Flex+

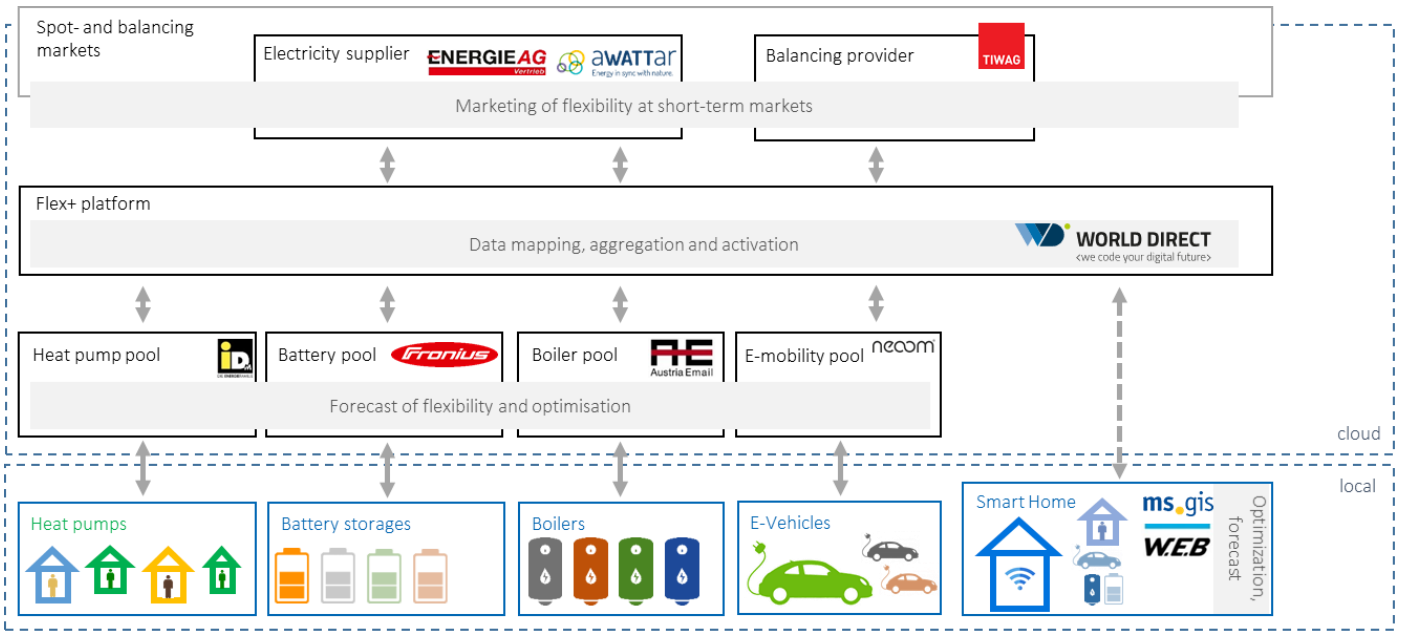

Figure 1: Project overview, interaction and data processes between stakeholders

Summary of project

The project Flex+ investigates the flexibility provision by heat pumps in the context of the provision of automatic and manual frequency restoration reserve (aFRR, mFRR). Different use cases were tested in demonstrations. A reference use case represents the conventional operating mode, where the heat pump is activated, in case the room temperature falls below a certain reference temperature. In another use case, the operating schedules are optimized based on day-ahead spot market prices. In a third use case, also free capacities for frequency restoration reserve are reserved and considered when optimizing the schedules. Since the actually consumed energy can differ from the forecasted one, the deviations can be rebought at the intraday market. For 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.

The architecture used in the project is shown in Figure 1. Suppliers send day-ahead spot price forecasts to the Flex+ platform on the day before delivery. At the same time, the balancing provider sends price forecasts for frequency restoration reserve and the corresponding forecasts of call probabilities to the Flex+ platform. Two price positions are provided by the balancing provider. One price position with high call probability and a low price and one with low call probability and a high price.

The Flex+ platform forwards this price/call probability information to the component pools. Each component pool produces a consumption forecast and the forecast of available flexibility. Based on the predicted prices, the call probabilities, the consumption forecasts and the forecasts of the available flexibility, an optimal schedule and an optimal control energy participation is calculated for each component pool.
The balancing energy potentials of the pools are aggregated by the Flex+ platform and transmitted to the balancing provider. When an aFRR or mFRR bid is activated, the activated balancing energy is communicated to the Flex+ platform. It is distributed by the Flex+ platform among the individual component pools. Depending on the amount of activated balancing offers, the supplier will rebuy or sell energy on the intraday market if necessary, to cover the total consumption and to not violate storage or temperature limits.

For most processes that do not require real-time transfer, a REST with CSV interface was chosen. For the live interface between Flex+ Platt-form and the balancing provider, a VPN is used using the IEC 60870-5-104 transfer protocol. For the connection between the Flex+ Platform and the pools, which must be continuously available for balancing energy activation, the pools can choose between a Modbus protocol (RTU, TCP/IP) and JSON via a REST API.

Learnings and results

- Total simulated revenues for all stakeholders per year per heat pump between 8-23€ (Day-ahead-market participation) and 65-117€ (aFRR provision)
- Households can profit from reduced grid tariffs for negative balancing reserve, because in Austria balancing is partly exempt from grid tariffs
- Business case becomes more interesting, the simpler the processes and the lower the implementation costs

FACTS ABOUT THE PROJECT

IoT Category: Grid services, flexibility provision

Goal: Integration of small-scale flexibility components in to the balancing market & reduced operational cost of heat pump

Beneficiary: user, supplier, component manufacturer

Data required: forcasts for DA-prices and balancing prices, weather forecast

Analysis method: simulation, demonstration

Modelling requirements: Mixed integer linear programming

Quality-of-Service: daily close to real-time

Project participants: AIT Austrian Institute of Technology, Energie AG Oberösterreich Vertrieb GmbH , neoom group gmbh, aWATTar GmbH , Technikum Wien GmbH , World-Direct eBusiness solutions Gesellschaft m.b.H., Sonnenplatz Großschönau GmbH , Technische Universität Wien, WEB Windenergie AG., MS.GIS Informationssysteme Gesellschaft m.b.H. , TIWAG-Tiroler Wasserkraft AG, Software Competence Center Hagenberg GmbH, Fachhochschule Technikum Wien, IDM-Energiesysteme GmbH , Austria Email Aktiengesellschaft , FRONIUS INTERNATIONAL GmbH

Time schedule: 2018-2022

Technology availability: 7

Link to webpage: www.flexplus.at

- With change of aFRR and mFRR market regime (MARI/PICASSO)/ introduction of short-term balancing energy markets, also short-term offers can be made and free capacities can be offered (and no longer only day-ahead)
- There are different flexibility products and market regulations in different countries, also product specifications within Austria have changed a lot in the last years – optimization algorithms always have to be adapted to these (often rapid) changes
- Prequalification for aFRR provision of the pool is complex
- Regulatory framework in Austria suitable for market integration (which was the goal of Flex+)
- For DSO TSO interaction even more need for research
- Prediction of user behaviour is challenging (hot water, heating demand, electrical load)
- Difficulty to find the right modelling depth for technical components (duration of the solution time of the MILP (mixed integer linear programming) increases strongly with model depth)
- Demonstrations have shown that the concept is technically feasible, but to use it as "Plug and Forget", more research is needed.

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