FHP

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

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The basic idea of FHP is to use the inertia of thermal processes to create flexibility for the power grid. In FHP there are two different demonstration sites, one in Uden (NL) and one in Karlshamn (SE). The demonstration site in The Netherlands uses large thermal storage solutions such as the Ecovat system, while the Swedish demonstration site focuses on larger heat pumps in multi-family residential buildings and office buildings. This newsletter looks a bit more closely on the demonstration site in Sweden.

The Swedish demonstration site is located in the city of Karlshamn, in the south of Sweden. The project partner Karlshamn Energi is the power grid operator in this area, and they also manage the local district heating grid. For the FHP project, a set of buildings was selected to act as demonstrators. All these buildings use heat pumps as their primary heating source, which makes it possible to use them as flexibility sources.

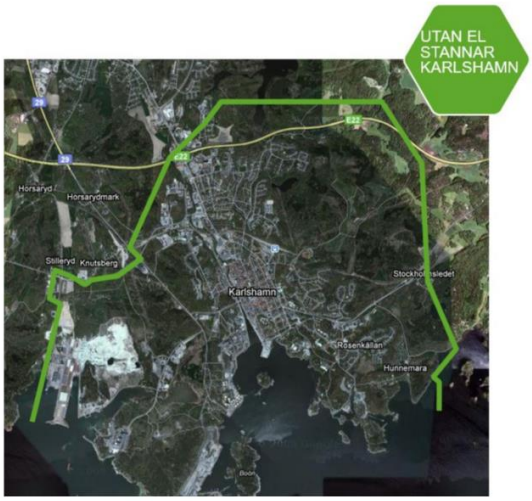

Figure 1: A satellite photo of Karlshamn. The green line shows the city limits of Karlshamn

The inertia in the thermal process of heating the buildings can be controlled and thereby modulate the power usage of the heat pumps, which in turn generates flexibility on the power side without jeopardising the quality of service for the tenants in the buildings.

All the buildings used in FHP have existing controllers and heat pumps, so for FHP they were retrofitted to make them grid-enabled. To do this, a specific sensor-override technology is used, which makes the installation less intrusive and more cost efficient than traditional building automation solutions. The sensor override technology makes it possible to influence the operational behaviour of the existing heating controller by overriding the outdoor temperature signal. The hardware used for this also includes clamp-on sensors for measuring temperatures in the radiator system going into and returning from the building, while also being connected to the power meter for the heat pumps. The connection to the power meter makes it possible to follow the power usage in near-real-time. In addition to this, the FHP system also supports wireless indoor sensors. The indoor sensors have been a vital part of the project, since they support the development of mathematical models of the indoor temperature. The models are important when building control systems such as the FHP system.

Figure 2: The sensor-override hardware used for the installation in Karlshamn

There are two main areas in Karlshamn being used for FHP. One is an industrial area and the other one is a residential area. At the industrial area there are three main installations, located along the same road and connected to the same electricity grid station. This area presents the combined opportunity of a common electrical grid while also enabling a wide range of testing abilities without any disturbance to materials stored at warehouses in the buildings or customer complaints. Some of the building have office areas, but they are still less vulnerable than a normal residential building.

The first installation is a logistics company with three main buildings, a combined office and hangar, two refrigerated containers, a frost-protected warehouse and a combined garage and warehouse. The load on the electrical grid is dictated by the power consumption of the heat pumps together with the power for compressors, welding equipment and chargers for the fork lifts.

The second installation is another logistics company that rents out half of their hangar to another company selling industrial robots, and which uses the hangar for control assembly of the same robots before delivery. The hangar is separated in the middle by a thick plastic curtain. Adjacent to this hangar is an office building. This installation has two industrial air handling units for heating.

The third of the industrial installations is an engineering company producing check valves. The building has both an office part and a workshop area. The residential area consists of three main installations in the central parts of the town. The buildings are all smaller multi-family residential buildings and as such are representative of the type of buildings normally found in Karlshamn.

All-in-all, the buildings included in the Swedish demonstrator are interesting installation objects with a variety of use cases, from industries and offices to residential multi-family buildings. This shows the versatility of the FHP system, and highlights its ability to adapt to different types of thermal processes to extract flexibility.

There are currently on-going testing and evaluation in the demonstration site in Karlshamn. Initial results show a good impact on the heating systems, while still adapting to the differences in the participating buildings.

The graphs below show two examples using different types of set-up of heat pumps. Figure 3 shows an example of an on-off air-to-water heat pump, which requires high intensity control signals to react on the demand.

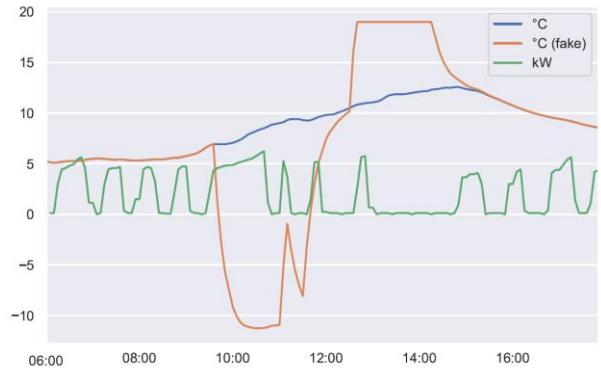

Figure 3: Example of control actions in a building with a heat pump. The blue line is the actual outdoor temperature and the brown line is the overridden outdoor temperature that the controller reacts on. The green line is the power demand of the heat pump.

Figure 4 shows an example of an air-to-water heat pump connected to an internal primary circuit, which in turn is connected to secondary radiator circuit within the building. This example shows a slower, but still noticeable impact in the demand.

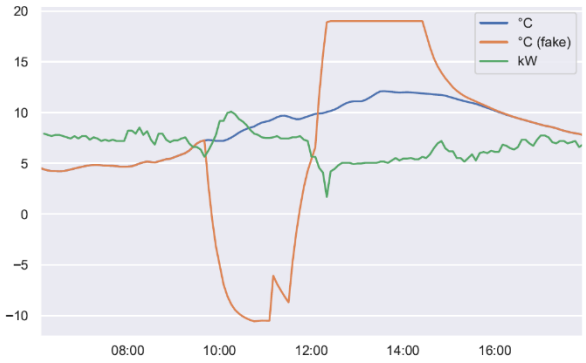

Figure 4: Example of control actions in a building with a heat pump. The blue line is the actual outdoor temperature and the brown line is the overridden outdoor temperature that the controller reacts on. The green line is the power demand of the heat pump.

These buildings are just two examples of how different buildings and their heating systems can behave. However, the adaptive behaviour of the FHP controller makes it possible to hide such complexity for the market actors harvesting the thermal flexibility for the power grid.

Partners

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