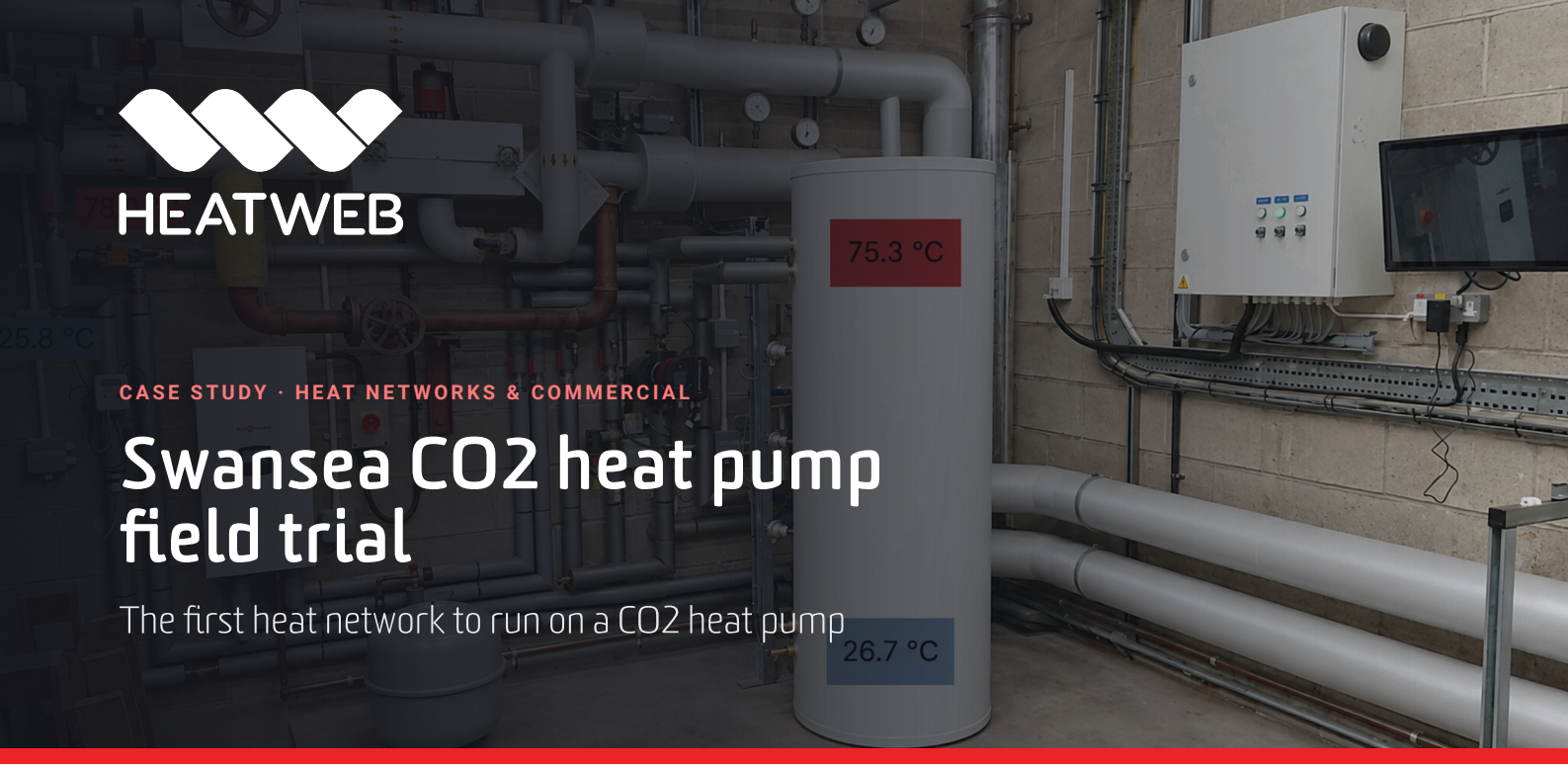


HEATWEB

CASE STUDY · HEAT NETWORKS & COMMERCIAL

Swansea CO2 heat pump field trial

The first heat network to run on a CO2 heat pump

AT A GLANCE

PARTNER
Solar Heat Energy Demonstrator (SHED), Swansea University

SECTOR
Residential heat network retrofit to net zero

SYSTEM
40 kW CO_2 heat pumps topped up by direct electric heating, 20 heating zones

PROGRAMME
Innovate UK SBRI-funded project

YEAR
2023–2024

HEATWEB SERVICES
System design from heat source to pipe sizing, controls supply and commissioning

With the Solar Heat Energy Demonstrator at Swansea University we delivered the first heat network to run on a CO2 heat pump, testing whether CO2 heat pumps can refurbish residential heat networks from the riser top without upgrading the homes beyond their radiator controls.

The challenge

The CO_2 heat pump on the trial had until then only been used to make domestic hot water, where there is a guaranteed large temperature drop. These units like a 30–50 °C drop, so an ordinary UK heat network, with drops as low as 3 °C, was considered incompatible.

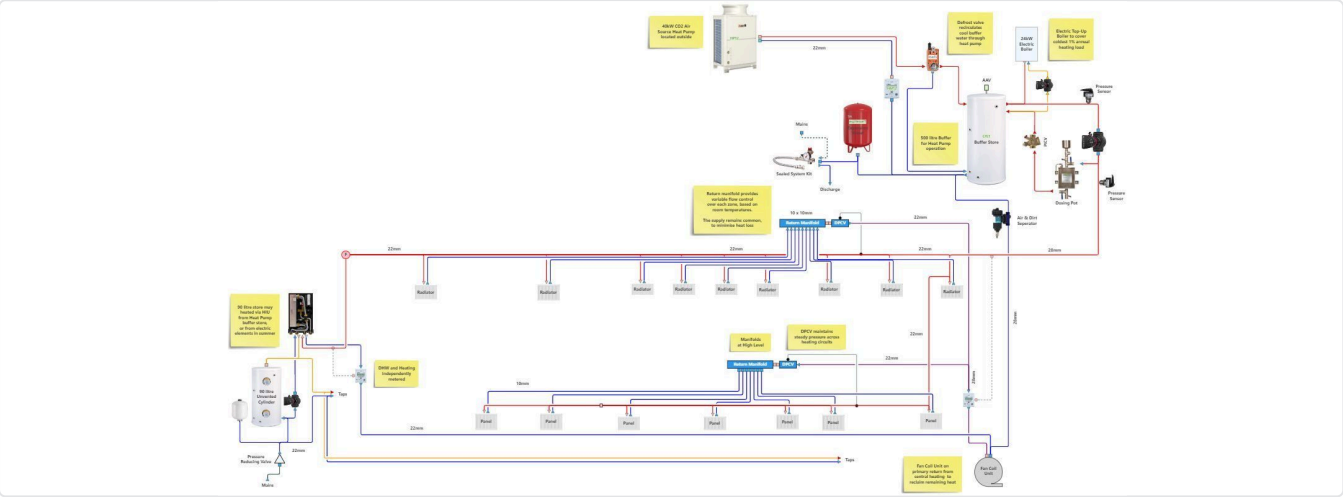
If a riser-top approach works, a block can go all-electric with little or no network downtime. We also wanted to show that return temperature controls could replace radiator balancing altogether.

What we did

- Designed the entire system, from heat source selection to pipe sizing, and supplied and commissioned the controls.
- Ran all control on site on the new BEMS 2.3 controller developed under our SBRI open-source controls project.
- Fitted manifolds on the heating returns for room temperature control and return temperature limiting, with setpoint ramping in place of installer balancing.
- Watched the system remotely through the winter and adjusted the operating logic to hold service levels and maximise COP.

What we found

- Early operating data showed a COP of around 3.2, running 20 zones of central heating on a mix of radiators, ceiling panels and fan convectors.
- Return manifolds with setpoint ramping achieved a 24-hour VWART as low as 22 °C with a 63 °C flow, with no installer balancing or setup.
- Supply temperatures can be raised above 80 °C on the coldest days, allowing far smaller pipes that keep minimum velocities all year; through the winter every room got heat as required.



The CO_2 heat pump heat network at the SHED, with 40 kW heat pumps topped up by direct electric heating.

3.2
COP from early operating data

22 °C
24-hour VWART, with a 63 °C flow

< £5k
possible cost per property for a riser-top refurbishment

The outcome

- The trial's success led the manufacturer to warranty the heat pump installed in a primary system in this way, opening the door to CO_2 heat pumps on residential and commercial developments.
- Setpoint ramps with return temperature limiting gave the best return temperatures while holding room temperatures, and radiators outperformed every emitter except underfloor heating.
- All the control logic used in the field trial has been published on GitHub under an open-source licence.

About Heatweb. Heatweb Solutions is a UK provider of engineering support for heat networks and commercial HVAC: monitoring, fault diagnostics, technical compliance, optimisation, commissioning and maintenance.

Talk to an engineer

The full case study: www.heatweb.co.uk/blog/case-study/swansea-co2-heat-pump-field-trial/

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