Case Studies

https://heatpumpingtechnologies.org/annex57/

ANNEX 57

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

Flex+, Austria

"Large-scale deployment of prosumer flexibility in short-term electricity markets considering prosumer interests."

KEY FACTS

RD&D status:
Large-scale demonstration

Type of heat pump:
Decentralized HP for heating

Building description:
existing residential buildings

Energy storage:
Decentralized thermal energy storage
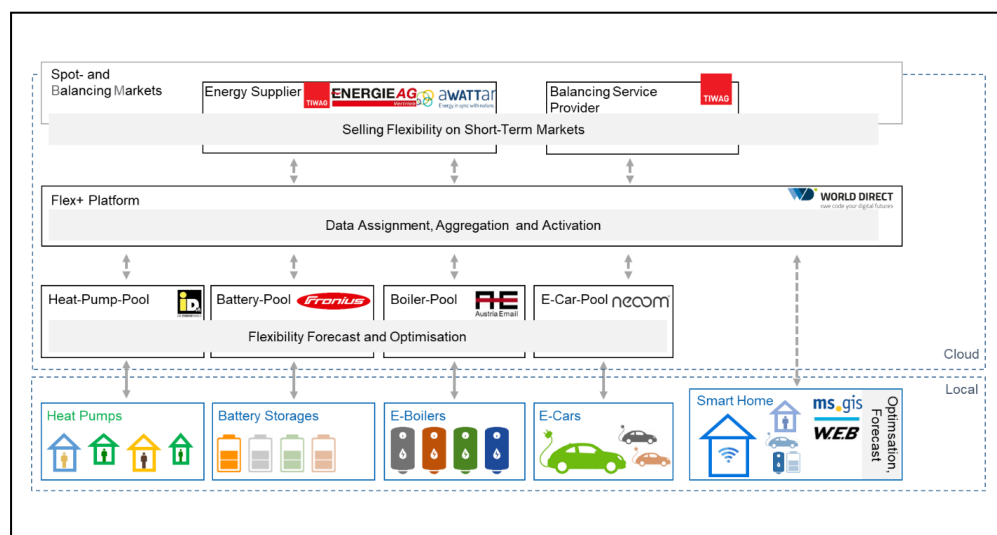
Control for the flexible heat pump operation:
Predictive control

Heat source:
Air, geothermal

Power supply:
Electricity grid, PV

Summary of the project:

In the Flex+ project, the deployment of remotely controllable prosumer components such as heat pumps, boilers, home storage systems and e-mobility in short-term electricity markets in Austria was researched. A special focus was on the economic use of flexibilities at spot and balancing energy markets (frequency restoration reserve) and on the consideration of the end consumers' own interests. The developed concepts were first tested by simulation and then validated in large-scale real operation. Based on these results, remuneration models and tariffs for prosumers were developed.

Result of the project:

According to the simulation results, the total variable energy costs of the heat pump pool could be reduced by up to 12%. The most profitable use case was when the heat pumps participated on the day-ahead spot market, and additionally provided balancing energy (automatic frequency restoration reserve (aFRR)). Per heat pump and year, this amounted to a cost reduction between 65-117 € for the combination of day-ahead spot market and aFRR and between 8-23€ for only day-ahead spot market participation. The biggest share of cost reduction was due to reduced grid tariffs for frequency restoration reserve. The participation in the electricity markets resulted in up to 3% increased electricity consumption.

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System description:

This project focused on heat pumps in single family homes, where the heat pumps were a part of a coordinated pool. The heating system of the individual households consisted of the heat pumps (both air and geothermal), domestic hot water storages, in many cases additional buffer tanks and the buildings themselves.

The heat pumps send data regarding their room and water temperature levels to the pools. Scalable optimization algorithms were implemented at the pool level, which not only take into account the interests of the aggregator, but also the needs/self-interests of the prosumers. Thus, an optimal cross-market use and marketing of the existing flexibility in private households can be achieved for all involved stakeholders. The Flex+ platform was planned and implemented as the interface between the pools and the market. It coordinates the pools and the electricity suppliers and is responsible for the aggregation and forwarding of balancing energy calls. The suppliers have the task of marketing the schedules created by the component pools on selected spot and balancing energy markets. The entire process was tested and evaluated in demo operation.

Flexibility –control strategy of the system:

For the scheduling of the heat pumps, mixed integer linear programming algorithms were used. The buildings were depicted as RC models, which are thermal network models commonly used to predict building dynamics using thermal resistances and capacitance. Further, storages for domestic hot water and heating water have been used for load shifting. Measured heating curves were provided by the heat pump manufacturer and linearized.

FACTS ABOUT THE PROJECT

Place:
various locations within Austria

Time frame:
2018 – 2022

Project owner/ leader:
AIT Austrian Institute of Technology GmbH

Project partners:
IDM Energy Systems GmbH
Fronius International GmbH
World-Direct eBusiness solutions GmbH
Technikum Vienna GmbH
aWATTar GmbH
TIWAG-Tyrolean Hydropower AG
TU Vienna - Institute for Energy Systems and Electric Drives
Sonnenplatz Großschönau GmbH
Software Competence Center Hagenberg GmbH
Austria Email AG
WEB Wind Energy AG
neoom group gmbh
ms.GIS Information Systems GmbH
Energie AG Upper Austria Distribution GmbH
University of Applied Sciences Technikum Wien

Published articles:

Hemm, R. et al.: Flex+ - Large-scale deployment of prosumer flexibility in short-term electricity markets considering prosumer interests. Final Report 2022

Hemm, R. et al.: Marktteilnahme von EndkundInnenflexibilität durch Pooling, 16. Symposium Energieinnovation, 12.-14.02.2020

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