Project case study: Smart Temperature Automation Technology (STAT)

Project theme: Smart and flexible heat pumps

Project lead:

PassivUK

Partners:

n/a

Contact:

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What were the objectives of the project?

The STAT project aimed to develop and make future-ready the existing Passiv Smart Thermostat (PST), launched in June 2024. Specifically, it was looking to build an understanding of users' experience of heat pump controls and develop new features that could:

- **Reduce customer bills through demand-side response and efficiency improvements** to heat pump operation and an improved Passiv Smart Thermostat.
- **Support a just and fair transition** by enabling a solution for the less able-to-pay consumer by developing communication protocols with smart meters that do not require a Wi-Fi connection, such as those in social housing.

What activities were undertaken?

To better understand the existing PST product and develop its new features, the following activities were undertaken:

- Reducing costs in the product specification and build.
- Testing user experience and user expectations for the existing PST device.

- Developing a prototype ‘version 2 hub’.
- Integration of the prototype V2 hub with three original equipment manufacturers (OEMs).
- Systemising Passiv’s demand-side response (DSR) and participation in Demand Flexibility Services (DFS).
- Developing and incorporating Wi-Fi functionality to expand the applicability of the PST.

What did the project achieve?

The STAT project has successfully developed the PST device’s functionality, enhancing the consumer experience and helping reduce heat pump operation costs. A unique hardware prototype has been built, offering standalone connectivity and integration with domestic smart meter infrastructure. This allows all customer groups to benefit from flexibility services, irrespective of a Wi-Fi connection in the home. Pending agreement over smart meter data access and common consent protocols, this technology is ready to be incorporated into the PST. Passiv’s Greener Grid Payments platform has also been incorporated into the PST, allowing customers to access the additional savings possible through participation in DFS events.

Following user interviews, several new features, such as an installer data portal and the incorporation of hybrid heat pumps with the PST, have been added to the PST’s development pipeline. The new features will support Passiv’s development and investment plans in the near, short and medium term. Alongside developing a roadmap for the incorporation of new features, the project has also fully integrated its technology with three OEM products- Clivet, Ebac and Panasonic and is holding talks with several other OEM manufacturers. These integrations allow the PST to control the OEMs’ heat pumps directly. This enables customers to optimise their heat pump’s operation and make additional savings in running costs.

The features developed through this project will support and improve the installation experience for installers and the overall customer experience.

Project objective 1: Reduce customer bills through demand-side response and efficiency improvements to heat pump operation

Why is this important?

One of the main barriers to heat pump adoption in the mass market is the negative perception of the high upfront financial cost and the poor financial case against a customer’s existing gas boiler. Whilst the capital expense can be high, heat pumps are often also believed to carry higher operational costs. While this can be true in some cases, there is ample evidence that heat pumps can achieve parity with the running costs of a gas boiler or reduce running costs for consumers (Electrification of Heat Demonstration Project). Continued evidence in this area is needed to help inform customers of the advantages of heat pumps. Passiv is looking to leverage demand-side response capabilities, alongside efficiency improvements through the PST to add to this evidence base. By demonstrating the possibility of additional revenue streams through participation in demand flexibility events and energy efficiency

improvements, Passiv can help improve the financial case for heat pump adoption and support the wider rollout of the technology.

Participation in DSR supports flexible load management on the wider electricity grid as it transitions to a low-carbon grid based on renewable generation. Heat pumps have the potential to reduce or remove their demand during peak times without loss of comfort to customers. By pre-warming the home, the heat pump can turn off during a DFS event and the property will remain above the temperature set-point. When multiplied over many thousands of homes, the impact on the grid can be significant and can help reduce demand and support network resilience. Managing the network in this way can save considerable sums of money and resources in reinforcing the electricity network.

What activities were funded?

The following activities were funded under the Heat Pump Ready programme:

- PST integration by three OEM partners (Clivet, Ebac and Panasonic). A set of criteria was produced that can be applied to support PST integrations with any heat pump manufacturer.
- A prototype hub that facilitates a connection from the PST to the internet via Wi-Fi. This included wireframes for a fully developed user interface.
- Passiv's Demand-side Response (DSR) service for heat pumps is called 'Greener Grid Payments' (GGP). It is an embryonic service: manual, based on spreadsheets, and not available to PST users. Work was done to incorporate the GGP into the PST, making it a prototype, party-agnostic platform to support the Demand Flexibility Service.
- Installation of the current PST by various installers – final count at project close was 61 installations with a further 59 dispatched to installers and awaiting installation.
- User experience surveys to understand how customers use the PST to help shape its future development (189 total participants through five engagement channels).

What were the project findings and did the project achieve its objectives?

Through the STAT project, Passiv has successfully developed and built a prototype version 2 of its PST hub.

The partnerships with the OEMs have been successful and we are now fully integrated with Clivet, Ebac and Panasonic. Furthermore, we now can optimise and control 12 different OEM heat pumps (this was only at 3 prior to the project) and we have a clear process written through this project for how to approach adding other manufacturers heat pumps into our portfolio. However, it was noted that it takes time to develop these relationships. The OEMs need to be fully informed about the PST, have time to test it with their units, make any adjustments, and be trained on its use. Multinational manufacturers have several layers of seniority and regional authentication to pass through. Smaller, UK-based installers were more agile, so the commercial agreement process was relatively streamlined. The prototype hub has now been integrated and is capable of controlling these OEMs' heat pumps. Conversations have already taken place with additional OEMs for integration with their heat pumps soon.

Originally, Passiv had intended to build their PST hub with a partner. However, the software development partner and Passiv diverged in their understanding of what was required and possible within the project's timeframe and costs. It was decided that creating their own hub was not commercially viable within the project constraints. Passiv engaged new project partners to progress an off-the-shelf solution to which specific modifications could be made.

In response to pre-project feedback from installers, the prototype has been upgraded from the hardwired PST to connect directly to the internet via Wi-Fi. The wireframes have been completed, and the user interface is now fully developed and deployed within the architecture of the prototype v2 hub. The Wi-Fi internet connection will facilitate an easier installation and onboarding process for installers and customers, particularly in retrofit properties, saving time during installation and commissioning.

The project supported Passiv's early adopters programme and leading to the first 120 installations (61 of which were completed within the timescale; the rest being with installers awaiting installation). Feedback from users, installers and non-users has been gathered through this project and the detailed report on this by a third-party research company, CSE, have fed into our future development roadmap.

Passiv previously developed its Greener Grid Payments (GGP) platform for participation in demand flexibility services (DFSs). The GGP has now been successfully integrated with the new prototype, allowing participation in DFS events to be controlled through the device. Additional flexibility services will require further adaptions of the device, but these have been added to the development roadmap for the PST.

These findings support the deployment of heat pumps by improving the financial case for customers and supporting the development of a wider, Net Zero electricity network.

Project objective 2: Support a just and fair transition by developing communication protocols with smart meters that do not require a WiFi connection.

Why is this important?

For the UK to meet its ambitious climate change and heat pump roll-out targets, it's critical that as many homes as possible can access heat pumps' benefits. One of the key benefits is the potential to leverage the lower running costs of time of use (ToU) tariffs and additional revenue from taking part in Demand Flexibility Service events. However, these benefits are dependent on the use of a smart meter. Communication between optimisation devices (such as in-home displays and Passiv's PST) and smart meters is normally achieved via Wi-Fi. If properties do not have Wi-Fi, this connection is not feasible. Consumers without Wi-Fi, who are often already vulnerable, risk being left behind on the transition to Net Zero. They also risk being excluded from accessing the additional revenue and reduced running costs that can improve the financial case for installing a heat pump.

Passiv is looking to overcome this barrier by creating a communication protocol in their device that talks to the smart meter inside the home over a Global System for Mobile Communications (GSM) network rather than Wi-Fi. This will allow direct communication between the heat pump controller and the smart meter, regardless of whether Wi-Fi is present. In doing so, a broader socio-economic customer base will be able to take advantage of additional revenue and reduced running costs, and a greater number of homes capable of providing grid flexibility services will support the wider electricity network in managing demand.

What activities were funded?

To achieve the project objective, Passiv undertook the following actions:

- Smart meter research and exploration of control options.
- Developing smart meter communication protocols with the prototype hub without the need for a Wi-Fi connection.
- Building a smart-meter-integrated prototype capable of being applied to the PST in the future.

What were the project findings and did the project achieve its objective?

Passiv has successfully developed a working prototype that can communicate directly with a smart meter without the need for a Wi-Fi connection and which will be capable of being incorporated into future versions of the PST. This objective encountered several challenges during the project. Firstly, it was discovered that Smart DCC has very tight control over smart meters and regulations that control them. Their technology and their data are subject to strict protocols, and initial work was challenging, with limited access to the technology or the communication protocols. However, once the project engaged with Smart DCC, some of these barriers were removed; a key learning was early engagement with Smart DCC is essential.

The 'boxed' environment from the DCC was used to improve the project's understanding of the smart meter infrastructure. This was a critical step in the development of the solution. Through this environment the project team were able to develop a Consumer Access Device (CAD) that can access the DCC Home Area Network, retrieving instantaneous power import and export data, total accumulated energy, current energy price, and tariff structure information. This data enables ToU tariff and DFS participation.

The project has made significant progress in enabling the communication of the PST and a smart meter without the need for a Wi-Fi connection, enabling the adoption of ToU tariffs and DFS participation for a greater proportion of customers. An initial prototype, compatible with the PST, has been created. However, some barriers still remain regarding the regulatory pathway for smart meter access and final steps in software refinement. Passiv will need the support of a 'Data Communications Company Other User' (an eligible, authorised party) to access smart meter data in the field and for the Consumer Access Device to access a customer's Home Area Network. The level of administration, management, and cost involved in becoming a DCC Other User is prohibitive, so Passiv will require a partnership with an existing DCC Other User to commercialise their technology. Conversations are currently underway, but there will be a need to establish a common consent process for this relationship and an assurance the data can be provided at the ~1 second resolution required to fully leverage the ToU and DFS participation.

Project summary:

How might the project outcomes support and accelerate heat pump rollout?

Operating a heat pump efficiently and optimising its energy consumption in line with external weather conditions or price signals from time-of-use tariffs will be incredibly important in improving the financial case for heat pump ownership and in helping to drive mass market deployment. Participating in DFS events can add an additional revenue stream to further support this financial case and support the grid's

transition to clean power. Through the STAT project, Passiv has made developments to its existing PST device and developed a new working prototype capable of better supporting its customers through these heat pump features and services.

To get the most value out of a heat pump, homes need to leverage their smart meter and heat pump simultaneously. However, communication between a heat pump and a smart meter typically relies on a Wi-Fi connection, which is not feasible in some homes. Passiv has now made technological developments to allow these homes to access additional services such as DFS event participation. Using a GSM network, the PST device can communicate with the smart meter and provide DFS event participation services to the customer via Passiv's Greener Grid Payments platform. Once fully incorporated into the PST, this opens up a new market for DFS providers, supporting grid flexibility, and supporting a wider market for heat pump adoption by improving the potential financial case for heat pumps.

What next?

The STAT project has improved the current PST's technological capabilities and improved features by creating a working v2 prototype. This technology will now be integrated into a new version of the PST ready for commercialisation. The user experience survey has identified various additional features users would like to see from an updated PST such as the ability to see the home temperature when the home is in 'away' mode (where the resident is on holiday) and the wish from installers for a short training film designed for residents which covers the difference of having a heat pump as well as the thermostat . These workstreams have helped to create a device roadmap for the short and medium term. Specifically, Passiv will be looking to undertake the following actions in the near term:

- Continue installing the existing PST and receive learnings from the installer base.
- Continue to build relationships and technological integration with current OEMs and look to create new partnerships with additional OEMs.
- Fully incorporate Wi-Fi connection drivers to the prototype hub and finalise app modifications, then launch the protocol alongside a new data portal available to installers.
- Build in new features to the current hub and PST in line with the newly-developed features roadmap.
- Build a partnership with a DCC Other User and complete the consent processes.
- Complete software development and integration for smart meter communication with CAD.
- Open up flexibility markets beyond DFS events through collaborations with demand-side response service providers.

Where to find out more

More information can be found on the Heat Pump Ready website at Heat Pump Ready - Heat Pump Development & Deployment (NZIP) and on Passiv UK's website: Home - Passiv Smart Thermostat.

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