Market participance of retail customer flexibility by pooling

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Concurrent Session 114: Flexibility

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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“

<table>
<thead>
<tr>
<th>Project partners</th>
<th>Market access</th>
<th>IT</th>
<th>Component manufacturers</th>
<th>Customers</th>
<th>Research Institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIWAG</td>
<td>World Direct</td>
<td></td>
<td>Fronius (batteries)</td>
<td>W.E.B.</td>
<td>AIT</td>
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<tr>
<td>aWATTar</td>
<td></td>
<td></td>
<td>iDM (heat pumps)</td>
<td>Sonnenplatz Großschönau</td>
<td>FHTW</td>
</tr>
<tr>
<td>Energie AG</td>
<td></td>
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<td>Austria Email (boilers)</td>
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<td>EEG</td>
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<tr>
<td>Energie AG</td>
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<td>neoom (e-mobility)</td>
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<td>SCCH</td>
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<tr>
<td>MS.GIS (Smart Home)</td>
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</tbody>
</table>
Commercialization of flexibility

- Spot- and balancing markets
- Electricity supplier
- Balancing provider
- Marketing of flexibility at short-term markets

Flex+ platform
- Data mapping, aggregation and activation

- Heat pump pool
- Battery pool
- Boiler pool
- E-mobility pool
- Forecast of flexibility and optimisation

- Heat pumps
- Battery storages
- Boilers
- E-Vehicles
- Smart Home

09/06/21
Structure of heat pump pool
<table>
<thead>
<tr>
<th>Use Case</th>
<th>Balancing market</th>
<th>Spot-markets</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>-</td>
<td>day-ahead</td>
<td>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.</td>
</tr>
<tr>
<td>DA</td>
<td>-</td>
<td>day-ahead</td>
<td>Minimization of costs when using day-ahead-prices, no offering of balancing reserve.</td>
</tr>
<tr>
<td>PRL+DA+ID</td>
<td>Primary balancing reserve</td>
<td>day-ahead + intraday-rebuy</td>
<td>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.</td>
</tr>
<tr>
<td>SRL+DA+ID</td>
<td>Secondary balancing reserve</td>
<td>day-ahead + intraday-rebuy</td>
<td>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.</td>
</tr>
<tr>
<td>TRL+DA+ID</td>
<td>Tertiary balancing reserve</td>
<td>day-ahead + intraday-rebuy</td>
<td>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.</td>
</tr>
<tr>
<td>DA+ID</td>
<td>-</td>
<td>day-ahead + intraday</td>
<td>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.</td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>day-ahead</td>
<td>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.</td>
</tr>
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</table>
Balancing reserve

- 4h- products
- Power is reserved the day before for different timeslots
- Component has to reserve energy amounts (represented as $T_{\text{max}}$, $T_{\text{min}}$) 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?
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
Maximum negative call

Has to be reserved in the other direction for a potential rebuy.

Maximum

Negatve call

Planned temperature

No Call, day-ahead-schedule

This temperature deviation has to be compensated.

Most probable case

Maximum Call

Maximum Call

Difference to the most probable case

Most probable case

Maximum negative call

Has to be reserved in the other direction for a potential rebuy.
Example

Day-ahead-schedule + balancing reserve

Date


power [kW]

0 5 10 15 20 25 30 35 40

frr_neg da
Physical components: Heat pump

- Polynomials 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

Reduction of total costs

Yearly cost reduction (€/component)

Scenario

- DA
- PRL
- SRL
- TRL

WP  Boiler  E-Autos  Batterien
Users TCP: Social Licence to automate

- Research about social acceptance factors
- Until: October 2021
- Project Lead: Australia
- Project Partners from:
  - Austria
  - Switzerland
  - Netherlands
  - 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.