Case Studies

https://heatpumpingtechnologies.org/annex57/

ANNEX 57

Flexibility by implementation of heat pumps in multi-vector energy systems and thermal networks

Couperus smart grid, the Netherlands

Key Facts

RD&D Status: applied research on Large-scale demonstration

Type of heat pump:
Decentralized flexible heat pumps

Building description:
Residental

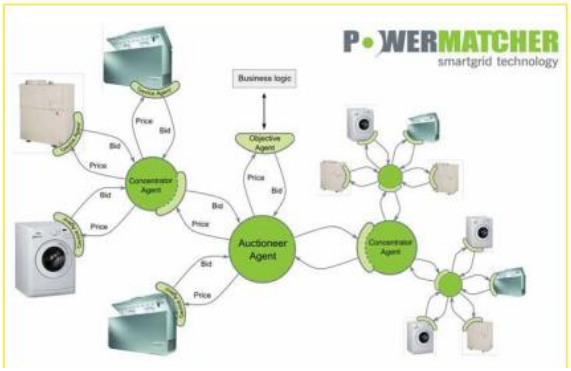
Energy distribution System:
Electric infrastructure

Energy Storage:

Control for the flexible heat pump operation:
Use of Power Matcher

General description:
Number of heat pumps:
Appr. 150

Heat Source:
Electricity

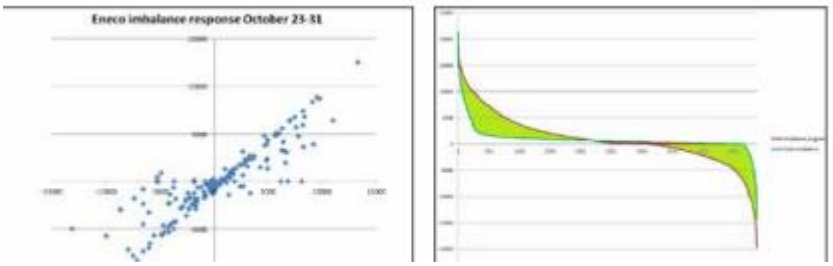


Summary of the project:

Couperus SG has demonstrated that reduction of peak load in the grids and imbalance is possible with the help of smart grid technology. In addition, practical knowledge has been gained with a completely different design of energy infrastructure

What is the degree of imbalance reduction with the heat pumps at Couperus What are the technical and business opportunities created by the use of the PowerMatcher

Approximately 150 heat pumps were in operation during the measurement period. The (scaled) imbalance ranged from -10 to +10 kW [November]. The figure below shows that the imbalance has been significantly reduced by the PowerMatcher. Each point on the light green surface represents a decrease in the cost of the imbalance. The actual decrease in costs is determined by the value in the imbalance market at the time the reduction took place. It is considered very likely that reduction in costs during the peaks left to top or right to bottom is greater.



IEA Technology Collaboration Programme on Heat Pumping Technologies (HPT TCP)

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In the end, around 21 % of the total capacity of all participating heat pumps, 150 units in this period, appears to be flexible. This is the result of this specific measurement period and can vary per season (weather dependent) In the evenings, the controllable heat pumps require about 30% of the total power. Together with the 150 non-regulated heat pumps, this would be around 60% in total. This observed behaviour is related to the setting (for all heat pumps) that the boiler for the tap water may only be heated at the nightly rate. The heat pumps not controlled by the PowerMatcher all switch simultaneously, the controlled heat pumps are distributed over a longer period of time.
The total potential for peak shaving depends on the season. In summer, the required power is low, so a low potential. However, due to lower demand, there is no need for peak shaving. In winter, on cold days, it appears that almost all heat pumps in Couperus have to provide heat, so a lower potential. The mid-seasons therefore provide a higher potential. The potential would have been higher if the power of the heat pumps were greater (in Couperus 1kW per heat pump).

The conclusion is that the PowerMatcher technology offers an efficient and highly scalable system for unlocking energy flexibility from just a few dozen connections. This can be used in aggregate for multiple purposes, including congestion management and imbalance, as demonstrated in Couperus. • Peak shaving by PowerMatcher in combination with imbalance compensation functions as expected. Incidentally, the highest peak in consumption is already dampened by the PowerMatcher's control of the heat pumps when heating water in boilers: without control, they would all start heating up at the same time and thus cause the highest load. • A device such as a heat pump is suitable for making the power used more flexible due to the relatively high energy consumption. • The flexibility from heating up the boiler is limited in Couperus to the period with the night rate, while imbalance in the generation of the wind turbine is greater during the day. In another situation, the results would be more favourable. • The energy flexibility per heat pump is unlocked by the PowerMatcher. The variation over time and its value has been successfully measured. • Partly due to the mild winters, the adjustable power was less than previously estimated. However, it has been shown that this system can be used to adjust imbalance, without the resident having to sacrifice comfort. • The variation in flexibility spread throughout the day is great. Especially radiation from the sun greatly limits rotation time.

FACTS ABOUT THE PROJECT

Place: the Netherlands

Time Frame: finalisation 2016

Project leader:
Stedin

Project partners:
Eneco Energy Trade B.V.

IBM Netherlands B.V.

Itho Daalderop Netherlands B.V.

Stichting Woonformatie Ypenburg

TNO

Contact Information/Links

Couperus Smart Grid - Top Sector Energy

Published articles:

Digitale Aggregatie en Collectieve Sturing van Hybride Warmtepompen - Topsector Energie

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