Optimisation of heat pumps

What is Flexity: Flexity is one of the leading Use Cases within the IO.Energy Ecosystem. Flexity investigates which household assets (EVs, boilers, night storage heaters...) can be technically operated and which value can be offered to the end-consumer in return. Moreover, Flexity investigates how the digital meter can be used to facilitate the settlement of new services on residential level.

Objective of this note: this note summarises Flexity's test results from the optimisation of heat pumps

Context

Heat pumps are becoming increasingly popular and are recognised as one of the future ways to reduce emissions in the heating sector. Heat pumps are known be an effective way to heat houses and are typically more efficient than traditional electrical heaters[1]. The reason for this is, heat pumps extract heat from the ambient environment and only need a smaller amount of electricity to run efficiently.

The nature of running an effective heath pump is therefore quite complex: switching off a heat pump is managed well, knowing when the heat pump switches on again is more difficult to manage without in depth knowledge and experience with heat pumps and collaborations with the heat-pump manufacturers.

Figure 1: visual representation of a heat-pump[1]

What did we test?

Within Flexity both tiko and Voltalis operated heat pumps for two distinct value streams:

- **Load reduction exercise:** sell the load reduction as an alternative for production on the whole-sale market.
- **Balancing (aFRR):** as the switching off is managed well and load profile is quite predictable, heat pumps were used to strengthen tiko's pool of night storage heaters and test the potential to delivering aFRR balancing services.

1. Traditional electrical heaters typically rely on an electrical resistor to convert electrical energy into heat

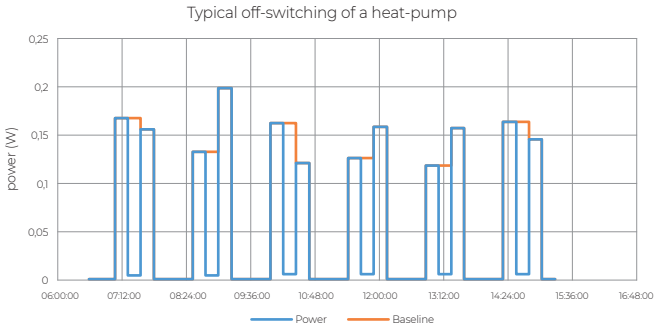
Results from the load reduction exercise

Technically speaking: Voltalis is capable to accurately switch off heat-pumps almost instantaneously.

Value for end-consumer: Value for end-consumer: Energy savings seem to emerge. Since the scope of testing were limited (3 sites, 5 days), and knowledge about heat-pump technology requires in-depth analysis, it is hard to assess the % of savings that can be achieved with load reduction. The direct value for end-users need to be confirmed through a wider scope study.

Voltalis

Graphical representation of the testing



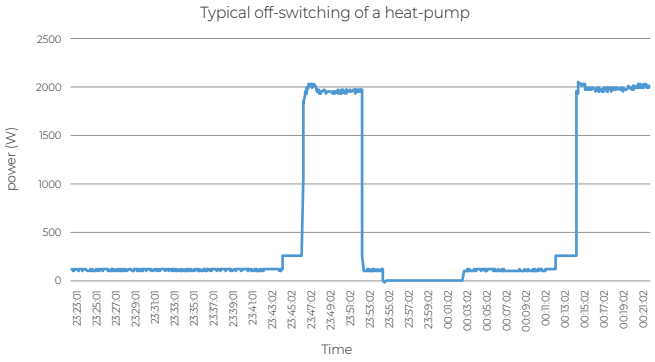
Results from the participation in aFRR balancing services

Technically speaking: Off switching is managed well with fast reaction times within 5 seconds. On switching the heat pump is challenging as the heat pump control is complex: it is the internal logic of the heat pump which decides when the heat pump will turn on or off.

Value for end-consumer: not enough insight to assess the potential benefit that can be generated per end-consumer.

ENGIE tiko

Graphical representation of the testing



Conclusion and moving forward

Voltalis is capable to accurately switch off heat pumps almost instantaneously. By aggregating this operation on a large pool, Voltalis would be able to sell energy blocks resulting from these load reductions as an alternative for production on the wholesale market. Voltalis would be ready to engage a massive roll-out of its solution in Belgium with the support of the European Investment Bank (just like in France now) in a perspective of further development of demand side response in all electricity markets as set forth by the Clean Energy Package. Such large-scale deployment will provide a broader basis for the assessment of the energy savings which could then be analyzed under real operating conditions. Therefore, this analysis can be seen as the starting point for a more in-depth study covering a larger pool of assets over a longer period of time.

tiko and ENGIE demonstrated they can technically operate heat-pumps with real households by switching of heat-pumps. However, a sufficiently large pool is needed for the delivery of aFRR. Therefore, heat-pumps show to be a useful technology to strengthen a pool in combination with other distributed assets such as night storage heaters and electrical boilers. It should be noted that tiko's technical capability is already commercially proven as they are offering aFRR to Swissgrid with its pool, which consists mainly of heat pumps since 2014.

Finally, it should be noted that as from 2022 grid[3] costs will be invoiced to the end-consumer via a capacity tariff[4], based on the average monthly peak (kW)[5]. In a next step of investigation, we should focus on whether heat pump activity can be optimized in function of the total household consumption to help the end-consumer avoid peak consumption and lower his energy bill.

3. costs w.r.t. construction, management and maintenance of the electricity grid
4. More information can be found on the site of VREG: https://www.vreg.be/nl/toekomst-nettarieven-capaciteitstarief
5. The monthly peak is the highest quarter-hour power (or «peak power») you have used in a month

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