Hybrid Heat Pumps Win:
Helping to achieve
UK climate targets

White paper

Contents

For further information and full data visit:
worcester-bosch.co.uk/hybrid-heat-pumps-win

Foreword

Since Worcester Bosch was founded back in 1962, we've strived to be a pioneer in heating technology for the industry. From introducing the first combi boiler in 1971 and the condensing boiler in 2004, to our recent developments in heat pump and hybrid technology, we've always had an eye on the future to deliver the right solutions for homeowners across the UK.

Currently, that future is not clear. A drive for lower carbon home heating solutions is being slowed by a lack of consumer demand, fuelled by uncertainty, a significant skills gap among installers and high running costs – thanks to the current price difference between electricity and gas (the spark gap^).

We strongly believe that hybrid systems are viable – and essential – alternatives for home heating. And importantly, will directly contribute to the government's 2050 Net Zero target. The first-of-its-kind trial is proof of this.

Before you review our findings, I'd like to thank our partner, the University of Salford. It is the best in its field and specifically set up to deliver trials such as these for many industries in the UK. Their support and collaboration has been essential to the success of the trial.

Carl Arntzen
CEO, Worcester Bosch

^Spark gap refers to the ratio between the price of electricity and the price of gas.

1 Executive summary: The UK's journey to lower carbon heating*

Executive summary

The UK's 2050 Net Zero target presents a significant opportunity to innovate and transform our residential heating sector, which is currently responsible for around 18% of national carbon emissions [1]. While standalone heat pumps are a vital part of this future, their widespread adoption faces practical challenges, including upfront costs and the nature of the UK's varied housing stock. This suggests a need for a wider range of supported solutions.

This white paper presents compelling new findings from a joint research project with Energy House Labs at the University of Salford, demonstrating that bivalent parallel hybrid heat pumps offer a pragmatic and highly effective solution to lower carbon heating*. In a direct, like-for-like comparison we found that a hybrid heat pump system installed in a typical "hard-to-treat" end-terrace property, without any fabric or radiator upgrades, can:

- Enable the heat pump to deliver a weighted average of **94% of the annual heating demand**, while substantially reducing reliance on gas.
- Provide an estimated annual CO_2 emission reduction of **1,270kg** from the heating system when compared to a boiler-only system.
- Deliver annual running cost savings of **£79**** with a typical smart tariff under today's energy prices, with the potential for savings to grow if the price of electricity is reduced.
- Improve Energy Performance Certificate (EPC) rating of the property from **Band D to C**^. This improvement aligns with national housing goals and can add value to the property for homeowners [2].
- Provide a more **cost-effective route to lower carbon heating***, delivering 1.5 times the carbon savings per pound of public spending compared to the current scheme's structure.

We recommend that hybrid heat pump systems are recognised as a key technology for accelerating the UK's transition to lower carbon* heating, enabling a more inclusive approach that supports diverse property types while delivering long-term economic and environmental benefits. Specifically, we urge the government to amend the Boiler Upgrade Scheme (BUS) to include a £3,750 grant for qualifying hybrid heat pump systems. This policy change would unlock a faster, fairer and more efficient journey to net zero for millions of homes.

2 x hybrid heat pumps
(If government provided a £3,750 grant)

£2.95 per kg of CO_2

1 x heat pump
(£7,500 grant each funding one property)

£4.54 per kg of CO_2

*A hybrid heat pump system when running emits less CO_2 compared to only using a gas or oil boiler.
**Analysis conducted based on Flexible and Cosy Octopus Tariffs (Oct. 2025). Assumed unit from Octopus: (gas: 6.29 p/kWh), (electricity: 26.35 p/kWh), Time of Use Tariff based on Cosy Octopus (weighted average: 21.07p/kWh). Average boiler efficiency: 85%.
^Analysis conducted with RdSAP 9.94.
[1] Energy Systems Catapult, "Electrification of Heat Demonstration Project," Energy Systems Catapult, 08 Jan, 2025.
[2] O. Knight, "Improving your EPC rating could increase your home's value by up to 20%," Knight Frank Research, UK, 27 Oct. 2022.

Based on our analysed data from the trial, a hybrid heat pump has the potential to:

Deliver

94%

of annual heat demand from the heat pump element

Reduce

1,270kg

of CO_2

Save

£79

on energy bills**

Improve

EPC

rating from Band D to C^

In comparison to a gas-fired combi boiler. Results are indicative of performance in a controlled lab environment.

2 Defining the technology: A foundation for the UK evidence base

What is a hybrid heat pump?

A hybrid heat pump system typically combines two proven technologies: an **air source heat pump** and a gas or oil-fired **boiler**, managed by a **smart control unit** which acts as the 'brain' of the system.

The system's default control mode is set to be **heat pump-led**, with the heat pump delivering the vast majority of the annual heating requirements. However, not all hybrid system controls operate in the same way. The key difference lies in how the two heat sources work together:

Bivalent alternative operation: In a traditional bivalent system, the heat pump and boiler operate alternatively. The heat pump runs until it reaches a preset outdoor temperature, at which point it switches off completely and the boiler takes over 100% of the load. This can be an inefficient strategy, as it fails to utilise the heat pump during colder periods when it can still contribute efficiently.

Bivalent parallel operation: The system tested in this trial is a more advanced **bivalent parallel system**. Rather than simply switching between the two, the smart controls can run the heat pump and boiler in parallel. The heat pump always acts as the primary heat source. When outdoor temperatures drop, the boiler does not take over; instead, it precisely modulates to add just enough supplementary heat to meet the demand, while the heat pump continues to operate efficiently.

As our findings show, this bivalent parallel approach is critical. It allows the heat pump to contribute a far greater share of the annual heat load (**average of 94% in our trial**) and ensures the boiler's role is minimised to targeted, supplementary support. This intelligent parallel operation is the key to maximising efficiency and achieving significant carbon savings*.

Figure 1 shows the Bosch CS5800i hybrid heat pump system used in the trial comprising of an outdoor heat pump, combination boiler and smart control unit.

Figure 1: Bosch CS5800i hybrid heat pump system

*A hybrid heat pump system when running emits less CO_2 compared to only using a gas or oil boiler.

The hybrid unit was installed within the Salford Energy House, a full-scale reconstruction of a pre-1920 end-terrace dwelling, representative of the "hard-to-treat" building stock commonly found across the UK — built within a controlled environmental chamber at the University of Salford's Energy House 1 test facility. The hybrid heat pump system was sized in accordance with MCS guidelines (MIS3005-D) [3]. The existing boiler was replaced with a modern condensing unit to also enable domestic hot water delivery, and the hybrid manager was installed externally, ensuring no loss of internal space.

In addition, the hybrid heat pump system required no changes to the building envelope, insulation levels, pipework, radiators, or existing TRVs, which allowed the system to be installed with minimal disruption to the home.

The experiment was performed using both hybrid and boiler-only operations. Conducting a like-for-like comparison at the Salford Energy House, which represents a common type of property in the UK, provided clear insights while offering valuable lessons directly relevant to addressing the UK's housing challenges. Figure 2 shows the internal and external areas of the Salford Energy House at the Energy House 1 test facility.

Figure 2: The Salford Energy House at the Energy House 1 test facility

[3] MCS MIS 3005-D: Heat Pump Design Standard, Microgeneration Certification Scheme 2025.

3 Performance insights: High efficiency and lower carbon* emissions

The findings from the trial show that a bivalent parallel hybrid system can perform exceptionally well in a typical UK home, without the need for costly and disruptive preparatory work.

3.1. Substantial heat pump share

Figure 3: Heat pump share at various outdoor temperatures

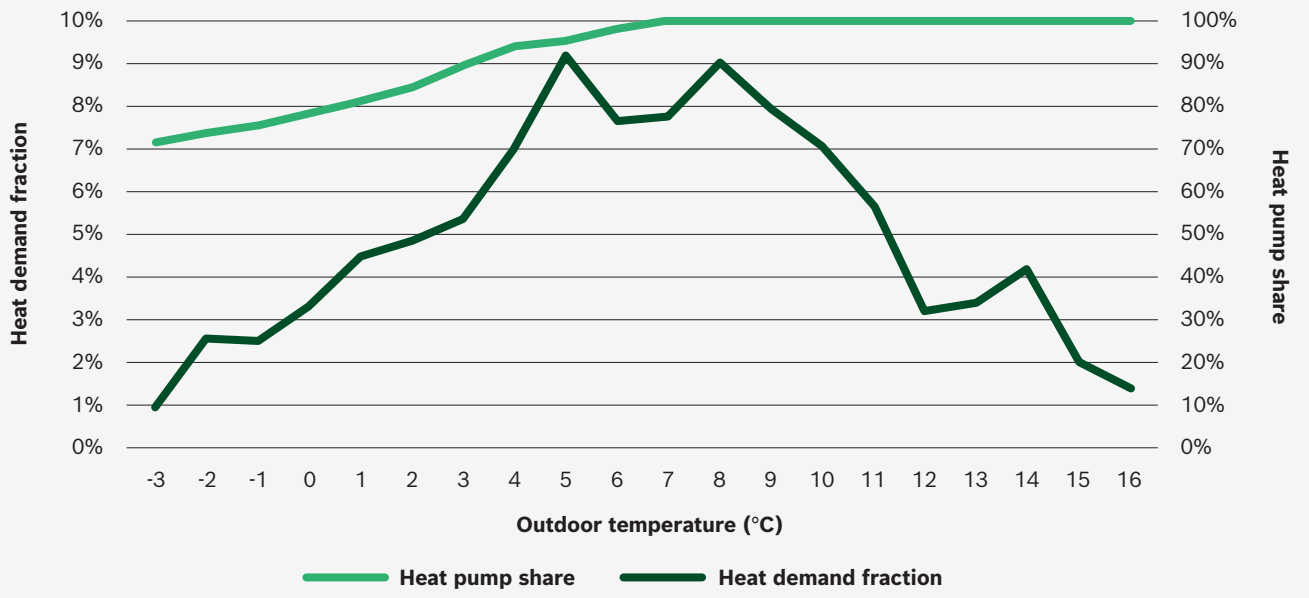


Figure 3 shows the heat pump share contribution and the fraction of heat demand at various outdoor temperatures. As demonstrated, the bivalent parallel operation of the hybrid system results in a significant contribution from the heat pump to meeting the space heating demand. The boiler's role becomes one of support, rather than being the primary heat source.

Heating from the heat pump: The bivalent parallel system was able to deliver a weighted average of 94% of the home's total annual heating needs via the heat pump.

A supportive role for the boiler: At all external temperatures above 7°C, the heat pump handled 100% of the heating requirements. Even in colder weather (down to -3°C), it still contributed above 70% of the total space heating, with the boiler modulating in parallel to provide a boost when needed. The boiler never operated independently to meet the full heat demand.

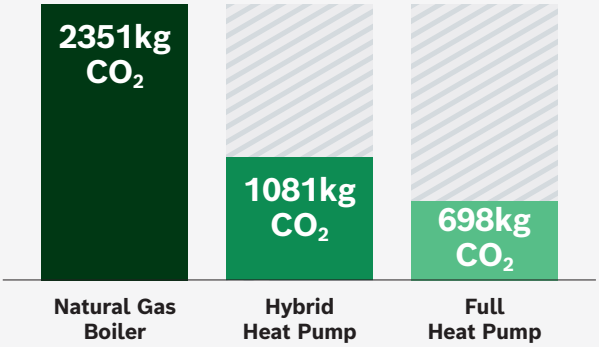
The appendices from the trial are available at: worcester-bosch.co.uk/hybrid-heat-pumps-win

3.2. Significant CO_2 emissions reduction

Numerical analysis performed by Worcester Bosch showed that the bivalent parallel hybrid heat pump system could reduce annual CO_2 emissions by 1,270kg compared to a boiler-only system, achieving approximately 77% of the carbon savings of a full heat pump**. This analysis also accounted for the delivery of domestic hot water (DHW) in the hybrid system from the boiler. It should be noted that installing a heat pump requires space for a DHW tank, which may be challenging in a property like the Salford Energy House due to limited internal space.

Considering that 80% of heating systems sold in the UK are combination boiler types that require no space for hot water tanks, hybrid systems offer an effective and attractive solution, particularly in smaller properties such as terraced and semi-detached houses that may not be able to benefit from a full-electric heat pump. Figure 4 illustrates the total CO_2 emissions associated with meeting the property's annual space heating and domestic hot water (DHW) demand using different technologies.

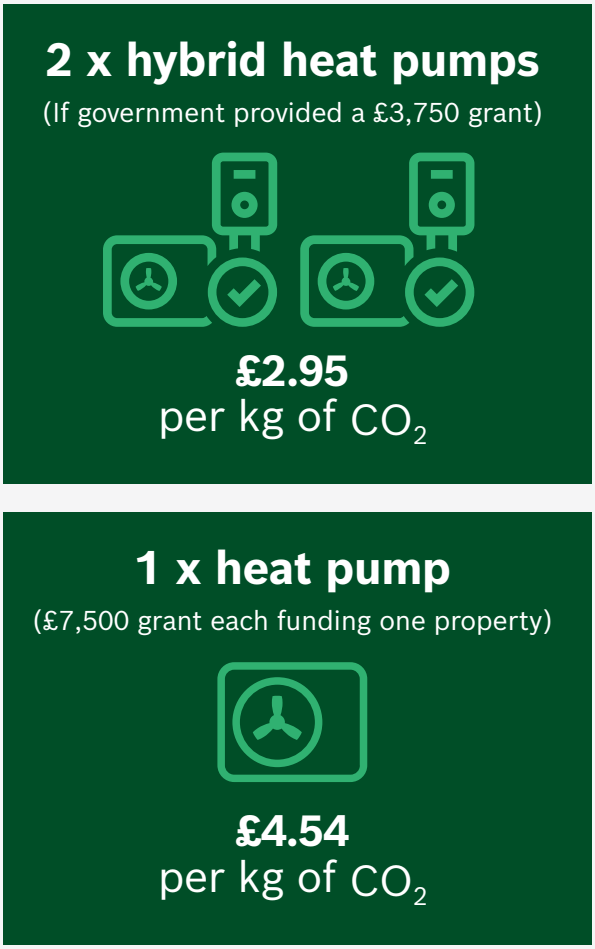
Figure 4: Total CO_2 emissions from meeting the property's annual heating and DHW demand**



The government's net zero plans highlight the importance of adopting lower carbon* and energy-efficient technologies. Significant attention has been given to heat pumps, with grants of up to £7,500 available through the Boiler Upgrade Scheme (BUS) to support their deployment; however, hybrid heat pumps are specifically excluded. Conversely, they are included as a measure within the Clean Heat Market Mechanism as counting towards the target quota.

Including hybrid heat pumps in the Boiler Upgrade Scheme with an upfront grant half of a heat pump would not only cover a wider range of use cases, thanks to the flexibility of the technology, but also maximise carbon savings per pound (£) of public spending by 1.5 times. Figure 5 presents pounds (£'s) per kg of CO_2 saved if hybrid systems are funded under the Boiler Upgrade Scheme compared to a full heat pump system.

Figure 5: Pounds (£'s) per kg of CO_2 saved



*A hybrid heat pump system when running emits less CO_2 compared to only using a gas or oil boiler.
**Assumed CO_2 emissions per usage of kWh of electricity (0.207kgCO_2/kWh) and gas (0.183kgCO_2/kWh). Average boiler efficiency: 85%.


ENERGY
HOUSE
TEST IN PROGRESS
DO NOT ENTER


BOSCH
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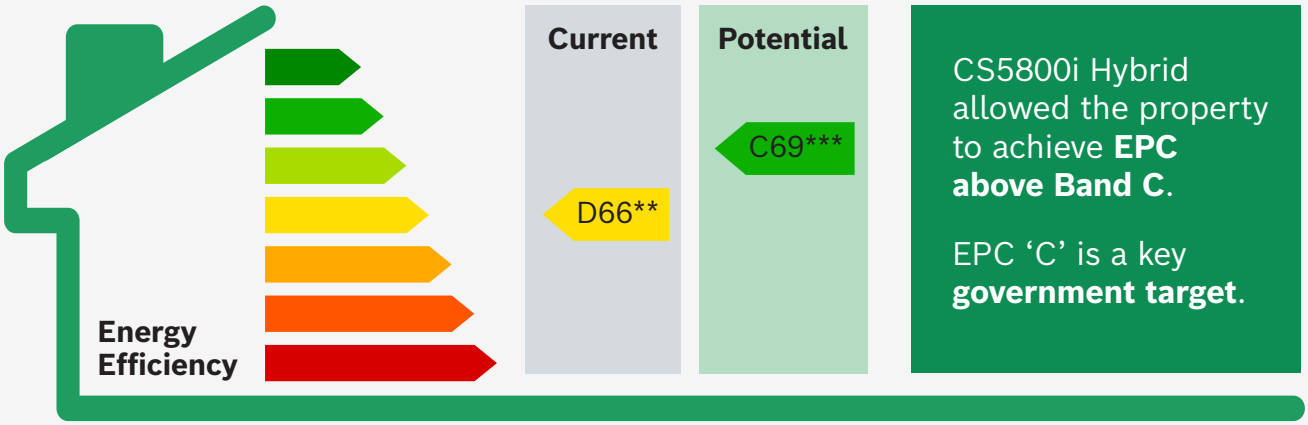
4 Homeowner perspective: Lower bills and improved homes

For any lower carbon* technology to be widely adopted, it needs to be an attractive option for homeowners. Our findings confirm that a hybrid heat pump system offers real, practical benefits.

Figure 6: EPC Band Uplift with the Hybrid System Analysis with RdSAP 9.94†



4.1. A clear case for lower running costs

Based on numerical analysis using historic heating degree days (HDD) data^, in comparison with a boiler-only operation, the hybrid system has been shown to have the potential to reduce running costs for the heating system, offering immediate financial benefits as well as significant future potential.

Annual savings today
When combined with a typical smart electricity tariff, the hybrid heat pump system offers an estimated annual running cost saving of £79^^ compared to a gas boiler.

4.2. A tangible improvement to the home

The Energy Performance Certificate (EPC) is an important measure of a home's energy efficiency. Improving a home's EPC rating aligns with national goals and is a clear benefit for the homeowner.

From Band D to C†
With no other changes to the property, the installation of the hybrid system was sufficient to improve the test home's rating from D66** to C69*** with the potential increase to Band C75. This is a meaningful upgrade that helps meet national targets and can enhance a property's value, all without the need for extensive retrofit work to the building. Figure 6 shows the potential of EPC band increase of the Salford Energy House based on Standard Assessment Procedure.

*A hybrid heat pump system when running emits less CO_2 compared to only using a gas or oil boiler.
**Based on a condensing gas boiler (non-condensing boiler: D63).
***Potential to increase to C75 with PV and intelligent zoning control.
^Degree days for Leeds and Bradford (EGNM Station), Sept. 2022 – 2025.
^^Analysis conducted based on Flexible and Cosy Octopus Tariffs (Oct. 2025). Assumed unit from Octopus: (gas: 6.29 p/kWh), (electricity: 26.35 p/kWh), Time of Use Tariff based on Cosy Octopus (weighted average: 21.07p/kWh). Average boiler efficiency: 85%.
†Analysis conducted with RdSAP 9.94.

5 Next generation: The evolution to lower carbon heat*

A key consideration for any long-term energy policy is ensuring that technologies supported today remain aligned with the UK's 2050 Net Zero goal and Energy Security. The hybrid heat pump system is uniquely positioned not as a destination, but as an intelligent and adaptable first step on a clear pathway to safeguarding the future of heat.

5.1. A win for the grid and energy security

As the heat pump element of the hybrid system covers most of the heat demand, the gas network can benefit from utilising smaller volumes of traditional fossil fuel.

Thanks to the flexibility of its dual-source heating configuration, bivalent parallel hybrid heat pumps can significantly reduce peak electricity demand for heating. The outdoor unit is sized in accordance with MCS MIS 3005-D standards [3], to provide a minimum of 55% of the peak heat load. Given that heat demand varies substantially throughout the year, hybrid heat pumps can dynamically modulate the heat pump while utilising the boiler as a supplementary heat source. This enables efficient heat delivery – particularly during winter peaks when demand is at its highest – without placing additional strain on the electricity grid.

A study by Imperial College London [4] demonstrated that, due to the specific characteristics and operation of hybrid heat pumps, these systems can reduce peak demand by at least 30%, resulting in about 50% lower associated costs to meet the demand when compared to rapid uptake of standalone heat pumps.

This flexibility supports the balancing of electricity networks, particularly during peak periods or when renewable generation is low, while maintaining reliable heating for households. On a national scale, widespread deployment of hybrid heat pumps can smooth the transition to lower carbon* heating including biogases, lower overall gas demand, and enable a more stable and diversified energy mix – all of which contribute to greater energy independence and system resilience for the UK.

*A hybrid heat pump system when running emits less CO_2 compared to only using a gas or oil boiler.
**Spark gap refers to the ratio between the price of electricity and the price of gas.
[3] MCS MIS 3005-D: Heat Pump Design Standard, Microgeneration Certification Scheme 2025.
[4] M. Aunedi, P. Djapic, E. Ling, G. Strbac, Accelerated Electrification and the GB Electricity System, Imperial College London, Apr. 2019.
[5] OFTEC Ltd. and UKIFDA, "Written evidence submitted by OFTEC Ltd. and UKIFDA (RFH0016),"
UK Parliament – Energy Security and Net Zero Committee, Nov. 2024. [Online]

5.2. Off-gas grid: an immediate switch to liquid fuels

For the ~1.7 million oil-heated homes, hybrids offer a practical route away from fossil fuels.

HVO-compatible boilers
The oil boiler can be easily modified to run on Hydrotreated Vegetable Oil (HVO), a bio-liquid fuel that reduces net CO_2 emissions. In fact, and as supported by OFTEC and UKIFDA [5], blending 20% HVO with kerosene can deliver an additional 18% reduction in carbon emissions across the entire hybrid-HVO heating system. This compatibility not only enhances the environmental performance of hybrid systems but also provides a practical, near-term approach to lower-carbon heating* for off-gas-grid properties.

5.3. The ‘full electrification’ off-ramp

Over time, fabric and retrofit improvements can be delivered to make a property heat-pump-ready. In any scenario where a property moves to full electrification, the hybrid provides the least disruptive “off-ramp”.

- **The home is already ‘Heat-pump-ready’**
  The heat pump, controls and radiator system are already installed and proven, the heat pump can deliver the full heat demand as the spark gap** reduces.
- **A simple final step**
  The transition involves decommissioning the boiler and, if needed, adding a hot water cylinder or an electric boiler. This phased approach de-risks the journey and spreads investment for the homeowner.
- **Supporting positive user behaviour**
  By combining the familiarity of a traditional boiler with the operation of a heat pump, hybrid heat pump systems reduce behavioural barriers to adoption and allow users to adapt gradually to electrified heating.

This adaptability demonstrates that a hybrid heat pump system is not a diversion from the path to net zero, but a crucial enabler of it.

6 Conclusion and a policy opportunity

Lowering the carbon emissions of UK's homes is a shared goal that requires a range of effective and accessible solutions. The findings from our work with the University of Salford are clear: bivalent parallel hybrid heat pumps are a practical and highly effective technology for the UK today. They deliver significant carbon reductions*, lower homeowners' bills and improve property ratings, all without requiring major, upfront disruption.

We believe government recognition and financial support for hybrid heat pumps, such as including this proven technology in the Boiler Upgrade Scheme (BUS), presents an opportunity to make the transition to lower carbon* heating faster, fairer and more effective. It offers a practical and accessible stepping-stone on the journey to net zero for millions of households.

Why including hybrid heat pump systems in the Boiler Upgrade Scheme would be beneficial:

1

Accelerate progress

Supporting a widely applicable technology that builds on the established boiler population will significantly increase annual adoption of heat pump technology in homes.

2

Ensure a fair transition

It offers an affordable lower carbon* option for households who may not be able to finance major home upgrades.

3

Build a skilled workforce

Encouraging hybrid installations will rapidly grow the number of installers familiar and confident with heat pump technology.

4

Support a resilient grid

Smart hybrid systems can be programmed to ease demand on the electricity grid during peak times, contributing to a more stable and manageable energy system.

*A hybrid heat pump system when running emits less CO_2 compared to only using a gas or oil boiler.

We respectfully recommend that the UK government:

Considers the new, UK-specific evidence presented in this paper as part of its ongoing policy development, including counting hybrid heat pumps towards the 600,000 heat pump installation target.

Explores amending the Boiler Upgrade Scheme (BUS) eligibility criteria to include qualifying bivalent parallel hybrid heat pump systems with £3,750 funding support.

Works in partnership with industry to communicate the benefits of the full range of lower carbon* heating technologies, helping to build consumer confidence and support the installer community.

Taking this step would unlock a journey to lower carbon* heating for more people, protecting consumers from volatile energy prices and strengthening the UK's position as a leader in climate action.

This trial provides concrete data that hybrid technology is a viable, progressive option for home heating in the UK. It proves that when compared with a heat pump, a hybrid heating system would be easier to install, take up less space and be more affordable for homeowners. We hope it will reduce the uncertainty felt by many and lead to a higher uptake of alternative heating technologies in UK homes – whilst easing the current pressures on the heating industry as a whole.

With these findings as clear evidence, we're now looking for key decision makers to seriously consider hybrid technology as a heating solution – and, vitally, include it in the government's Boiler Upgrade Scheme.

The data we've collected from 'real houses*' is invaluable for the industry to solidify our argument that hybrid technology should be a key part of the macro energy system within the UK, and ultimately contribute to our national net zero targets.

Carl Arntzen
CEO, Worcester Bosch

*Results are indicative of performance of the hybrid system in a controlled lab environment.

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