Project case study: Guru Smart Heat Pumps

Project theme:

Smart and flexible

Project lead:

Guru Systems Ltd

Partners:

N/A

Contact:

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Funding:

£445,943

Project duration:

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What were the objectives of the project?

The Guru Smart Heat Pumps project aimed to:

1. **Reduce upfront costs** by providing social housing landlords with bespoke information, using their **Guru HeatSmart** product, about the optimum size of a heat pump for individual homes in their portfolio. This information would be based on data from smart meters and temperature sensors.
2. **Reduce the need for on-site maintenance** by enabling landlords or their contractors to remotely recommission heat pumps using the new **Guru Integrate** product. This is essential, as it is common for residents and contractors to accidentally 'decommission' heat pumps by changing settings without understanding the impact of this on the heating system.
3. **Minimise the running costs of heat pumps** through ongoing performance monitoring using the **Guru Pinpoint** platform product. This enables monitoring at both the portfolio and individual home levels to identify issues and allow early resolution.

What activities were funded?

For each new product area (Guru HeatSmart, Guru Integrate and Guru Pinpoint), the project was funded to:

- Conduct market and user-centred research to ensure products developed are tailored to social housing provider needs and fill a gap in the market.
- Develop new hardware and software specific to heat pumps. Tailor existing Guru Systems customer interfaces for heat pumps.
- Conduct field trials of new products including the use of Guru Pinpoint in 116 high-density homes.
- Develop documentation including guidance on heat pump installations and operations, sales and marketing materials, training materials and client engagement strategies, alongside disseminating project results and outputs.

What did the project achieve?:

The project team completed user-centred research into the need for and viability of a heat pump sizing product in the social housing sector, as described in objective 1. The team concluded that, while this is a key area for improving heat pump performance and the customer journey for both residents and landlords, other providers in the market had more advanced propositions in this space, and a smart thermostat offering was unlikely to be a unique selling point (USP) for Guru Systems. A preferred approach of partnering with others for this capability is being taken forwards.

However, heating system performance monitoring and issue resolution was confirmed to be a client need, as described in objectives 2 and 3, and it sits clearly within Guru's strategic priorities. This is especially relevant in the context of ambient loop heat networks. The project focused its product development and field-testing activities on these objectives. Guru has successfully developed and launched the Guru Integrate functionality which will be used alongside the Guru Pinpoint software platform. Through this innovation, fleet managers and ambient heat network operators can monitor the heat pumps in their portfolio, flagging error messages and identifying poor performance based on seasonal performance factors (SPF). The application of the technology on ambient loop networks is an extension of the original scope, which was focused on improving the performance of multiple individual heat pumps managed by landlords of large housing portfolios.

The user can further integrate performance with metrics such as flow rates and temperatures, electrical input, heat and cooling output and heat loss factors. These are available as key performance indicators (KPIs), and graphical visualisations of energy flows at different time resolutions are easily accessible. The dashboard has been designed to enable compliance with new heat network regulations coming into force in 2025(the upcoming Heat Network Technical Assurance Scheme, HNTAS). Guru has also developed its Integrate hardware to enable direct two-way communication with its systems and Daikin Altherma heat pumps. Where this hardware is installed, the user of the Pinpoint platform has access to higher accuracy SPF values and can remotely adjust settings on individual heat pumps to resolve issues.

The project team has delivered 19 training sessions to the wider industry on metering and monitoring of heat pumps in ambient loop networks and is rapidly being seen as an industry leader on this topic. Attendees included representatives from heat network operators, housing associations and heat network design consultants.

Project objective 1: Reduce upfront costs by providing social housing landlords with bespoke information about the optimum size of a heat pump for individual homes in their portfolio.

Why is this important?:

It is current practice to assess the thermal performance of a building's fabric (its walls, floors, roof, windows, etc.) based on its physical characteristics, often determined during an in-person survey by a heating engineer. These surveys can be costly and time-consuming. They also rely upon theoretical assumptions of fabric thermal performance, which could lead to inappropriate heat pump sizing, high costs and poor customer experiences if incorrect.

Large landlords who manage buildings or sites containing multiple homes, such as housing associations and local authorities, are key stakeholders in accelerating heat pump deployment and are a key client base for Guru System's existing products e.g. Heat Smart, which manages fleets of boilers. Such landlords commonly upgrade multiple properties simultaneously, potentially exposing themselves to high upfront capital costs and ongoing higher maintenance costs if units are oversized due to poor specifications. Guru Systems has identified assisting these stakeholders in correctly sizing heat pumps as a key opportunity to reduce customer costs and improve the customer experience, building on their existing Heat Smart product for managing fleets of gas boilers.

What activities were funded?:

- User-centred research was conducted with internal stakeholders and external experts to identify the required improvements to make the Heat Smart product relevant for residential heat pump installations. This included analysing competitors' and heat pump manufacturers' products.
- The Product team defined a minimum viable product (MVP) for the Heat Smart product to be compatible with heat pumps.
- The Product and Technology teams completed a set of user stories, the underpinning functionality required for these users and the corresponding user interface designs required to deliver the MVP successfully.

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

The team completed user market research and competitor analysis to inform the development of a product design for a smart thermostat and heat pump sizing calculator. This was used to assess the costs of developing the proposition against the benefits of delivering it and alternative options in the market. The team concluded that while this is a key area for improving the performance of heat pumps and improving the customer journey for both residents and landlords, other providers in the market had more advanced propositions in this space, including for gas boilers, and a smart thermostat offering was unlikely to be a USP for Guru Systems. A preferred approach of partnering with others for this capability is being taken forward.

Project objective 2: Reduce the need for on-site maintenance by enabling landlords or their contractors to remotely recommission heat pumps.

Why is this important?:

Currently, over 80% of heat pumps are installed without being connected to the internet and without smart controls, even in more mature heat pump markets than the UK. This means that:

a) Data on how the heat pumps are performing is missing; and
b) Any errors or faults that may occur can go undiscovered for some time until the system displays clear signs of issues.

Installers or engineers must visit properties in person to diagnose and fix heat pump problems. This can negatively impact the post-installation experience for residents, damaging their perceptions of heat pumps and increasing maintenance costs for landlords and ambient loop heat network operators, a key client base for Guru Systems.

Guru Systems sought to overcome these challenges by developing the Guru Integrate product, which focused on integrating Guru's systems directly into the heat pump's control and monitoring systems using a secure Modbus connection. This allows landlords and ambient loop heat network operators to monitor and control the heat pumps remotely, flagging error codes and enabling remote recommissioning. Moreover, site visits could be faster, as the fault is pre-identified. This allows the right equipment to be brought to the site and reduces on-site investigations for the engineer, minimising the need for follow-up visits. All data is covered under Guru's certification for cyber security (ISO 27001). The time and cost savings of this remote recommissioning approach had not been quantified at the time of writing.

What activities were funded?

- User-centred research with internal and external stakeholders to understand what was required for potential integration with heat pumps and a broader look at how to manage integrations with third-party devices. This included competitor research focusing on competitors and heat pump and heat interface unit (HIU) manufacturers' products that control their devices.
- Definition of the MVP for Guru Integrate as a product compatible with a wide range of heating devices.
- Development of the Guru Integrate product and integration of this functionality into the Pinpoint analytics platform interface.
- Laboratory testing of Guru Integrate with the Daikin Altherma heat pump.
- Implementation at one pilot site, at Daikin's Woking office.

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

Guru Systems successfully developed its Guru Integrate product, enabling remote access to Daikin Altherma heat pump data and controls via its Guru Hub 3 hardware and the Guru Pinpoint platform. The Guru Hub 3 Core device is mounted to the heat pump and is connected securely using a Modbus connection. A wireless mesh network is then used to send data from the Guru Hub 3 Core device to Guru's systems auto-updating every 5 minutes. This wireless mesh network is more secure than unencrypted wired systems and all data is covered under Guru's ISO27001 certification for cyber security. The platform flags error codes and poor performance (as described in Objective 3), allowing

users to click into specific heat pumps to remotely control the settings. During the project, the product was successfully demonstrated in the Daikin testing laboratory and in a field trial in the Daikin office

Figure 1: Screenshot of existing Guru Systems platform integration with heat interface unit

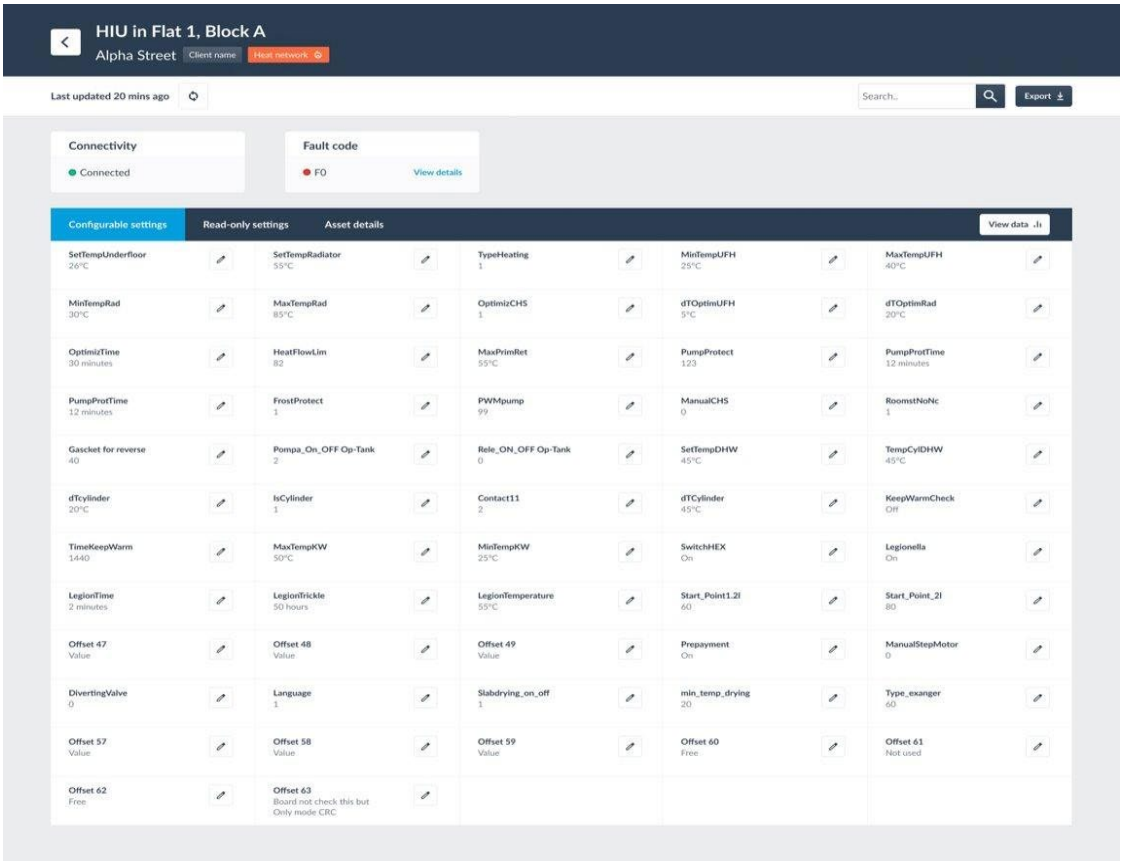
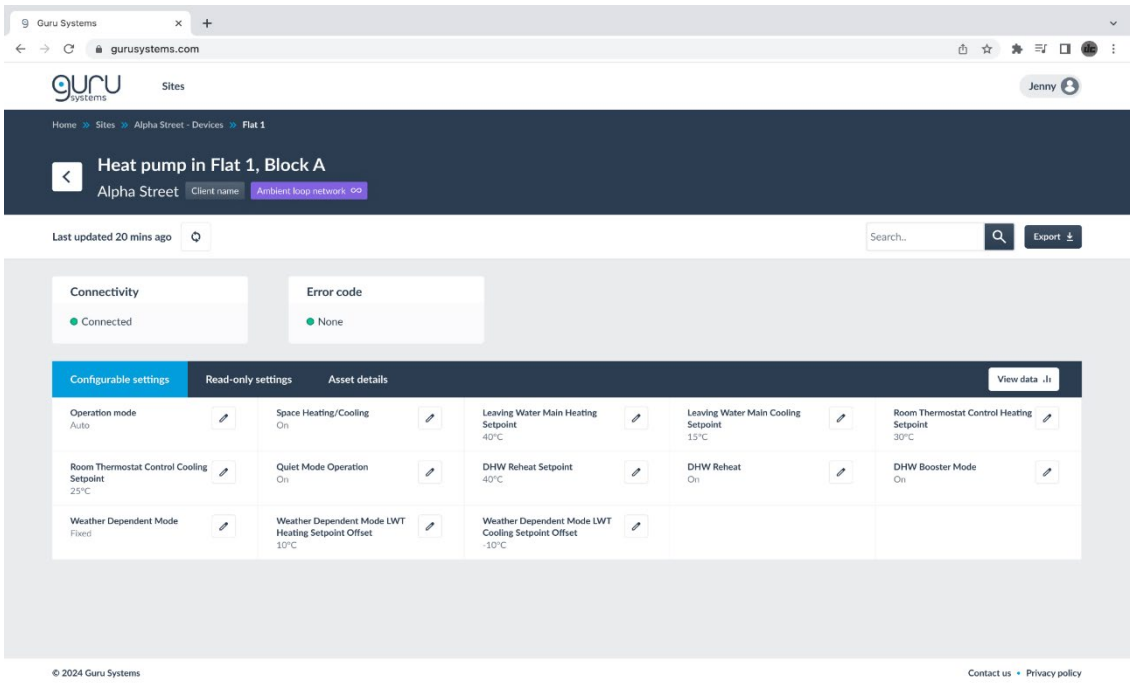


Figure 2: Screenshot of future Guru Systems platform



The project team identified several challenges when developing this solution, where further work is required:

- In order to receive high granularity of data, every 5-10 minutes, the communication network needs to be able to manage the increased network traffic and maintain success rates.
- More hardware was required than initially anticipated, leading to increased installation complexity. This complexity led to the contractor at a potential pilot site not progressing with the integration .
- Each heat pump may have different communication protocols, though Modbus seems to be the likely favourite. Additionally, each heat pump will have different Modbus registers which leads to bespoke integration. This will increase costs as Guru looks to expand this solution to other heat pump manufacturers.
- Further work is required to demonstrate no impact on heat pump manufacture warranties from implementation of the remote diagnostics.

Project objective 3: Minimise the running costs of heat pumps through ongoing performance monitoring at both the portfolio and individual home level to identify issues, allowing early resolution.

Why is this important?:

Building on the benefits of remote diagnostics outlined in Objective 2, remotely monitoring heat pumps can also help ensure optimal performance even when faults are absent. Without remote monitoring or smart controls, inefficient heat pump operations can go unnoticed, resulting in higher running costs.

This is particularly the case in ambient loop heat networks, where monitoring at the heat network level can mask variations in the performance of the individual heat pumps connected to the network. This issue is being addressed by Ofgem, with ambient heat networks within the scope of the new Heat Network Technical Assurance Scheme regulations that will come into force in mid-2025. This regulation sets minimum technical standards for new and existing heat networks and requires assessment, certification and ongoing performance monitoring, including KPI reporting. Whilst not all details of required KPIs have been released, HNTAS will likely require an efficiency calculation for dwelling-level heat pumps and energy centre heat pumps. An efficiency calculation for ambient loop heat networks is more complex than for individual heat pumps, with methodologies still to be developed.

Guru Systems is addressing these challenges by developing its Pinpoint platform and adapting it for ambient loop heat networks and housing association landlords managing fleets of individual heat pumps. Using different metering and data points, the platform enables users to identify the worst-performing heat pumps based on their Seasonal Performance Factor (SPF). Users can interrogate these results, generating graphs of heat, cooling and electrical energy flows at varying time resolutions, allowing the identification of mitigating measures that can be implemented to improve performance.

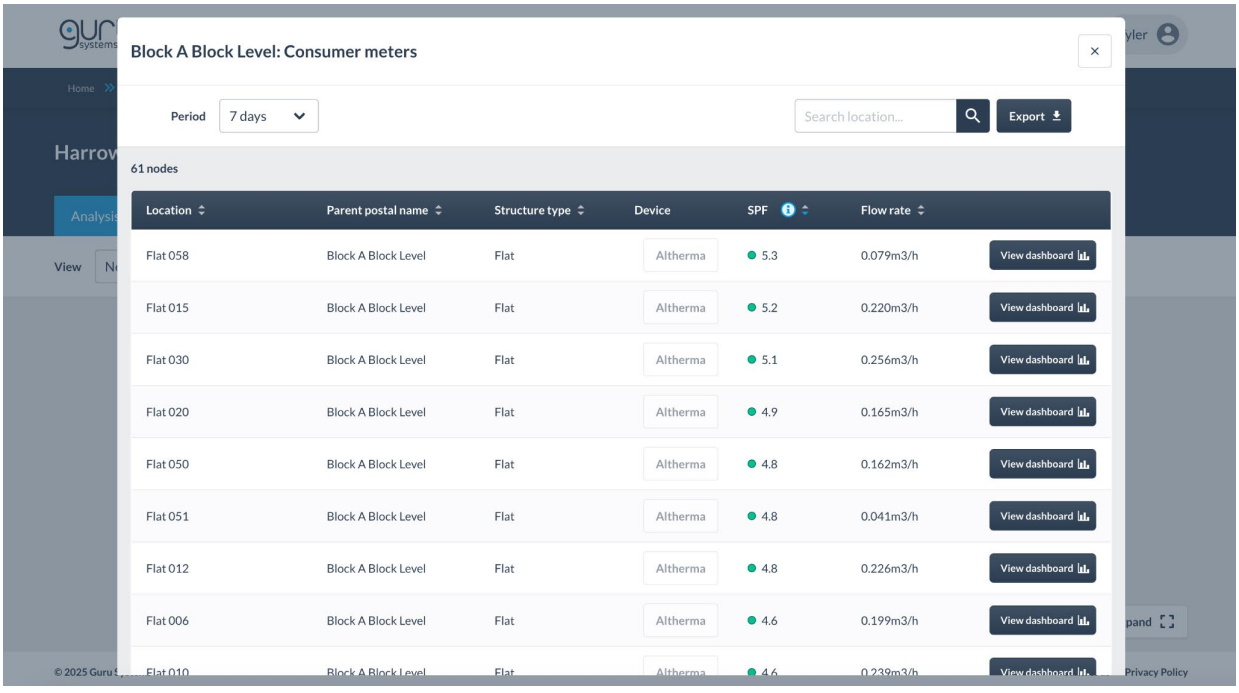
What activities were funded?

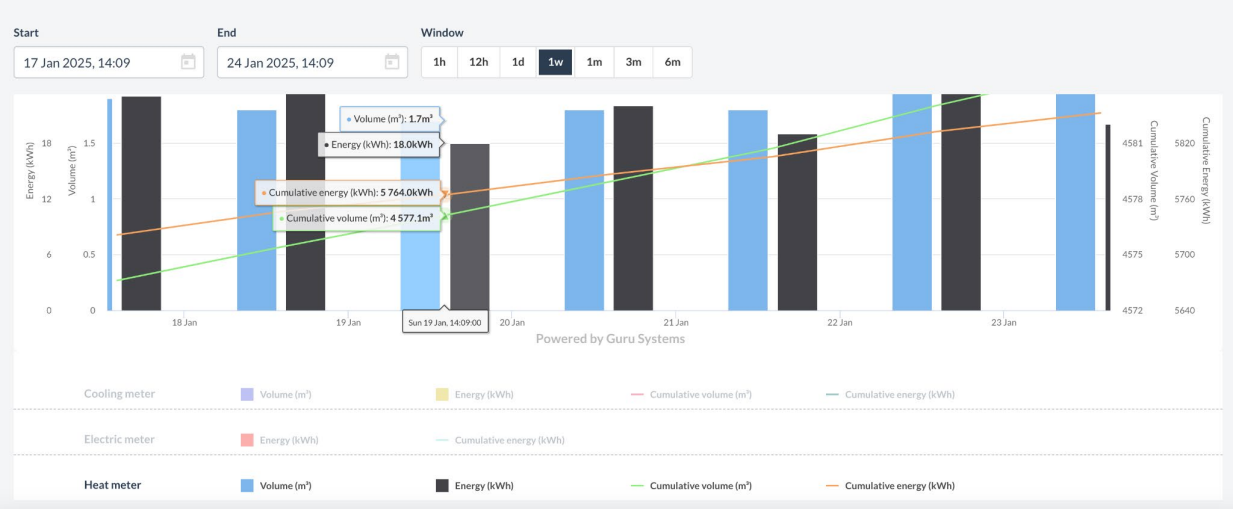
- Developing multiple approaches to calculating Coefficient of Performance (COP () and SPFs based on a range of dataset types that might be available with and without Modbus integration and assessing the accuracy of outputs.
- Developing and completing User Acceptance Testing of a new user interface for the Pinpoint analysis platform tailored for ambient loop heat networks.

- Field testing the Pinpoint analysis platform ambient loop site, with 116 flats connected.
- Completing marketing and dissemination activities, including an event to share new and upcoming Guru functionalities. These functionalities include Pinpoint for Ambient Loop, a training course for those interested in metering and monitoring Ambient Loop systems and updating existing website pages to include Guru's new capabilities.

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

The project developed the Pinpoint platform to deliver the KPIs required by the upcoming HNTAS regulations. This provides landlords and heat network operators of ambient loop heat networks with a user-friendly method for ensuring compliance with these regulations. It also is a valuable tool for identifying poor-performing heat pumps and rapidly addressing any identified issues. KPIs include flow and return temperatures and flow rate, average temperature differential, volume-weighted average return temperatures, power usage and heat loss, and an SPF value for each heat pump connected to the network. The time and cost savings achieved from this approach had not been assessed at the time of writing.





Two approaches to calculating SPF values were developed, one utilising electricity and heat meters only and the other relying on data only accessible by direct integration with the heat pump. The project concluded that although the additional data provided via the heat pump integration would yield a highly accurate SPF, a valuable estimated SPF can be calculated using meter data alone. While less accurate, this method will be widely applicable across ambient loop heat networks, regardless of the heat pump manufacturer, allowing poor-performing installations to be clearly identified. This conclusion has been validated in field trials. Pinpoint-enabled analysis identified variations in SPF of between 1.0 and 6.0 across the heat pumps connected to the network, with 16% performing poorly with an SPF of less than 2.5 (see Table 1). Due to this discovery, the landlord and heat network operator, alongside wider stakeholders such as heat network consultants, are more closely engaged in improving operating standards and reducing costs for residents. Engagement is expected to increase further when the Heat Network Technical Assurance Scheme comes into force.

Following conclusions from its product development and field trials, Guru Systems has created training material for those interested in metering and monitoring Ambient Loop systems. This has been delivered successfully, with 279 attendees from heat network operators, housing associations and design consultants over 19 events, showcasing Guru Systems role as an industry leader in this sector.

Table 1: Example data from a 3-month period in winter 2024-25, showing the proportion of heat pumps in each SPF category, per block

	Block A 61 heat pumps	**Block B** 37 heat pumps	**Block C** 18 heat pumps
Green: SPF >4	22 (36%)	9 (24%)	3 (17%)
Amber: SPF 2.5 < 4	24 (39%)	17 (46%)	8 (44%)
Red: SPF <2.5	20 (16%)	6 (16%)	3 (17%)
N/A: Data collection issues	5 (8%)	5 (14%)	4 (22%)

Summary:

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

The Guru Smart Heat Pumps project has successfully demonstrated capabilities for remotely monitoring heat pumps, including identifying faults and poor performance. These capabilities will improve the user experience of heat pumps and ensure running costs remain low. Their proposition is

especially relevant in accelerating the deployment of ambient loop heat networks, ensuring that the sector easily adopts new regulation on monitoring and performance and does not lead to delays in deployment.

What next?

Guru Systems is continuing to develop its Integrate and Pinpoint solutions and starting to deliver these in a commercial context, including through a commercial partnership with Daikin. This includes expanding Pinpoint from only being suitable for households with credit billing into the pre-payment metered sector.

Where to find out more

Guru Systems - Intelligent technology for the future of heat

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