HEAT PUMP READY | Department for Energy Security & Net Zero

Part of the Net Zero Innovation Portfolio

Right Sizing Heat Pumps

CARBON TRUST

Project Lead: Hoare Lea

Funding: £505,442

Partners: City Science Corporation, Purrmetrix, Places for People Group Ltd

HOARE LEA | CITY SCIENCE delivering decarbonisation | PURRMETRIX | Places for People

> We are excited to be taking part in Heat Pump Ready, to increase the understanding of heat demand, improve cost for homeowners and stimulate uptake of the technology.
>
> **Eimear Moloney**
> Director, Hoare Lea

The problem: How can heat pumps be correctly sized?

Heat pumps are frequently oversized, sometimes considerably. This incurs additional upfront investment in the technology and installation and, as the oversized heat pump runs with suboptimal efficiency, higher running costs. This threatens the financial viability of heat pumps. The inefficiency in operation also puts additional load on the grid. With widespread oversizing, this will lead to additional grid infrastructure upgrade costs.

The solution

The heat demand of the building needs to be better understood before installation so that the most appropriate heat pump can be recommended. The Right Sizing Heat Pumps project aims to better understand the heat demand of dwellings so that better recommendations for the size of the heat pump required can be made.

Further, a standardised tool will encapsulate the skills, knowledge and design process, creating a consistent approach to the sizing of heat pumps.

Using artificial intelligence to size heat pumps accurately

What are we going to do?

The Right Sizing Heat Pumps project will be using smart meter data, local weather data and readings from internal sensors to calculate the heat transfer coefficient (HTC) for various dwellings. The project will develop and validate a bespoke algorithm, based on an output from the Government funded SMETERS programme. This will allow the accurate heat loss and appropriate heating demand for the property to be determined. With this information, a better recommendation for the heat pump size can be made.

Specifying the most appropriate heat pump for the dwelling offers significant benefits to the consumer over the current process.

Why is this an improvement on current solutions?

Current heat pump specification can often lead to the oversizing of heat pumps. This can be for a number of reasons but is often due to the assumptions required in order to carry out the sizing calculation. Through direct measurement and using a heat pump sizing tool developed on measured energy demand, a more bespoke offering can be made to consumers for their individual home. This can lead to optimised system sizes with reduced upfront expenses and lower running costs.

What would success look like?

The development of an accurate heat pump sizing tool based on measured energy use data, readily used by installers or others in the supply chain, and applicable to a range of dwelling archetypes.

How will this project help towards the target of installing 600,000 heat pumps per year by 2028?

The target is ambitious and will require the heating industry to have a range of tools at its disposal. This project will support the industry through the development of a fast and accurate method to correctly size heat pump units across a range of dwelling archetypes.

This will reduce both upfront costs of the units and ongoing running costs, to support the rapid uptake from consumers required.

The Optimised solutions development stream of the Heat Pump Ready programme supports the development of innovative tools, technologies and processes to overcome specific barriers to heat pump deployment in the UK. This stream supports solutions aiming to reduce the life time cost and increase the performance of domestic heat pumps, minimise home disruption whilst providing high quality installations, develop and trial financial models to support heat pump deployment, improve the heat pump consumer journey and provide a smart and flexible home energy system.

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Right sizing heat pumps

Project Progress (Autumn 2023)

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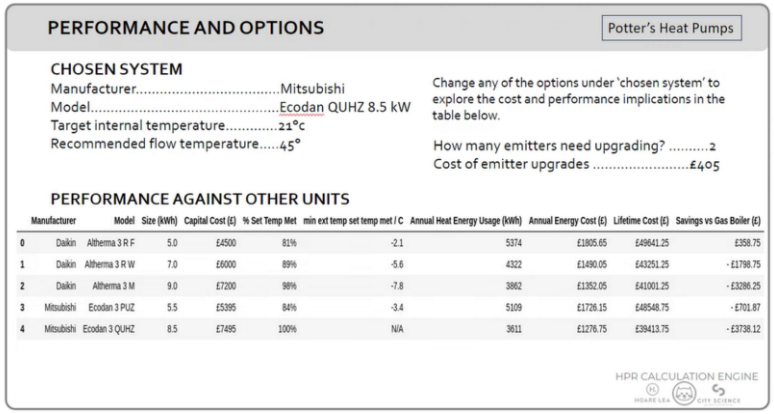
Key Findings

- It is very important to correctly place the internal room temperature sensors to ensure reliable data is collected. Homeowners and surveyors need support and education in how best to set up the sensors.
- As this approach to calculating room-by-room heat loss differs from the current industry standard, sufficient evidence of testing and comparative calculation is required to validate its accuracy and relevance.
- Good data that is representative of the specific daily household use is critical in order to create a model of energy use that can be used to calculate the right sized heat pump for that property.



PERFORMANCE AND OPTIONS

Potter's Heat Pumps

CHOSEN SYSTEM

Manufacturer.....Mitsubishi
Model.....Ecodan QUHZ 8.5 kW
Target internal temperature.....21°c
Recommended flow temperature.....45°

Change any of the options under 'chosen system' to explore the cost and performance implications in the table below.

How many emitters need upgrading? 2
Cost of emitter upgrades £405

PERFORMANCE AGAINST OTHER UNITS

	Manufacturer	Model	Size (kWh)	Capital Cost (£)	% Set Temp Met	min ext temp set temp met / C	Annual Heat Energy Usage (kWh)	Annual Energy Cost (£)	Lifetime Cost (£)	Savings vs Gas Boiler (£)
0	Daikin	Altherma 3 R F	5.0	£4500	81%	-2.1	5374	£1805.65	£49641.25	£358.75
1	Daikin	Altherma 3 R W	7.0	£6000	89%	-5.6	4322	£1490.05	£43251.25	-£1798.75
2	Daikin	Altherma 3 M	9.0	£7200	98%	-7.8	3862	£1352.05	£41001.25	-£3286.25
3	Mitsubishi	Ecodan 3 PUZ	5.5	£5395	84%	-3.4	5109	£1726.15	£48548.75	-£701.87
4	Mitsubishi	Ecodan 3 QUHZ	8.5	£7495	100%	N/A	3611	£1276.75	£39413.75	-£3738.12

HPR CALCULATION ENGINE

What progress have we made so far?

Building performance monitoring equipment has been installed across 14 houses and the associated heat pump sizing algorithm is at an advanced development stage. We are expecting the number of monitored homes to increase over winter 2023/24.

Sensitivity analysis of the algorithm has been performed to determine how the internal-external temperature gradient and time of monitoring affects the accuracy of the results.

Two co-heating tests have been performed to determine a whole build heat loss coefficient. These tests will be used as a 'gold standard' against which the project's algorithm will be assessed.

What barriers have we identified and how has this changed our approach to delivering our project?

The approach we are taking to heat loss calculation deviates from industry standard desk-based calculations, so we are investigating how the project's methodology can be validated and certified for use.

Sensors capturing data on the heat emitted from radiators are useful, but data transfer from the installed sensors is sensitive to room placement and can be affected by radiators which block the mobile signal. However, the quality of data obtained elsewhere is of higher accuracy than predicted which has meant the sensitivity issues can be offset.

What are our next steps?

- Finalise algorithm development and develop a user interface for testing.
- Refine the commercial offer, including identifying the suitable target audience (e.g. installers vs consumers).