Project Case Study: AI Smart Heat Pathway

Project theme: Survey, Design and Installation Process

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Partners:

Scottish Power, Vaillant

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What were the objectives of the project?

The AI Smart Heat Pathway (AISHP) project, in collaboration with major heat pump installers, identified the need to streamline and reduce the costs of the survey process. The project aimed to use measured household data and AI technology to accurately size and cost heat pumps without the need for an initial site visit, saving both the installer and customer time and costs. This technology could then be incorporated into an installer's customer flow as an app to enable a faster and more accurate data-led approach. The AISHP project, therefore, had the following objectives:

- **Remove the need for initial property surveys** by installers through the use of measured data to size heat pumps, helping **reduce the upfront time and cost** for installers
- **Improve the user journey for installers and customers** at the initial enquiry stage through a **data-led approach** by developing a white label app and sizing tool, which can be integrated into the project partner's customer flows.

What activities were funded?:

- Developing and testing Heat Transfer Coefficient (HTC) calculations using data collected from Geo's Home Energy Management System (HEMS) and smart meter data.

- Using the HTC calculation tool to develop a novel Digital Twin AI model capable of determining a property's heat loss and sizing the appropriate heat pump from actual measured data.
- Validating the AISHP tool against industry-leading benchmarks (namely, Smart HTC developed by Build Test Solutions).
- Deploying Geo's HEMS platform to 330 homes and leveraging the energy and temperature data from a further 104 homes to further develop, calibrate and validate the model.
- Progressing the AISHP tool to use Energy-only HTC, allowing heat pump sizing to be calculated with only smart meter data.
- Developing the AISHP tool as a white label app to enable API integration, allowing access for any compatible service provider.
- Evaluating project partners' customer journeys for purchasing and installing heat pumps, alongside working with project partners to help develop improved data-led customer flows.
- Developing the AISHP tool to produce a personal Net Zero pathway recommendation for each home that can be generated by individuals and service partners.

What did the project achieve?:

The AISHP project successfully integrated a HTC calculation into a heat pump sizing tool. This enabled the rapid and more accurate sizing of heat pumps compared to the incumbent method of EPC data and site visits. The tool's accuracy was validated against industry-leading technology and through a large trial of the technology in over 400 homes. Initially, the HTC calculation tool developed did not reach parity with existing market-leading products. Therefore, a collaborative partnership between Geo and Build Test Solutions was formed that incorporated the best-in-class SmartHTC tool into AISHP. This provided confidence in the tool's accuracy and suitability for widescale adoption by installers.

The SmartHTC calculations still require sensors to be physically installed in a property to measure the temperature data. This led the project to be expanded and to the development of the Energy-OnlyHTC method, which uses only smart meter data and does not require any site visit to size the heat pump. Validation tests of the Energy-onlyHTC showed it performed very close to the SmartHTC method and performed better than RdSAP or BS EN 12831 (in-person room-by-room heat loss calculations) calculations when calculating the HTC of a property and accurately sizing a heat pump. This opened up the potential for the Energy-OnlyHTC to be adopted by installers in their customer flows to accurately size heat pumps without needing a site visit.

The AISHP tool saves installers 2-4 hours in time and hundreds of pounds in costs by not needing to physically attend the site (initially) and by providing fast heat pump designs. Producing personalised heat decarbonisation pathway suggestions will also help intrigued but uninformed households progress with their property's decarbonisation, support harder-to-decarbonise homes, and encourage the wider uptake of heat pumps for domestic use.

Project objective 1: Remove the need for initial property surveys

Why is this important?:

Through working with two large installers as project partners, Geo gained valuable insights into barriers for installers within domestic heat pump adoption. Heat pump installers wish to prioritise installations over survey visits as site surveys take time away from paid installation work, and many site visits may not materialise in a successful installation. Some site visits can take 1-2+ hours (plus the time to arrange the logistics of visiting the site), so half a day can be lost once travel time is accounted for. Unsuccessful site visits (where the customer doesn't progress to install) can be for various reasons: because the customer is uninformed about heat pumps; the property could require additional retrofit work before a heat pump is fitted (e.g. increased fabric insulation); the property could be lost to a cheaper quote; or the customer may be 'just looking' with no intention of progressing to install. These 'wasted' visits take time out of the diary that could be spent on installations and add costs that need to be recouped through successful installation costs. The ability to provide remote, accurate, and rapid heat pump sizing, initial costs, and a personalised Net Zero property pathway can remove many of these obstacles for installers, saving both time and costs.

Additionally, to support high levels of pump adoption, it's important that homes can quickly, accurately, and affordably determine the appropriate heat pump size and indicative costs for their household. By enabling this, customers can become more informed and progress quickly along the customer journey. An effective way to achieve this at the scale required is to carry out assessments at a property level remotely. Geo's AISHP project looked to leverage smart meter data to develop a tool that, without the need for internal temperature data, could quickly and cost-effectively be deployed across the more than 12 million homes in the UK with smart meters.

What activities were funded?:

The AISHP project initially looked to use measured internal temperature data from their HEMS and energy consumption data from smart meters to be able to determine a property's heat loss and HTC. Through another Heat Pump Ready project, , this method has been shown to be more accurate than the incumbent BS EN 12831 calculation or through using EPC data (RdSAP). The project later progressed to an energy-only method, requiring smart meter data only. Key activities were:

- Building and developing the software's technical architecture for a HTC calculator using smart meter and HEMS data.
- Partnering with Built Test Solutions to validate Geo's HTC calculation tool against empirical data and ~28 co-heating tests[1].
- Following testing results, Build Test Solutions' Smart HTC tool was incorporated into the digital twin with APIs enabling access to cloud data storage.
- Collecting internal temperature data from Geo's HEMS via 330 trial homes to correlate with smart meter data.

[1] Co-heating tests are a highly detailed property heat loss calculation methodology, considered the gold-standard approach and the benchmark for other tools to test their accuracy.

- Trial data was supplemented with additional data from publicly available third-party trials (SMETER, ECO4 Pay-for-Performance solution thresholds[2]) to develop and train the model through NMBE and CVRSME[3] analysis. This allowed the sizing and initial costs of a heat pump to be determined and enabled the creation of a Net Zero property pathway for harder-to-treat homes (homes that would benefit from additional fabric measures prior to a heat pump) without an installer attending the property.
- Further interrogation of the test data to determine if accurate results can be obtained without using temperature data provided by a smart thermostat or sensors.

What were the project findings and did the project achieve this objective?:

Geo has successfully developed a tool to remotely calculate a building's HTC via data from Geo's HEMS and smart meters to size a heat pump. This can be performed with a higher accuracy than the standard RdSAP or BS EN 12831 approach, which requires a site visit. This saves a service provider both time and costs in getting a potential customer an initial size and cost estimate. Following a validation exercise, it was found that Geo's initial attempts to calculate the HTC remotely could not compete with the accuracy of existing commercially available opinions, which have been developed over several years. Geo, therefore, collaborated with Build Test Solutions to incorporate their market-leading Smart HTC tool into the Geo AI digital twin.

The Smart HTC tool achieves a HTC accuracy of 12% (assessed against the co-heating test benchmark) compared to 34% for RdSAP or 49% for BS EN12831 assessments. Although the Smart HTC method requires an internal temperature sensor and a number of weeks to collect the measured data, the process can be led by the resident without installer intervention. This facilitates the accurate sizing of heat pumps without installers attending the site, saving time and costs and allowing installers to focus on installation work rather than initial site surveys, many of which may not progress to an installation.

The measured data approach with sensors can take up to two months to gather the data. Geo, therefore, investigated an Energy-only Smart HTC approach where, if smart meter data already exists, an assessment can be created without the need for internal temperature data. This could be performed in under 60 seconds and does not require an additional sensor to be installed. The accuracy for this method was still an improvement over traditional methods (BS EN 12831 and RdSAP) at 22%. For homes without a smart meter, once one has been installed, a quote can be generated after 21 days of 'winter days' (days with a +7 degree difference between inside and outside temperatures). These can also be produced for a few pounds per assessment (<£10) compared to £100-£500+ for in-person site visit assessments using traditional methods.

	RdSAP	BS 12831	SmartHTC	Energy-only SmartHTC
Speed	⏱ ⏱ 3-4 Weeks	⏱ ⏱ ⏱ c.3-4 Months	⏱ ⏱ 2 Months	⏱ <60 Seconds
Cost	£ £	£ £ £	£ £	£

[2] SMETER: Smart Meter Enabled Thermal Efficiency Rating; ECO: Energy Company Obligation
[3] NMBE: Normalized Mean Bias Error; CVRSME: Coefficient of the Variation of the Root Mean Square Error.

	< £100	< £500	< £100	< £10
Accuracy	🎯 34%	🎯 49%	🎯🎯🎯 12%	🎯🎯 22%

The AISHP project has successfully created a mass market tool that is more accurate, faster and cheaper for heat pump sizing estimates for properties than the incumbent methodologies, saving installers both time and costs. This tool, with some minor legislation changes to the Great Britian Companion Specification (GBCS) to include a measured home heat loss indicator, could be suitable for the 12+ million homes in the UK with smart meters to receive a heat pump estimate that is faster, cheaper and more accurate than the current methodologies, supporting the UK heat pump rollout ambition.

Project objective 2: Improve the user journey for both installers and customers at the initial enquiry stage through a data-led approach by developing a white label app and sizing tool

Why is this important?

For installers, being able to shorten the customer journey saves on time and costs, and reduces the risk of customer drop offs. Being able to take a data-led approach not only allows installers to provide faster quotes but also, as per objective 1, allows for more accurate and cheaper initial estimates to be produced. Building this data-led approach into the customer flows for service providers allows for a digitised customer journey to be built into the business model. Customers, or installers, can input basic property details online (i.e. address, number of bathrooms) and utilising the smart meter and/or Geo's HEMS, a rapid heat pump quote can be produced. By incorporating this process into the service provider's customer flow the initial customer journey can be performed online without input from the installer, minimising time and cost, whilst providing accurate information to inform the customer on the next steps.

What activities were funded?

Geo worked with both Scottish Power and Vaillant as project partners to integrate the AISHP tool into their customer flows. Key activities were:

- Analysis of current customer journeys for Scottish Power and Vaillant to identify areas for improvement.
- Development and validation of AISHP tool to demonstrate benefits for service providers.
- Build technological infrastructure and creation of APIs to allow for integration of the tool into service providers interface.
- Testing of AISHP tool within service provider customer flows.

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

Whilst both Scottish Power and Vaillant were project partners from the outset of the Heat Pump Ready programme, during the latter stages of the project, Scottish Power re-evaluated their priorities at a corporate level. This meant that the pilot study did not progress as widely as initially intended. However, it still delivered successful outcomes and working with two large service providers has demonstrated the value in AI methods and a data-led approach as both organisations have advocated for this approach moving forward.

As a result of this project, and pending commercialisation agreements, both ScottishPower and Vaillant now have the potential to improve their customer and installer journeys through the development of novel data-backed design and quotation tools. This could then offer an improved customer experience for potential heat pump purchasers allowing them to receive a rapid and accurate heat pump sizing with initial costing, alongside suggested Net Zero pathway improvements for some homes where relevant. It could also allow their installers to provide quotes without the cost and time implications of attending site in the first instance. Although, the impact on the customer-installer relationship as a result of

reduced site visits was not part of the project scope this could present an opportunity for further research. At the end of the project, the Geo team had active engagement from over 10 other service providers, including UK energy retailers, who have identified the value in this approach and will be holding talks with them on the commercialisation of the AISHP technology and API integration after the Heat Pump Ready project closes.

Current MCS standards still require a site visit before a quote is signed by the customer, which prevents this approach being carried through to later stages in a customer's journey and the perceived benefits (reduced time spent on site, cost savings through focusing on pre-qualified leads, faster customer journeys with reduced potential drop offs etc.) being realised by the installers. Geo is working with other industry partners (including from the Heat Pump Ready cohort) on lobbying for change to these standards through evidenced research. Further work is required to understand consumer confidence in entirely removing pre-quote site visits, as site visits can provide additional value through customer satisfaction and consumer protection. Additionally, further work is also underway to provide evidence that can lead to minor changes in The Great Britain Companion Specification (GBCS) and Smart Metering Mandate, which can further support the use of AISHP's approach in the wider market.

Summary:

What impact could this have on accelerating the heat pump rollout?:

Removing barriers for customers and installers by enabling remote property assessments has the ability to support the heat pump rollout by increasing the number of properties having an initial heat pump estimate. Using a data-led approach to digitise the customer journey can also help reduce customer drop offs. For the installer, being able to remotely assess a property to a high (or higher) degree of accuracy without needed to physically attend the site has the ability to save time and reduce costs. The ability to carry out initial remote heat pump quotes for <£10 and in under 60 seconds, using just energy data has the potential to open significant new markets for installers. This will allow them to focus their time on successful installations, remove 'wasted' site visits, and remove costs from their activities that need to be recouped by other customers. The demand for the skills required for heat pump installations is expected to grow in the coming years. So, by reducing the burden on installers for initial site visits more time can be spent on delivering real installations and supporting the wider heat pump rollout.

What next?

Having gained interest from more than 10 potential service providers, Geo and BTS will embark on a thorough market validation exercise early in 2025 before delivering the service to potentially millions of homes later in 2025. Across the project participants they will continue to advocate for legislative barriers to be removed and create space for measured approaches to underpin the UK's net-zero journey.

Following successful market validation and removal of legislative barriers, the parties will look to scale the service to serve commercial opportunities that will come with an available market of the 12 million UK homes with a smart meter.

Where to find out more

More information on the measured approach can be found here. Whilst additional information on Geo's activities can be found on their website: Homepage - geo (Green Energy Options). The updated, data-led Scottish Power customer flow for heat pump quotes can be found here: ScottishPower.

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