Q(P[t]) >= 0$, $P[t] >= 0$
  - $P[t] <= P_{max}[t]$
  - $P[t] >= P_{min}[t] * binary[t]$
  - P_{max} und P_{min}
  - Heating mode for domestic hot water and space heating -> to avoid another binary variable: $P[t]/P_{max}[t] + P_{dhw}[t]/P_{dhw,max}[t] <= 1$



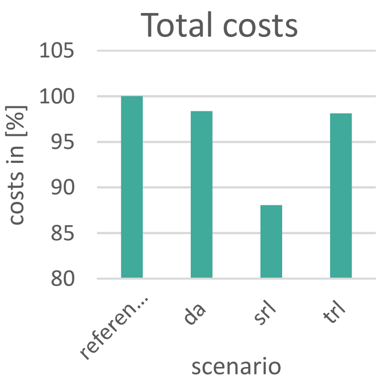
Physical components: Building model

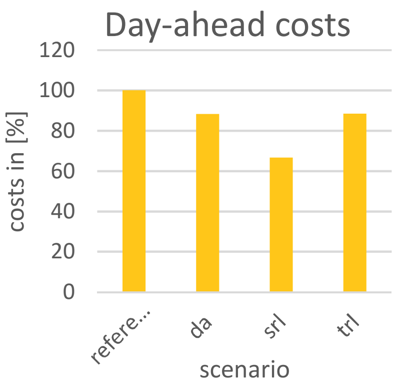
- RC-Model
- 5 building masses/nodes (floor, roof, walls, air, internal masses)
- State-space equation for calculation of the temperature state in every timestep: $\dot{x}=A\cdot x+B\cdot u \rightarrow x(t+1)=\Phi(t)\cdot x(t)+\Gamma(t)\cdot u(t)$
  - $x(t)$ vector of temperatures for different nodes
  - u(t) Input vector (energy from heat pump, solar irradiation, internal thermal loads)
  - $\Gamma(t)$, $\Phi(t)$ State-space-matrices
- Calibration of the last two days with measured reference data (room temperatures, outdoor temperatures, irradiation)
- Optimization for two days into the future
  - Optimization variable: Heating amounts in one node (floor)

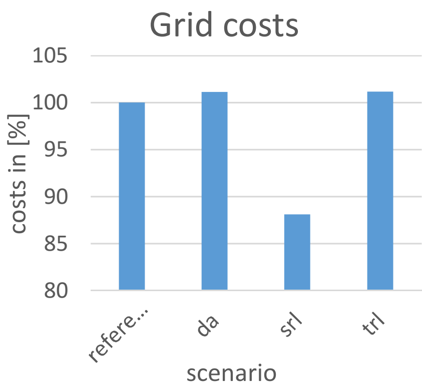


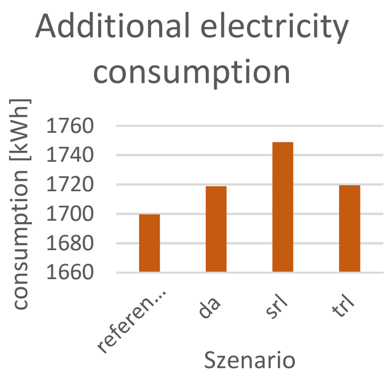
Simulation results for the heat pump pool

Reduction of total costs



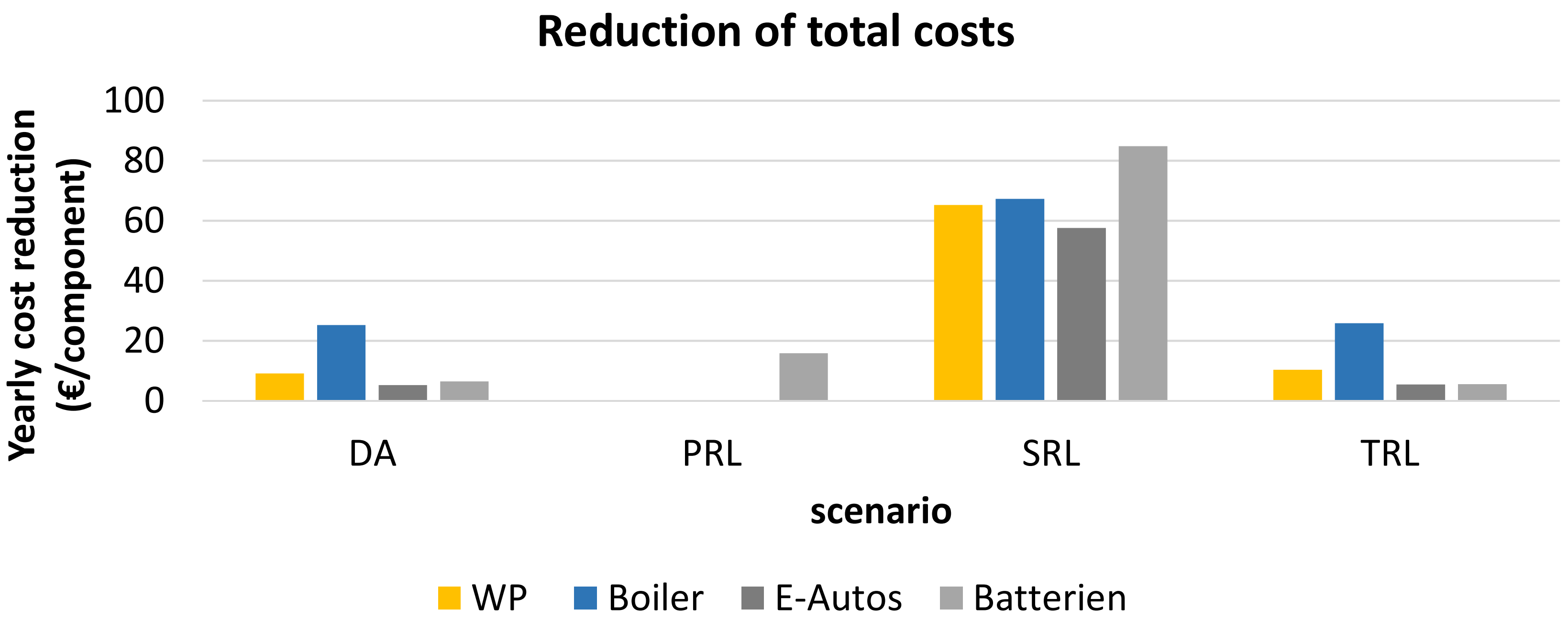






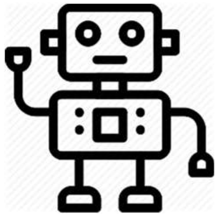
→ Up to 12% reduction of total costs
→ Up to 3% increase of electricity consumption
→ Biggest share of cost reduction is due to reduced grid tariffs for balancing reserve

Comparison of results for different prosumer technologies



Users TCP: Social Licence to automate

- Research about social acceptance factors
- Until: October 2021
- Project Lead: Australia
- Project Partners from:
    - Austria
    - Swizerland
    - Neatherlands
    - Denmark
    - Sweden
    - US



How and to what extent can non-technical issues prevent the success of the automation of DSM, and how can they be addressed?

This Annex aims to understand the non-technical obstacles to user engagement with automation technologies in demand side management, and to identify what is required to build and maintain the 'social license' – which includes user understanding, acceptance and trust – essential to the success of these technologies.

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