FHP

Flexible Heat and Power, connecting heat and power networks by harnessing the complexity in distributed thermal flexibility

Newsletter Oct 2019

Introduction FHP

The goal of the FHP project is to prevent curtailment of renewable energy sources, e.g. wind turbines and photovoltaics by indirectly controlling power-to-heat systems. These systems provide the required flexibility to eliminate congestion and power quality problems. Two pilot sites are part of the FHP project; the first one in Uden (NL) and the second one in Karlshamn (SE). While the site in the Netherlands demonstrates large, centralized storage systems, e.g. the Ecovat system, the site in Sweden focuses on small, distributed power-to-heat systems, i.e. heat pumps in buildings. This newsletter introduces the pilot site in the Netherlands.

Dutch Pilot Site

The Dutch pilot site is located in the city of Uden, in the south of the Netherlands (figure 1).

Figure 1: The Netherlands. The star indicates the location of the Ecovat in Uden.

Before October 2017, when the Ecovat offices moved to Veghel, the offices were located in the same town. Ecovat works closely together with Enexis, the distribution system operator (DSO) in this area of the Netherlands. Enexis replaced the nearby medium voltage substation to accommodate Ecovat's power requirements.

Ecovat Concept

An Ecovat Energy System (figure 2) is part of a larger energy system and balances energy supply from renewable sources with energy demand of residential, commercial and industrial buildings. Its high storage capacity (up to 100,000 m^3) and efficiency (90% over 6 months) make the Ecovat particularly suitable for seasonal storage.

Figure 2: Ecovat vessel with constructive column in the center.

Ecovat Vessel

The vessel is the main and largest part of the Ecovat Energy System. The vessel at the pilot site in Uden (figure 3) has a diameter of 13 m. and a depth of 15 m. This vessel has been built for testing purposes and is therefore small compared to future operational vessels with diameters ranging from 30 m. to 48 m. and heights from 30 m. to 54 m.

The vessel is thermally stratified, meaning that the top layer is relatively warm and the bottom layer is relatively cold. This results in the ability to supply both heat (up to 95 °C) and cold (down to 5 °C).

Figure 3: Ecovat vessel at the pilot site in Uden under construction.

Ecovat Hardware

An Ecovat Energy System can store heat from various sources, e.g. waste heat from industry, heat produced by solar thermal collectors or by heat pumps and boilers.

Type	Number	Total Thermal Power
AW Heat Pump	1	12 kW
WW Heat Pump	1	12 kW
Boiler	6	168 kW

Table 1: Ecovat hardware at the pilot site in Uden.

At the pilot site in Uden a variety of systems has been installed (Table 1). In the FHP project the heat pumps (figure 4) are controlled, to prevent network congestion and voltage deviations.

Figure 4: Pilot site in Uden, inside the technical room. From left to right: control unit for the AW heat pump; 6 boilers; WW heat pump; piping (black) and valves(blue); control cabinet.

Ecovat Software

The Ecovat software consists of various components, i.e. (1) a SCADA system, which communicates with both the pilot site and the outside world, stores data and provides a graphical user interface (figure 5), and (2) optimal control software, which determines when to charge and discharge the Ecovat in order to minimize costs.

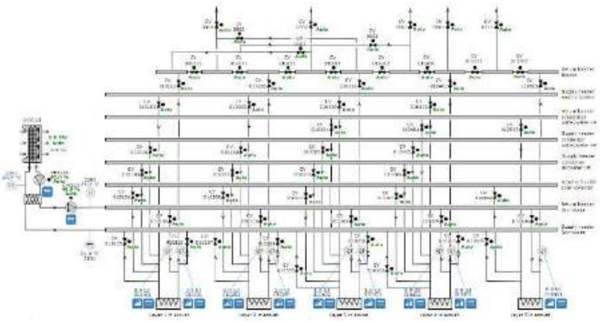

Figure 5: SCADA system; schematic representation of piping and valves (see also Figure 4).

FHP Tests

Testing is currently ongoing at the pilot site in the Netherlands. The test schedule consists of three parts.

Figure 6: Clockwise, starting from the top right: Micha Verbeeten, Wiet Mazairac, Joost Verhagen (Ecovat), Arnoud Brouwer (Enexis), Etienne Hilgen (DataWatt), Reinhilde D'Hulst, Davy Geysen (VITO).

The 1st part, the system integration test (figure 6) was performed in October 2018. This test was designed and performed to make sure all software components developed by Ecovat were able to communicate with each other and with the Dynamic Coalition Manager (an aggregator developed by VITO).

The 2nd part of our test schedule determines how accurately the Ecovat systems are able to follow a predefined power profile (figure 7). Being able to exactly follow a predefined power profile is important for the stability and power quality on the electric grid.

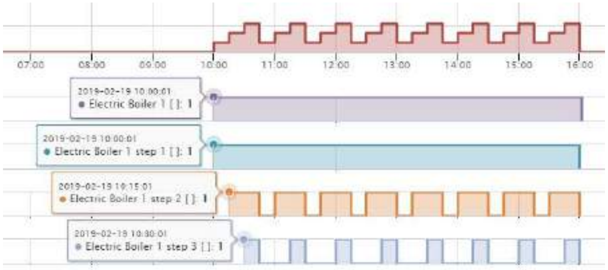

Figure 7: Measurements of consumed power during a test in which the power-to-heat systems have to follow a staircase power profile.

The 3rd part of our test schedule relates to the use cases (UC) defined in the FHP project plan. The UCs differ in region and time (Table 2).

Use Case	Region	Time period
1	Local (DSO)	Day-Ahead
2	Nationwide (TSO)	Day-Ahead
3	Nationwide (TSO)	(Near) Real-Time

Table 2: The use cases defined in the FHP project.

In the 1st UC the loads in the distribution grid are forecasted and power profiles for power-to-heat systems are calculated accordingly. Testing of the 1st UC is in its final stage.

In the 3rd UC power-to-heat systems are activated to prevent negative imbalance prices. Negative imbalance prices are an incentive for renewable energy sources to curtail, which is exactly what the FHP project is trying to prevent.

Partners

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